# Wetlands Action Plan for the Lordsburg Playa Watershed

## Hidalgo County, New Mexico

**Prepared for**

Surface Water Quality Bureau
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## TABLE OF CONTENTS

## TABLE OF FIGURES

## TABLE OF TABLES

## GLOSSARY OF ACRONYMS

AAT - Average Air Temperature
ACEC - Area of Critical Environmental Concern
AIM - Assessment Inventory and Monitoring
AP - Annual Precipitation
AUM - Animal Unit Months
BAMONA - Butterflies and Moths of North America
BLM - Bureau of Land Management
BMP - Best Management Practice
CAA - Clean Air Act
CRMP - Cooperative Resource Management Plan
CWA - Clean Water Act
DPS - Arizona Department of Public Safety
EA - Environmental Assessment
EIS - Environmental Impact Statement
EQIP - Environmental Quality Incentive Program (NRCS)
ES - Ecological Site
ESA - Endangered Species Act
ESD - Ecological Site Description
FHWA - Federal Highways Administration
FLPMA - Federal Land Policy Management Act
FWS - US Fish and Wildlife Service
GDC - Giant Desiccation Crack
GPM - Gallons per Minute
HUC - Hydrologic Unit Code
IPaC - Information for Planning and Consultation (USFWS)
JER - Jornada Experimental Range
LCDO - Las Cruces District Office (BLM)
LFO - Las Cruces Field Office (NRCS)
LiDAR - Light Detection and Ranging
LUA - Land Use Authorization
MLRA - Major Land Resource Area
MOA - Memorandum of Agreement
MOU - Memorandum of Understanding
NAWCA - North American Wetlands Conservation Act
NEPA - National Environmental Policy Act
NFWF - National Fish and Wildlife Foundation
NMDGF - New Mexico Department of Game and Fish
NMDOT - New Mexico Department of Transportation
NMED - New Mexico Environment Department
NMSHPO New Mexico State Historic Preservation Office
NMSLO - New Mexico State Land Office
NRCS - Natural Resources Conservation Service
NWI - National Wetlands Inventory
NWS - National Weather Service
ORV - Off-road Vehicle
OSE - Office of the State Engineer

p.z. - Precipitation Zone
PEA - Programmatic Environmental Assessment
PM10 - Particulate Matter with a diameter of 10 microns or less
ppm - Parts per Million
RMP - Resource Management Plan
ROW - Rights of Way
SCFO - Silver City Field Office (NMSLO)
SGCN - Species of Greater Conservation Need
SLO - State Land Office
SWCD - Soil and Water Conservation District
SWQB - Surface Water Quality Bureau
TMDL - Total Maximum Daily Load
USGS - United States Geological Survey
WAP - Wetlands Action Plan
WHIP - Wildlife Habitat Improvement Program (NRCS)
WQCC - Water Quality Control Commission
WREP - Wetlands Reserve Enhancement Partnership

# EXECUTIVE SUMMARY

The Wetlands Action Plan for the Lordsburg Playa Watershed (the Plan) brings together information from studies and restoration work that has been conducted on the playa since 2018 as well as historical data on ground water and surface water resources from the early 1900s through the present. The Plan covers an area of approximately 88,000 acres within the Animas Valley, including portions of eight Hydrologic Unit Code (HUC) 12 watersheds that cover more than 228,000 acres.

The question often asked is "Where is the wetland?" The Lorsdburg Playa is a collage of many features. It has been mapped as a single Ecological Site, the Saline Bottom, by Natural Resources Conservation Service (NRCS). However, recent work by researchers from Jornada Experimental Range (JER) and NRCS has focused on the role of playa soil cracking and has led to the development of four new draft Ecological Site Descriptions. The situation has been summed up well by NRCS staff:

> These soils may be of a problematic hydric soil scenario, such that they may actually function as a wetland, but fail to meet the requirements of a published hydric soil indicator. Soil map unit descriptions are general and not specifically mapped to each feature of a landscape, therefore any specific playa could be ponded periodically and for a duration long enough to endure anaerobic conditions. The fact that the soils don't display hydric morphology could be due to many reasons, most likely the alkalinity and lack of organic matter for microbial decomposition to occur enough to create redox features (Miller A 2025).

The Playa has been mapped as a Mineral Soil Flat using the hydrogeomorphic classification system. This designation requires that there be no connectivity between surface water and ground water. However, information provided on ground water depth from historical documents indicated that a surface water connection perhaps did occur at one time. Lordsburg Playa is also unique from other watersheds in the region. For example, nearby neighbor valleys (San Simon Valley to the west and Pyramid Valley to the east) have ground water levels at several hundreds of feet deep. Animas Valley has shallow ground water levels of 25-150 feet deep. Static water level draw down has only been about 30 feet since 1917, even with a great amount of irrigation in the Animas Valley. Recent static water levels in the middle of the playa complex near Lordsburg Draw are surprisingly ten feet higher than historic recordings.

Shallow ground water levels, accompanied by the presence of giant desiccation cracks of unknown depth, put a pause on the classification of the playa as a Mineral Soil Flat; however, that is what we will call it until further studies can be done. To that extent, additional data from piezometer studies will help to inform the question of ground water level. Studies are also needed on the giant desiccation cracks which cover large areas. One polygon on the east side of the Playa, for example, is more than 1,000 acres in size in an area that frequently ponds and is also watered by Lordsburg Draw.

The presence of dust storms on the Playa have made Interstate Highway 10 one of the deadliest reaches of highway in the country. Studies completed for dust emission and soil strength show that the surface crust when dry and intact is very strong. However, repeated impact from wheeled traffic and established cow trails destroys the crust and creates a large source of dust. The west side of the Playa is also impacted from surface erosion sources in the lower piedmont and ascending where there is a concentration of roads, trails, and disturbed land features such as mining claims.

Another feature that has caused much discussion is the Pleistocene shoreline of the ancient Lake Animas. Some researchers have reported it as a shoreline feature that would have required a lagoon scenario (much like a spit lagoon in modern ocean estuaries). This collection of berm features is approximately ten feet high and ten feet wide, and varies in length. Multiple berms occur around the

Playa; some occur in concentric rings. Others say at least one of the prominent berms is a remnant from one of three major geologic faults that cross through Animas Valley. Although we do not have a clear picture of its evolution, the shoreline feature provides a clear marker between the Playa and the piedmont slopes of the surrounding mountain ranges. Inside this boundary, the Playa is a very complex ecosystem of frequent inundation, ponding, occasional flooding, sediment deposition, and eolian erosion. Within the shoreline boundary, the Playa acreage covers about 56,000 acres. The Plan covers this area as well as an additional 32,000 acres buffer area in the lower piedmont outside of the shoreline boundary.

The Playa is home to many wildlife species of concern. Though there is no U.S. Fish and Wildlife Service (FWS) designation of critical habitat, numerous bird species of concern use the Playa, and the Animas Valley is an important corridor for migratory birds and birds of prey. The Monarch butterfly (FWS candidate species) was documented at the “duck pond” area in summer 2024 near the intersection of Hwy 338 and Interstate Highway 10; a second butterfly, the Mexican fritillary was observed on the duck pond and is on the watch list for FWS. The presence of Clam shrimp was documented but not Fairy shrimp. A lengthy list of insectivores and crustacea were observed and point to the need for a thorough inventory of aquatic species.

Outside of the Playa berm (shoreline), on-going soil erosion control projects and land treatments are underway to aid in mitigating sources of sedimentation and increase vegetation on the landscape. Erosion control and habitat restoration/mitigation work have been conducted on the west side of the Playa since 2018, and we are learning more about what works and does not work. A complete inventory of surface erosion features is needed to develop a strategic plan for restoration.

Within the Playa shoreline, a plan is needed to reduce the impact to soil crust. This area requires adjustment in management, such as excluding the area from traffic except for service vehicles, mitigating broken soil crust around livestock waters, and possibly excluding livestock grazing from the Playa altogether. The Ecological Site reference condition is a barren landscape topped with hardened soil crust. Because of saline and alkaline conditions, the increase of vegetation on the Playa is unlikely. A similar playa landscape is Lake Lucero on White Sands Missile Range which has not had livestock grazing for more than 50 years. The shoreline vegetation looks very much like that of Lordsburg Playa: slender stringers of Alkali sacaton and salt-loving half shrubs. Long periods of inundation in pond water drown these species and eolian deposition buries them in a constant cycle of resetting.

In the Data Gaps section of the Plan, we identify the need for: piezometer studies to better understand the potential connection between surface water and ground water; penetrometer studies to better map soil erosivity gradients; and phenocam studies to better understand the cycles of soil cracks, ponding, inundation, soil moisture, and eolian erosion. We also identify opportunities for citizen science as well as activities high schools and colleges can engage in to help fill data gaps, especially for wildlife and soil erosion components.

We have tried to keep the Plan concise. However, accounting for eight watersheds, several ranches, and a three-part playa complex has required additional text. Data resources included in the appendices include more detailed information on soil and ecological sites, surface soil chemistry, wildlife, seed mixes and ideas for sediment monitoring.

# INTRODUCTION

The New Mexico Environment Department (NMED) Surface Water Quality Bureau is currently providing funding for the development of this wetlands action plan. The project funds enable the department to reduce dangerous pollutants in New Mexico's rivers and streams; safeguard water supplies against flooding, drought and climate change by restoring the functionality of wetlands and natural waterways; and protect vital wildlife habitats for endangered species.

The Plan provides historical information and summarizes information on geology, hydrology, soils, vegetation and ground water. It also provides a summary of research and soil erosion control activities that have been on-going since 2018. Researchers, contractors, and ranchers offered insight into issues surrounding the Playa and offer recommendations for continued conservation.

## Project Setting

The Lordsburg Playa is a large geologic landform located within the semi-arid Chihuahuan Desert of southwestern New Mexico several miles west of Lordsburg (Figure 1). The watershed is flanked to the west by the Peloncillo Mountains straddling the Arizona/New Mexico state line, to the east by the Pyramid Mountains, and to the north by the Burro Mountains.

Figure 1 shows the National Wetlands Inventory (NWI) boundary with black lines as the interior polygon. This area encompasses about 32,000 acres. Outside of this is a green line that estimates the ancient Lake Animas shoreline. Including the NWI boundary, this area is about 56,000 acres. Extending outward to the red line is a buffer area in the lower piedmont of the Peloncillo and Pyramid mountain ranges that provides an additional 32,000 acres for a total of 88,000 acres in the Plan area.

The playa proper is a closed basin with no outfall, is mostly free of vegetation, and frequently exhibits large ephemeral lakes after significant rainfall events (New Mexico Department of Transportation 2019). It is a mineral deposition playa where collected water from rainfall evaporates, leaving a deposit of salt and forming crusts that stabilize the playa surface. This layer is topped with unstable soil sediment from surface water run-on coming in from the surrounding watershed (New Mexico Department of Transportation 2019).

Fine sediments are easily entrained by the wind and further exacerbated by anthropogenic activities common to the area. Most of the playa is managed by the Bureau of Land Management's (BLM) Las Cruces District Office; the remainder is interspersed with New Mexico State Trust Lands and private lands. These lands are leased for grazing and have rights-of-way, including gas pipelines and access roads to infrastructure (e.g., livestock water tanks). The playa is crossed by Union Pacific railroad and Interstate Highway 10 (Figure 2), with the upland watershed marked with county-maintained dirt roads, access roads (2-tracks), livestock waters, and mining claims.

Figure 2 shows the major road corridors and a portion of the service roads and 2-tracks. A thorough inventory and assessment of roads is needed for the entire area.

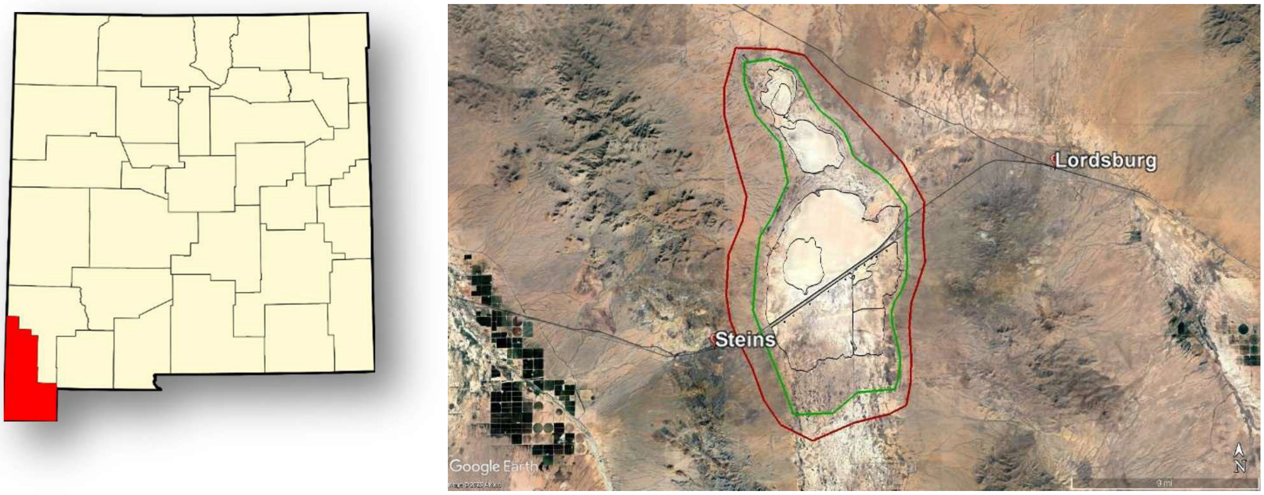



**Figure 1. The location of Lordsburg Playa in Hidalgo County, situated between Steins, AZ and Lordsburg, NM.**

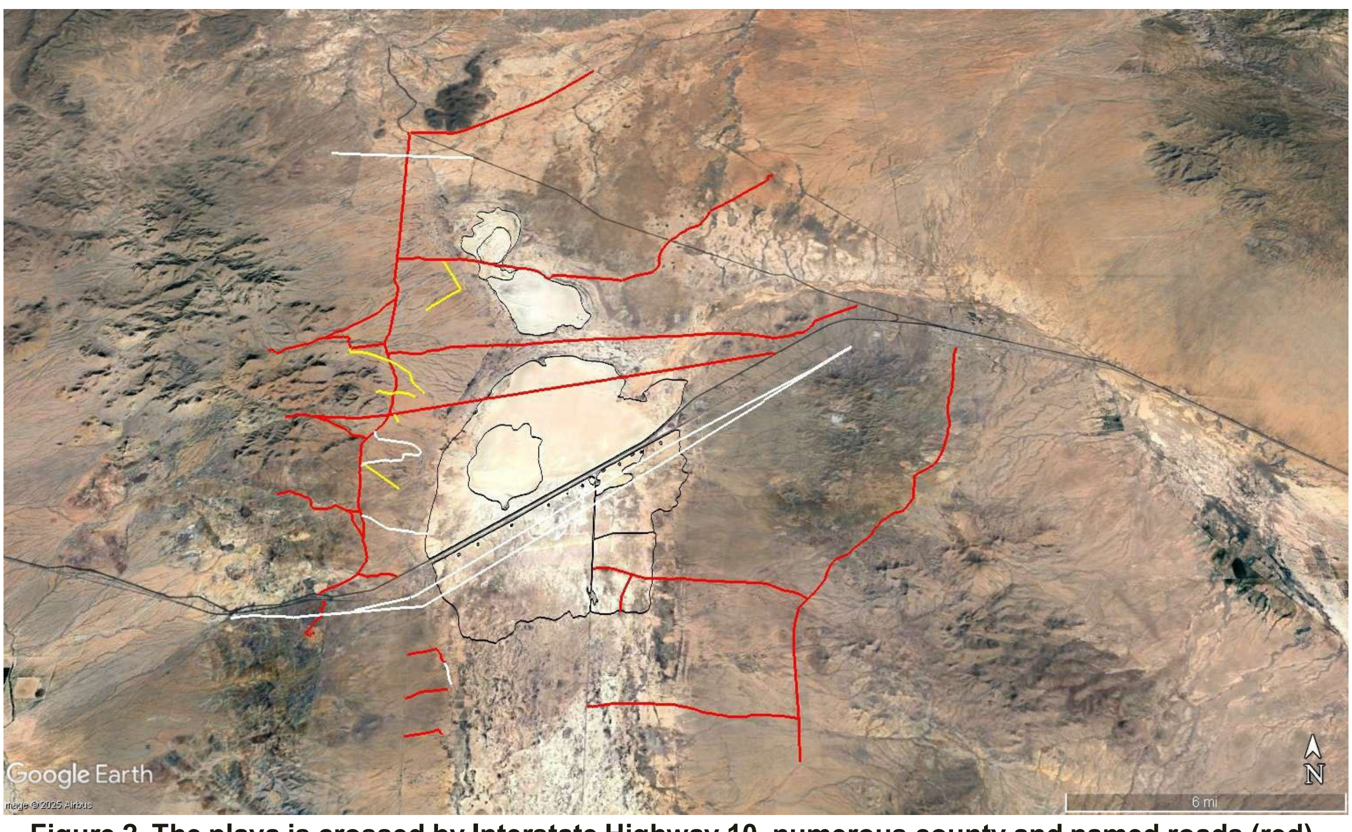



**Figure 2. The playa is crossed by Interstate Highway 10, numerous county and named roads (red), ranch and service roads (white), and 2-tracks (yellow).**

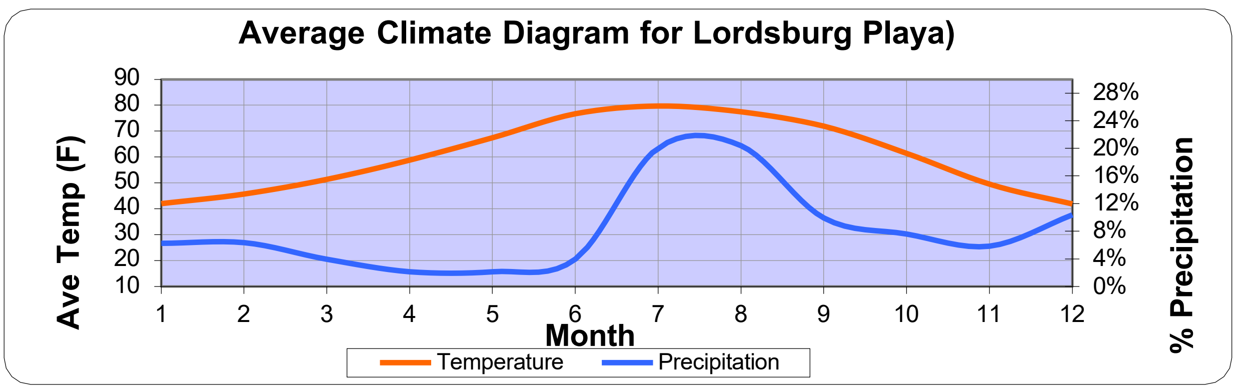
## Climate

### *Climatic Features*

The thirty-year Mean Annual Precipitation (MAP) for the playa is 11.3 inches (28.7 cm), with a range of 9 to 12.5 inches (22.9 to 31.7cm). July thru August is monsoon season, with rain attributed to moisture-laden tropical storms originating in central Mexico and the Gulf of California. As monsoonal flows move north and northeast into Arizona and Southern New Mexico, rainfall occurs as high intensity convective thunderstorms. During this two-month period, sites receive 4.6 inches (11.7 cm) or 40% of their annual precipitation (AP). Monsoonal flow can extend into September, adding 1.0 inch (2.5 cm) or 10% of rainfall. Monsoon flows eventually give way to fall and winter, when cumulative precipitation for October to February is 3.75 inches (9.5 cm) or 33% of AP (Natural Resources Conservation Service [date unknown]).

March through June is the dry season, cumulatively receiving 1.5 inch (3.8 cm) or 12% of the AP; some months receive no measurable amounts. In February through April, cold fronts sweep across the southern portion of the state. These cold fronts dispense most of their moisture in the northern mountains, leaving the southern portion of the state with low relative humidity and a high number of desiccating high wind events. Toward the end of spring, ambient air temperature begins to rise and the area becomes extremely hot and dry. June climate is exceptionally harsh for organisms (Natural Resources Conservation Service [date unknown]).

From mid-winter to late June, the average air temperature (AAT) in the playa area gradually increases from 42°F (5.6°C) to 80°F (26.7°C). In July, the AAT can reach as high as 95°F (35°C), with consecutive days exceeding 100°F (37.8°C). Temperatures then gradually decrease to 42°F (5.6°C) by late December. Freeze-free days average 213 and Frost-Free days average 194 (Natural Resources Conservation Service [date unknown]). This average climate data for Lordsburg Playa is displayed in Figure 3.




| Climate Station Name | Climate Station Code | Period of Record |
|---|---|---|
| Animas | 290417 | 1986-2008 |
| Lordsburg 4 SE | 295079 | 1985-2010 |
| Gage NM | 293368 | 1989-2006 |
| Hachita NM | 293775 | 1985-2002 |

**Figure 3. Average climate data for Lordsburg Playa from SW Hidalgo County climate stations.**

### *Climatic History and Events*

Schwennesen and Hare (1918) captured climate data from Lordsburg from 1882-1914. Mean annual precipitation then was 9.23 inches (23.4 cm), with most rain arriving in the summer months of July, August, and September. The annual total precipitation varied widely within the years of their study with ten years receiving less than 6 inches (15.2 cm) of precipitation and 13 years in which more than 10 inches (25.4 cm) of precipitation were recorded. Precipitation ranged from 3.99 inches (10.13 cm) to

19.70 inches (50.04 cm). These findings are similar to National Weather Service data reported for more recent periods of time.

More current National Weather Service Data for Animas precipitation (1921-2020) shows an average annual precipitation of 10.35 inches (26.2 cm), slightly higher than the Schwennesen and Hare climate data and within the normal range of variability. Most precipitation was received during the summer months of July, August, and September.

In July 2006, a rainfall event caused much flooding in the area. This event was localized to Lordsburg and the Animas Valley, whereas the west side of the Peloncillo Mountains did not receive similar rain. Sudden and concentrated rainfall events, that include the Gila River corridor, frequently see localized flooding in the village of Duncan, AZ. Yet testimony (spoken to the author) from Duncan residents living there in 2006 shows that there was no appreciable rainfall in Duncan or west of Nine Mile Hill on Highway 70, but Lordsburg Draw and the playa were inundated. Water was backed up into the village of Lordsburg and the intersection of Highway 70 and Highway 90 (13 miles northeast of playa center) was underwater. Water was backed up north of Highway 70 perhaps about one mile (personal testimony of the author). Flood waters were not seen west of Nine Mile Hill on Highway 70.

Multi-generational ranch families in Lordsburg and Animas report they had never seen flooding like it nor did they recall family stories that told of such events. Annual rainfall in 2006 was 12.05 inches (30.6 cm), compared to the 1921-2020 average of 10.35 inches (26.2 cm), and within range of normal variability. A closer look at monthly total precipitation prior to the event may help explain the flooding.

National Weather Service (NWS) data for Animas 1990-2020 show that a record low precipitation was received in June and July of 2005. The missing data point from August of 2006 can be picked up from NWS daily rainfall records.

Maximum summer precipitation 1990-2020 are compared to 2006 in Table 1.

**Table 1. Record Summer Rainfall 1990-2020 Compared to 2006**

| Month and year of max summer precipitation, 1990-2020 | Total precipitation (inches) | July – Oct, 2006 | Total precipitation (inches) |
|---|---|---|---|
| June 1996 | 2.37 | June 2006 | 0.35 |
| July 2008 | 5.85 | July 2006 | 3.15 |
| August 1991 | 4.35 | August 2006 | 3.45 |
| September 1996 | 3.01 | September 2006 | 2.39 |
| | | October 2006 | 2.22 |

Summer precipitation received in 2006 was below maximum levels (Table 1) and no flood stories are associated with the years of record.

If we follow the record low precipitation in summer 2005, the twelve months preceding the July 2006 flood event had less than normal precipitation (Table 2). July, August, and September, 2006 saw substantially higher than average rainfall. Desert soils that have no moisture in them shed water rapidly. An extended dry period lasting eight months may have caused extra dry desert soils which then shed water when sudden and abundant rain was received in July 2006, with above average rainfall occurring July, August, September, and October 2006.

| Table 2. Drought months preceding the 2006 Flood | | | |
|---|---|---|---|
| **Month** | **Total Precipitation Normal (inches)** | **2005 PPT** | **2006 PPT** |
| January | 0.71 | 2.51 | 0.20 |
| February | 0.51 | 1.65 | 0.03 |
| March | 0.40 | 0.48 | 0.15 |
| April | 0.18 | 0.11 | T |
| May | 0.20 | 0.50 | T |
| June | 0.50 | 0.00 | 0.35 |
| July | 2.29 | 0.31 | 3.15 |
| August | 1.95 | 2.04 | 3.45 |
| September | 1.00 | 1.30 | 2.30 |
| October | 0.99 | 1.90 | 2.22 |
| November | 0.59 | 0.00 | T |
| December | 1.03 | 0.03 | 0.20 |
| **Annual** | **10.35** | **10.83** | **12.05** |

# EARLY HISTORY OF LORDSBURG PLAYA

### Human Occupation

Human occupation in the Southwest is estimated to have begun near the end of the Pleistocene epoch during the Paleoindian period from 10,000 BC to 6000 BC. At that time, the area sustained grasslands and Pleistocene fauna where several playas supplied fresh water. Paleoindian people subsisted on big game hunting. The Archaic period (6000 BC to 400 AD) represented shifts in adaptation to sustain population growth. People were less mobile and more territorial, developing regional cultural areas and networking (Parametrix 2019). The Late Archaic and Early Agricultural population (San Pedro Phase) 1500 BC to A.D. 300 saw adopted cultivars such as corn, beans and squash which led to a more sedentary lifestyle.

Beginning in 1760, the area was part of the Viceroyalty of New Spain and gained independence from Spain as Mexico in 1821. Most of New Mexico was ceded to the United States under the 1848 Treaty of Guadalupe-Hidalgo, ending the U.S.- Mexican War. United States military posts and forts became a prominent feature of the American influence. Conflicts between local Apache and U.S. forces escalated until a treaty was negotiated in 1873 (Kalosky et al 2019).

The Southern Pacific Railroad was completed in 1880, and non-native residency increased sharply with the development of the grazing and mining industries. The communities of Lordsburg, Deming, Hachita and Steins were established nearby. By this time, residents were adapting to arid land conditions. Stored water impoundments, or dirt tanks, were constructed across the landscape to collect surface water (Schwennesen and Hare 1918).

### Hydrology

Between the late Pleistocene and the mid-Holocene eras (12,000 – 5000 years ago), Lake Animas covered 150 square miles reaching north/south 17 miles long, 8 miles wide, and 50 feet deep (Fleischhauer and Stone 1982). Over time, the lake decreased in size, producing at least three relict shorelines, beach deposits, bars, and lagoons (Schwennesen and Hare 1918). By the late Pleistocene, the lake was supplied by local piedmont run-off and channelized by the ancestral Lordsburg Draw and, possibly, input from the San Francisco and Gila Rivers (Kottlowski et al. 1965). During the Holocene, Lake Animas lost much of its recharge from Lordsburg Draw and was reduced to the ancestral Animas River. Today, the region has three intermittently dry lake beds, with the largest being Lordsburg Playa at approximately 20 square miles in area (New Mexico Department of Transportation 2019).

## DUST STORMS

The Chihuahuan Desert is a global eolian hotspot (Gillette 1999). Erosion by wind and water are connected, with one source influencing another (Okin et al 2011). For example, on playas, saltation occurs when bouncing particles dislodge additional particles with each impact, making additional material available for wind and water erosion and dust storms (Gillete et al 2001).

### Types of Dust Storms

The New Mexico Department of Transportation (NMDOT) describes three types of dust storms (New Mexico Department of Transportation 2019). The first are localized dust channels, or dust devils, ranging in size from tens to hundreds of meters. Dust channels arise by wind blowing across small erodible areas. They can be hazardous because they are hard to predict and can change quickly in response to wind direction and speed.

The second type is associated with convective summer thunderstorms, when the landscape experiences a shift in wind direction bringing in moist air masses. Convection storms often start out over the Gila and Chiricahua Mountains to the west and southwest. Smaller storm cells develop over the surrounding foothills. Convective storms grow in size and intensity, steered by upper-level winds and pressure gradients. Once mature, they decay, losing energy through rainfall. If the lowest level of the atmosphere is dry, the drops evaporate and transfer energy to winds. These winds move toward the ground and spread horizontally, and can achieve speeds of 70 mph. In this way, summer thunderstorms can create dust clouds on the playa floor when turbulent wind contacts the playa surface and entrains loose sediment particles. The wind can move across the playa unobstructed for great distances (New Mexico Department of Transportation 2019).

The third type of dust storm occurs mainly in the spring. These dust storms are generated by mid-altitude cyclones that bring in cold fronts and high winds over the region. These high winds occur over a much longer period of time compared to the summer convective events, lasting more than 12 hours and reaching 50 miles per hour sustained. This type of storm is easier to forecast and the local National Weather Service often provides several days' notice for these events (New Mexico Department of Transportation 2019).

### Frequency of Dust Storms

From 1965 to 2024, more than 40 dust-visibility related deaths have occurred on Interstate Highway 10. From 2012 to 2024, there have been 21 deaths, 43 closures of Interstate Highway 10, and 121 dust events requiring Arizona Department of Public Safety (DPS)/New Mexico Department of Transportation (NMDOT) response. In 2017 alone, eleven people were killed (New Mexico Department of Transportation 2019). An inventory of dust-related crashes by mile post on Interstate Highway 10 indicate hot spots at the east and west edges of the playa with 11-17 crashes at each of three-mile posts (Botkin and

Hutchinson 2024). A single fatality is estimated to cost $1.38 million when considering medical care, emergency services, productivity over a lifetime, insurance, workplace costs, and legal costs (Blincoe *et al*. 2015). Not to mention the loss of life. At the time of this writing, dust storms have claimed another three lives in February 2025 (KRQE News 13 2025).

### Vegetation Influence on Wind Erosion

Three aspects of vegetation are important predictors of wind erosion: percentage cover related to simple surface protection; the frontal intercept area related to how much momentum the vegetation can extract from the wind; and the spatial distribution of the vegetation which impacts the length the wind can run, or fetch distance (Okin et al 2009).

The USDA Jornada Experimental Range (JER) examined five different ecological sites and their various vegetation states (Webb et al 2014) to assess horizontal flux fluvial sediment erosion. They determined that accelerated soil transport and erosion were reduced or controlled when bare ground was less than 20 percent of a site or when total ground coverage was greater than 50 percent of a site (Webb et al 2014).

The rapid pace at which a landscape can be eroded is illustrated on the west side of Lordsburg Playa, the site of a ground water study conducted for the US Geological Survey by Schwennesen and Hare in 1918. The researchers described sand dunes averaging 15-20 feet in height and occasionally 60 feet. The movement of the sand dunes was retarded by mesquite and sagebrush. Today these dunes are deflated to a few feet tall at most. The erosion of this landscape has been attributed to saltation of loose soil sediment on the playa that mobilize other soil particles and to erosion of man-made features on the embankments (New Mexico Department of Transportation 2019).

### Fragile Soils

The Bureau of Land Management (BLM) 1993 Resource Management Plan identified the playa shoreline as a fragile soil resource with little grass coverage and all associated grazing allotments in unsatisfactory condition (Bureau of Land Management 1993). In 1998, the BLM created an off-highway vehicle closure area due to recreational vehicles causing dust that was responsible for four fatalities (Botkin and Hutchinson 2024).

In 2018, the Natural Resources Conservation Service (NRCS) provided soil updates, including erosion potential maps for the playa area. Most of the playa was mapped as moderate to severe erosion potential (Natural Resources Conservation Service [date unknown]).

In 2020, the New Mexico Department of Transportation (NMDOT) conducted a surface disturbance analysis to determine whether dust events on the playa are anthropogenic in origin. The study concluded that historic and modern ranching practices are increasing the amount of sediment transported to the playa through erosion of soil and channels, breached tanks and berms; they also reported that grazing is restricting vegetation recovery. The study further concluded that the playa surface is destabilized through trampling of the soil crust, increasing the amount of available dust for dust storm events (Botkin and Hutchinson 2024).

Industry proponents have a right to explore and apply for the use of public domain. In 2024, two lithium brine mines have submitted proposals to BLM for extraction wells on the playa.

## DUST EMISSION STUDIES

Because of the many dust storms causing highway accidents on Interstate Highway 10, the US Department of Transportation funded dust emission studies. Van Pelt et al (2020) set about quantifying the dust emissivity of likely potential dust sources surrounding and within the Lordsburg Playa.

### Testing on Lordsburg Playa

Van Pelt et al (2020) used a PI-SWERL to test the surface emissivity characteristics at sites representing different landscape positions: sedimentology, management histories, and surface crust disturbance at Lordsburg Playa. A wide range of values for threshold friction velocity were indicative of the complexity of the surfaces encountered in the immediate vicinity of Lordsburg Playa: friction velocity at which the National Ambient Air Quality Standard would be exceeded in a 30 m column of air (representing formation of a dust cloud), PM10 (fine dust) vertical flux rates, and total PM10 vertical flux during the nine-minute test. They also found that the critical friction velocities and emissivities were not strongly dependent on the surface sediment texture; rather, they were highly dependent on surface crust strength, thickness, and disturbance.

Van Pelt et al (2020) concluded that the actual lake bed surface is not strongly dust-emissive when intact, even when dry. However, shoreline margins (or beach areas and areas of the Animas Creek delta) are highly dust-emissive and should be the focus areas of management to mitigate wind erodibility, including limiting disturbance and augmenting native sediment-trapping vegetation where possible. They found that the western shoreline of the playa was the most emissive of the sites tested and was one of the few areas without dust supply limitation even though the surface sediments contain by far the lowest percentage of PM10. This finding is likely due, in part, to legacy sediment control structures (dams and berms) on the slopes above the playa; these control structures are failing and releasing pulses of debris onto the western playa surface. For these reasons, this area should be a priority for dust emission control measures, followed by areas on the Animas Creek delta that develop more fragile crusts. In order to improve highway safety and reduce the risk of continued visibility-related crashes and shutdowns, the playa should be carefully monitored for and protected against activities that disturb the crust and increase dust emissions (Van Pelt et al 2020).

### Testing in Doña Ana County

Studies on a dry playa on the Jornada Experimental Range (approximately 150 miles east of the playa) used a portable field wind tunnel to quantify the PM10 emissions from a bare, fine-textured playa surface. The natural, undisturbed crust was subjected to one cow pass and ten cow passes. For the study playa, no significant differences in PM10 concentration and emission flux were found between the untrampled surface and following a single animal pass. Significantly higher dust loading was only associated with the effect of 10 animal passes. The findings highlight the role of a threshold of disturbance that determines whether supply-limited surfaces will exhibit enhanced wind erosion after undergoing perturbation (Baddock et al 2011).

### Incidental Observations on Lordsburg Playa

High Desert Native Plants (2017) captured on video a comparison between a person stomping on hardened mineral crust compared to walking naturally on an established cow trail. Stomping the mineral crust produced no dust, while walking the cow trail produced a considerable amount of visible dust.

In reference to the Baddock et al (2011) study on Jornada Experimental Range, Figure 4 shows cow trails in the center of Lordsburg Playa leading to and from a livestock watering source. Cows are creatures of habit and will use the same trail many times.


**Figure 4. Many established cow trails lead out from livestock watering facilities and corrals**

Figure 5 shows cattle moving across the playa during a dust storm on February 28, 2025 that killed three people in an eleven-car pile-up on Interstate Highway 10 at the east edge of the playa. One of the deceased was a resident from Lordsburg and the other two were travelers from Florida (KRQE News 13 2025).

**Figure 5. Cattle move away from a dust storm in February 2025. Photo by M. Gaglio**

## GEOMORPHOLOGY OF THE LORDSBURG PLAYA

### NRCS Major Land Resource Area

The Natural Resources Conservation Service (NRCS) maps the Lordsburg Playa as part of Major Land Resource Area (MLRA) 41. This portion of MLRA 41 occurs predominantly west of the Rio Grande Rift.

These basins and ranges have surface hydrology systems that are either open or closed. In open systems, surface water flows out of a specified watershed taking with it salts and sediments. Closed basin systems have no outlet and produce an associated pluvial lake. Animas Playa and the relic Lake Cloverdale in Hidalgo County, New Mexico are examples of closed basin lakes (Natural Resources Conservation Service [date unknown]).

Stratigraphy of the area shows Animas Playa sediments were laid during Pleistocene interglacial periods (2.5 -11,000 million years ago) and during several periods of late Holocene of high effective precipitation (11,700 years ago to present). Dryer periods of the late Holocene dried the lakes, produced a high saline and alkaline playa floor that is now only periodically ponded at a fraction of its flood level. Currently, wave action continually redistributes sediments throughout the lake (Natural Resources Conservation Service [date unknown]).

**Physiography and Landscape**

Flege (1959) described Lordsburg Playa as a structurally defined basin bounded by the Pyramid Mountains to the east and the Peloncillo Mountains to the west. The basin trends north/south and is thought to be more than 5000 feet deep. Sediments infilling the basin include clays, silts, and suspected highly saline brines (Fedikow 2023).

Schwennesen and Hare (1918) and a few others in the Bootheel region of New Mexico described Lordsburg Playa as follows:

> Alkali flats, or playas, are features distinctive of the closed drainage basins of the arid West. - They occupy the lowest parts of the basins. In (Hidalgo) County alkali flats occur in Lower Animas, Lower Playas, and Lordsburg valleys. After heavy rains they may be covered by sheets of water, seldom more than a few inches in depth but often several square miles in extent. These shallow sheets of water soon evaporate, and on evaporation deposit their dissolved mineral matter and the fine clayey material which they hold in suspension, thus in time forming surfaces that are smooth and nearly level. When dry these surfaces are generally checkered with innumerable small sun cracks, are mottled with black, brown, and white alkali stains, and are so hard that the wheels of a heavily laden wagon hardly leave an impression. The flats are devoid of vegetation except for scattered bunches of alkali resistant weeds and grasses, found chiefly along the margins. When flooded the playas perform some of the function of ordinary lakes. Along their edges shore features, such as pebbly beaches, beach ridges, sand bars, spits extending out from the shore, and sand dunes on the sides opposite the prevailing winds may be reproduced in miniature (page 26).

***Sand Dunes***

Schwennesen and Hare (1918) described sand dunes covering about 30 square miles in the region north of the northern most playa (primarily in Townships 21 and 22 South, Ranges 19 and 20 West). They described the dunes as not over 15 or 20 feet high in this area; but, in some places near the southern border of the area where the sand sheet is thickest, dunes reached a height of 50 or 60 feet. Schwennesen postulated that the building of the dunes was related to the history of the ancient lake whose shore line is traceable along the southern boundary of the sand area. At that time (1918), movement of the sand by the winds was retarded by the vegetation.

***Lake Animas Shoreline***

Schwennesen and Hare (1918) described the Lordsburg Playa:

> The axial part of the valley consists of a low, nearly level plain, about 5 miles wide. Bordering this lowland on both sides are wide stream-built slopes, which extend down from the mountains with gentle gradients, but which at their lower ends pitch abruptly downward to the central plain. The bank that borders the central plain is hardly distinguishable in some places and is very

> conspicuous in others, but it can be traced around nearly the whole circumference of the central plain and gives this plain a distinctive and sharp boundary. Certain marked resemblances between this feature and old beaches leads to the belief that it originated at the time the lake existed in the valley and that it marks the old shore line. Such a bank could have been formed by delta deposits of sheet floods (page 83).

***WEST SHORELINE***

The most conspicuous feature of the old beach line described by Schwennesen and Hare (1918) is a gravel ridge that extends for four miles from a point in the middle of Lordsburg Draw on the west side. The ridge is 500 to 600 feet wide at the base, about 30 feet high on the lake side, and 10 feet high on the opposite side. Longitudinally, the crest line, except for local irregularities, is practically level (Schwennesen and Hare 1918).

***EAST SHORELINE***

Schwennesen and Hare (1918) described the east beach ridge as running 11.5 miles south from Lordsburg Draw, consisting of a single gravelly beach slope extending 10 to 25 feet above the valley floor. They also noted smaller ridges at the southern end of their mapping and a remnant ridge on the north side of Lordsburg Draw that may have defined an eastern arm of Lake Animas (Figure 6).

Schwennesen's theory of how the shoreline ridges developed requires that a lagoon be present outside of the main lake area. "The low area immediately back of the ridge was probably originally covered by the old lake, but as the ridge was built up it was cut off from the main body of water and transformed into a lagoon. The drainage from this area and from parts of the stream-built slope and of the mountain range back of it now finds outlet through two gaps in the ridge near the middle of the west line of sec. 13, T. 23 S., R. 21 W. (noted in Figure 6).

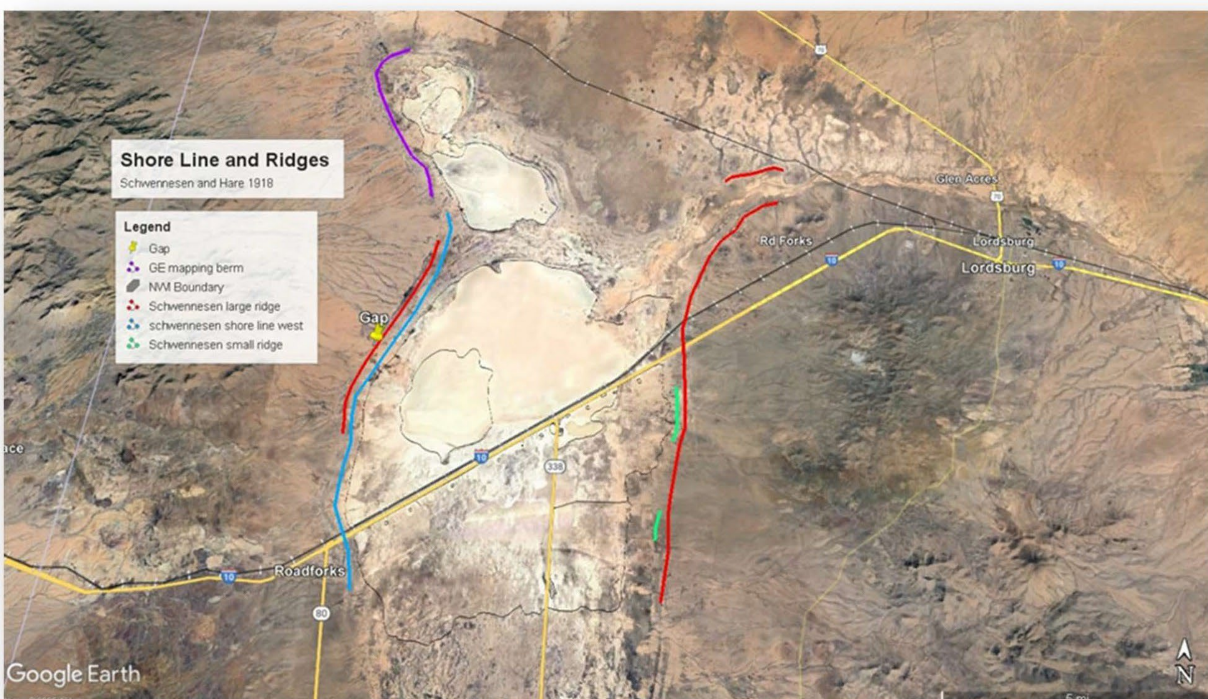



**Figure 6. Shoreline berms surround the playa.**

Figure 6 shows land mark notes from Schwennesen and Hare (1918), with large ridges 10-25 ft high shown in red, smaller ridges shown in green, and the western shoreline shown in blue. The purple line is a ridge easily seen in Google Earth imagery.

#### *1970'S COLLABORATIVE STUDY OF LAKE ANIMAS*

By the 1970s, it became apparent that a number of conflicting opinions existed in literature pertaining to the Lake Animas shoreline. A collaborative study was undertaken by New Mexico Bureau of Mines and Mineral Resources, and New Mexico Institute of Mining and Technology (Fleischhauer 1978). In the study, Fleischhauer described a variety of shore features, such as asymmetric ridges of sand and gravel. In profile, these shore features often showed steep landward slopes, flat to convex crests, and concave foreshore slopes. This assortment of ridges number from two to five, but three are usually present and can be traced with a fair degree of continuity. The shoreline features are confined to an elevation interval of 1,269 to 1,280 m (4,165 to 4,200 ft). The lower shoreline (Flege 1959) is a fault scarp that, in places, cuts obliquely across the contour of the piedmont, a characteristic not typical of shorelines. Some shorelines mentioned by Schwennesen and Hare (1918) near Animas, New Mexico, may in fact be fault scarps and others are ridges of erosional origin.

At its high stage, Lake Animas had a surface area of about 390 $km^2$ (150 $mi^2$) and depth of nearly 15 m (50 ft). Low and intermediate shorelines contain a variety of features, including beaches, spits, bay-mouth bars, offshore bars and barriers. Consequently, stage elevations are more difficult to estimate, owing to a greater variability of elevations of shore features.

This variability can be accounted for by depositional environment and shore processes. The nearly identical elevation of the high shore ridge on both sides of the lake, together with its narrow elevation range, precludes consideration of post-lacustral, tectonic movements as a mechanism to produce the observed variability in elevations of the lower two shore ridges (Fleischhauer 1978).

### *The Mountain Ranges*

The Pyramid Mountains are about 22 miles long north/south, less than four miles wide, and cover approximately 90 square miles. Maximum elevations are about 5000 ft. Drainage patterns are irregular.

The Peloncillo Mountains to the west are approximately 100 miles long in the U.S. portion, reaching from the Gila River on the north to the Mexican boundary on the south. They trend north/south, crossing into New Mexico from Arizona about 12 miles north of Interstate Highway 10. The highest point in this range is Steins Peak at 5670 ft (1728 m) elevation.

Hot wells are present along the eastern side of the valley. These wells have provided high regional heat flow to drive fluid movement. Basin structures provide the fluid pathways to potentially form brine pool traps in the host sediment-filled basin (Fedikow 2023).

## GEOLOGICAL SETTING

The Lordsburg Playa is flanked on the east, west, and south by unconsolidated piedmont alluvial deposits and alluvium and by eolian deposits on the north. Lithologies developed during the Quaternary and Tertiary sub eras. A time chart of the Quaternary time period of Lake Animas is provided in Figure 7 (Fleischhauer and Stone 1982).

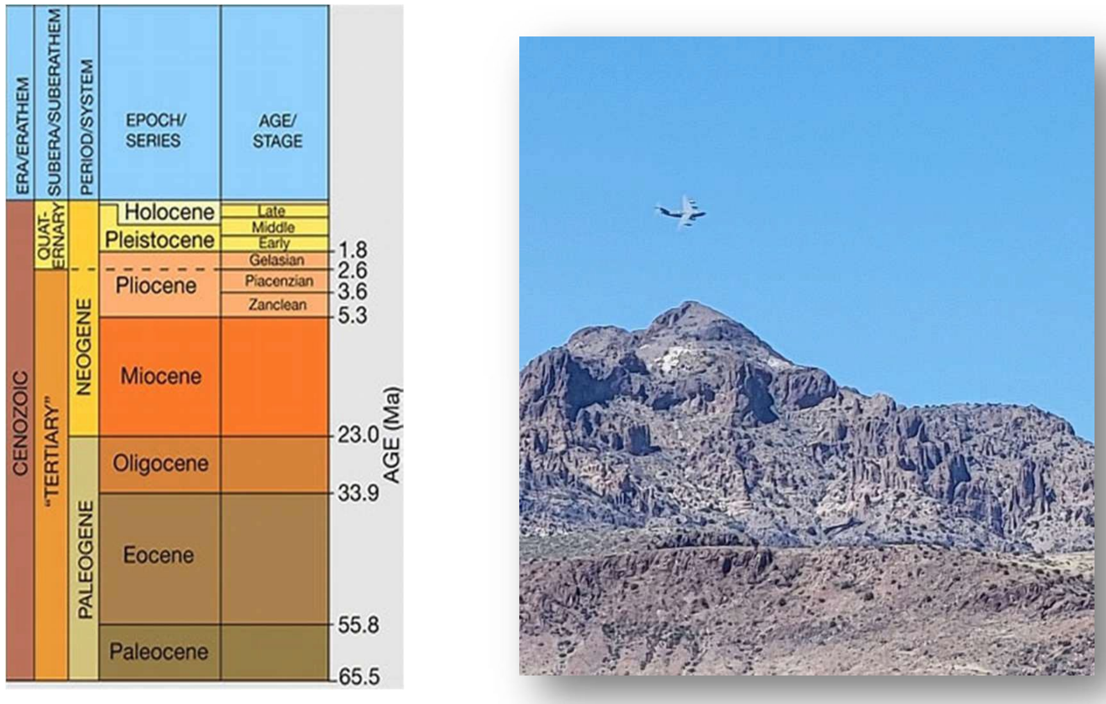



**Figure 7. The geologic time chart shows the Quaternary time period of Lake Animas. Military plane flying over Steins Peak in the Peloncillo Mountains, Photo by J. Cockman.**

## Quaternary Geology

The Quaternary geology of ancestral Lake Animas has been defined by Fleischhauer and Stone (1982). They described the lake at an elevation of 4190 – 4195 ft, approximately 17 miles long, 8 miles wide and 50 feet deep, covering an area of over 150 square miles. The shorelines of Lake Animas are marked by the development of homogenous sand and gravel beaches. Limited archeological work and soil morphology indicates a Holocene age for the beaches and the age of the soil and additional material of the high shore ridge is Pleistocene.

> **Holocene**: Second epoch in the Quaternary period. Began at the end of the last ice age, post-glacial, about 11,700 years ago.
>
> **Pleistocene**: First epoch of the Quaternary period. Between the Pliocene and Holocene epochs. Also known as the Ice Age that lasted from 2.58 million to 11,700 years ago. It spans the most recent period of the Earth's repeated glaciations.

Elston et al (1983) described the Animas Valley surficial deposits. They described piedmont and valley floor deposits consisting of a mix of Holocene and Pleistocene alluvial fans and pediment deposits. Modern active wash sediment originates in the interior of the mountain ranges and deposits on the piedmont surface. These are estimated to be no more than 82 feet (25 m) thick. Valley floor deposits are associated with ancient deposits from Lake Animas and modern deposits such as sand dunes, sand blankets, and active sheetwash. The valley floor deposits are much thicker than the piedmonts but that depth is not known. The Quaternary piedmont deposits were displaced by the Animas Valley fault, probably during the late Pleistocene or early Holocene (Fedikow 2023).

## Animas Valley Pre-Tertiary and Tertiary Lithologies

Distinct rock types in the Animas Valley include a succession of rhyolite ash-flow tuff units and a zone of bedded pumiceous tuff. Welding of the ash-flow tuffs varies from poor to intense. Compressed pumice lenses are conspicuous. Flanking the playa to the east and west are successions of volcanic and intrusive lithologies of intermediate to silicic composition. These include Tertiary and Tertiary-Cretaceous andesitic to dacitic lavas, pyroclastic breccias, and Lower to Middle Tertiary rhyolitic to dacitic pyroclastic rocks (Fedikow 2023).

> **Tertiary Period:** A geologic time period that lasted from 66 million to 2.6 million years ago. The first period of the Cenozoic Era which began after the extinction of the non-avian dinosaurs.
>
> **Cretaceous Period:** A geologic time period that lasted from about 145 million to 66 million years ago. The final period of the Mesozoic Era and was marked by the extinction of the dinosaurs, except for birds.

### Mid-Tertiary Lithologies

Elston (1978) and Deal et al (1978) described Mid-Tertiary geologic events in southwestern New Mexico as dominated by many volcanic eruptions with lots of ash-flow tuff from very large calderas. These calderas have been deeply eroded with only a few remnants of structures remaining. The southern two-thirds of the Pyramid Mountains are interpreted as a segment of an Oligocene ash-flow tuff cauldron, elongated to the northwest. Hydrothermal alteration is widespread in the Pyramid Mountain section near the geothermal plant about 8 miles south of the main playa. The geothermal anomaly is probably related to caldera formation and not to the modern geothermal anomaly that is responsible for driving convective fluid movement in the Valley (Fedikow 2023).

Mid-Tertiary structures are dominated by the Muir cauldron in the Pyramid Mountains. There were two phases of eruptions. The first began with rhyolite lavas and small amounts of rhyolite tuff. This culminated in ash-flow tuff which can be altered. Caldera collapse was accompanied by widespread slumping of the caldera walls and formation of megabreccia. This was followed by a period of hydrothermal alteration, which in turn was followed by renewed eruptions. This second stage of eruptions began with eruption of an ash-flow tuff. The limited outcrop area of this tuff is surrounded by two belts of felsic flows, domes, associated tuffs, and andesite flows. The earlier and inner belt consists of rhyolite of Pyramid Peak and associated tuff. Successive outer bands of ring fracture domes of the Muir caldera include latite and rhyolite (Fedikow 2023).

Similar layers of rhyolite and ash-flow tuff are seen in the Peloncillo Mountains to the west, especially north of Interstate Highway 10. On the Arizona side is an area where the softer ash-flow has eroded out, leaving numerous small caves and overhangs in the landscape which were at one time occupied by indigenous people (Cockman 2015).

#### *Mineralization*

The gentle slopes between the mountain ranges and playa are listed as Piedmont Alluvial Deposits by New Mexico Bureau of Geology and Mineral Resources. The playa itself is described as Lacustrine and Playa Deposits. Mineral resources within the playa zone are influenced by sedimentation from the Peloncillo and Pyramid mountain ranges (New Mexico Bureau of Geology and Mineral Resources).

### Peloncillo Mountains

Geology of the Peloncillo Mountains parallel to Lordsburg Playa spans about 15.5 miles, including a span of 1.5 miles south of Interstate Highway 10 to the approximate location of the south end of the National Wetlands Inventory (NWI) boundary. This area of the mountain range is dominated by Lower Middle Tertiary rhyolitic lavas, local tuffs, and dacitic pyroclastic rocks of the Datil (Table 3). These comprise about 70% of the map coverage, followed by Gila Group, formation, or conglomerate with about 20% of the map coverage. There is a lesser amount of Lower Middle Tertiary andesitic to dacitic lavas and pyroclastic flow (New Mexico Bureau of Geology and Mineral Resources).

| Table 3. Peloncillo Geology Spanning the Length of the National Wetlands Inventory Boundary | |
|---|---|
| **Rock Type** | **Map Coverage*** |
| Tlrf – Lower Middle Tertiary Rhyolitic Lavas and Local Tuffs | 35% |
| Tlrp - Lower Middle Tertiary Rhyolitic to Dacitic Pyroclastic Rocks of the Datil | 35% |
| Qtg Gila Group, Formation, or Conglomerate | 20% |
| Tla - Lower Middle Tertiary Andesitic to Dacitic Lavas and Pyroclastic Flow | 10% |
| *Ocular estimate of percentage cover for the project area estimated by the author. | |

From the south end of the National Wetlands Inventory boundary, the corresponding portion of the Peloncillo range becomes more complex. For approximately 5 miles south, the range is dominated by Tertiary-Cretaceous andesitic to dacitic lavas and pyroclastic breccias followed by Mancos shale and Beartooth and Sarten formations (Table 4). There are lesser amounts of Upper-Cretaceous rocks and Gila Group.

| Table 4. Peloncillo Geology From the South NWI Boundary to About 5 Miles | |
|---|---|
| **Rock Type** | **Map Coverage*** |
| Tkav – Tertiary-Cretaceous Andesitic to Dacitic Lavas and Pyroclastic Breccias | 30% |
| Kmb – Mancos Shale and Beartooth and Sarten Formations | 25% |
| Plp – Permian and Pennsylvanian Rocks, Undivided | 25% |
| Ku – Upper Cretaceous Rocks, Undivided | 10% |
| Qtg - Gila Group, Formation, or Conglomerate | 5% |
| Yg – Mesoproterozoic Granitic Plutonic Rocks | 5% |
| *Ocular estimate of percentage cover for the project area estimated by the author. | |

**Pyramid Mountains**

The Pyramid Mountains on the east side of the playa (from Lordsburg to 14 mi south) are dominated by Tertiary-Cretaceous and Lower Middle Tertiary rocks and are more similar to the southern section of the Peloncillo Mountains with a dominance of andesitic to dacitic lavas and pyroclastic breccias (Table 5).

| Table 5. Pyramid Mountains Geology from Lordsburg and 14 Miles South | |
|---|---|
| **Rock Type** | **Map Coverage*** |
| Tkav - Tertiary-Cretaceous Andesitic to Dacitic Lavas and Pyroclastic Breccias | 30% |
| Tki – Tertiary-Cretaceous Intrusive Rocks | 20% |
| Tlrf - Lower Middle Tertiary Rhyolitic Lavas and Local Tuffs | 20% |

| | |
|---|---|
| Tlv – Lower Middle Tertiary Volcanic Rocks | 20% |
| Tlrp - Lower Middle Tertiary Rhyolitic to Dacitic Pyroclastic Rocks of the Datil | < 10% |
| Kmb - Mancos Shale and Beartooth and Sarten Formations | < 5% |
| Ti – Tertiary Intrusive Rocks of Intermediate to Silicic Composition | < 5% |
| *Ocular estimate of percentage cover for the project area estimated by the author. | |

### Sand Dunes

Schwennesen and Hare (1918) described the dunes as consisting principally of a medium grained clean arkose sand of a prevailingly gray color with a slight reddish tinge imparted by the presence of red feldspar grains. At the time of the study, the average thickness of the deposit for several miles back from the old shore line was about 50 or 60 feet, with the maximum thickness in some places being nearly 100 feet. Today, wind erosion has reduced much of the dunes to a few feet thick. Toward the edges, the sand sheet thins out gradually and merges into the plain. Sand and clay, evidently deposited in their present position by the wind, are found along the northeastern border of the northern most playa and on the east side of the main playa.

### Playa Sediment Profile

Prior to exploratory testing by Lancaster Lithium, Inc., the unconsolidated sediment profile had previously been interpreted as uniform (Fedikow 2023). Results from the Lancaster survey indicate that variations in element concentrations, including lithium, are present in the vertical soil profile. Samples were taken from the 10–18-inch profile. A summary of 14 sample locations shows the range of values for seven elements:

| | |
|---|---|
| Lithium | 119.4-142.8 parts per million (ppm) |
| Magnesium | 1.56-1.82% |
| Arsenic | 6.4-55.7 ppm |
| Sulfur | -.05 all samples except one at .06 % |
| Calcium | 3.63-4.98 % |
| Sodium | 1.81-2.09% |
| Strontium | 432-547 ppm |

### Lithium Resource

Closed-basin brine deposits contain an estimated 58% of the world's lithium resources (Bradley et al 2017). The only location of lithium production currently active in the United States is a brine operation at Clayton, Nevada (Jaskila 2019).

Lithium sources in Lordsburg Playa are most likely shed from the Pyramid Mountains that contain abundant felsic volcanic and intrusive lithologies. Preliminary soil geochemical testing by Lancaster Lithium, Inc. shows that lithium concentrations range from 69.6-147.9 ppm and that concentrations tend to be higher on the eastern side of the playa. The east side of the playa coincides with the position of a geothermal area approximately 8 miles to the south. Hydrothermal fluids in this area may have contributed to the lithium content of deep aquifers and possible lithium-clay formations at depth. Elevated lithium may occur in this vicinity (Fedikow 2023).

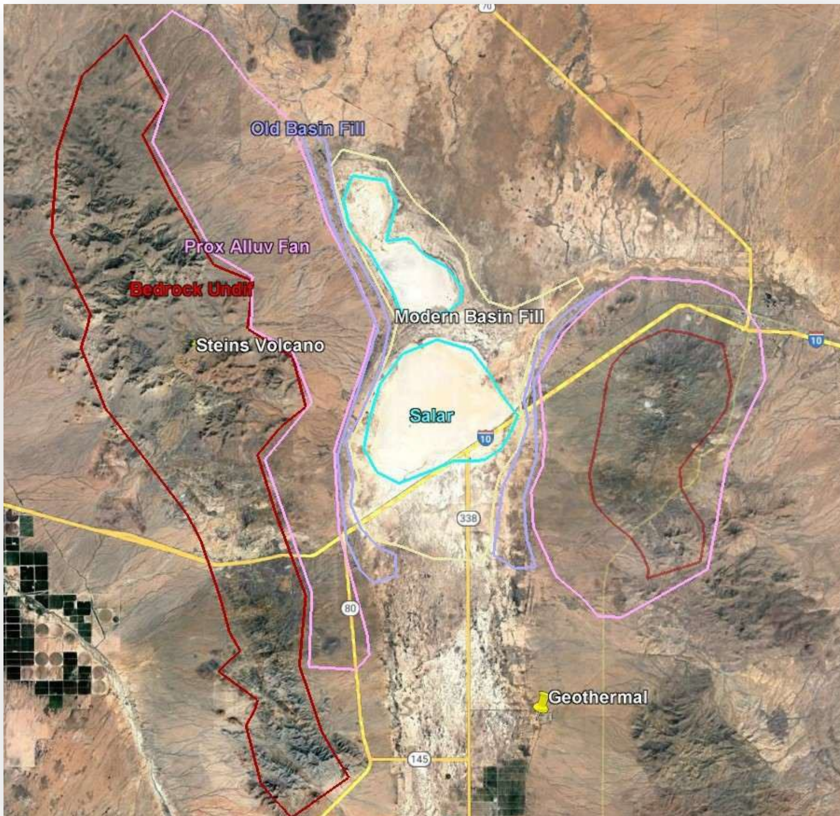



**Figure 8. Potential sources of lithium are shown around and within Lordsburg laya.**

| | | |
|---|---|---|
| Salar | | Evaporite concentration of lithium. |
| Bedrock Undifferentiated | | Lithium delivered in magmatic fluids from hot rocks at depth. |
| Proximal Alluvial Fan | | Lithium weathered from older rocks; lithium sequestered around hot springs in clays. |
| Old Basin Fill (now exhumed) | | Pre-concentrated lithium from exhumed basin strata. |
| Modern Basin Fill | | Lithium delivered in solution from connected basin. |

*Adapted from Bradley et al 2013*

In arid regions, subsurface brines are pumped into a series of surface ponds, where water evaporates, concentrating lithium chloride (Bradley et al 2017). The lithium chloride is then treated with sodium carbonate to form lithium carbonate (Li2CO3) (Goonan 2012). Nearby rhyolites are suspected sources of lithium (Bradley et al 2017).

Geothermal waters and oilfield brines also are known to contain locally high concentrations of lithium (Bradley et al 2017) but are not currently exploited.

Lithium sources, pathways, and sinks were summarized and diagramed by Lancaster Lithium, Inc. (Fedikow 2023). In summary, potential sources of lithium in brine include: older bedrock, primary magmatic hydrothermal fluids, volcanic ash, loess, exhumed basin deposits (recycled lithium), and ground water leaks from the adjacent basin.

Mechanisms for concentrating lithium in brines include evaporation and hydrothermal fluids reacting with an aquifer and liberating lithium. Mechanisms for removing lithium from a brine pool include: brine spills out of the basin; brine leaks out from the bottom of a basin; Li minerals crystallize from saturated brine; Li clays crystallize from hydrothermal fluids; Li brines are trapped in fluid inclusions in halite. Potential lithium sources within and around Lordsburg Playa are shown in Figure 8 (adapted from Bradley et al 2013).

In Figure 8, the model for lithium sources, pathways, and sinks in formation of a lithium brine were described by Bradley et al (2013). The diagram can be compared to the Lordsburg Playa where volcanics on the west represent the Peloncillo Mountains with abundant volcanic peaks and rhyolite/ash-flow tuff, the Pyramid Mountains on the east where lithium was weathered from older rocks. Where the diagram notes lithium sequestered around hot springs in clays, a geothermal plant is located about 8 miles south of the playa.

## SOILS AND ECOLOGICAL SITES

The geologic units and the relationship of topography and soils illustrate landform development and landscape evolution of the surface sediments on Lordsburg Playa and its adjacent watershed. Generally, sediments deposited by the formation of and subsequent retreat of Lake Animas during the Pleistocene developed into moderately fine-textured valley fill soil associations in the valley between the Peloncillo and Pyramid mountains. These soils lie at the surface on piedmont toeslopes (known locally as the lower bajada) west of the playa; toward the playa, they are overlain by lacustrine sediments that form the shore ridges and alluvium that fills depressions between shore ridges (Fleischauer and Stone 1982; Cox 1973).

Sediments between the shoreline ridges and the floor of the playa were deposited as Lake Animas dried, and includes Holocene-age shorelines, lagoon sediments, sand bars, as well as eolian deposition of deflation-derived playa sediments. Surface water coming into the playa crosses this zone via the Lordsburg Draw on the eastern side of the playa and through Rustler Draw (Volcano Draw and Sixty-Six Draw) area on the western side of the playa. These sediments are composed primarily of silt and clay with minor beds of medium- to fine-grained sand (Figure 9). These processes were also described by Schwennesen and Hare (1918, page 26): “When flooded the playas perform some of the function of ordinary lakes. Along their edges, shore features may be reproduced in miniature, such as pebbly beaches, beach ridges, sand bars, spits extending out from the shore, and sand dunes on the sides opposite the prevailing winds.


**Figure 9.** ***Tributaries contribute sediment to the playa***

Current NRCS Web Soil Survey information describes the entire playa complex Ecological Site as a single Saline Bottom 8-12” precipitation zone (p.z.) (Natural Resources Conservation Service [date unknown]). Work is underway at NRCS Las Cruces to provide Ecological Site Descriptions (ESD) which account for the complexity described by Schwennesen and Hare (1918), Cox (1973), Fleischhauer and Stone (1982), and others. Details of this provisional work is described in Appendix A.

The entire playa complex is somewhat organized by concentric rings of various soils that transition from the center of the playa outward to the desert uplands. This transition consists of units that are ponded to occasionally ponded, saline to non-saline, and barren to grassland to shrubland. The eastern watershed also includes eolian deposition that forms small lunette dunes on the toeslopes.

Depressional center of the playa: Soil #1003: Highlonesome, ponded, silty clay loam, 0 to 1 percent slopes, with ESD Saline Bottom 8-12” p.z.

Extending out from the center of the playa: Soil # 1004: Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes with ESDs Clayey and Desert Shrub.

Second ring out from playa center: Soil #1006: Highlonesome, non-saline surface-Agustin complex, 0 to 3 percent slopes. The ESD is Saline Bottom 8-12" p.z.

Third ring out from playa center: Influenced by the uplands.

The east side is mapped as 1015: Argic Petrocalcids-Yturbide-Chutum complex, 0 to 5 percent slopes. The ESD is Sandy Loam Upland 8-12" p.z. This portion of the watershed is influenced from the north by the Burro Mountains.

The western flank of the playa is influenced by the Peloncillo Mountains watershed. The soil is # 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes. The ESDs are Gravelly, and Desert Shrub. It should be noted that the Peloncillo Mountains are diverse with portions of the watershed that are dominated by volcanics with limy seams and other portions that are dominated by volcanic rhyolite with layers of ash.

**Soil Crust and Surface Erosion**

The playa is seasonally inundated in summer and winter, dependent on precipitation runoff. Wetlands are degraded through surface erosion. Perennial plants are both pedestaled through erosion and buried by deposition (Botkin and Hutchinson 2024).

Since vegetation is scarce on playas, surface crusts are a major source of protection against wind erosion and a vital control affecting dust emission from dry lakes (Gill 1996). Physical soil crusts form on the Lordsburg Playa floor. When the sealed-over soil surface dries out after inundation, it creates a dense but relatively thin, weak layer of fine-textured soils that protect the loose and friable sandy soils beneath. Crusts protect the soil from water and wind erosion but can be negatively affected by physical disturbances caused by vehicles and animal hooves. Soil features (e.g., fine texture, compaction, loss of organic matter, and soil structure) and an increase in the amount of bare ground decrease the rate of water infiltration and increase runoff, eroding the soil surface and protective soil crusts.

Both biological and chemical crusts can form on and extend into a physical crust; both are present within Lordsburg Playa (Van Pelt et al 2020). A biological crust is a living community of lichen, cyanobacteria, algae, and moss growing on the soil surface and binding it together. A chemical crust forms readily in soils with high sodium content since these soils are more readily dispersed when inundated. Biological crusts that are in areas of low rainfall, on coarse textured soils with low stability, and in areas with large amounts of bare ground are most susceptible to frequent disturbances and have the longest recovery times.

As bare ground increases, saltating particles are moved farther as fetch distances increase (Floyd and Gill 2011). This results in the migration of coarse-textured upland soils (“sand sheets”) onto fine-textured soils, which abrades and weakens the protective soil crusts on the playa floor, creating zones especially prone to eolian erosion (Gillette et al 1996).

Van Pelt et al (2020) discussed soil distribution on Lordsburg Playa as dominated by two soil classes: the Hondale series and the Playas series, including the playa floor soils/sediments. These general classes have been divided into more precise soil classes in Lordsburg Playa; they include several types easily eroded by wind, sheet flow and channelized flow, including the Adelino, Turney, Armijo, Highlonesome Family and the Highlonesome Severely Erodible.

***Fragile Soils of the Piedmont Slopes***

The Adelino, Turney, and Armijo soil classes are present on the piedmont above the playa floor. All three of these soils are fine-grained loamy soils that are being eroded by sheet and channelized flow, and are the parent material for the modern alluvial fans flowing onto the playa floor. In general, these Pleistocene-age alluvial fans on the landward side of the shoreline ridges and the shoreline ridges themselves have a loose clastic (conglomerate) covering, composed of sand with small amounts of clay and gravel. None of the Turney soils have a crust, and in most locations, they have little clastic covering. The loose clastic covering has very little strength and is extremely susceptible to physical disturbance. However, the soil below the ground cover on the Pleistocene-age fans and on the shoreline ridges is stronger than the covering itself. The fan-toe soils and sediments vary in strength depending on particle size and soil development (Van Pelt et al 2020).

### *Fragile Soils of the Playa*

Between the shoreline ridges and the playa floor are two soil classes that are susceptible to surface disturbance: Highlonesome family and the Highlonesome severely erodible. In Lordsburg Playa, both of these soil classes are composed primarily of silt and clay, which is not well cemented. Both soil classes have a poorly developed crust, making them susceptible to degradation when disturbed. The Highlonesome severely erodible is fine-grained, poorly cemented, and in close proximity to Interstate Highway 10. In several areas, the Highlonesome severely erodible crops out and is exposed (Van Pelt et al 2020).

### *Penetrometer Study*

Soil compaction is often a problem in rangelands and can be affected by trampling by livestock, game animals, and vehicle traffic. Compaction of the mineral soil fraction in surface soils has important hydrologic implications in terms of reduced infiltration rates and subsequent impacts on plant growth. It is most severe when the soil is moist or after heavy rains. With increased soil compaction, surface run-off potentials is increased, erosion potentials may be increased, and in time, plant composition and coverage may change (Gifford et al 1977).

Soil penetrometer studies are needed for Lordsburg Playa.

# HYDROLOGY

## Surface Water

### *Lake Animas*

Lordsburg Playa comprises several intermittently connected, ephemerally flooded, dry lakebeds in the northern part of the Animas Basin within the Basin and Range physiographic province and the northwestern Chihuahuan Desert ecoregion. These dry lakebeds represent the bottom of Pleistocene Lake Animas (Allen 2005). The lakes are the termination of drainage from the Pyramid Mountains, the south and west slopes of Burro Peak, the east-facing slopes of the Peloncillo Mountains, and the west and north slopes of the Animas Mountains. The largest and southernmost of the dry lake beds is sometimes named Kathrine Playa, and is the lakebed through which U.S. Interstate Highway 10 traverses. The altitude of the lakebed is approximately 4143 ft (1263 m) above mean sea level.

### *Tributaries*

Eight class 12 hydrologic units (HUC 12) make up the watershed landscape. Many small tributaries contribute to the watershed as sourced from the Peloncillo Mountains to the west and the Pyramid Mountains to the east). Significant tributaries include Lordsburg Draw coming in from the east, and Rustler Draw, Volcano Draw and Sixtysix Draw coming in from the western bajada along the Peloncillo Mountains (Figure 9) (New Mexico Department of Transportation 2019).

The numerous tributaries have eroded through the shoreline ridges on the east and west sides of the playa, bringing new, unconsolidated fluvial sediments to the valley floor with each rainstorm runoff event. These sediments are unconsolidated and unstable and are regularly disturbed by fluvial/eolian erosion and subsequent redeposition; they are commonly composed of a highly variable mixture of gravel, sand, silt, and clay (New Mexico Department of Transportation 2019; Van Pelt et al 2020).

### *Floods, Ponding and Sediments*

Most rain events that mobilize sediments occur during the summer monsoon (Van Pelt et al 2020). Landsat data between 2008 and 2018 indicate the following:

- The playa floor has been flooded at least one time a year over the past eleven years.

- The extent, or amount of playa floor covered by flood water ranges from 5 percent to 95 percent.
- The playa floor has commonly been flooded with rainwater during two semiannual periods, early winter and summer through early fall.

Because the playa is a significant contributor of dust, the impact of playa flooding is of special interest. On one hand, flooding stops dust from being generated on the playa surface during the flood period and results in crust formation. On the other hand, flooding deposits sand, silt, and clay on the playa floor. Clay is the lightest and is deposited on top where it can be entrained by the wind once the flood recedes. When the clay is eroded away, it frees up the larger silt and sand sediments which have higher occurrences of saltation and greater abrasive power (Baddock et al 2011).

In historic studies, Schwennesen and Hare (1918) described surface water flowing in from the Peloncillo and Pyramid Mountains (west and east) to the southern part of the valley near Animas. Surface waters then collected toward the east side of the valley and trended north toward Interstate Highway 10 where they became very shallow at less than 15 feet deep to ground water. The study indicates that waters may have surfaced at a point under a Southern Pacific railroad trestle known as the Conrad crossing. We do not have documentation of that location but speculate that it might be in the area of the Alkali Flat Duck Pond which is located at the junction of Interstate Highway 10 and NM Highway 338. The South Alkali Flat Duck Pond has been excavated and maintained as a wildlife unit. In addition, there are excavations south of Interstate Highway 10 and east NM Highway 338.

### Ground Water

Schwennesen and Hare (1918) first described ground water depth on the Lordsburg Playa. They described the larger main playa north of Interstate Highway 10, extending south to the Animas agricultural fields. Fourteen sample locations were visited across the playa where they located ground water at 10-180 feet deep (Figure 10 and Table 6). Samples of 10-30 feet depth to ground water were located across the main playa and to the south end of the National Wetlands Inventory (NWI) boundary. On the north edge of the main playa and in Lordsburg Draw, samples ranged from 100 – 175 ft depth to ground water.

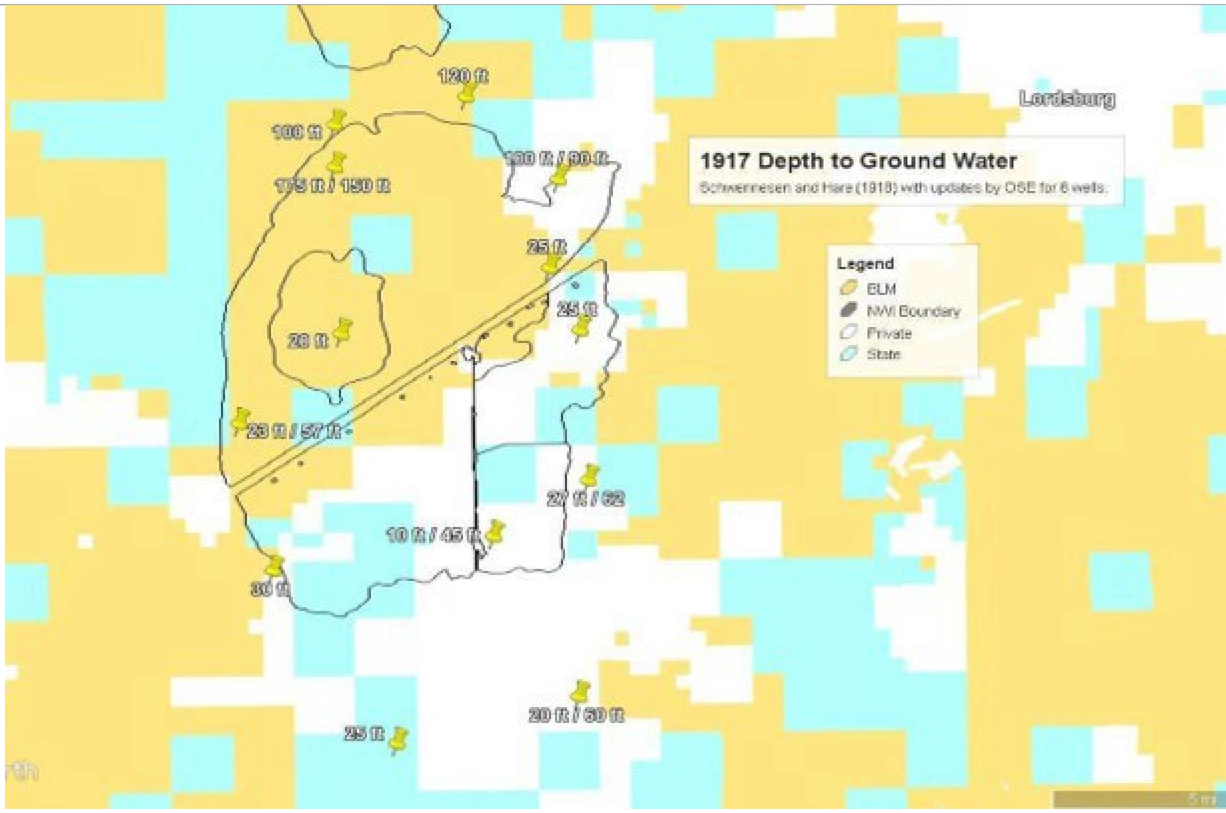



**Figure 10. Ground water levels from 1917 compared to more recent readings from the early 2000s**

Updates on depth to static ground water were provided by New Mexico Office of the State Engineer District 3 in Deming. Location data shown in Figure 10 were used to locate wells with more current records (Table 6). Two of the wells located at the northern end of the main playa showed a shallower depth to static ground water (10-25 ft). Four wells near and south of Interstate Highway 10 showed increased depth to static ground water (34-40 ft.) It is interesting to note that the wells south of Interstate Highway 10 show consistent increases in depth to static ground water. The two northern wells are in alignment with Lordsburg Draw. Piezometer studies would aid in understanding ground water levels.

| Table 6. Depth to Static Ground Water Level | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Schwennesen and Hare (1918) Table 3 #** | **Township South** | **Range West** | **Section** | **Quarter** | **Within Quarter** | **Depth to Ground Water (ft) 1917** | **Ground Water update** | **Year of Update** |
| 3 | 23 | 20 | 8 | NE | NWSW | 175 | 150 | unknown |
| 9 | 23 | 20 | 12 | SW | NWSW | 100 | 90 | 2006 |
| 13 | 23 | 20 (21) | 31 (36) | SW (SE) | SW (SE) | 23 | 57 | 2006 |
| 16 | 24 | 20 | 1 | SE | SE | 27 | 62 | 1983 |
| 17 | 24 | 20 | 11 | SW | Near (?) (center) of (?) (west) line | 10 | 45 | 2022 |
| 19 | 24 | 20 | 25 | SE | NW | 20 | 60 | 2012 |
| Updates provided by NM Office of the State Engineer District 3 Deming; Justin Broomfield, Water Resources Professional II<br>*Illegible figures in original table represented by question marks.* | | | | | | | | |

In Water Supply Hand Book 422, Schwennesen and Hare (1918) also provided provisional maps of the depth to ground water. While the maps were not available for viewing, the authors did provide a text description based on public land survey and landmarks. A very coarse representation of what the ground water map may have looked like is redrawn on Google Earth imagery in Figure 11, with areas mapped as less than 15 feet (blue), 15-25 ft (light green), 25-50 ft (light blue), and 50-100 ft (dark green) from ground water.

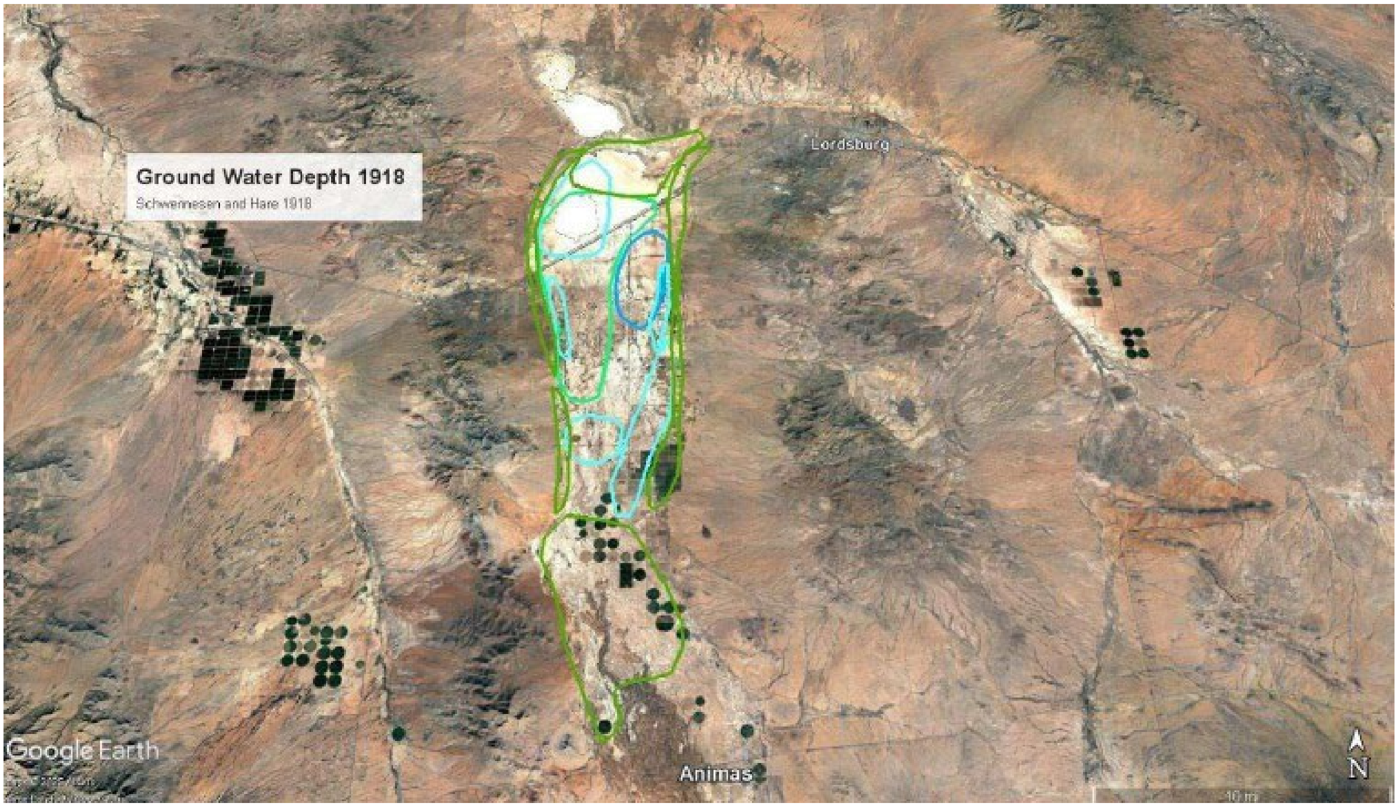



**Figure 11. A coarse resolution maps showing areas of depth to ground water**

## Wetlands

The Lordsburg Playa has been tentatively mapped as a Mineral Soil Flat by Saint Mary's University of Minnesota Geospatial Services (Allen et al. 2023) following protocol described by Brinson (1993) (McGraw 2025, pers. com). In addition, the New Mexico Surface Water Quality Bureau definition of a wetland provides a broad view to include complex resources such as the Lordsburg Playa.

The Brinson (1993) manuscript introduces a classification approach for wetlands that places emphasis on the hydrologic and geomorphic controls. These controls are apparently responsible for maintaining many of the functional aspects of wetland ecosystems. The approach places emphasis on the importance of abiotic features of wetlands for such functions as the chemical characteristics of water, habitat maintenance, and water storage and transport. The approach attempts to accommodate all wetland types.

### *Geomorphic Setting*

Implicit in the hydrology of a particular wetland is its landscape position, or geomorphic setting, which accommodates the flows and storages of water. From a geomorphic perspective, water flows and wetland position are inextricably linked. Consequently, it is difficult to describe geomorphic setting without also discussing hydrology (Brinson 1993). That is why discussion of the geology and geomorphology of the Animas Valley is provided in previous sections of this document.

### *Water source*

In the Brinson (1993) protocol, hydrologic inputs are simplified to three water sources: precipitation, groundwater discharge (inflow, usually into and through wetland sediments), and surface or near-surface inflow. Because of the expanse of rock outcrop in the Peloncillo and Pyramid mountain ranges, a large percentage of surface water flow makes its way toward the playa. Schwennesen and Hare (1918) estimated that about 15% of the precipitation in the mountain ranges makes its way to the edges of the playa or into the main valley and then trends north toward the playa. They also show that groundwater is shallow across much of the playa (less than 30 ft to ground water). At one small location, the Alkali Flats Duck Pond, water is maintained as a perennial water resource. However, at the time of this writing the author observed the pond to be completely dry in March 2025. Precipitation falling directly onto the playa, especially during monsoon season, contributes to seasonal ponding that may last for a few months.

### *Hydrodynamics*

The term “hydrodynamics” refers to the motion of water and the capacity of that water to do work (i.e., transport sediments, flush hypersaline water from sediments, and transport nutrients to root surfaces). Because this is hard to quantify, those studying this area are constrained to making inferences about hydrodynamics based on velocity of flow, rate of water table fluctuations, particle size distribution of bedload sediments, and the capacity to replace soil moisture deficits created by evapotranspiration (Brinson 1993). The playas are a closed basin system of ponds that do not move water and do not flush saline water and have little capacity to transport nutrients except through surface cracks. Evapotranspiration plays an important role in the hydrologic cycle.

### *Classification of Lordsburg Playa*

The Brinson (1993) protocol outlines the importance of water source and makes a distinction between Depressional Wetlands and Mineral Soil Flats. The latter does not receive ground water discharge. Historical records show that ground water across the playa is very shallow. Modern well records show the ground water to be about 50 feet deep near Interstate Highway 10 and about 100 feet deep near Lordsburg Draw. Historical records (Schwennesen and Hare 1918) also indicate that ground water surfaced in an area by a railroad crossing known as Conrad Crossing, though the specific location is not known today. Small areas of the playa hold water much of the year. It is not known for certain whether these surface water sources are connected to ground water. Work to date has assumed that they are not connected. During monsoon season, when the playa ponds for extended periods of time, there may be connection to ground water. Further studies, such as employment of piezometers, is needed to better understand this relationship. Without confirmation of these data, the playa could be classified as Depressional Wetland or a Mineral Soils Flat.

#### *DEPRESSIONAL WETLANDS*

Depressional wetlands occur in topographic depressions. Dominant water sources are precipitation, ground water discharge, and both interflow and overland flow from adjacent uplands. The direction of flow is normally from the surrounding uplands toward the center of the depression. Elevation contours are closed, thus allowing the accumulation of surface water. Depressional wetlands may have any combination of inlets and outlets or lack them completely. Dominant hydrodynamics are vertical fluctuations, primarily seasonal. Depressional wetlands may lose water through intermittent or perennial drainage from an outlet, by evapotranspiration, and, if not receiving ground water discharge, may slowly contribute to ground water. Peat deposits may develop in Depressional wetlands (Brinson 1993).

#### *MINERAL SOIL FLATS*

Mineral Soil Flats are most common on interfluves, extensive relic lake bottoms, or large historic flood plain terraces where the main source of water is precipitation. They receive no ground water discharge, which distinguishes them from Depressional and Slope wetlands. Dominant hydrodynamics are vertical fluctuations. Mineral Soils Flats lose water by evapotranspiration, saturation overland flow, and seepage to underlying ground water. They are distinguished from flat upland areas by their poor vertical drainage, often due to sodic horizons and hardpans, and low lateral drainage, usually due to low hydraulic gradients. Mineral Soils Flats that accumulate peat can eventually become the class Organic Soils Flats (Brinson 1993).

# WATER QUALITY

## Surface Water

When assessed as playa lakes, it was determined that the north playa was only partially supporting attainable uses. The probable cause of nonsupport was identified as siltation and high radium content from agriculture and unidentified sources. Acreage affected was estimated at 2880 acres. The south playa was found to be fully supporting attainable uses but threatened due to siltation from agriculture and unknown sources. Acreage affected was estimated at 7040 acres.

### *Water Chemistry*

Direct measurements for water chemistry have not known. Ponding of water for any length of time will reflect the chemistry of the near-surface soil. Schwennesen and Hare (1918) took surface soil samples at well locations across the playa. Most locations were found to be strong to excessive in alkali content (Figure 12). One location near Roadforks had weak alkalinity.

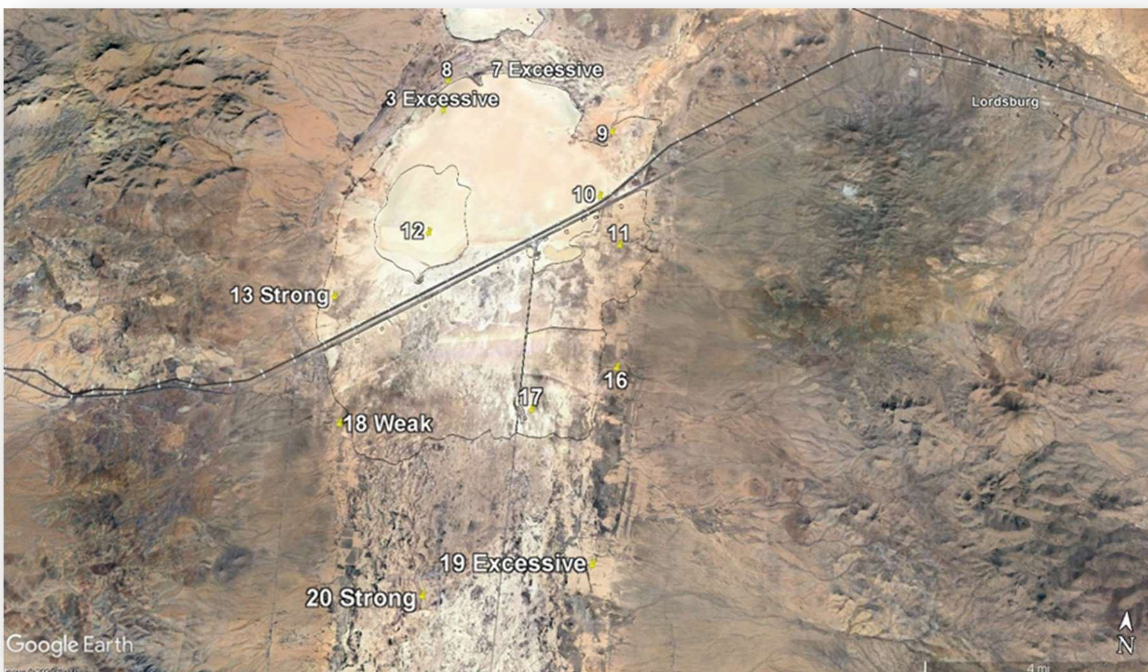



**Figure 12. Water quality inferences on alkalinity were made from surface soil data.**

Schwennesen and Hare (1918) also looked at soil parameters in the one-inch layer and the one-to-four-inch layer. Parameters tested included Calcium, Magnesium, Sodium + Potassium, Carbonate, Bicarbonate, Sulfate, Chloride, and undetermined constituents. Measurements were based on water-soluble constituents of soil (expressed in percentage of total soil). Soil chemistry values are listed in Table 7. Alkalinity values ranged from 0.286 (weak) to 1.264 (excessive). A full display of values for each chemical at each well can be viewed in Appendix B.

| Table 7. Surface Water Quality in Ponds will Reflect Surface Soil | | |
|---|---|---|
| **Water-soluble constituents of soil (expressed in percentage of total soil)** (Schwennesen and Hare 1918) | **Min** | **Max** |
| Calcium (Ca) | 0.002 | 0.159 |
| Magnesium (Mg) | 0.001 | 0.014 |
| Sodium and Potassium (Na +K) | 0.047 | 0.697 |
| Carbonate Radicle (CO3) | 0 | 0.303 |
| Bicarbonate Radicle (HCO3) | 0.092 | 0.29 |
| Sulfate Radicle (SO4) | 0.012 | 0.875 |
| Chloride Radicle (Cl) | 0.006 | 0.291 |
| Water and undetermined constituents | 0 | 0.343 |
| Black alkali (Sodium Carbonate) Na2CO3 (Avg. for total soil sections) | 0.027 | 0.71 |

## Water Quantity

### *Water Rights*

The north and south playas host significant water infrastructure (Figure 13). The northern playa hosts a windmill belonging to the Rafter JL Ranch. Well A-732 reaches a shallow water aquifer and is serviced by a solar pumpjack. It is permitted three acre-feet per year.

Several wells are scattered across the Playa Allotment and are operated by the Jim Walter ranch. All are wells with steel casings. A-677 was drilled in the early 1900s to a depth of 980 feet. Well water is too brackish at that location for consumption and water is piped in from another location to water holding tanks. Details are provided in Table 8.

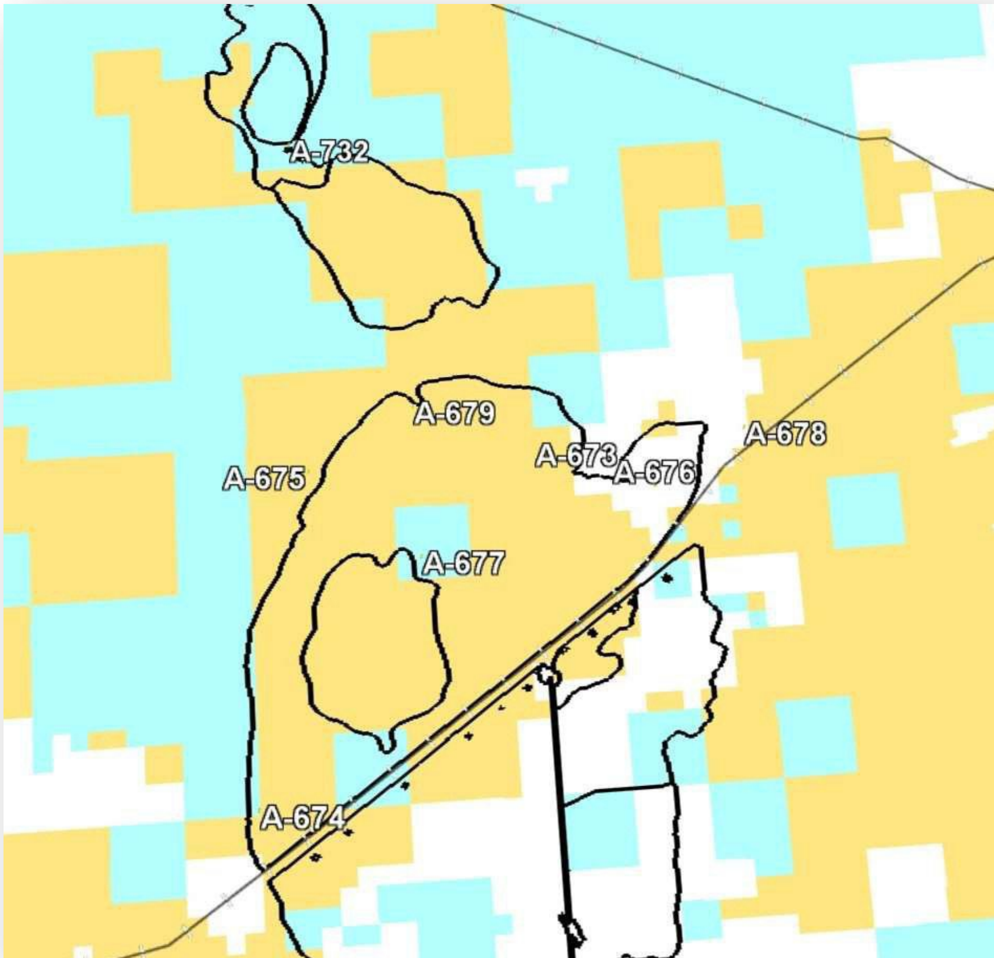



**Figure 13. Permitted water wells are scattered across the playa.**

| Table 8. Wells Permitted by New Mexico Office of the State Engineer (OSE) | | | | | |
|---|---|---|---|---|---|
| **OSE Permit #** | **Description** | **Year Drilled** | **Drilled to** | **Static Water Level** | **Rancher input (Jim Walter, 2025 March 31)** |
| A-732 | Hackberry Windmill with solar pumpjack. | | | | |
| A-673 | Hand dug well, 6 inch casing | | | | Weatherby Well. Est 90 GPM, Static water at 100 ft deep; solar pump works in the moonlight. |
| A-674 | Unequipped well, 6 inch steel casing. | Sept. 1982 | | | Need to drill new well and place pipeline 1/2 mile north to new drinker. Also pipe east |

| Table 8. Wells Permitted by New Mexico Office of the State Engineer (OSE) | | | | | |
|---|---|---|---|---|---|
| OSE Permit # | Description | Year Drilled | Drilled to | Static Water Level | Rancher input (Jim Walter, 2025 March 31) |
| | | | | | and place new drinker along railroad track. |
| A-675 | Unequipped well, water has high salt content. | | | | |
| A-676 | Well, 6 inch steel casing, drilled by Elbrock. Franklin Electric control, 5000 gallon storage tank. | 1994 | 530 ft | 180 ft | Last Chance Well pumps all the water. Has water storage tank and 1.25-inch water line; piped to A- 677 in the center of the South Playa. |
| A-679 | Well, 8 inch steel casing, drilled by Elbrock. Franklin Electric Control. 1 HP 230 volts. Two 10,000 gal storage tanks. | 2004 | | | |
| A-678 | Well, 6 inch steel casing, under old windmill, not equipped. | | 150 ft | | |
| A-677 | Well has 8 inch steel casing. | early 1900s | 980 ft | | Pipes in from east twin tanks at A677. Makes about 30 GPM; runs 15 min and shuts off. |

### Ground Water

Schwennesen and Hare (1918) noted a steady increase in the mineral content of well water trending south to north in the Lower Animas Valley, with the highest mineral contents north of the Southern Pacific Railroad. Groundwater moves in a northward direction and is in contact with buried alkali strata. Water absorbed by the ground near the head of the valley gradually increases in mineral content in its passage northward by coming into contact with the soluble salts in the soil. The movement of the water underground is necessarily very slow and the opportunities for leaching are correspondingly great. Water that enters the ground comparatively pure (from surface run on) may, in the long distance that it has to travel, attain a concentration equal to that of the highly mineralized waters at the north end of the valley.

Because the Lordsburg Playa is a closed basin, the soils in the low central part of the valley (Lordsburg Playa) are heavily charged with mineral salts. Old soils containing much soluble matter are likely buried in the zone of circulating ground waters (Schwennesen and Hare 1918). Schwennesen and Hare also provide historical accounts from the well drillers in the area that sometimes saw exceptions to the pattern of mineralization being more concentrated in the north.

Exceptions to the south-to-north trend of increasing mineralization were noted by well drillers. In their experience, "good" or "bad" waters do not occur at any particular horizon, and the quality of water from any particular water bed does not depend on its depth or relative-position. As one driller expressed it: "The alkali seems to occur in pockets and there is no regularity. Sometimes the first stratum is more alkaline and sometimes the second" (Schwennesen and Hare 1918, page 96). The water-bearing formations of the valley have been prospected to only comparatively shallow depths; deeper beds may yield water of more uniform and possibly better quality.

Certain exceptions in the general northward increase of mineral content of the waters can be explained by the irregular distribution of salts in the deep soils below the ground-water level. For example, at the Sellars Place, there are two wells within a short distance of each other that differ in character and content of total solids: The irrigating well yielded a calcium-carbonate water containing 421 parts per million of mineral matter; the domestic well, a few hundred feet away, yielded a sodium-sulphate water containing 1,060 parts per million of dissolved matter. This difference in composition is likely due to the fact that the water is drawn from different strata in the two wells. The domestic well was 19 feet deep, drawing its water from the first stratum; the irrigating well was 39 feet deep, tapping the second stratum with the first cased off.

About seven miles south, a similar difference existed between the waters from the irrigating well of J. P. Kerr and the well of M. B. Keithley. Both wells are approximately 45 feet deep, yet the water from the Keithley well contained 516 parts per million of dissolved solids, while water from the Kerr well contained 3,165 parts per million, more than six times as much.

Location of the Sellars Place and the Kerr and Kiethley wells are shown in Figure 14. The Sellars Place is near the south end of the NWI boundary. The Kerr and Kiethley wells are 6.6 miles south of the Sellars Place and in the vicinity of today's circle-pivot irrigation for the Animas agricultural community.

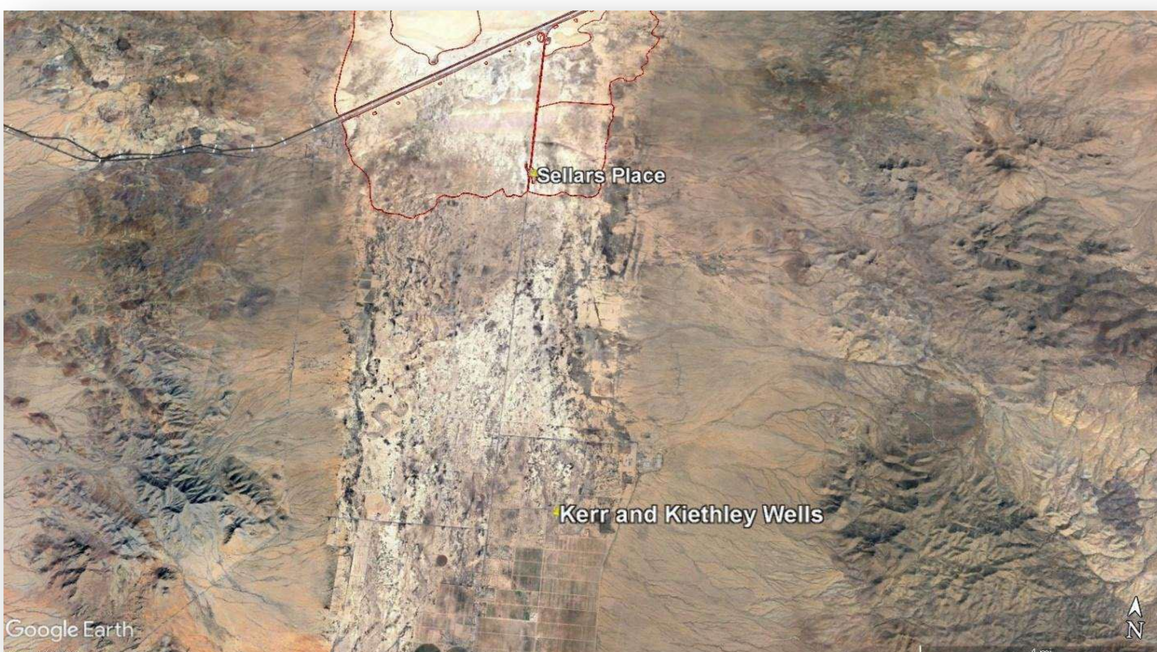



**Figure 14. A large difference in dissolved solids is seen among Animal Valley Wells.**

Two livestock waters are located within the center of Lordsburg Playa on state lands. Water that is reasonably obtainable from wells is too brackish for consumption, and livestock water is piped in from other locations.

# VEGETATION

Van Pelt et al (2020, page 4) described vegetation of the main playa and surrounding shore line:

> Vegetation of the area is typical of the lower elevation Chihuahuan Desert with dominant shrubs such as several species of Saltbush (*Atriplex spp.*) and Seablight (*Suaeda nigrescens* I.M. Johnst) with Alkali sacaton (*Sporobolus airoides* (Torr.) Torr.) as the dominant grass in the saline areas and Sand dropseed (*Sporobolus cryptandrus* (Torr.) Gray) and Ring muhly (*Muhlenbergia torreyi* (Kunth) Hitchc.) in well drained sandier areas above the shoreline.

Habitat restoration work has been on-going west of the main playa since 2018. Work has been conducted just above the shoreline berm in conjunction with the New Mexico Department of Transportation (NMDOT) dust mitigation project. Baseline surveys were conducted by Jornada Experimental Range (JER). The work was described by JER staff:

> Between 2021 and 2024, 510 fifty-meter vegetation monitoring transects were recorded in and around Lordsburg Playa using standard core methods (inter-agency approved) for vegetation monitoring in drylands (Pellant et al 2020). The resulting dataset contains over 50,000 individual measurements of species and functional group cover, soil surface condition, and other indicators. Vegetation height and canopy gap were also measured at each transect, providing, to our knowledge, the most comprehensive vegetation survey of the region (Wojcikiewicz 2025).

Preliminary analysis of this dataset show that in the bajada, or paleo-lakeshore region, the most common vegetation are the grasses *Bouteloua barbata* (Six-weeks grama), *Pleuraphis mutica* (Tobosa grass), and *Aristida adscenionis* (Six-weeks threeawn). Mean herbaceous vegetation cover is about 10 percent. Woody plants are scattered throughout the landscape, with *Larea tridentata* (Creosote bush) the most common, increasing from the Pleistocene shoreline into the surrounding mountain ranges.

Herbaceous vegetation cover is much lower, about 1.5%, in the playa region, with both physical and biological crusting (about 80% soil surface cover combined) common on the soil surface. *Sporobolus airoides* (Alkali sacaton) is the most common vegetation found in this region, with scattered Cresosote bush also present. The forbs, *Boerhavia* L. (Spiderling), *Thelesperma megapotamicum* (Hopi tea) and *Traianthema portulacastrum* (Desert horsepurslane) are the most common in the vegetation surveys, tending to appear in both the bajada and playa regions when there is sufficient moisture.

It should be noted that the vegetation transects were located only on the Steins and Playa Allotments, and predominantly concentrated on the western edge of the playa near the Pleistocene shoreline, so may not be representative of all vegetation communities in the watershed area. However, it is likely that these data sufficiently capture general trends in vegetation community and structure associated with position on the playa and surrounding area with respect to elevation (Wojcikiewicz 2025).

Habitat restoration work associated with the NMDOT dust mitigation project has utilized native seed from within the region. A mix of native grasses, wild flowers and shrubs have been utilized that are local to the area and have been shown to be effective in other rangeland seeding projects. (A full list is provided in Appendix C; further discussion of vegetation is provided in Appendix A.

Residents of the Animas Valley provide a historical perspective. The Kerr family has resided in the Animas Valley since 1905. Ed Kerr recalls that his grandmother's ranch gathered cattle to the dry lake bed south of Interstate Highway 10 in the 1930s which, at that time, had no vegetation to speak of. Kerr explained that prolonged flooding drowns out grass plants. The Alkali sacaton grassland that occupies a large area south of Interstate Highway 10 today does not get flooded as frequently as it did in the 1930s. Kerr explained that the South Alkali Flat area was used as staging for gravel resources during the construction of Interstate Highway 10. A very large area was left with a thick layer of gravel which he believes allows for soil aeration and establishment of the grasses that are seen today (Kerr E 2025). In regard to haying of the Alkali sacaton grassland south of Interstate Highway 10, Lindsey Kerr reported that she does not recall that. However, she does remember that one year, Curtis and Curtis Seed Company harvested seed from the grassland (Kerr L 2025).

## WILDLIFE

The Chihuahuan Desert is dominated by desert and semi-desert grasslands and shrublands. The goal of the New Mexico Statewide Wildlife Action Plan in this biome is to balance cost-effective livestock production with Species of Greatest Conservation Need (SCGN) habitat, impact of industrial development, and conserving and restoring aquatic and riparian habitats (NMDGF 2016).

Wildlife species of concern are compiled from various sources. First, a geographic query with U.S. Fish and Wildlife Service provides a priority list. Ecologist VonLoh (2024) made several field visits to standing water on the playa. The authors also examined a wildlife and bird list from a wetland site 25 miles to the northwest in Arizona along the San Simon River corridor that provides a long-term data set and provides a list of species that should also be anticipated in the Animas Valley corridor around Lordsburg Playa (Cockman 2025).

### USFWS IPaC

A query was conducted with USFWS IPaC for the Lordsburg Playa without extending north and south along the Animas Valley. This query provides a list of species that are listed under the Endangered Species Act of 1973 (Table 9).

**Table 9. ESA Listed Species for the Lordsburg Playa**

| Common Name | Sci Name | Listing | Critical Habitat | Playa Polygon |
|---|---|---|---|---|
| **Mammals** | | | | |
| Jaguar | *Panthera onca* | Endangered | Yes | Does not overlap with critical habitat |
| **Birds** | | | | |
| Mexican Spotted Owl | *Strix occidentalis* | Threatened | Yes | Does not overlap with critical habitat |
| Northern Aplomado Falcon | | EXPN | None | |
| Southwestern Willow Flycatcher | *Empidonax traillii extimus* | Endangered | Yes | Does not overlap with critical habitat |
| Yellow-billed Cuckoo | *Coccyzus americanus* | Threatened | Yes | Does not overlap with critical habitat |
| **Amphibians** | | | | |

| Table 9. ESA Listed Species for the Lordsburg Playa | | | | |
|---|---|---|---|---|
| **Common Name** | **Sci Name** | **Listing** | **Critical Habitat** | **Playa Polygon** |
| Chiricahua Leopard Frog | *Rana chiricahuensis* | Threatened | Yes | Does not overlap with critical habitat |
| **Fishes** | | | | |
| Gila Topminnow (incl. Yaqui) | *Poeciliopsis occidentalis* | Endangered | None | |
| Loach Minnow | *Tiaroga cobitis* | Endangered | Yes | Does not overlap with critical habitat |
| Spikedace | *Meda fulgida* | Endangered | Yes | Does not overlap with critical habitat |
| **Insects** | | | | |
| Monarch Butterfly | *Danaus plexippus* | Candidate | None | Documented at Alkali Flats Duckpond (VonLoh 9.23.2024) |
| **Flowering Plants** | | | | |
| Swale Paintbrush | *Castilleja ornata* | Proposed Endangered | None | |
| Bald and Golden Eagles | | | | |

This query is not project-specific and any project in the area will need to do due diligence in coordinating with US Fish and Wildlife Service (FWS) for species of concern. The query conducted for the Lordsburg Playa Wetland Action Plan (WAP) shows that no critical habitat for listed species overlaps with the immediate playa area.

Other observations of ESA-listed or sensitive species on or near the playa have been documented as well. The Monarch butterfly (*Danaus plexippus*) (ESA Candidate) has been documented at the South Alkali Flats Duckpond (VonLoh 2024) (Figure 15). The Northern Aplomado falcon (*Falco femoralis septentrionalis*) (ESA Experimental) was documented in similar valley habitat in the San Simon Valley of Arizona (Hansen 2011). Eagles and migratory birds are also likely to be present. Not shown in the FWS query is a former candidate plant species, Chihuahua scurfpea, or Indian breadroot (*Pediomelum pentaphyllum*) that is New Mexico state-listed. During FWS candidacy review in 2008, New Mexico BLM State Botanist Cecelia Alexander found the plant growing along the Pleistocene shoreline. Chihuahua scurfpea was not warranted for listing under the ESA but remains a Focus Species for FWS. Alexander also found a new species of forb in the Asparagacae family for Hidalgo County within the Lordsburg Draw corridor in 2020 and had the privilege of naming it for Lordsburg muilla (*Muilla lordsburgiana*). The status of this plant should be on radar for consideration as a species of concern.

Mexican fritillary (*Euptoieta hegesia* Cramer, 1779), a US Fish and Wildlife Service Focus Species, was observed in summer 2024 at the South Alkali Flat duckpond (VonLoh 2024, 2025) (Figure 16). The butterfly is rarely seen in New Mexico. The latter are species that are currently not listed but are declining and at risk of becoming candidates for listing under the Endangered Species Act. VonLoh coordinated with Butterflies and Moths of North America (BAMONA) and established the observation as a new record (Butterflies and Moths of North America 2024).

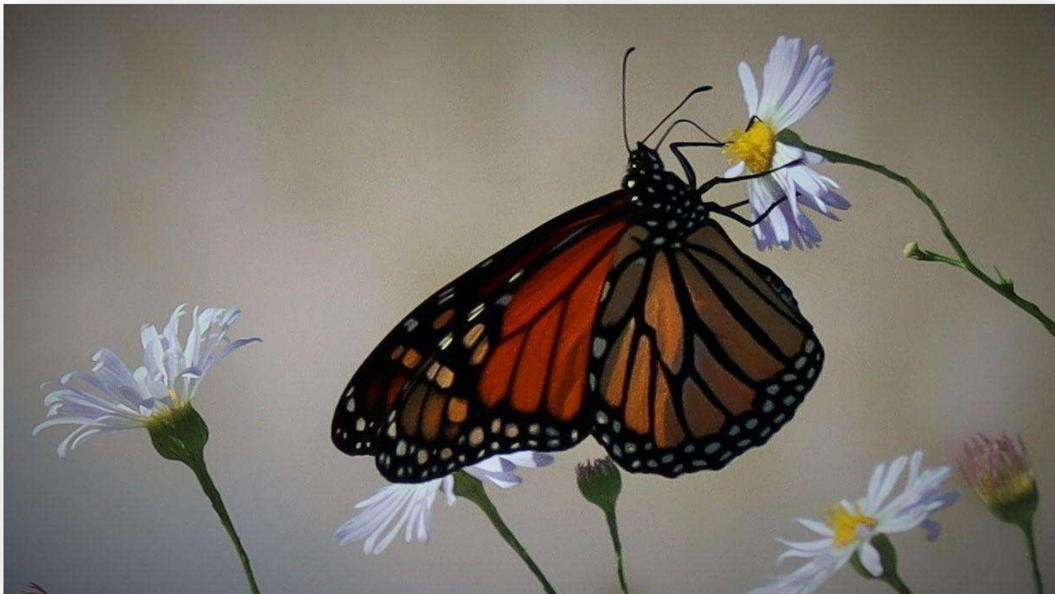


**Figure 15. A Monarch butterfly (ESA Candidate species) was documented at the South Alkali Falt duckpond in 2024. Photo by J. VonLoh.**

**Figure 16. The Mexican fritillary is an FWS Focus Species. Photo by J. VonLoh.**

## USFWS IPaC Birds of Conservation Concern

Two queries were submitted to IPaC for birds of conservation concern. The first is the immediate Lordsburg playa area, identical to the polygon used for the ESA listed wildlife. The second query extended the playa polygon north and south through the Animas Valley. The two queries resulted in the same listings, except that the valley listing also included the Black-chinned sparrow (*Spizella atrogularis*) (Table 10).

**Table 10. Birds of Conservation Concern IPaC Query**

| Common Name | Scientific Name | Listing | Playa List | Valley List |
|---|---|---|---|---|
| Bendire's Thrasher | *Toxostoma bendirei* | BCC | X | X |
| Broad-tailed Hummingbird | *Selasphorus platycercus* | BCC | X | X |
| Black-chinned Sparrow | *Spizella atrogularis* | BCC | | X |
| Cactus Wren | *Campylorhynchus brunneicapillus guttatus* | BCC BCR | X | X |
| Cassin's Sparrow | *Peucaea cassinii* | BCC BCR | X | X |
| Chestnut-collared Longspur | *Calcarius ornatus* | BCC | X | X |
| Eastern Meadowlark | *Sturnella magna* | BCC BCR | X | X |
| Ferruginous Hawk | *Buteo regalis* | BCC BCR | X | X |
| Henry's Common Nighthawk | *Chordeiles minor henryi* | BCC BCR | X | X |
| Long-billed Curlew | *Numenius americanus* | BCC BCR | X | X |
| Scott's Oriole | *Icterus parisorum* | BCC BCR | X | X |
| Sprague's Pipit | *Anthus spragueii* | BCC | X | X |
| Thick-billed Longspur | *Rhynchophanes mccownii* | BCC | X | X |
| BCC - Birds of concern throughout their range in the USA.<br>BCR - Birds of concern in a specific bird conservation region in the continental USA. | | | | |

**Birds of Prey**

Birds of prey, or raptors, are protected by federal and state laws in the United States. These laws prohibit the capture, killing, or possession of raptors, or any parts of them, without proper permits. Some laws that protect birds of prey include:

- Migratory Bird Treaty Act: Makes it illegal to kill or possess any native migratory bird or its parts
- Bald Eagle Act: Makes it illegal to kill or disturb bald eagles, golden eagles, their nests, or their trees
- Endangered Species Act (ESA): Protects species that are endangered or threatened

We reviewed eight years of data from a BLM wetland in the San Simon Valley, Arizona, 25 miles northwest of Roadforks, NM (Cockman 2024a). From this data set, we see that several birds of prey frequent the area (Table 11) and are likely to occur in the Animas Valley.

| Table 11. Posey Well Birds of Prey | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **2006** | **1980** | **1981** | **1982** | **1983** | **1984** | **1998** | **2011** |
| *Falco sparverius* | American kestrel | | | x | | | | | |
| *Falco femoralis septentrionalis* | Northern Aplomado falcon | | | | | | | | x |
| *Glaucidium brasilianum cactorum* | Cactus ferruginous pygmy owl | | | | | | x | | |
| *Accipiter cooperii* | Cooper's hawk | | | | x | | x | | |
| *Aquila chrysaetos* | Golden Eagle | | | | | x | | | |
| *Circus cyaneus* | Northern harrier | x | x | x | x | x | x | | |
| *Falco peregrinus* | Peregrine falcon | | | | x | | | | |
| *Buteo jamaicensis* | Red-tailed hawk | x | | | x | | | x | |
| *Buteo swainsoni* | Swainson's hawk | | | | x | | | | |
| *Cathartes aura* | Turkey Vulture | x | | x | x | x | x | | |

Among the birds of prey, some are or have been listed under the ESA. The Northern Aplomado falcon is ESA-listed as Endangered and Experimental non-essential. It is known from both Cochise County, Arizona and Hidalgo County, New Mexico.

The Cactus ferruginous pygmy owl is listed under the ESA as threatened wherever found. Its historical range included Arizona and Texas. According to USFWS, it occurs in Graham and Cochise Counties in Arizona, and is more common around the Tucson to Phoenix to Yuma triangle in the Sonoran Desert.

The Peregrine falcon was previously listed in 1970 then delisted in 1999 due to recovery of the species. Its historical range included much of the US extending from Alaska to Arizona and California to District of Columbia.

**Migratory Birds**

The Migratory Bird Treaty Act (MBTA) protects many birds, including ducks, flamingos, grebes, doves, cuckoos, swifts, cranes, shorebirds, tropicbirds, and California Condor.

The MBTA protects all native North American birds, as well as species that were reintroduced to the United States after becoming extirpated. The MBTA does not protect non-native species, such as the European Starling and House Sparrow, or hunted birds, such as ducks, geese, and doves (Department of the Interior 2020).

Among 90 bird species observed in the Posey Well data set, the vast majority (85) are protected as migratory by the Migratory Bird Treaty Act (CFR50-Part10.13-2023) (Cockman 2024a). A list of the Posey Well birds is provided in Appendix D.

**VonLoh 2024 Field Visits to Lordsburg Playa**

VonLoh (2024) field surveys documented 58 species of insects, including 26 species of moths and butterflies, including the Monarch butterfly. He also noted a large number of pollinators using the

Chiricahua Mountain tansyaster (*Arida riparia*) that grows on the water's edge along the playa and ditches. VonLoh noted that the waters he encountered had a lot of sediment and he did not observe Fairy shrimp (*Anostraca*). He did however, observe one genus of Clam Shrimp (*Lamnidae*) and the Long-tailed Tadpole Shrimp (*Triops spp*) was observed a few miles south of Alkali Flats.

He noted that further investigation should be conducted to identify the species. He also observed a number of species ranked G4 by the Nature Conservancy (Nature Serve) (Table 12). The G4 implies that the species is "apparently secure," at fairly low risk of extinction or collapse due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors. A complete list of VonLoh species observations is provided in Appendix E.

**Table 12. Wildlife Species of Conservation Concern (VonLoh 2024)**

| Common Name | Scientific Name | Status | General Location | Notes |
|---|---|---|---|---|
| Clam shrimp | *Limnadidae* | Unk. *Cyzicus mexicanus* on the Rio Grande and Pecos are Cat D. | South Alkali Flats Duckpond at the fence line in the water-filled ditch along SH338 off-ramp from I10. | 8.25.24: tiny, pinkish, occasionally surfaced from the cloudy water, most are carrying eggs under their dorsal carapace. |
| Monarch butterfly | *Danaus plexippus* | FWS candidate | South Alkali Flats Duckpond | Three stages of mature butterflies were observed. |
| Checkered white | *Pontia pratadice* | G4 | Alkali Flat west of Fraggle Rock | 8.25.24 individual nectaring from cowpen daisy flowers in arroyo; 9.15.24 individual nectared from blue aster along the ditch. |
| Orange sulfur | *Colias eurythenne* | G4 | Alkali Flat west of Fraggle Rock; South Alkali Flats Duckpond; in water-filled ditch at SH338 xs I10 off-ramp | Observed 8.25, 9.1, 9.8, and 9.15.24 nectaring from cowpen daisy and blue aster or avoiding strong winds in dense vegetation. |
| Western pygmy blue | Brephidium exilis | G4 | South Alkali Flats Duckpond; in water-filled ditch at SH338 xs I10 off-ramp | 8.25 individual perched on dry stems to warm and display for mates. 9.8 and 9.15 a few individuals nectared from blue asters along the ditch |
| Mexican fritillary* | Euptoieta hegesia (Cramer, 1779) | | South Alkali Flat Duckpond | Individual fritillary perching low out of the wind and sunning on dark gravel adjacent to the South Alkali Flats Duckpond habitat. |

| Table 12. Wildlife Species of Conservation Concern (VonLoh 2024) | | | | |
|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Status** | **General Location** | **Notes** |
| Loggerhead shrike | *Lanius ludovicianus* | G4 | South Alkali Flat Duckpond | Observed an individual on 9.1, 9.8, and 9.15.2024 either flying or avoiding the wind while perched in a tamarisk tree. |
| *VonLoh 2025 February 12; also BAMONA Sighting #1398706 | | | | |

**National Nightjar Survey**

Nightjars are a group of nocturnal, aerial insectivores. There are several species across the continent. Conservationists have become concerned that these birds are in dramatic decline. In 2007, the Center for Conservation Biology developed a standard protocol to be used across the nation to gain a better understanding on population status of these birds and to bring information to conservation and management actions. The program is coordinated nation-wide with partners at state and local levels.

According to the Nightjar Survey Network:

> Nocturnal behaviors of nightjars are influenced strongly by moonlight. Activities such as calling and foraging increase under bright moonlight conditions and it is thought that breeding may actually be timed with the lunar schedule. Project protocol was designed to take advantage of these behaviors by conducting surveys only during bright moonlit nights so detection rates will be higher and more consistent (Nightjar Survey Network [date unknown]).

The Common Nighthawk (*Chordeiles minor*) is a wide-spread species across the country. Lesser nighthawk (*Chordeiles acutipennis*) is a specialist of arid and semiarid habitats of the American Southwest and Central America. Both species are of interest for the Lordsburg Playa. A survey was conducted by two observers in May 2024, with confirmation of Lesser Nighthawk at several locations. At two locations, one of the surveyors thought she detected the Common Nighthawk, but this was not confirmed by the second observer. It is recommended that the science community establish a dedicated route for the nighthawks and that local high schools and citizen scientists be employed to continue this survey work (Cockman 2024b).

## OWNERSHIP AND LAND USE

Activity within Lordsburg Playa and its adjacent watershed is primarily managed by the BLM. The New Mexico State Land Office (SLO) has holdings in the area, but defer management of shared grazing allotments to the BLM Las Cruces District Office (LCDO). The New Mexico Department of Transportation (NMDOT) and Federal Highways Administration (FHWA), Union Pacific Railroad, and other utility and private industry also have roles or interests on the playa (Van Pelt et al 2020). Land ownership with grazing allotment boundaries and the National Wetlands Inventory boundary are shown in Figure 17. The map is color-coded as follows: white = private, yellow = Bureau of Land Management, blue = State of New Mexico, red lines = grazing allotment boundaries, black lines = NWI boundaries.

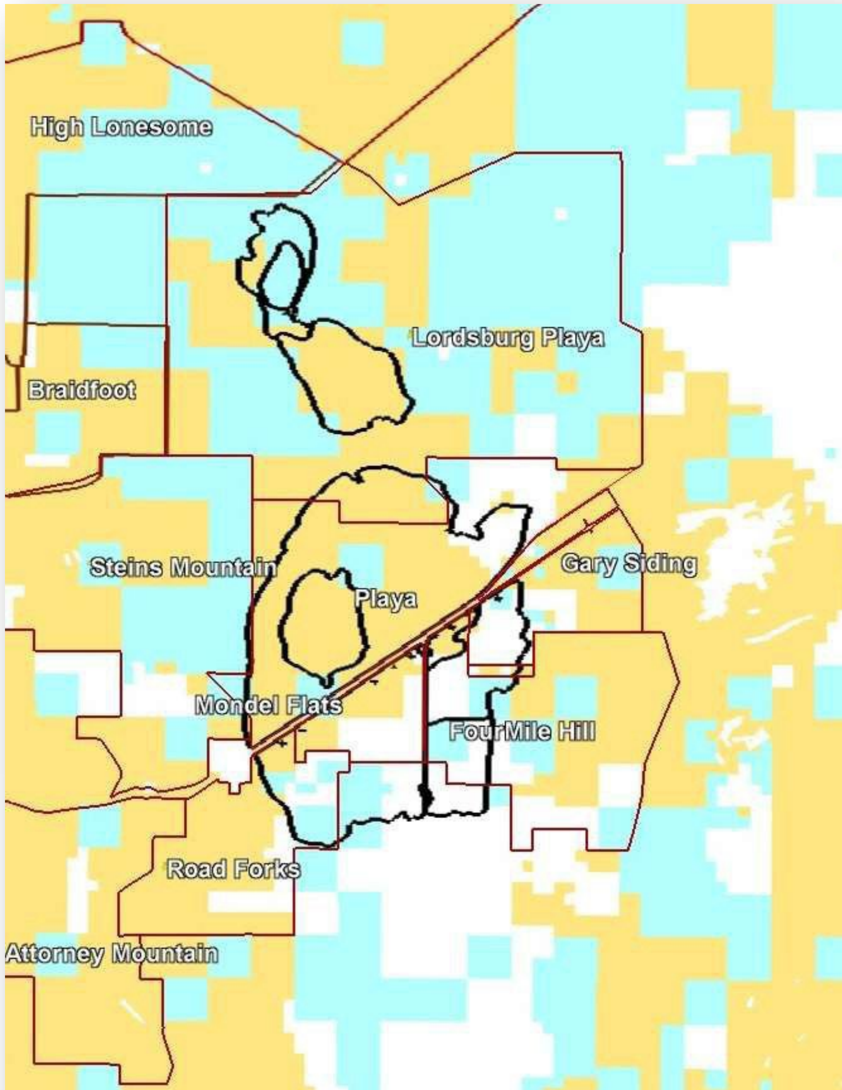



**Figure 17. Land ownership and grazing allotments are seen relative to the wetlands boundry.**

# THREATS AND IMPAIRMENTS

## Ground Water Impairments

Currently, there are no known impairments to ground water. Waters are naturally saline and sodic. There is evidence of some draw down of static ground water (about 30 ft) across the south playa and south of Interstate Highway 10. Comparisons of well data are shown in Table 8 above.

## Surface Impairments

### *Breach of Legacy Structures in the Uplands*

Breach of legacy structures in the near uplands on the east facing slope of the Peloncillo Mountains has been observed. There is no current inventory or assessment of resources known. Repair or decommissioning of legacy structures would decrease soil erosion and potential sedimentation running into the playa. Ranchers on the playa report that some repair and decommissioning of dirt tanks has been done (Washburn 2025).

Legacy structures include stock tanks for livestock watering and berms and swales for managing water on the landscape. These may appear as dug out soil pits with berms to capture surface run-on and rainfall. They may also appear as small dams in ephemeral drainages to capture run-on water, especially during monsoon season. Legacy structures also include abandoned mine land features, usually located higher up in the watershed. The vast amount of rock outcrops in the Peloncillo and Pyramid Mountains make any disturbance in the upper watershed prone to erosion from rainfall events.

***Ephemeral Drainages Crossing Major Access Roads***

County roads and two-track roads cross ephemeral drainages in many locations throughout the watershed. Repair has been undertaken on some of these features since 2018 related to the dust mitigation project. A complete inventory and assessment would be beneficial. Light Detection and Ranging (LiDAR) studies are being utilized by dust mitigation contractors to track progress of gully and ephemeral drainage repair.

***Road Blow-outs***

The saline content increases the dispersion rates of even the most clayey soils. These soils are highly susceptible to erosion from water. Inventory and assessment of roads and conditions stratified by soil type (texture and sodicity) would enable better planning of road maintenance and the areas that need repair/reinforcement. Simply applying gravel on the road surface or drainage crossing may not be beneficial because of the highly erosive nature of the soils. Additional infrastructure such as culverts and well-designed drainage may be needed.

***Off-road Vehicle Activity***

Off-road vehicle traffic is intended for designated county roads and two-track roads. However, once a vehicle makes a pass, others assume that it is permissible to follow; thus, two-track roads are easily created that are not official roadways. Signage and closure of some of these roads would be beneficial. A road inventory for the area would also be helpful. Because many of these roads lead to valuable infrastructure, such as ranch operations and mining claims, they have value to the county. Hidalgo County should be involved in inventory and assessment procedures. Because of the vast amount of BLM lands in the project footprint, this effort would most likely be led by the Bureau of Land Management.

***Livestock***

Dust emissions studies (New Mexico Department of Transportation 2019; Van Pelt et al 2020; Baddock et al 2011) indicate that livestock trailing and trampling on the playa surface is a significant source of dust for entrainment and dust storms. The Cooperative Resource Management Plan (CRMP) for the Playa Allotment (Bureau of Land Management, No Date) and its environmental assessment did not take into account the relationship between livestock and dust created from trailing and other livestock-related activities that can damage playa surface crusts (Van Pelt et al. 2020).

***Eroded Areas***

A Google Earth search was conducted along the shoreline perimeter. The search found that much of the shoreline shows shallow rills and gullies that are a natural occurrence in soil that “melts” quickly and fills in shallow rills. The playa is also crisscrossed in many areas by giant desiccation cracks naturally occurring on the playa. These are discussed further in the Soil and Ecological Site Descriptions (Appendix A). Several areas of concentrated soil erosion were mapped along the perimeter of the north playa, south playa, and south of Interstate Highway 10.

This list is not complete for the toeslopes or mid-bajada region. An intensive inventory and assessment of surface soil erosion, ephemeral drainage erosion and road erosion should be completed for the playa watershed.

About 715 acres of surface disturbances were identified around the shore perimeter. This does not include on-going habitat restoration work being conducted north of Steins for the NMDOT dust mitigation project, representing another 3000 acres. Ten parcels were identified that display accelerated erosion. A full description and location of each parcel is provided in the Table 13. Figure 18 shows the locations of the surface eroded areas around the edge of the Playa.


**Figure 18. Surface erosion polygons.**

| Table 13. Surface Soil Erosion Near Shore | | | | | |
|---|---|---|---|---|---|
| **Polygon** | **Playa** | **Location STR** | **Acres** | **Ownership** | **Description** ***(rancher input in italics)*** |
| 1 | South | T23S R20W Sec 2 SWSE | 2.2 | State and Private | Near road and infrastructure. |
| 2 | South | T23S R20W Sec 4 NE center | 4.6 | BLM | Wagon wheel concentration of livestock trails related to pasture gates. |

| Table 13. Surface Soil Erosion Near Shore | | | | | |
|---|---|---|---|---|---|
| **Polygon** | **Playa** | **Location STR** | **Acres** | **Ownership** | **Description *(rancher input in italics)*** |
| 3 | South | T23S R20W Sec 1 NE | 27.8 | BLM | Concentration of livestock trails along the shore are related to an incoming 2-track road from the south and a livestock water 3 mile north on state land. |
| 4 | North | T22S R20W Sec 6 W1/2 center | 88 | State | Concentration of livestock trails at livestock water. Scars on the ground look like the operator has tried to do range seeding and pitting. A gravel apron around the water may help. *High Lonesome Well is 800 ft deep well for irrigation. Pump is set at 555 ft.; 80 GPM; north south trending lines are irrigation pipe. Native alkali sacaton and salt bush expanded. Vegetation is hanging in. No info on water quality....good enough for sacaton. Potable for cattle and probably for people.* |
| 5 | North | T22S R20W Sec 18 SW | 32 | State | Concentration of trails associated with livestock water, corrals, livestock driveways and pasture fences. |
| 6a | North | T22S R20W Sec 32 N1/2 NE | 23 | State | This area is treated on state land but not on BLM. The area is associated with a bottle neck of 2-track roads coming into the playa from the east on the BLM parcel. The concentrated surface flow from the roads is causing gullies on the playa. |
| 6b | North | T22S R20W Sec N1/2 NW | 40 | BLM | |
| 7a | North | T22S R21W Sec 12 SE, 13 NWNW | 134 | BLM | Rafter JL ranch operations attempted native vegetation seeding: Ripped 6 ft apart, tines @ 8 inch deep; @ 5 year ago; resulted in increases of volunteer shadscale saltbush. Alkali sacaton was seeded but it did not take (J. Lunt 2025). |
| 7b | North | T22S R20W Sec18 NWNW | 13 | State | |
| 8a | South I10 | T28S R20W Sec 36 NWNW | 1.8 | BLM | Associated with a large ephemeral drainage coming in from the Pyramid Mountains. The drainage has a long straight stretch of about 1 mile that does not meander. It comes out of a braided section that is more "natural" to the bajada (lower piedmont). The drainage is about |
| 8b | | | 7.5 | State | |

| Table 13. Surface Soil Erosion Near Shore | | | | | |
|---|---|---|---|---|---|
| **Polygon** | **Playa** | **Location STR** | **Acres** | **Ownership** | **Description *(rancher input in italics)*** |
| | | | | | 25 m wide. It is exacerbated by incoming run-on from 66-acre BLM parcel to the north that is heavily overgrazed with many gullies. The adjoining BLM parcel to the east needs to be included in the treatment.<br>This erosion is impacting State pasture land within the NWI boundary. Google Earth imagery indicates that land treatment has been applied on the State but the source of the problem is the drainage on BLM to the east. |
| 9 | South I10 | T23S R19W Sec 31 SW | 66 | BLM | BLM parcel needs upland gully repair and induced meander treatment in a straight and wide drainage (about 1-mile x 25 m) |
| 10a | South I10 | T24S R21W Sec 12 NESE | 23 | BLM | This are near Roadforks has upland gullies feeding the playa area. Old infrastructure such as a decommissioned land fill, dredging and filling dot the area. This area includes on-going work related to the dust mitigation studies. |
| 10b | South I10 | T24S R20W Sec 7 W1/2, 6 SW | 223 | BLM | |
| 10c | South I10 | T24S R20W Sec 7 SENW | 19 | State | |
| 10d | South I10 | T24S R21W Sec 12 NENE | 10 | Private | |

Six of the areas are associated with concentrations of livestock trails and access roads serving ranch infrastructure. One located at the north end of the north playa was an attempt to seed native vegetation by one of the ranches. One area located near Roadforks has an assortment of historical activities causing gullies and has already received some restoration work. Two areas south of Interstate Highway 10 are related to one another; they include upland erosion from over-grazing, causing too much run-on, and sedimentation dumping into an ephemeral drainage which needs induced meander treatment. The origin is on BLM land, spills out onto State land and further aggravates private land operations.

### *Future Proponent Applications*

The Bureau of Land Management (BLM) has had applications for lithium operations on the playa within the last few years, along with discussion of potential for solar operations. High Desert Native Plants requested input from BLM for this document but did not receive a response for information requested.

### Dust accumulation

Sediment accumulation in dry lake bottoms is one source of dust that causes many vehicle crashes on Interstate Highway 10. (On average, one person is killed each year in dust-related crashes on Interstate Highway 10). Habitat restoration actions to reduce erosion and sediment accumulation in the playa have been on-going since 2018.

## CURRENT REGULATIONS FOR PROTECTION

### FLPMA and NEPA

The Federal Land Policy and Management Act (FLPMA) is a United States federal law that governs the management of public lands administered by the Bureau of Land Management (BLM). Enacted in 1976, FLPMA codified and expanded the powers of the BLM, with the goal of maximizing "multiple use" and "sustained yield" of public lands and resources. It authorizes the BLM to manage over 245 million acres of public land and 700 million acres of sub-surface mineral estate throughout the nation. It is the organic act of BLM.

The National Environmental Policy Act (NEPA) of 1969 was established to recognize the profound impact of human activity on the interrelations of all components of the natural environment. Section 2 of the Act states:

> The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare or man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality. (42 U.S.C. 4321).

The National Environmental Policy Act provides a checklist of natural resources, social justice and economic elements that must be addressed for any project or activity on lands administered by the BLM.

### Water Quality and Wetlands

Water quality in New Mexico is managed through various regulatory measures in three broad categories: removing or replacing a designated use; site-specific criteria based on relevant conditions; and temporary standards for specific parameters preventing attainment of the designated use. Water quality programs cover drinking water, groundwater, surface water and waste water.

The basic authority for water quality management in New Mexico is provided through the State Water Quality Act, which establishes the Water Quality Control Commission (WQCC). The WQCC is the state water pollution control agency for purposes of the Federal Clean Water Act. The New Mexico Environmental Department (NMED) is responsible for implementing the Federal Clean Water Act in New Mexico and ensuring that surface waters meet their designated beneficial uses and New Mexico state water quality standards (New Mexico Environment Dept [date unknown]).

New Mexico regulates wetlands through surface water quality management and 401 certifications under the Clean Water Act (CWA). New Mexico Environment Department Surface Water Quality Bureau (SWQB) is responsible for the protection and management of the waters of the state, including wetlands. The CWA document incudes reference information about the types of wetlands that occur in New Mexico, wetland functions and the value of wetlands, and why wetland condition is important (New Mexico Environment Dept [date unknown]).

BLM policies for soil, water and air quality are addressed in the Mimbres Resource Management Plan (Bureau of Land Management 1993).

### Mining and Minerals

The policy of the Bureau of Land Management's (BLM) Las Cruces District Office is to facilitate the development of mineral resources to meet national, regional, and local needs for domestic and defensive purposes. The BLM is also responsible for ensuring that mineral development is carried out in a manner which minimizes environmental damage and provides for the rehabilitation of affected land (Bureau of Land Management 1993).

Mining of hardrock minerals on federal lands is governed primarily by the General Mining Law of 1872. The law grants free access to individuals and corporations to prospect for minerals in public domain lands, and allows them, upon making a discovery, to stake (or "locate") a claim on that deposit. A claim gives the holder the right to develop the minerals and may be patented to convey full title to the claimant. A continuing issue is whether this law should be reformed, and, if so, how to balance mineral development with competing land uses.

Congress has imposed a moratorium on mining claim patents through the annual Interior spending bill since FY1995. Broad-based legislation to reform the General Mining Law of 1872, the Hardrock Mining and Reclamation Act of 2009 (H.R. 699), was introduced on January 21, 2009. Similarly, Senate bill S-140 (Abandoned Mine Reclamation Act of 2008) was introduced in January 2006. These bills aim to provide financial resources for active mining claims and the cleanup of abandoned mines (Congressional Research Service 2016).

The New Mexico mine law is governed by the New Mexico Mining Act of 1993. The Act promotes responsible mining practices, including reclamation and resource utilization. The Mining Act Reclamation Program (MARP) regulates hard rock mining reclamation for most minerals except those that are specifically excluded. The law addresses mine safety, coal surface mine reclamation and abandoned mine land reclamation. It is enforced by the New Mexico Mining and Minerals Division.

Mining activities on federal land are subject to federal, state, and local regulations for air and water quality, solid waste, public safety, and fire control (Gerard 1997).

#### *The Watershed*

Hardrock mining in the Peloncillo and Pyramid Mountains dates back many years. Hardrock mining is regulated under the 1872 Mining Act and New Mexico Mine Law of 1993. Many small mines are still active and many sites fall under the administration of the Abandoned Mine Land (AML) program. Most of these sites are small in nature as they are composed of a small disturbed area (sometimes less than an acre) leading into the mountain for underground operations. Still, these small areas present a source of erodible sediment. An inventory of AML sites and active mining claims is needed for the inventory of disturbed acres in the watershed.

#### *The Playa*

In 2018, the Bureau of Land Management (BLM) analyzed the potential effects of an exploration plan of operation for the locatable, nonmetallic mineral lithium in Lordsburg Playa. The Environmental Assessment acknowledged that Lordsburg Playa is subject to high winds and vulnerable to frequent dust storms where visibility is greatly reduced. The BLM's Las Cruces District Office focused its analysis on understanding sources of dust and ensured that surface-disturbing project elements (e.g., drilling, road grading, and vehicle access) were designed to minimize impacts on soil chemistry, structure (crusts), and water flow patterns/erosion (Van Pelt et al 2020).

Proposed actions identified through the National Environmental Policy Act (NEPA) process will need to address each surface-disturbing project element with discrete mitigation measures.

## Livestock Grazing

### *Rangeland Monitoring*

Twelve grazing allotments are associated with Lordsburg Playa and its adjacent watershed (Figure 19). Nine allotments are administered by BLM's Las Cruces District Office. Due to watershed units spanning the Arizona/New Mexico state line, three of the allotments are administered by Arizona BLM Safford Field Office. The vertical lavender line in Figure 19 is the Arizona/New Mexico state line.

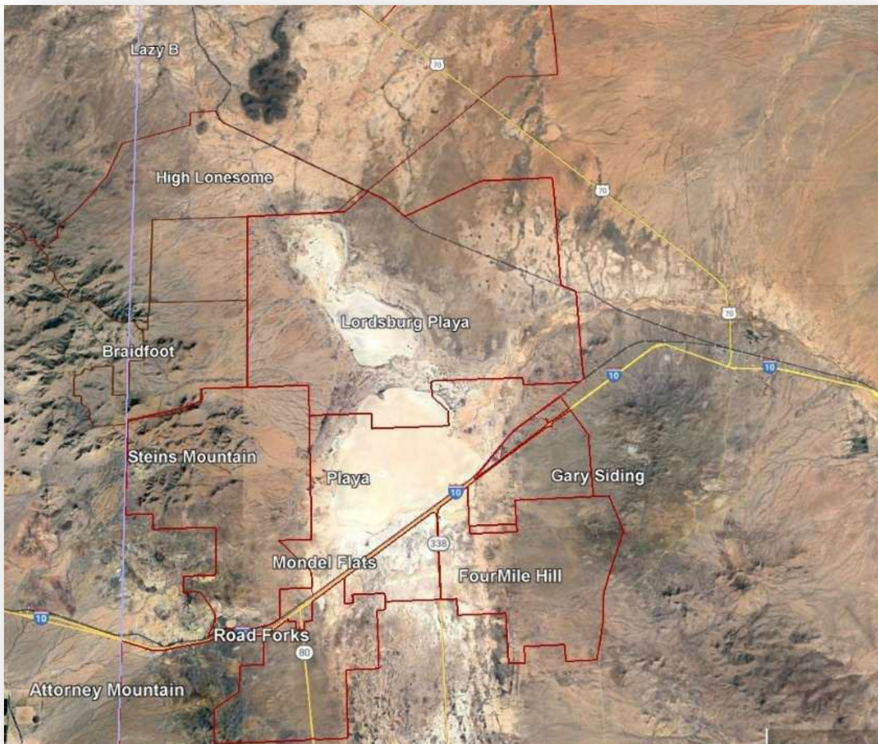



**Figure 19. Grazing allotments include three crossing the state line that are managed by Arizona BLM.**

Each allotment has a grazing capacity set by the BLM (Table 14) and grazing use on these allotments is covered by a term permit. Grazing allotment capacity is based on the total capacity for the public, state, and private lands within the allotment. All grazing allotments are permitted year-round grazing from 1 March through 28 February. Livestock, owned by ten operators, utilize the forage on these permits. At a rancher meeting on 31 March 2025, Greg Kerr reported that Mondel Flats is grazed only three months of the year (Kerr G 2025). Mondel Flats is located south of Interstate Highway 10 and supports a robust Alkali sacaton grassland.

The Bureau of Land Management (BLM) has specified management categories for each grazing allotment based on similar resource characteristics, management needs, and both resource and economic potential for improvement:

Maintain (M) Allotments with current satisfactory conditions

Improve (I) Allotments where existing conditions are unsatisfactory and can economically be improved and those allotments which contain plant or animal species of concern

Custodial (C) Allotments where the opportunity for positive economic return on public investment is unlikely

Permitted use (livestock stocking rates) are provided for each allotment in Table 14. Each of the allotments is permitted for year-round grazing.

Table 14 includes the following definitions:

Allotment Management Category

M Current satisfactory conditions

I Current unsatisfactory conditions and the allotment can be economically improved

C Opportunity for positive economic return unlikely; if the allotment hosts species protected under the Endangered Species Act, it automatically advances to the I category.

AUMs - Animal Unit Months. One AUM equals the amount of forage required by one animal unit for one month. AUMs are suspended by BLM Decision.

**Table 14. Grazing Allotments and Permitted Animal Unit Months***

| Allot Number | Allot Name | Pub Acres | Mgt. Cat (1) | Permitted AUMs (2) | Suspend AUM (3) | Livestock Kind | Public Land % | Actual AUMs |
|---|---|---|---|---|---|---|---|---|
| AZ50580 | Lazy B | 51181 | I | 13488 | 0 | Cattle | 65 | 13393 |
| AZ50620 | Braidfoot | | M | | | Cattle/ Horse | 67 | 651/24 |
| AZ50670 | High Lonesome | 13908 | I | 3456 | 0 | Cattle | 69 | 3469 |
| NM01010 | Steins Mountain | 10696 | I | 1480 | 0 | Cattle | 59 | 1480 |
| NM01032 | Four Mile | 5198 | I | 318 | 0 | Cattle | 34 | 318 |
| NM01034 | Lordsburg Playa | 17714 | I | 1852 | 0 | Cattle | 34 | 1852 |

| Table 14. Grazing Allotments and Permitted Animal Unit Months* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Allot Number** | **Allot Name** | **Pub Acres** | **Mgt. Cat (1)** | **Permitted AUMs (2)** | **Suspend AUM (3)** | **Livestock Kind** | **Public Land %** | **Actual AUMs** |
| NM01048 | Attorney Mountain | 11143 | I | 1225 | 526 | Cattle | 81 | 1205 |
| NM01060 | Roadforks | 6406 | I | 504 | 210 | Horse | 42 | 30 |
| NM01068 | Playa | 11738 | I | 720 | 0 | Cattle | 60 | 533 |
| NM01072 | Gary Siding | 3474 | C | 298 | 0 | Cattle | 62 | 298 |
| NM01079 | Mondel Flats | 3133 | M | 510 | 0 | Cattle | 36 | 510 |
| NM01545 | Four Mile Hill Lease | 80 | M | 24 | 0 | Cattle | 100 | 24 |
| ** Data were obtained from the BLM Range Administration System (RAS) in April 2025. Numbers recorded may not reflect the actual use dates reported by the Permittee.* | | | | | | | | |

Grazing allotments are largely governed by the Mimbres Resource Management Plan (New Mexico) (Bureau of Land Management 1993) and the Safford Resource Management Plan (Arizona) (Bureau of Land Management 2018). The Safford District RMP incorporates by reference: (a) Upper Gila-San Simon Grazing Environmental Statement (Bureau of Land Management 1978); (b) Eastern Arizona Grazing EIS (Bureau of Land Management 1986); and (c) Statewide Land Use Plan Amendment for Implementation of Arizona Standards for Rangeland Health and Guidelines for Grazing Administration EA Decision Record (Bureau of Land Management 1997).

Other management actions outlined by the various plans include allotment management plans, grazing systems, rangeland improvements, livestock use adjustments, and monitoring studies.

Vegetation monitoring and compliance for the BLM’s land health standards are governed by accepted monitoring protocol utilizing core standards defined by the Assessment Inventory and Monitoring (AIM) program. These are outlined in BLM Technical Reference 1734-6 (Pellant et al 2020) and the BLM Integrated Monitoring Handbook H-1740-2 (Bureau of Land Management 2008).

Vegetation monitoring updates are provided in Table 15.

| Table 15. Vegetation Monitoring and Management Category | | | | |
|---|---|---|---|---|
| **Allot Num** | **Allot Name** | **Mgt. Cat.** | **Monitoring** | **Last Data** |
| AZ50580 | Lazy B | I | AIM | 2024 |
| AZ50620 | Braidfoot | M | AIM | 2024 |
| AZ50670 | High Lonesome | I | AIM | 2024 |
| NM01010 | Steins Mountain | I | Restore NM, Brush Treatment | 2019 |
| NM01032 | Four Mile | I | AIM | 2019 |
| NM01034 | Lordsburg Playa | I | AIM | 2019 |

| Table 15. Vegetation Monitoring and Management Category | | | | |
|---|---|---|---|---|
| **Allot Num** | **Allot Name** | **Mgt. Cat.** | **Monitoring** | **Last Data** |
| NM01048 | Attorney Mountain | I | AIM | 2019 |
| NM01060 | Roadforks | I | AIM | 2016 |
| NM01068 | Playa | I | AIM | 2021 |
| NM01072 | Gary Siding | C | AIM | 2023 |
| NM01079 | Mondel Flats | M | AIM | --- |
| NM01545 | Four Mile Hill Lease | M | AIM | --- |
| *Last Data: BLM Natl AIM TerrADat Hub inquired 2025 April 24. (Bureau of Land Management 2024).* | | | | |

***Water Rights***

Water and windmill permits are discussed in the Hydrology/Water Quality section and Table 8.

***Migratory Wildlife and Threatened & Endangered Species***

The Endangered Species Act of 1973 is the primary authority protecting threatened, endangered, or candidate species. It includes migratory bird treaties with Mexico and Canada. It is the policy of BLM and New Mexico State Land Office to cooperate with the ESA.

- The Migratory Bird Treaty Act of 1918 prohibits the harming of native birds, their nests and eggs. It is a primary tool for protecting non-endangered species. It prohibits the take of protected migratory bird species without prior authorization from US Fish and Wildlife Service.
- The Bald and Golden Eagle Protection Act specifically protects these two species.

A number of candidate species, species of concern, and migratory bird species, are known to occupy Lordsburg Playa and the adjacent watershed. These are discussed in the wildlife section.

***Coordinated Resource Management Plan***

A Coordinated Resource Management Plan (CRMP) has been developed for the Lordsburg Playa Allotment with cooperation from the grazing permittee, the BLM, NRCS, the New Mexico Association of Conservation Districts, the Hidalgo County Soil and Water Conservation District, and the State Land Office. The CRMP outlines the opportunities to combine the efforts and resources belonging to the private landowner and multiple resources from the various land management agencies to reduce fragmentation and ultimately enhance the productivity of the natural resources. Each partner entering into the plan has specific roles and responsibilities to ensure the success of the program. The BLM drafted an Environmental Assessment (EA) for range improvements to the Lordsburg Playa; it concluded that impacts to soil and water resources and vegetation would be very localized and short-term. Dust production from or dust mitigation for approximately 18.8 acres of surface disturbance was not addressed in the EA (Van Pelt et al 2020).

Grazing allotments administered by Arizona BLM include Braidfoot, High Lonesome and Lazy B. The Safford BLM Field Office has incorporated CRMPs into the grazing renewal permit (Peterson 2025).

**Fragile Land Areas**

Fragile lands are areas that are particularly sensitive to disturbance, potentially irreversibly (Schwarz et al 1976) The Mimbres Resource Management Plan (RMP) identifies several fragile land areas in the Mimbres Resources Area. According to the RMP, these areas will receive high priority for Allotment Management Plans or other activity plan revision or development, allotment monitoring, land treatments, allotment recategorization, and possible reduction or exclusion of surface disturbing activities including range improvement development and livestock grazing use. Additionally, the Mimbres RMP states that efforts will be directed towards improving range condition and reaching desired plant community objectives within these areas (Bureau of Land Management 1993).

The Mimbres RMP designates two types of fragile lands within Lordsburg Playa and its adjacent watershed: creosote-fair and grass-poor. The grass-poor delineation encompasses the entire western and most of the eastern shoreline areas of the playa. The Playa Allotment and other Management Category I-rated grazing areas intersect an area of grass-poor fragile lands. To date, the Playa Allotment has only been monitored by photo point once, and the fragile-lands designation has not triggered quantitative monitoring or management decisions about range use (Van Pelt et al 2020).

The common-sense reason for BLM not following through with the required AIM monitoring for Management Category I allotments is that the playa is naturally barren. While there is no forage to monitor, soil crusts should be monitored. Provisional Ecological Site Descriptions (ESD) have been developed by NRCS Las Cruces to describe the ecosystem. This topic is described further in Appendix A.

**Soil, Air, and Water Resources**

The objective of the soil, air and water program is to protect, maintain, and enhance these resources on the Mimbres Resource Area as well as provide support to other resource programs. The Mimbres RMP places emphasis on the management of soils resources so that they do not deteriorate or degrade. It specifies that activities that occur within the Mimbres Resource Area should have appropriate measures developed to mitigate impacts to air quality (e.g., dust abatement) and watersheds (e.g., erosion control, minimizing surface disturbance, controlling off-road vehicle use, and installation of exclosures) (Bureau of Land Management 1993).

Activities associated with mining and minerals are required to adhere to air and water quality regulations as governed by the Environmental Protection Agency (EPA). The Water Quality Standards Regulation (40 CFR 131) establishes the requirements for states and tribes to review, revise and adopt water quality standards. It also establishes the procedures for the EPA to review, approve, disapprove and promulgate water quality standards pursuant to section 303 (c) of the Clean Water Act. The EPA requires that water quality standards adopted by states and authorized tribes on or after 30 May 2000 be approved by EPA before they can be used as the basis for actions (e.g., establishing water quality-based effluent limitations or total maximum daily loads (TMDLs), under the Clean Water Act. 40 CFR 131.21) (Environmental Protection Agency 2021).

The Clean Air Act (CAA) is a comprehensive federal law that regulates air emissions from stationary and mobile sources. The CAA authorizes EPA to establish National Ambient Air Quality Standards to protect public health and public welfare and to regulate emissions of hazardous air pollutants. Under the CAA, EPA sets limits on certain air pollutants, including setting limits on the quantity in the air anywhere in the United States. The Clean Air Act also gives EPA the authority to limit emissions of air pollutants coming from sources like active mines (Environmental Protection Agency 1970).

**Vegetation**

The objective of vegetation management in the Mimbres Resource Area is to maintain vegetation resources so that they meet or exceed the land use plan goals and activity plan objectives. This program also establishes and processes vegetation sales, provides direction for land treatments, and evaluates activities in fragile land areas. The Mimbres RMP specifies land treatments (e.g., prescribed burning, herbicide application, prescribed grazing management) to achieve Desired Plant Community Objectives, optimal ranges of percent composition for various plant communities. These include plant communities that occur in Lordsburg Playa and its adjacent watershed. However, management guidance and actions for activities in fragile land areas are not specified (Bureau of Land Management 1993).

The BLM should review the provisional Ecological Site Descriptions (ESD) developed for the playa by NRCS. These ESDs necessarily use a spatial scale rather than a temporal scale and describe natural features on the playa such as large and small soil crack areas that should not be confused as erosion features. The presence and condition of soil crusts are the most important component of the playa resources. The soil crusts are addressed in the BLM monitoring protocol (Pellant et al 2020; Bureau of Land Management 2008), but are frequently omitted from practical application.

In 2012, the BLM's Las Cruces District Office applied herbicide treatments to an area between Doubtful Canyon and Rustler Draw, northwest of Lordsburg Playa. The treatments were intended to restore grassland in areas that have been converted to shrubland through grazing as part of the Restore New Mexico program. Results are not yet available on the public access data base (BLM Natl AIM TerraDat Hub).

### Access

The BLM manages roads and vehicles on public lands in a manner that is compatible with the protection of sensitive resource values. It decides what public land should be designated as open, limited, or closed to vehicle use; what areas should be managed for intensive off-road vehicle (ORV) use; and within restricted areas, how vehicle use for authorized activities (other than recreational) should be accommodated. BLM has permitted access to El Paso Natural Gas for their ongoing use of Gas Line Road for pipeline inspections and maintenance (Van Pelt et al 2020).

The BLM frequently has agreements with the county road departments for shared maintenance. Clarification was requested of BLM but not received. The ranchers report that to their knowledge Hidalgo County maintains the roads (2025 rancher input meeting).

### Temporary Closure to Off-Highway Vehicles

Lordsburg Playa was designated as "open" use in 1993 (Bureau of Land Management 1993). In 1998, the BLM Las Cruces District Office ordered Lordsburg Playa closed to all non-administrative motorized and non-motorized vehicles, including land sail craft (wind-driven recreational vehicles) in order to reduce dust production across the playa. The temporary closure order detailed that disturbance of the playa surface by vehicles caused dust clouds that resulted in 4 fatalities on Interstate Highway 10. The closure order was filed in the federal register five days after the fatalities occurred. The closure order remains in effect today (Bureau of Land Management 1998).

## TOOLS FOR CONSERVATION

### Inventory and Assessment of Resources

As the saying goes, it is difficult to take are of what you do not know that you have. Vegetation studies are fairly robust with the use of BLM monitoring protocol. Additional work is needed for aquatic species, the avian corridor, and small mammals. These were addressed in the wildlife section above.

### Education and Outreach

The Hidalgo County Comprehensive Plan Update (Community by Design 2011) identifies the lack of educational and cultural opportunities as among its community's issues. There will be opportunities for the community to participate in long-term studies and conservation projects for Lordsburg Playa through citizen science. Western New Mexico University Hidalgo Center, Lordsburg High School, Animas High School and other regional colleges and universities could be engaged in studies and projects that benefit education and community engagement. Animas High School staff have expressed an interest in incorporating playa studies into their curriculum. Suggestions for citizen science engagement are listed in Table 16.

**Table 16. Suggestions for Citizen Science Engagement**

| TOPIC | TASK | PROFESSIONAL PARTNERS |
|---|---|---|
| **Ground Water** | Monitoring of static ground water levels in area wells. | USGS, NM OSE |
| | Piezometer studies. | USGS, NM OSE |
| | Water Quality. | NMED |
| **Surface Water** | Water Quality. | NMED |
| | Macro biotic studies. | EPA TMDL |
| **Wildlife** | Nightjar surveys | Center for Conservation Biology |
| | Small mammal trap surveys | NMDFG |
| | Bird Emlin transects | NMDFG |
| | Butterflies, moths, and dragonflies | BAMONA |
| | Aquatic species | EPA TMDL |
| | Ponded water surveys | EPA TMDL |
| **Habitat Restoration** | Gully and arroyo repair | SWCD, local contractors |
| | Dirt tank repair and maintenance or demolition | SWCD, local contractors |
| | One-rock structures | SWCD, local contractors |
| **Soil/Geology** | Inventory and mapping at local projects | NRCS |
| | Monitoring of sediment traps | USGS, SWCD |
| **Vegetation** | Inventory of Ecological Sites | NRCS, JER |
| | Monitoring of treated habitats | NRCS, JER |

### Best Management Practices

Best Management Practices (BMPs) are defined by BLM Handbook H-1601-1 as a suite of techniques that guide or may be applied to management actions for achieving desired outcomes. These methods and practices employ integrated vegetation management that can be applied on a site-specific basis to reduce or avoid adverse environmental or social impacts. They should also be given consideration during the development of land use and activity plans (Bureau of Land Management 2008).

In addition to the Integrated Vegetation Management Handbook, BLM implements a number of planning documents: Manual Section 6840 (Special Status Species); H-4120-1 (Grazing Management); and H-8550-1 (Management of Wilderness Study Areas). These manuals provide guidance on standard operating procedures, prevention measures and mitigation measures that must be addressed for actions such as herbicide application, mechanical treatments, weed prevention, and other actions dealing with vegetation management (Bureau of Land Management 2008).

**Designated Management Areas**

The BLM maintains the Peloncillo Wilderness Study Area on the Braidfoot allotment. The playa is also gated and vehicles are limited to permitted service vehicles; however, the gates are not locked. The Las Cruces District Office has considered designation of the playa as a special Area of Critical Environmental Concern. These are more frequently used for the protection of special habitat, species of concern, or cultural and paleo resources. However, they can also be used to facilitate management of eroded or sensitive areas such as the playa.

# PLAYA WETLAND RESTORATION AND CONSERVATION PROGRAMS

The New Mexico Department of Transportation (NMDOT) has undertaken watershed restoration activities in the bajada (piedmont slopes) of the Peloncillo Mountains west of the Lordsburg Playa. These activities involve a number of different strategies aimed at changing the way water flows across the landscape using techniques inspired by and modified from “induced meandering” principles. The restoration practices used in-channel erosion control structures such as one-rock dams, Zuni bowls, and other hand-built structures made of natural materials (primarily rock); in-channel and near-channel earthworks to divert water from incised channels; road drainage earthworks such as rolling dips; and broadscale application of native grass seed through a method that combines Keyline plowing, Imprinting, and Seeding (KIS) all in one pass of the tractor. The following is an excerpt from the NMDOT BLM Draft Programmatic Environmental Assessment (unpublished) that explains these strategies. Across the watershed contributing to the Lordsburg Playa, implementation of these strategies is thought to have a beneficial effect on the land health and ability for the watershed to maintain and improve its hydrology.

NMDOT proposes to reduce dust sources on the Lordsburg Playa and its watershed by establishing a Program of treatments designed to stabilize soils and reduce ongoing erosion in areas where existing surface disturbance contributes to low- and zero-visibility dust storms on Interstate Highway 10. Treatments could include revegetation, erosion control and infrastructure modification to restore natural hydrological function, conservation and cultivation of soil crusts, and fencing to protect treatment areas. The Proposed Action would authorize a Program of treatments that would take place on Lordsburg Playa within the 30,486-acre (47.6-square mile) Program Area on lands administered by the BLM. NMDOT estimates that up to 500 acres of treatment could occur annually.

To date, NMDOT has treated approximately 3,000 acres of SLO-managed lands using a variety of techniques described in this section, including exclusion fencing, soil stabilization and revegetation treatments, and installation of hand-built erosion control structures.

***Maintenance Agreements***

Projects funded by the Federal Highway Administration (FHWA) PROTECT program that occur on lands outside of the highway right-of-way on lands not managed by the NMDOT (i.e., BLM lands) are required to have a maintenance agreement in place prior to approval of construction (i.e., restoration actions) funding. This plan can be a joint agreement between the FHWA/NMDOT and the BLM (e.g., MOA, MOU), or a BLM management plan (e.g., Coordinated Resource Management Plan, grazing allotment plan, Resource Management Plan, Area of Critical Environmental Concern). The maintenance agreement will ensure that the proposed project will meet its goals and objectives and will be maintained during the project’s life cycle.

### *Revegetation*

Revegetation treatments would be prescribed in areas of active erosion to reduce bare ground and decrease sediment transport. Site-specific treatments would be designed to promote functional plant communities that are resilient and adapted to local conditions.

Active revegetation would include treatment methods to increase the percentage of vegetative cover and surface modification, such as imprinting the surface with microtopography (imprinting), contour subsurface plowing (keylining), seeding native species, or any combination of these. Seeding for revegetation may occur in conjunction with imprinting and/or keylining or as a standalone treatment.

### *Erosion Control*

A suite of treatments would be used to address erosion caused by channelized water and headcuts that are disrupting natural hydrologic function. The purpose of these treatments is to improve conditions for vegetation and reduce erosion that contributes to sediment being transported to the playa downstream. Erosion control treatments would be prescribed according to site-specific needs and conditions. Access needed for required equipment would be a consideration for prioritizing erosion control treatments. Methods for erosion control would slow runoff speeds, retain precipitation, and store sediment, and would include site-specific treatments such as one-rock dams or weirs to raise a channel bed, Zuni bowls to arrest headcutting, and shallow basins to increase precipitation infiltration.

### *Infrastructure Modification*

Examples of past land management modifications include berms constructed along fence lines, livestock tanks and channels, windmills, corrals, and associated access routes. Some of this infrastructure is no longer functioning as intended and/or is accelerating erosion, devegetation, and disturbance – all conditions that increase dust emissions. Site-specific modifications to such infrastructure would restore sheet flow, infiltration, and vegetation potential. Prior to proposing a design modification to any infrastructure, the NMDOT will propose a conceptual design to the BLM to ensure that ranch infrastructure is not negatively affected. For example:

- Constructed berms that no longer serve a ranching or land management purpose and currently function as perched sources of soil particles for wind erosion would be flattened, tied into the current landform, and revegetated.
- Stock ponds that have developed channelized flow and headcutting, or that are accelerating drying and devegetation downslope, would be modified to return flows to historic channels or to remediated channels. This would reduce sediment transport and increase infiltration in surrounding revegetated areas.
- Temporary access routes would be treated with erosion control and drainage features and revegetated.

### *Soil Crust Conservation and Cultivation*

Chemical crusts that develop on soils with high salt content and biological soil crusts – composed of cyanobacteria, algae, fungi, mosses, lichens, and their byproducts – are present within the Program Area, mostly along the playa margins and upland areas. These crusts play a critical role in mitigating dust through stabilizing soils, accumulating organic matter, impacting seedling establishment, capturing dust, and preventing sediment transport onto the playa surface. The Proposed Action would conserve crusts for all treatments by avoiding existing crusts. The Proposed Action could also include site-specific application of cultivated soil crust organisms in soils that are suitable habitat for the crust community.

### Equipment Access

The Proposed Action would require equipment access to remote areas of the Lordsburg Playa. The area's perimeter is accessible along maintained public roads and a gas pipeline maintenance route. Some low crossings and berms would require temporary improvements to become passable for heavy equipment or an equipment trailer. Within the outer perimeter, many areas are currently accessible by existing two-track roads. Only temporary access routes would be proposed, and all access routes that would be closed would be revegetated and corrected for poor drainage as necessary.

### Protection Treatments

Protection treatments such as fencing and signage would be implemented in those areas with a high potential to contribute dust and thus present an increased risk to public safety. Areas with dust mitigation improvements (e.g., infrastructure modifications, erosion control treatments, and active revegetation) would be protected from grazing and other disturbance. Protection treatments would be coordinated with the BLM, permittees, and other agencies for co-occurring uses permitted by the BLM, such as grazing. Additionally, protection treatments would be temporary and timed to ensure opportunities for continued use of the Program Area managed by the BLM once the potential for dust generation and the associated risk to public safety have been reduced.

### Maintenance of Treatment Areas

Treatments may need future maintenance to sustain the effectiveness of the original implementation. All actions approved for the PEA would be further approved for maintenance. Access for maintenance would follow the least impactful route when it is conducted, and coordination with BLM resource specialists would occur to mitigate impacts to resources. Mapping of sensitive resources would inform any planning for maintenance treatments.

### Implementation Methods

Table 17 lists the proposed manual and mechanical methods that may be used.

**Table 17. Dust mitigation Proposed Actions and implementation methods**

| Proposed Action | Implementation Method |
|---|---|
| Revegetation | Imprinting and seeding<br>Keylining and seeding<br>Imprinting, keylining, and seeding<br>Planting<br>Vegetation removal |

| Table 17. Dust mitigation Proposed Actions and implementation methods | |
|---|---|
| **Proposed Action** | **Implementation Method** |
| Erosion Control | Plug and spread<br>Wattles<br>Weir<br>Induced meandering:<br>• One-rock dam<br>• Zuni bowl<br>• Media luna<br>• Baffle<br>• Vane<br>Rainwater harvesting<br>Head-cut control<br>Worm ditch<br>Rock rundown |
| Infrastructure Modification | Berm repair/removal<br>Road drainage issues |
| Soil Crust Conservation and Cultivation | Application of soil crust culture<br>Fencing |
| Access | Revegetation<br>Drainage correction |
| Protection Treatments | Fencing<br>Signage on access roads |

***Revegetation***

**Keyline Plowing, Imprinting and Seeding** - Keylining is a treatment used to reduce surface erosion by increasing infiltration and soil moisture retention. The process uses a Yeomans Plow, which consists of a set of narrow-shank subsoiling plows attached to a toolbar whose depth and spacing is adjustable (Figure 22). The plow is pulled by an agricultural tractor traveling along the existing topographic contour (Figure 24). The Yeomans Plow creates subsurface lateral passages for water infiltration. Following the keyline plow, imprinting is accomplished with a land imprinter towed by the agricultural tractor. The land imprinter is a set of angular steel teeth that rolls on an axle under its weight, creating an offset grid of basins in the land surface (Figures 20 and 21). The implement rolls over existing vegetation, such as grasses, with minimal or no harm, and existing shrubs and trees would be avoided. (Figure 23). Seeding is conducted simultaneous with the keyline plowing and imprinting utilizing an approved blend of native species of grasses, wildflowers and shrubs.

**Figure 20. Agricultural tractor with keyline plow, imprinter and seeder. Treatment results in a loosened soil surface with waffle-like texture that captures seed, litter, and rainwater. Photo by Esha Chiocchio.**

**Figure 21. Plan view of soil surface treated with keyline plow and imprinter. Each imprint is approximately 1 square foot, and holds about one gallon of water where it lands on the soil surface, enough to allow ¼ to ½ inch of rain to infiltrate. Photo by Esha Chiocchio.**

**Tackifier application** - This treatment includes the application of a guar- or psyllium-based natural tackifier and fiber with dye to increase particle cohesion and stabilize soil without preventing germination and establishment. Tackifier would be applied once, at the same time as keylining, imprinting, and seeding, but with different equipment. Tackifier application would occur over areas impacted by keylining, imprinting, and seeding near the interstate and the bare surface of the playa. Equipment access roads would be treated last as the equipment leaves the site.

**Vegetation removal** - A preponderance of shrubs has emerged where grasslands have degraded. For revegetation to succeed in areas where shrubs are mature and dominant, they would need to be removed. Site-specific design plans for removing these plants would include design features such as subsurface contour plowing to increase infiltration and soil moisture so that other species such as grasses can thrive.

#### *EROSION CONTROL*

Erosion control techniques proposed for the project comprise a variety of in-channel stream restoration approaches designed according to site-specific conditions. Some are built by hand; others would require equipment including a dump truck for rock delivery and heavy equipment appropriate for safely moving rock, such as a tracked skid steer.

**Plug and spread** - Plug and spread is a treatment for headcuts or deeply incised channels, especially when a single channel has become disconnected from a network of adjacent former channels. The purpose is to redirect the primary flow path of channelized flow onto a broader surface and to raise the channel bed. The primary flow is captured in a constructed shallow, on-contour pond that fills during peak events. Outflow is directed to a desired location over a contoured brim (Figure 22). The results are increased infiltration at the ponding site, restored connection of overland flows to the adjacent landform, and reduced velocity and sediment loads compared to channelized flows.

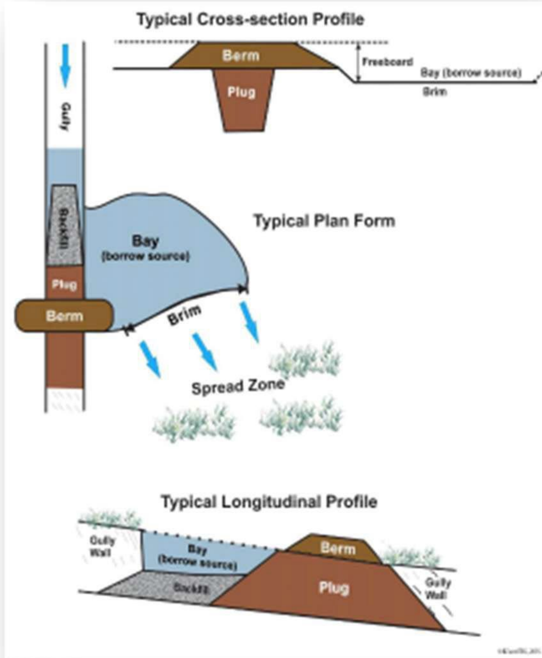



**Figure 22. Plug and spread diagram**

**Weir** - A weir is a channel-spanning drop structure that may be solid or porous, used to redirect stream flow, establish and maintain a higher width-to-depth ratio, increase sedimentation in channel bottom, control flow direction, stabilize stream gradient, and provide energy dissipation. The structure is completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).

**One-rock dam** – A one-rock dam is a low-grade control structure built with a single rock layer on the channel bed. One-rock dams stabilize the channel bed by slowing the flow of water, increasing roughness, recruiting vegetation, capturing sediment, and gradually raising the channel bed level over time. One-rock dams are maintained by adding another single layer of rocks offset toward the upstream end while the first layer captures sediment. The site-specific conditions determine the size of rock used. These are passive water harvesting structures that, as a rock mulch, increase soil moisture, infiltration, and plant growth.

**Zuni bowl** - A Zuni bowl is an in-channel headcut control structure composed of rock-lined step falls and a plunge pool. The structure prevents the headcut from continuing to migrate upstream by dissipating the energy of falling water and converting the single cascade at the headcut into a series of smaller, armored step falls. Zuni bowls also serve to maintain soil moisture on the face of the headcut, encouraging the establishment and persistence of protective vegetation.

**Media luna** - Media lunas are made of rock placed on the surface in a crescent shape to spread sheet flow across a broader area. Sheet flow encounters the rock structure, slows down, deposits seed and debris, soaks into the soil (contributing to increased soil moisture under the structure), and, once the soil is saturated, excess sheet flow leaves the structure in a wide fan. Media lunas would be constructed on-contour downslope from sheet flow.

**Baffle** - A baffle is an in-channel structure used to create lateral erosion of a streambank to widen the channel and alter the meander geometry. It concentrates flow and increases stream velocity along the opposite bank while decreasing velocity along the adjacent bank. Baffles would be made with rocks or posts or other plant material, such as whole trees imbedded in a stream bank.

**Vane** - A vane is another type of in-channel deflector. It is an upstream-pointing barb used primarily to divert high energy flow away from a cut bank on the outboard side of a meander bend. Like baffles, vanes would be constructed with rocks, wooden posts, or logs.

**Rainwater harvesting** - Rainwater harvesting is a general term for a wide set of practices and treatments that conserve rainwater where it falls, increase infiltration, and increase vegetation cover. Treatments include contour swales, shallow water infiltration basins, terraces, and organic ground cover.

**Headcut control** - Site-specific structures can protect these erosional features from growing by either reducing the volume and velocity of water that accumulates upstream of the headcut or stabilizing and arresting the headcut. Features include Worm Ditch, Zuni Bowl, and Rock Rundown.

**Worm Ditch** - A worm ditch is a bypass channel dug around the top of a headcut to direct flows away from the headcut and towards more stable ground, thus "starving" the headcut of the flows that were eroding it.

**Rock Rundown** - Commonly used by NMDOT to control runoff in steep channels, a rock rundown is an armoring made by carefully placing riprap on slopes in a small channel or headcut to prevent erosion.

#### *INFRASTRUCTURE MODIFICATION*

During site inspections, infrastructure elements that are no longer functioning as intended and/or are accelerating erosion, devegetation, and disturbance would be identified. The NMDOT would consult with the BLM and grazing permittee before proposing any modification to the existing ranch infrastructure.

**Berm repair/removal** - Berms would be modified and/or removed by grading equipment to create a new surface with a continuous downhill slope from the upland shore to the transition zone or final upland before the playa shore. The resulting surface would be treated with revegetation measures.

**Road drainage issues** - Roads that currently deliver excessive sediment-laden flows into channels would be addressed through treatments such as drop structures, armoring the channel with rock and vegetation at the point of road-channel intersection, plug and spread, rolling dips, and low-water crossings.

#### *SOIL CRUST CONSERVATION AND CULTIVATION*

Surface disturbance activities would be excluded from areas where biological soil crusts are identified for existing population conservation. Cultivation of biological soil crust organisms for application to the soil surface would occur off site. Application of cultivated biological soil crust organisms would occur in areas studied and confirmed to have conditions likely to support their establishment and persistence, such as soil moisture and soil type. Treatment areas of this type would be excluded to surface disturbance activities, as described by a specific project plan.

#### *ACCESS*

Temporary improvements would include placing local fill material to raise the roadbed or to fill in eroded channel crossings. Unmaintained two-track roads that currently provide administrative access between the maintained roads and infrastructure, such as wells and stock tanks, may require temporary improvements to become passable. Likewise, local fill material would be used to construct temporary elevated roadbeds or channel crossings. These temporary improvements would be removed once the permitted activity requires no further vehicle or equipment access, as described by a site-specific plan of development. Any temporary access route closed under the Proposed Action would be revegetated and corrected for poor drainage.

***PROTECTION TREATMENTS***

**Exclosure fence** - Project restoration areas may need to be fenced to achieve project goals. Consultation with the BLM and the permittee will be completed prior to proposing any fencing action. Fencing and access gate installation would adhere to BLM's General Project Design Features/Standard Stipulations for Rights-Of-Way and Other Land Use Authorizations (Bureau of Land Management 2016). The fence would be constructed prior to dust mitigation activities; it would be maintained by NMDOT.

**Signage** - Signs would explain the project's purpose and need and the reasons for reduced access. NMDOT would install the signs before dust mitigation activities and maintain them.

***Design Features***

**Inspections, maintenance, and monitoring** - Upon completion of a site-specific project, inspections of the project area by NMDOT or its contractor would occur semi-annually or when requested by BLM or NMDOT. NMDOT or its contractor would report the Maintenance Monitoring and Effectiveness Monitoring annually. For maintenance monitoring, the condition of structures and any need for maintenance or repair would be reported, and the maintenance would be scheduled and completed by NMDOT. Photographs would be used to document the maintenance.

All proposed surface disturbance areas will be inspected in the field to ensure that potential impacts to natural resources would be minimized by implementing design features. For the Proposed Action, standard and project-specific design features include, but are not limited to, the following:

- Protection treatments such as fencing and signage would be coordinated with the BLM, permittees, and other agencies for co-occurring uses permitted by the BLM, such as grazing. Additionally, protection treatments would be temporary and timed to ensure opportunities for continued use of the Program Area managed by the BLM once the potential for dust generation and the associated risk to public safety have been reduced.
- The exclosure fence will adhere to BLM's General Project Design Features/Guide Stipulations for Rights-Of-Way and Other Land Use Authorizations Right-of-Way (Bureau of Land Management 2016).
- A mapped inventory of infrastructure elements that are no longer functioning as intended and/or accelerating erosion, devegetation, and disturbance will be completed.
- A pre-implementation meeting will be held where all personnel will be instructed on protecting paleontological, cultural, and ecological resources.
- No equipment will be left overnight within the Interstate Highway 10 ROW.
- All project activities will be confined to permitted areas only.
- All equipment and vehicles will be cleaned before entering the ROW to prevent the introduction and spread of noxious weeds.
- Dust emissions will be controlled on the roads and other locations by applying water from a water truck if it is determined that it will cause a safety issue on Interstate Highway 10 or other health or safety concern
- The biological survey identified nesting habitat for migratory birds. Preconstruction surveys would be required ahead of ground-disturbing activities, and nests would be avoided or mitigated to comply with the Migratory Bird Treaty Act and if necessary, in consultation with appropriate agencies. Project

design features also include facility design, timing restrictions for construction, monitoring, and other best management practices to mitigate impacts to migratory birds.

- Implementation sites, staging areas, and access roads will be kept clean and orderly for the duration of project activities. Refuse and trash will be removed and disposed of in an approved manner. Waste disposal containers will be located at the staging area, if required. Recyclable materials will be diverted to recycling facilities to the extent possible.
- During project implementation, and during inspections and maintenance, any hazardous materials will be properly managed. Bulk chemicals and hazardous materials are not expected to be produced or stored on site. During cleanup and restoration, any hazardous materials (e.g., petroleum products used for equipment) will be properly managed in accordance with applicable federal, state, and local regulations.
- Any seed and mulch material used during project implementation will be certified weed-free and meet or exceed the requirements imposed by the BLM and NMDOT.

Restoration was implemented at the Roadforks site in 2018 with the intent of reducing wind-blown dust emissions from a site adjacent to Interstate Highway 10. This project encountered hyper-saline and sodic soils that were prone to inundation by stormwaters. The project modified flows across the landscape at the 200+ acre site to restore water, and thus irrigation, to the playa-steppe surface that had previously been shunted and cut off by historic earthwork activities related to highway constructions. The site was treated by installing water diversions to ensure sheet flow, rather than channelizing flows across the areas that had more than 4% slope. In the 100+ acres of land that had less than 2% slope, the land was treated by Keyline plowing, Imprinting, and Seeding. A final surface application of psyllium tackifier was installed to ensure short-term stabilization of soils loosened as a result of restoration activities. In addition, spots with hyper-sodic soils that were devoid of any vegetation were treated by a generous application of wood-chip mulch approximately 2” deep. Finally, fencing was installed and the site was effectively permanently excluded from cattle grazing. In the 8 years since this site was treated, BLM AIM monitoring has noted significant improvements to vegetation cover and soil crust development. Notably, the hyper sodic soils that were treated with mulch became among the first areas of this restored site to show evidence of vegetation growth, where previously it had been assumed that these soils were the least likely to support vegetation.

# PLAYA WETLAND ACTION PLAN STRATEGY

### Rest Treated Areas

Grazing permittees and the New Mexico State Land Office collaborated to rest areas that were treated as part of the NMDOT Dust Mitigation program for areas for approximately four years. This period expired in August 2024. It is unclear what the current grazing management plan will call for in these treated areas moving forward.

According to the National Resources Conservation Service (NRSC) Plant Materials Centers (Belen, Meeker, and Tucson), a warm season grass species such as Blue grama (*Bouteloua gracilis*) requires a minimum of five years to mature from seed to seed-producing plant. If weather conditions are hampered by drought, additional years are needed until adequate rainfall is received. Cool season species such as Needle-and-thread (*Stipa comata*) require a minimum of seven years plus additional years for drought contingency.

Complete year-round rest, perhaps for several years, could be recommended in order to allow overgrazed lands to become productive again. Furthermore, such rest could allow soil crusts to develop which will aid in stabilization and reduction of dust emissions. While this particular effort is geared at reducing dust emissions, it follows that resting the grazed areas on and around the Lordsburg Playa may also have an effect in allowing sacaton grasses to grow taller which provides for wind break and soil protection. This type of indirect affect will aid in sustaining functional wetlands.

**BLM ACEC Recommendation**

On 04 March 2025, the New Mexico Department of Transportation (NMDOT) submitted a Nomination of the Lordsburg Playa Area of Critical Environmental Concern (ACEC) to the Bureau of Land Management (BLM). An ACEC designation for the site would allow for special management considerations. Normally these designated areas are used for the protection of a special water resource or endangered species.; however, they can be used for the management of natural hazards (e.g., unstable soils) caused by human action. Relevance must be determined through the resource management plan (RMP) process. In this process, the BLM will determine whether the resource has qualities which warrant highlighting to satisfy public or management concerns about safety and public welfare. The BLM will also address the question of whether the resource situation poses a significant threat to human life and safety or to property.

**Increasing the Number of BLM Pastures**

There frequently are not enough grazing allotment pastures to facilitate rest rotation to ensure that each pasture receives a full year's rest once every three to seven years. The number of pastures could be increased through consolidation of grazing leases as allotments are retired.

**Install Small Experimental Plots**

Experimentation on a small scale is needed to test methods. Capitalizing on lessons learned from regional land treatments will provide a basis to improve experimental design. The following practices have shown marginal success and can be improved upon.

***The Use of Gravel Mulch***

During the construction of Interstate Highway 10, a staging area was employed at the intersection of New Mexico Highway 338. A large area of gravel was left behind, providing mulch in an area that is frequently inundated. Today, a healthy stand of Alkali sacaton occupies that area. Local ranchers speculate that the gravel provides a rough surface to capture seeds and prevents the grass from being drowned out during ponding events. This type of application could be employed around heavily trafficked areas such as livestock waters and corrals. The gravel would provide protection from wind erosion, and where seeded with Alkali sacaton, the gravel mulch would aid in preventing drowning during ponding events.

***The Use of Wooden Mulch and Other Organics***

Arizona BLM applied pecan branch mulch on native grass seed plots in the San Simon Valley, about 25 miles to the west. Two applications of tillage (imprinting and broadcasting seed versus drill seeding) were used in a split plot experimental design. These were overlaid with combinations of mulch (gravel, pecan branch, gravel plus pecan branch). When examining sediment run-off, all treated plots out-performed the control plot. The pecan branch treatment, with or without gravel, performed best in reducing sediment (Cockman and Henson 2017) (Appendix F).

Wooden mulch attracts termites, the earthworms of the desert. The branches also help control wind erosion and provide some shade for extremely hot soils.

Low-tech sediment traps constructed of cinder blocks and plyboard bottoms were utilized in this study. The sediment traps worked well for the first few years. Then Kangaroo rats (*Dipodymis sp.*) moved in. Borrowing from this observation, wooden pallets could be used as a treatment, scattered at intervals and topped with organic mulch. These would act as starter housing for various rodents which would help develop organic matter into the soil and aerate the soil.

### *Trials of Plant Materials*

Most of the playa is saline or sodic and produces minimal diversity of grasses. Alkali sacaton is a clonal species and is almost always seen as a monoculture. Collecting seed from the local grassland south of Interstate Highway 10 could facilitate the development of an adapted seed bank. Local ranchers say that Curtis and Curtis Seed Company from Clovis, NM has harvested the grassland seed in the past (Kerr L 2025).

Chiricahua tansyaster (*Arida riparia*) has been observed on Lordsburg Playa and supports a variety of pollinator species (VonLoh 2024). This plant should be harvested for seed. Research to identify additional pollinator species would be beneficial for habitat restoration and creating enhanced pockets of habitat for pollinators.

### *Road and Drainage Crossing Design*

Soils of the lower piedmont (lower bajada) just above the shoreline berm tend to be saline/sodic and disperse easily. Road crossings, even when reinforced with culverts and water bars, are easily disturbed by heavy rainfall events. Even clay soils melt in the rain due to high salinity levels. Research is needed to try out new road crossing designs.

## Rancher Input

### Rancher Input on Sediment Sources from Tributaries

A stakeholder meeting was held for the Playa ranchers on 31 March 2025, conducted by Dr. Joneen Cockman representing High Desert Native Plants, LLC. In attendance were Calista Kerr, Greg Kerr, Jim Walter, Mat Miller and Tricia Washburn. The group met at “the duck pond” to discuss the history of the grassland north of New Mexico Highway 338, and then proceeded on to a conference table to look at maps and strategies. A number of data gaps and observations were contributed by the ranchers at this meeting.

Observation: Regional dust source seems to come in from San Simon Valley via Steins Gap and Doubtful Canyon (Figure 20)

- Recommendation: Deploy wide angle cameras that would watch the weather and provide imagery on what the local weather is doing to pinpoint the source and movement of dust storms (Kerr G 2025).
- Additional information is needed for Doubtful Canyon, which is the furthest north tributary and intersects with Lordsburg Draw. It is uncertain whether Doubtful Canyon contributes to sedimentation in the Playa (Miller M 2025).
- Volcano Mine is located in Volcano Canyon. Are there sediments coming off of Volcano Mine area or other locations in the Volcano Canyon watershed (Miller M 2025)?
- Some dirt tanks located on the eastern slopes of the Peloncillo Mountains have already been dug out so they can better catch sediment (Washburn 2025). Additional work like this could be done.

Observation: Dust storms move from north to south. Dust arising from the North Playa is too far away to have an effect on the dust storms affecting traffic on Interstate Highway 10. Ranchers do recommend on-the-ground actions in this area, but actions would be for localized land restoration. Their observation is that dust arising from the North Playa area ascends into the high elevation atmosphere and does not contribute to the haboob-type dust that obliterates vision on Interstate Highway 10 (Kerr G 2025).

Observation: Lordsburg Draw frequently contributes to flooding of the Playa. Ranchers posit that flood waters from the Draw travel all the way around the South Playa.

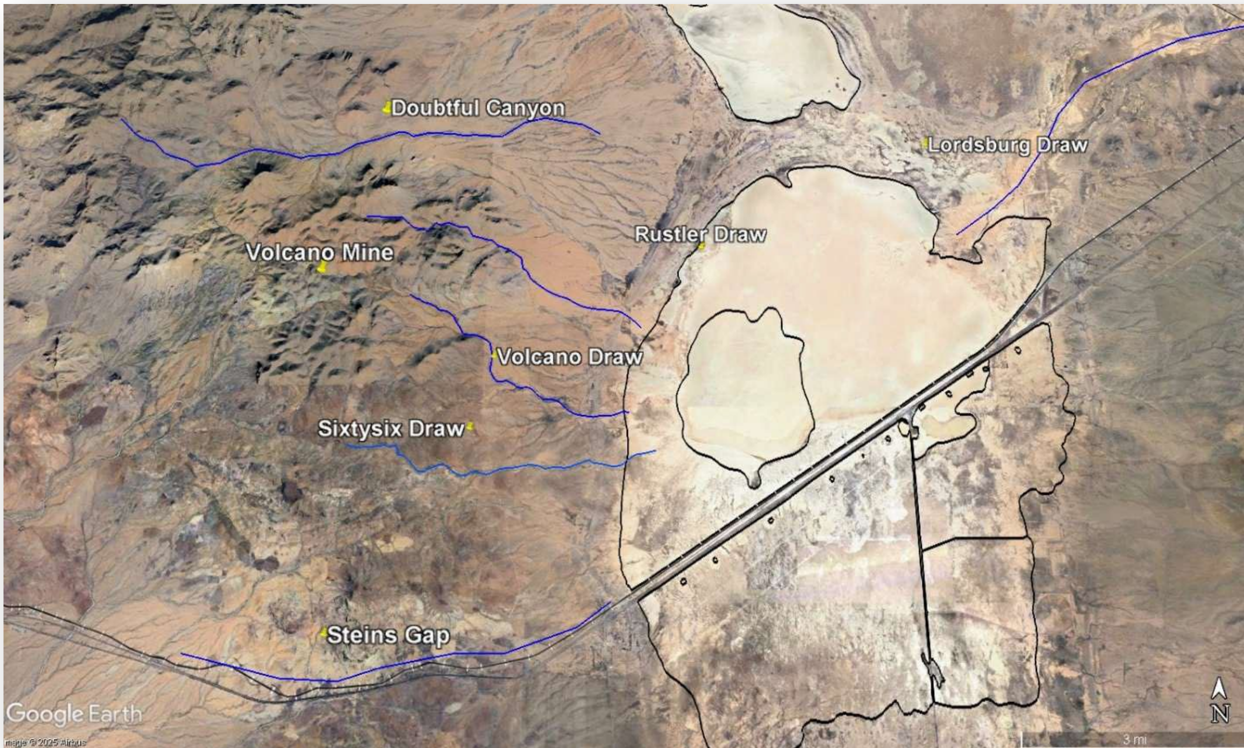



**Figure 23. Additional work is needed to determine locations and quantities of sediment transport in the Peloncillo drainages**

### Rancher Input on Playa Maintenance and Ranch Operations

Ranchers were in consensus on the management within the interior of the South Playa and offered four points for improved management (below). As stated by Greg Kerr, "Put all the eggs in one basket on the South Playa." (Kerr G 2025). (*Note that South Playa is where most of the impact from dust storms is observed on Interstate Highway 10*).

As described by the ranchers, dust storms cause a number of accidents on Interstate Highway 10 at the intersection of New Mexico Highway 338. This is the deadliest area of the Interstate (New Mexico Department of Transportation 2019). According to the ranchers, dust is generated from Lordsburg Draw between the North Playa and the South Playa; it then flows south across the South Playa. When it reaches vertical forces in the center of the playa (a super- heated area because it is barren), it gets exaggerated. By the time it reaches the New Mexico Highway 338 intersection, it is a solid wall of dust and vehicular traffic is blinded.

- Item 1 in Figure 27 represents a state section with substantial water infrastructure and corrals. This grazing lease is owned by Jim Walter. If Jim could be reimbursed for his investments on the state section, he would be willing to retire that section. The section would then be available for the state and BLM to implement a land exchange for other projects. At this point, a great portion of the South Playa could be fenced off.
- Item 2 in Figure 27 represents installed berms that the ranchers call "zero elevation" berms. Water drains from south to north across the Playa. Installed berms would be located at the lower elevations of the playa where the ponding edge frequently occurs. A buffer of at least ¼ mile wide would contour the playa. Berms would need to be large enough to stay above flooding elevation and perhaps should

be constructed of gravel so they do not melt in water when flooded. The function of these berms is to hold water, for example, between Interstate Highway 10/Railroad and the berms. Their purpose is to increase grassland production in a buffer area around the Playa. Fencing would facilitate small pastures where intensive, short-term grazing would occur ("poop-n-stomp"). This method of incorporating grazing has been used successfully on mine tails in Arizona.

- The ranchers also recommended tilling or ripping every ten feet between the berms and conducting a variety of experiments, including the installation of salt-tolerant shrubs such as Salt cedar (*Tamarix sp.).* We discussed the efforts to get rid of Salt cedar and how it might not be received well. Perhaps Russian olive (*Eleagnus angustifolia*) or other small trees could be installed. (Like Salt cedar, Russian olive is an exotic species.) Another small native tree is Screwbean mesquite (*Prosopis pubescens*); it has been shown to adapt to saline areas. Other treatments could be employed such as the application of different mulches. This area would be managed experimentally and the most successful treatments would then be employed in other areas.
- Item 3 in Figure 27 is another berm. The function of this berm is to keep flood water from flowing north and to make it available to the grassland south of Interstate Highway 10.
- Item 4 in Figure 27 is an approximately 90- acre parcel with studies designed to provide information for the BLM. This is a frequently ponded, barren area in which BLM will try out different treatments to encourage the growth of vegetation.

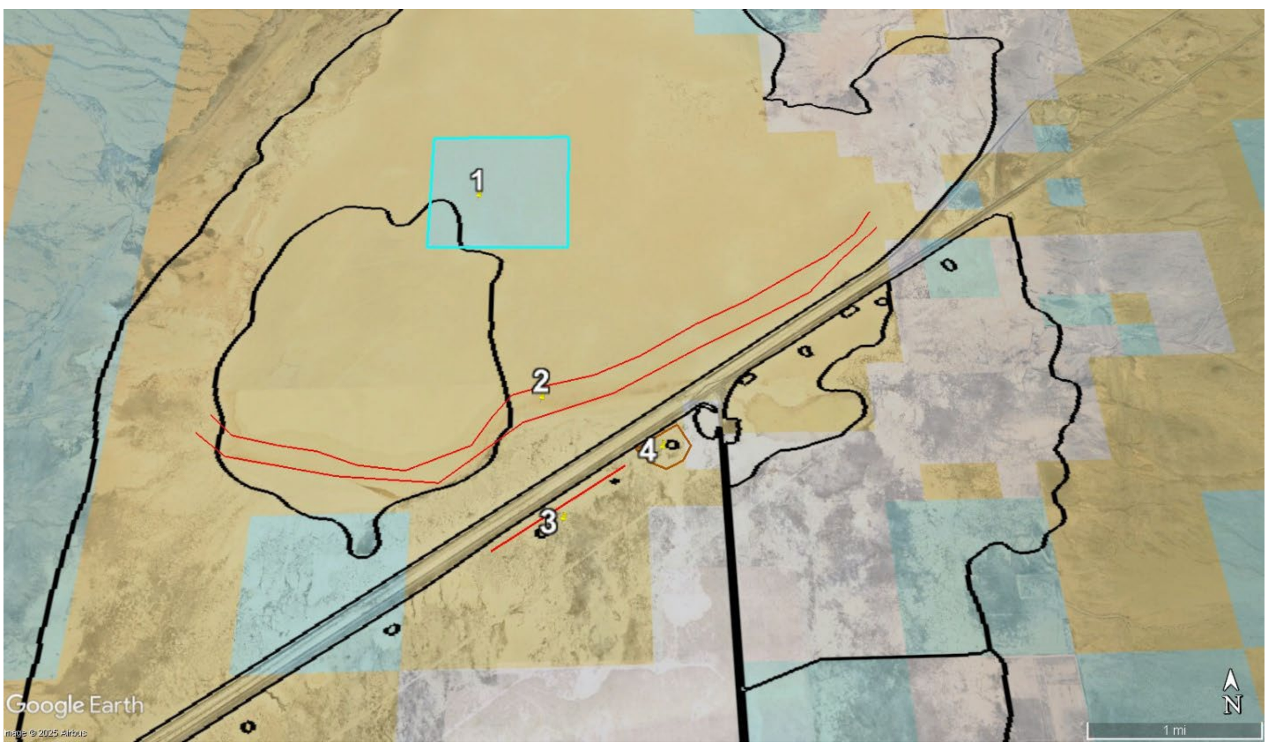



**Figure 27. Rancher input for management of the playa is shown at 4 locations.**

### Other Land Treatments Suggested by the Ranchers

Greg Kerr recalled an accident on Interstate Highway 10 when a tanker truck crashed, spilling sulfuric acid onto the playa. That area went from a barren state to growing grass. That incident prompted Kerr to look into the use of aluminum sulfate to correct soil pH. He suggested examination of the NRCS soil pedon map (still in draft stage) and locating the high pH areas for treatment. (Kerr G 2025)

Mat Miller and Greg Kerr both suggested the use of wood mulch for treatment. They suggested coordination with other land treatment areas. For example, land invaded with Creosote (*Larrea tridentata*) could be harvested, and the wood chipped for mulch treatments (Miller M 2025; Kerr G 2025).

The ranchers were queried for their thoughts about the prospect of a lithium industry on Lordsburg Playa. Jim Walter postulated that the lithium mine would be using well water and have holding ponds. He suggested that this water could be used as irrigation water to enhance grassland production (Walter 2025).

At the intersection of New Mexico Highway 338 and Interstate Highway 10 is an ephemeral water feature referred to as “the duck pond.” This area regularly holds water but is dry at least a few months out of the year. (*Author note: the area was completely dry at the time of the 31 March 2025 meeting with the ranchers*). Both Greg Kerr and Calista Kerr recalled the entire area south of Interstate Highway 10 as being barren in the 1970s and earlier. When asked about any rumors of the current grassland being mowed for hay production, they said that had not happened in decades; their recollection is that Curtis and Curtis Seed Company had harvested grass seed just one time (Kerr G 2025; Kerr C 2025).

On the north side of Hwy 338 at the intersection is an area that was used for staging gravel piles during the construction of Interstate Highway 10. A thick layer of gravel mulch was left behind. The ranchers postulate that the gravel mulch allowed for the establishment of Alkali sacaton and that gravel mulch could be applied elsewhere as a treatment.

A short discussion was had on the subject of designated areas such as an Area of Critical Environmental Concern (ACEC). An ACEC could be designated through an update to the Resource Management Plan (RMP) for BLM’s Las Cruces District Office. This type of designation could bring more attention to the area for financial resources and help BLM enforce a no-traffic area.

The 31 March 2025 rancher stakeholder meeting ended with ideas about the use of snow barriers and questions about whether snow barriers would be effective in corralling wind born sediments across the Playa.

On 09 April 2025, High Desert Native Plants staff met with rancher Jim Lunt on his ranch which encompasses the north playa. The purpose of this meeting was to view the arrangement of pastures which incorporates 76 high intensity, short duration grazing cells. Mr. Lunt suggested that irrigation might be used for the lower piedmont area of the Peloncillo Mountains by siphoning ponded water from the playa into holding reservoirs staged for irrigation of treated areas (Lunt 2025).

## POSSIBLE FUNDING SOURCES

The New Mexico Environment Department (NMED) Surface Water Quality Bureau is currently providing funding for the construction of this wetlands action plan. The NMED River Stewardship Restoration project funds enable the department to reduce dangerous pollutants in New Mexico’s rivers and streams; safeguard water supplies against flooding, drought and climate change by restoring the functionality of wetlands and natural waterways; and protect vital wildlife habitats for endangered species.

The New Mexico Department of Transportation (NMDOT) Environmental Bureau, in partnership with Federal Highway Administration, have funded approximately $4.3 million to dust mitigation actions, monitoring and research, and seed development for restoration. This project collaboration was shared among consultants (Stream Dynamics, High Desert Native Plants, Barr Engineering, and Tooley's Trees). Technical support was provided by NMDOT Research Bureau and Management, NRCS soil surveys, NMSU climatologist Dr. Dubois, and USDA Jornada Experimental Range. Additional support and information were provided by NM Department of Public Safety. The BLM and NM State Land Office along with their land owners and lessees provided valuable stakeholder information (Botkin and Hutchinson 2024).

### NRCS EQIP/WHIP Programs

#### *Environmental Quality Incentive Program*

https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives

This program helps farmers, ranchers and forest landowners integrate conservation into working lands.

- Improved water and air quality;
- Conserved ground and surface water;
- Increased soil health;
- Reduced soil erosion and sedimentation;
- Improved or created wildlife habitat; and
- Mitigation against drought and increasing weather volatility.

#### *Wildlife Habitat Incentives Program*

https://www.timbertax.org/getstarted/costshare/programs/whip

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that encourages creation of high-quality wildlife habitats that support wildlife populations of national significance. NRCS provides technical and financial assistance to landowners and others to develop upland, wetland, riparian and aquatic habitat areas on their property. The Agricultural Act of 2014 (enacted on 07 February 2014) repealed the Wildlife Habitat Incentive Program (WHIP). NRCS will continue to support existing active WHIP contracts entered into prior passage of the Agricultural Act of 2014, using the rules and policy in effect at the time of contract obligations.

Portions of the WHIP Statute were rolled into the Environmental Quality Incentives Program (EQIP). Anyone interested in applying for wildlife projects in programs can apply under the EQIP program.

Eligible lands include privately owned land, federal land when the primary benefit is on tribal or private land, state and local government land on a limited basis, and tribal land

If land is determined eligible, emphasis is placed on habitat areas for wildlife species experiencing declining or significantly reduced populations; and practices beneficial to fish and wildlife that may not otherwise be funded; and wildlife and fishery habitats identified by local and State partners and Indian tribes in each state

### National Fish and Wildlife Foundation

https://www.nfwf.org

Created by Congress in 1984, the National Fish and Wildlife Foundation (NFWF) has grown to become the nation's largest private conservation foundation. They work with both the public and private sectors to protect and restore the nation's fish, wildlife, plants and habitats for current and future generations.

NFWF is an independent 501(c)(3) nonprofit organization governed by a 30-member Board of Directors approved by the Secretary of the Interior.

NFWF specializes in bringing all parties to the table including individuals, government agencies, nonprofits and corporations. Collaborations protect and restore imperiled species, improve working landscapes for wildlife, advance sustainable fisheries and conserve water for wildlife and people.

This collaborative strategy has led to financial commitments exceeding $10 billion for the NFWF conservation mission. They currently partner with 15 federal agencies and more than 53 corporate and foundation entities.

**Wetlands**

***Wetland Reserve Enhancement Partnership (WREP)***

https://www.nrcs.usda.gov/programs-initiatives/wrep-wetland-reserve-enhancement-partnership

The Wetland Reserve Enhancement Partnership (WREP) is a voluntary program through which NRCS enters into agreements with eligible partners to leverage resources to carry out high priority wetland protection, restoration, and enhancement and to improve wildlife habitat.

The Wetland Reserve Enhancement Partnership is part of the Wetland Reserve Easement (WRE) component of the Agricultural Conservation Easement Program (ACEP), a Farm Bill conservation program. Through WREP, state agencies, county and local governments, non-governmental organizations and American Indian tribes are encouraged to submit proposals for priority project areas to collaborate with NRCS through program and partnership agreements. Once a proposal is accepted for funding, the partners work with tribal and private landowners who voluntarily enroll eligible land into easements to protect, restore and enhance wetlands on their properties.

The voluntary nature of NRCS easement programs enables effective integration of wetland restoration on working landscapes, providing benefits to farmers and ranchers who enroll in the program, as well as benefits to the communities where the wetlands exist. Easements enable landowners to adopt a variety of conservation practices with the help of funding from NRCS that improve the function and condition of wetlands.

Wetland Reserve Easements protect important wetlands within an agricultural landscape, provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

Partner benefits through WREP agreements include wetland restoration and protection in areas where priorities align to enable greater impacts on the landscape; the ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging; and the ability to provide in-kind staff capacity for acquisition, due diligence and restoration activities.

***NRCS Easement Program***

https://www.farmers.gov/data/easements-overview

***NRCS (NATURAL RESOURCES CONSERVATION SERVICE)***

NRCS offers voluntary easement programs to landowners who want to maintain or enhance their land in a way beneficial to agriculture and/or the environment. These programs include:

- Highly Restrictive Easement: For protection of conservation values and restoration/protection of native habitats in natural/historic condition.

- Moderately Restrictive Easement: For management of specific habitats to provide conservation benefits.
- Minimally Restrictive Easement: For protection of working lands and agricultural uses, including grazing.
- 30-year program: Landowner pays 25% of restoration; 60% of agriculture appraised value (NTE $5000/acre)
- In perpetuity/permanent easement: 100% restoration cost covered by the program; 80% of agricultural appraised value of acres enrolled (NTE $5000/acre)

***North American Wetlands Conservation Act (NAWCA) Grants***

https://www.fws.gov/service/north-american-wetlands-conservation-act-nawca-us-standard-grants

The North American Wetlands Conservation Act (NAWCA) provides matching grants for wetlands conservation projects across the United States, Canada, and Mexico. These grants support public-private partnerships aimed at protecting, restoring, and enhancing wetland habitats critical for migratory birds. To qualify for a NAWCA grant, project proposals must be submitted through GrantSolutions.gov. The program includes both standard and small grants, with the latter focusing on long-term protection and enhancement of wetlands.

***Ducks Unlimited***

https://www.wildfowlmag.com/editorial/largest-usda-grant-awarded-ducks-unlimited/459337

Ducks Unlimited secures state and federal grants to tackle ambitious conservation projects. They provide nesting habitat for waterfowl through the Conservation Reserve Program (CRP). This voluntary, incentive-based program provides excellent nesting habitat for waterfowl and shown to boost duck production. More ducks mean fuller flyways, which leads to more spent shot shells and fuller totes.

Farmers benefit greatly from enrolling their land in CRP. This land is mainly marginal land that likely won't produce an outstanding yield. By registering, farmers pen a contract (typically 10-15 years) and receive a Rental Rate Incentive that usually falls around the $150 per acre mark.

***Partners for Fish and Wildlife Programs***

https://conservationfinancecenter.org/partners-for-fish-and-wildlife

The Partners for Fish and Wildlife Program (Partners Program) is a voluntary federal program that provides free technical and financial assistance to landowners for habitat restoration on privately owned land. The program works with private landowners to conduct cost-effective habitat projects for the benefit of fish and wildlife resources in the United States. Current partners include farmers, ranchers, forest landowners, recreational landowners, corporations, local governments, and universities.

- Federal Trust Species: Listed and Candidate species, migratory birds, declining or “at risk” species, and State and Tribal species of concern.
- Eligibility: Non-federal, non-State-owned land such as private landowners, municipal, private groups, schools, counties.
- Cost Share: Match requirements – nationally 50% preferred (cash or in-kind, based on total project cost), in New Mexico > 25% preferred and projects with a greater landowner match rank higher.
- Funding Cycle: Project proposals accepted throughout fiscal year (October 1-September 30).
- Selection Process: Projects compete at the State level.

# POSSIBLE AGENCY PARTNERS AND OTHERS

| | |
|---|---|
| **US Department of Agriculture** | Farm Service Agency<br>Natural Resources Conservation Service<br>US Forest Service |
| **US Army Corps Engineers** | |
| **US Department of Interior** | Bureau of Indian Affairs<br>Bureau of Land Management<br>Bureau of Reclamation<br>US Fish and Wildlife Service |
| **State of New Mexico** | New Mexico Department of Game and Fish<br>New Mexico Environment Department<br>New Mexico Office of the State Engineer<br>New Mexico State Historic Preservation Office<br>New Mexico State Land Office |
| **Native American Tribes** | Chiricahua Apache Nation<br>Other |
| **Non-Profits and Others** | Arizona Antelope Foundation<br>Gila Resources Information Project (Watershed Keepers)<br>Grassland Charitable Foundation<br>Hidalgo Water Conservation District<br>Institute for Applied Ecology<br>Local Community Groups<br>Malpai Borderlands Group<br>Mule Deer Foundation<br>National Wild Turkey Federation<br>The Nature Conservancy of New Mexico<br>New Mexico Community Foundation<br>New Mexico Riparian Council<br>Quail Unlimited<br>Quivira Coalition |
| **Schools/Education** | Animas High School<br>Eastern Arizona College<br>Lordsburg High School<br>Natural Curiosity Hermosa Campus<br>New Mexico State University<br>University of New Mexico (Natural Heritage Foundation)<br>Western New Mexico University Hidalgo<br>Western New Mexico University Silver City |

# DATA GAPS

Data gaps were compiled throughout the process of researching and coordinating the Lordsburg Playa Watershed Action Plan. These came from a few different sources, including review of NRCS provisional Ecological Site Descriptions, conference meetings with individual agency staff who represent boots-on-the-ground, the New Mexico Surface Water Quality Bureau task force work group for mineral deposition playas, and coordination with playa ranchers and contractors working on the ground.

## Review of NRCS Provisional ESDs

### *Saline Sodic Dry Playa ESD (Provisional)*

Limited vegetative data and extreme variations in precipitation events make spatially delineating states difficult. It is currently too problematic to identify specific micro elevation changes, calculate duration of inundation, correlate these factors to vegetation changes, and then spatially apply it on the ground.

The Barren State is an area void of vegetation due to frequent flooding and duration. Indicators are void of vegetation, polished and hard to extremely hard surfaces, with or without Surface Crust-Related Cracks. A key indicator is state will have no visible Giant Desiccation Cracks. It is not clear whether GDCs develop in this state then are buried by wave action and redistribution of sediments.

The Alkali Sacaton Dominated Phase (P2a) is dominated with Alkali sacaton grass. The site is slightly elevated by eolian or alluvial deposition and Giant Desiccation Cracks are not present. Elevation of a few centimeters is all that is required to separate this phase from the barren most frequently ponded state. Surface RRC class is hard and will have surface cracks. NRCS needs to work on this by visiting site and getting soil samples.

#### *WORK NEEDED TO FILL DATA GAPS*

An on-site apparatus, such as a phenocam, that can deliver temperature, precipitation and date-stamped photography would assist in filling the data gap.

Long-term monitoring of Giant Desiccation Cracks and surface crusts is needed along with soil sampling to examine elevational differences and longevity/function of the cracks.

### *Sodic Flat Alkali Sacaton ESD (Provisional)*

We do not know the full ecological process of the Alkali sacaton grassland. NRCS staff says that the grassland does not seem to accumulate litter (Garcia 2025). The grassland south of Interstate Highway 10 appears to have enough standing crop to dissipate wind energy. It looks like it has good basal density. There are few Alkali sacaton grasslands left in the southwestern US that are in good condition. Is there a dynamic with organisms like termites that would turn the litter over? Does it need even better basal density and/or vertical height of the standing crop to prevent litter from blowing away? Does the litter not dehisce in one growing season and fall to the ground? Does it stay on the stem and get eaten as forage?

#### *WORK NEEDED TO FILL DATA GAPS*

Inventory and assessment work is needed for the grassland to provide a better understanding of the processes and to be able to describe a reference state condition for the grassland.

### *Saline Playa Rim Slope ESD (Provisional)*

This ecological site is located between the shoreline “berm” and active shoreline. The site is mostly barren with a few patches of vegetation. Barren areas could be a product of seasonal flooding or being left high and dry by a few centimeters of deposition.

There is a question of recreational use for this site. It is agreed that no vehicle traffic should be allowed. However, could it be valued for dispersed recreation such as dog-walking or wildlife-viewing?

#### *WORK NEEDED TO FILL DATA GAPS*

Employment of a phenocam to provide long term monitoring of sedimentation and scouring processes would provide information to better understand this site. Discussion on recreational value should be considered by the NMSWQB mineral deposition technical team.

### *Sodic Piedmont ESD (Provisional)*

This site is located on the lower piedmont where land treatments are being conducted. Results of treatments are highly dependent on rainfall. Across the landscape, forage production is variable on this site, with some areas being dry for years at a time and other areas a few miles distant getting consistent rainfall.

#### *WORK NEEDED TO FILL DATA GAPS*

Employment of a phenocam would provide data to better understand localized rainfall events and evapotranspiration versus precipitation.

### *Conference with NRCS Staff*

Review of the provisional Ecological Site Descriptions was provided by High Desert Native Plants contract support. A number of data needs were discussed relative to the playa in general (Garcia 2025):

- Ecological Site Descriptions (ESD) for the Playa – Traditionally, ESDs are discussed temporally. Discussion on spatial patterns are unconventional but are needed for the playa resources. Will NRCS expand the protocol on ESDs to allow for spatial evaluation and discussion?
- New ESDs are still provisional. They have not yet been mapped out in detail. NRCS needs a good map with the locations of the new ESDs.
- The Seventeen Indicators of Rangeland Health (BLM Tech. Ref. 1734-6) is not a good tool for the playa center due to flooding and salinity levels. A better tool is use of the Jornada Experimental Range handbook "A Field Guide to Pedoderm and Pattern Classes" (Burkett et al [date unknown]). This tool allows for examination of spatial relationships.
- Anecdotal comments indicate that the Alkali sacaton grassland south of Interstate Highway 10 was historically hayed. One rancher stated that she does not know about haying but she does recall that Curtis and Curtis Seed Company from Clovis, NM harvested seed (Kerr L 2025).
- Hard Surfaces – Garcia states that floods will deposit fresh sediments that will blow away (aeolian resources). A penetrometer will not penetrate the hard surfaces, but the same soil surface will quickly melt away in water. These soils will also scour in water. Do we need more data correlation?
- Cow tracks – Individual cow tracks are not a problem on dry sealed surface; cow trails, though, are a problem. This was validated in an experiment on Jornada Experimental Range (Baddock et al 2011). The question remains: Do individual cow trails stand up to high wind?
- Origin of the berm – The origin of the shoreline berm is debatable. Some say it is a remnant shoreline from Lake Animas. Others say that part of the berm visible today is from one of three major geologic faults that cross the Animas Valley. NRCS staff think that on the east side, it is partially buried under sand dune lunettes. One HDNP contractor thinks the feature may be a product of the interglacial period when the ancient lake went through periods of repeatedly freezing and thawing, pushing up a berm during freeze cycles; this would allow for more than one berm to be created which is what we see on the landscape today. The creation of the berm does not affect the classification of the playa or recommended land treatments, but it is a subject of interest.

### High Desert Native Plants Technical Team

A technical team review was conducted on 2025 January 27 to discuss key questions pertaining to the Lordsburg Playa. In attendance were Dr. Este Muldavin (UNM New Mexico Natural Heritage assigned to wetland classification for the NMSWQB), Mike Gaglio (Biologist and Managing Member of High Desert Native Plants, LLC), Dr. Jony Cockman (HDNP contractor), and Luis Garcia (ESD specialist, Las Cruces NRCS).

#### *Primary Points for Discussion*

- The east/west gradient of diminishing grasses across the edge of the playa has been “poked at” but no conclusions are official. We need more data on salinity content.
  - The east side of the playa has annual vegetation. We are not sure if no grazing will improve playa vegetation. The more important question is whether the playa be revegetated for dust mitigation.
  - Lake Lucero (White Sands Missile Range) has not been grazed by cattle since 1944 and the sparse vegetation pattern is similar to Lordsburg Playa. There is still no vegetation at the low point of the depression. We need salinity/electrical conductivity data that shows transition across the playa from the vegetation zone through to playa center.
- Soil surface areas with visible large cracks (Giant Desiccation Cracks) are the size of city blocks. Are these vertisols? Scientists from NRCS think these cracks are very deep, but there are also areas where the Giant Desiccation Cracks are buried under new deposits of sediment. More data are needed on salinity content.
  - The depth of Giant Desiccation Cracks is unknown. It is currently assumed that there is no connectivity between surface water and ground water. However, there are locations south of Interstate Highway 10 where the ground water is shallow and, potentially, there are unknown spots on the playa where surface water could connect with ground water. Piezometer studies would help us better understand this relationship.
  - Playa patina is created by fresh sediment from flood events (Figure 29). Patina gets ripped out during storm events. How well does patina stand up to storm events? Phenocam documentation
  - would help us better understand the process and the patina role in armoring the playa.

**Figure 29. Playa patina shines under moonlight. Photo by J.S. Cockman**

### *WORK NEEDED TO FILL DATA GAPS*

Salinity and electrical conductivity (EC) studies are needed across the playa to better understand the east/west gradient of diminishing grasses and whether or not grasses can be established.

Studies are needed to better understand the depth of Giant Desiccation Cracks and whether or not there is any place on the playa where there is connection between surface water and ground water. Historic records (Schwennesen and Hare 1918) indicate that ground water may have been present at a location on the railroad called "Conrad Crossing." Piezometer studies would aid in understanding the relationship between surface water, Giant Desiccation Cracks, and ground water.

Playa patina is the main element protecting the playa from wind erosion, but we do not know how well it stands up to storm events. More information is needed.

### New Mexico Surface Water Quality Bureau Mineral Deposition Task Force

The NMSWQB Mineral Deposition Task Force met on 2025 January 28. This team is comprised of agency staff, researchers, and contractors who have been on the ground working with dust mitigation and land treatments at Lordsburg Playa since 2018.

#### *Primary Points for Discussion*

- NRCS noted that the playa generates a red biofilm. Is this an archaea or a halophyte bacteria? Does it suppress plant growth?
- Does ground water ever surface? Trent Botkin, a NMDOT researcher, noted that if saturated during monsoon season, the playa fills more quickly. However, he does not know of any point location where the ground water has surfaced.
- Existing irrigation wells are shallow and saline. One must drill much deeper for sweet water.
- Deeper ground water is thought to be both geologic and recent. There is lithium present in geologic water.

- It was pointed out by NMSWQB Wetlands Program Coordinator Maryann McGraw that the classification of the playa as a Mineral Soil Flat is founded on the assumption that there is no connection between the playa and ground water. This also has to do with mineral soil versus organic soil. She suggested that the team revisit the playa classification protocol (Brinson 1993).

#### *WORK NEEDED TO FILL DATA GAPS*

The wetlands classification and mapping team (Saint Mary's University of Minnesota Geospatial Services) has worked under the assumption that there is no connection between the playa surface and ground water resources. Historic literature indicates that there may have been a connection at one time. Current understanding of water well depth for the Animas Valley is that it is much shallower than neighboring valleys (Pyramid Valley to the east and San Simon Valley to the west) which have ground water levels of several hundred feet deep. The Animas Valley still has wells as shallow as 25 feet and wells adjacent to one another have different strata and levels of salinity.

The District 3 Office of the State Engineer (OSE) in Deming reports that assistance is needed to develop a solid long-term monitoring program for water wells. The state does not have staff to do this and citizen science could be employed (Broomfield 2025).

### Other Data Gaps

Data gaps are mentioned throughout the document. Some of these include:

- Soil compaction data from penetrometer studies
- Ground water level data from piezometers
- Inventory of Abandoned Mine Land features in the watershed, particularly on the east-facing slope of the Peloncillo Mountains
- Inventory of surface soil erosion related to road crossings, ephemeral drainages and dirt roads of all categories (county, service roads, 2-tracks)

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# APPENDICES

APPENDIX A: Soil and Ecological Sites

APPENDIX B: Surface Soil Chemistry and Static Water Table

APPENDIX C: High Desert Native Plants, LLC Seed Mix

APPENDIX D: Posey Well Bird and Wildlife Data

APPENDIX E: Wildlife Documented at Lordsburg Playa August -

December, 2024

APPENDIX F Sands Draw Grassland Restoration Part II: Sediment Traps

# SOIL AND ECOLOGICAL SITES APPENDIX - A

## Summary of Draft Ecological Site Descriptions


### Abstract

A discussion of the primary soils for the Lordsburg Playa is extracted from the NRCS Web Soil Survey which describes the playa as one large Saline Bottom Ecological Site. Recent research indicates that the playa is quite complex and NRCS staff are in the process of creating new ecological site descriptions. Four new provisional site descriptions are discussed.



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# Contents

# List of Figures



# List of Tables

# NRCS Web Soil Survey Mapping Units

Soils of the Lordsburg Playa are complex. Discussion will be organized by the North Playa and the South Playa. The latter is crossed by Interstate 10 (east/west) and extends south of the interstate. The entire playa complex is somewhat organized by concentric rings of various soils that transition from the center of the playa outward to the desert uplands. This transition consists of ponded to occasionally ponded, saline to non-saline, and barren to grassland to shrubland. The eastern watershed also includes eolian deposition that forms small lunette dunes on the Toeslopes.

The entire playa also includes a feature that has been referred to as "shoreline" or "Pleistocene shoreline" in the literature. This feature extends most of the way around the playa, positioned between the lower Piedmont (lower Bajada) and playa complex. It is approximately ten feet high and ten feet across. It is easily observed on aerial imagery as extending most of the way around the playa except where the playa transitions into winding drainages at the southern extent, and where it has been disrupted by tributary drainages cutting through the feature. It is more accurately described as a berm (Figure 1) .

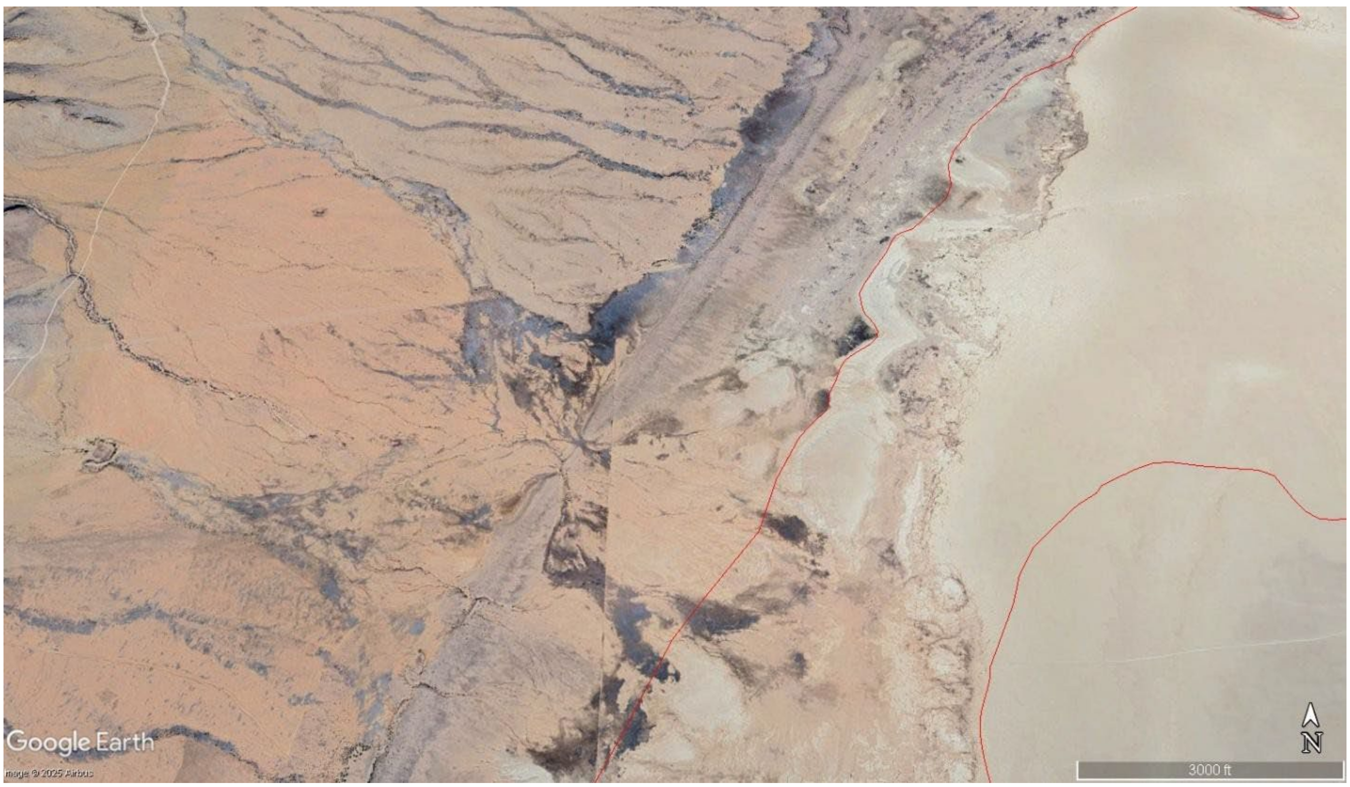



*Figure 1. A close-up view of the shoreline berm shows a breach caused by an ephemeral drainage flowing in from the Peloncillos Mountains.*

## North Playa Configuration

The North Playa has a figure-eight shape with depressional areas in each lobe. The depressional center has been mapped as soil #1003 - Highlonesome, ponded, silty clay loam, 0 to 1 percent slopes, with ESD Saline Bottom 8-12" p.z.

The northern portion then transitions outward to soil # 1004 - Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes with ESDs Clayey and Desert Shrub.

Proceeding outward again, the next mapping unit is soil #1006—Highlonesome, non-saline surface-Agustin complex, 0 to 3 percent slopes. The ESD is Saline Bottom 8-12" p.z. Proceeding outward to the next ring we see influence from the uplands. The east side is mapped as 1015—Argic Petrocalcids-Yturbide-Chutum complex, 0 to 5 percent slopes. The ESD is Sandy Loam Upland 8-12" p.z. This portion of the watershed is influenced from the north by the Burro Mountains.

The western flank of the playa is influenced by the Peloncillos Mountains watershed. The soil is # 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes. The ESDs are Gravelly, and Desert Shrub. It should be noted that the Peloncillos Mountains are diverse with portions of the watershed that are dominated by volcanics with limy seams and other portions that are dominated by volcanic rhyolite with layers of ash.

Organization of the North Playa soils and ecological sites is shown in Figure 2 and Table 1.


Figure 2The North Playa is shown with the NWI polygon and NRCS soil identification numbers.

*Table 1 North Playa Soil and Ecological Site Schematic*

| Table 1. North Playa Soil and Ecological Site Schematic – NRCS Web Soil Survey | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Center of Playa | | | |
| Soil Number | 3006 | Playa Rim | 1004 | 1003 | 1004 | Playa Rim | 1015 |
| Soil Name | Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes | | Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes | Highlonesome, ponded, silty clay loam, 0 to 1 percent slopes | Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes | | Argic Petrocalcids-Yturbide-Chutum complex, 0 to 5 percent slopes |
| Ecological Sites | Gravelly, Desert Shrub, Limy Fan, Limy Slopes | | Saline Bottom, Clayey Desert Shrub | Saline Bottom | Saline Bottom, Clayey Desert Shrub | | Sandy Loam Upland, Sandy Upland, Limy, Desert Shrub, Limy Fan |

## South Playa Configuration

Separating the North Playa from the South Playa is Lordsburg Draw, a large ephemeral drainage. It is mapped as soil # 1006 —Highlonesome, non-saline surface-Agustin complex, 0 to 3 percent slopes. The ESD is listed as Saline Bottom 8-12" p.z.

Similar to the North Playa, there is a central, frequently ponded area that is largely barren of vegetation. Soils include: 1000—Hondale, ponded, silty clay loam, 0 to 1 percent slopes, 1001—Hondale-Sodic Haplocambids complex, ponded, 0 to 1 percent slopes, and 1013—Hondale-Highlonesome complex, non-saline surface, 0 to 3 percent slopes. All have the ESD Saline Bottom 8-12" p.z. The Hondale, ponded is the deepest depression on the landscape.

Extending outward there is a ring of soil # 1002—Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes. The ESD is still described as Saline Bottom 8-12" p.z.

Extending even further outward is soil # 1011—Vado family-Agustin complex, moist, 1 to 3 percent slopes on both the east and west sides of the playa. To the south soil #1012—Highlonesome-Hondale complex, non-saline surface, 0 to 1 percent slopes. The Vado Agustin complex ESDs are listed as Gravelly, Gravelly Loam, and Desert Shrub. The Highlonesome-Hondale complex ESDs are listed as Saline Bottom 8-12" p.z. However, this mapping is largely south of Interstate 10 and produces a robust Alkali sacaton (*Sporobolus airoides*) grassland.

Extending to the next outer ring is the berm feature and outside of this the soils are different on the east and west watersheds. The east watershed is influenced by the Pyramid Mountains and transitions into soil # 3010 - Typic Natrargids-Adelino-Vado family complex, 1 to 8 percent slopes. The dominant mapping unit ESD is Saline Bottom 8-12" p.z. The Adelino and Vado units produce ESDs Loamy, Gravelly, and Desert Shrub.

The western slopes of the South Playa are influenced by the Peloncillos Mountains, and are mapped descending from north to south:

- 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes
- 3003—Tres Hermanos-Vado family complex, 2 to 20 percent slopes
- 3005 - Vado family-Typic Petroargids complex, 1 to 10 percent slopes

All ESDs for each soil map unit are listed as Gravelly, and Desert Shrub.

Extending south from the play grasslands south of Interstate 10 the soil is mapped as # 1017 - Turney-Highlonesome, non-saline surface complex, 0 to 2 percent slopes. The ESD is Limy Fan 8-12" p.z. This unit lies just south of the NWI boundary and features linear drainages dominated by Alkali sacaton, Honey mesquite (*Prosopsis glandulosa*), and other grasses.

The arrangement of soil and ESD mapping units on the landscape are displayed in Figure 3 and Table 2.

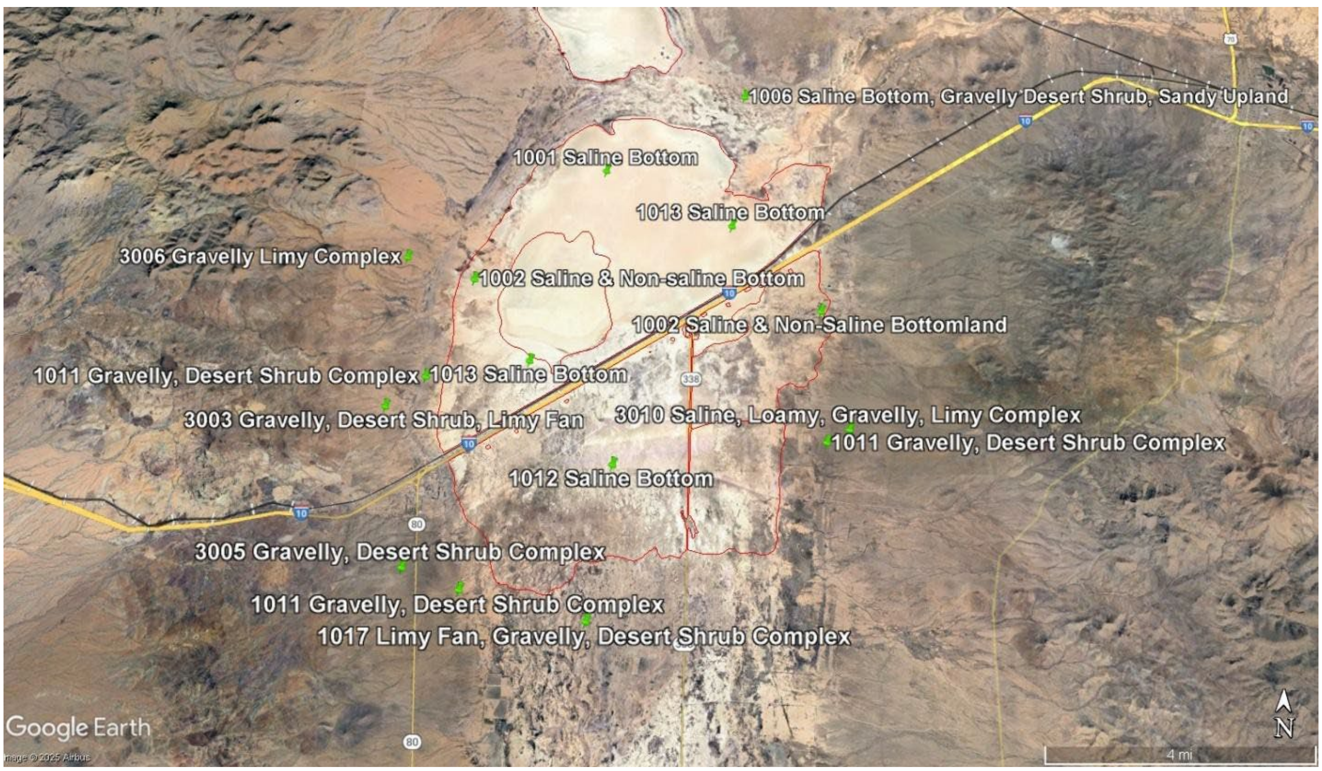



*Figure 3. The South Playa is shown with the NWI polygon and NRCS soil identification numbers.*

*Table 2 South Playa Soil and Ecological Site Schematic*

| South Playa Soil and Ecological Site Schematic – NRCS Web Soil Survey | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower Piedmont | | | Outside of Playa Center | | | Center of Playa | Outside of Playa Center | | | | Lower Piedmont |
| Soil Number | 3003/3006/ 3005 | Playa Rim | 1011/1012 | 1002 | 1001/1013 | 1000 | 1001/1013 | 1002 | 1011/1012 | Playa Rim | 3010 |
| Soil Name | Tres Hermanos-Vado family complex, 2 to 20 percent slopes | | Vado family-Agustin complex, moist, 1 to 3 percent slopes | Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes | Hondale-Sodic Haplocambids complex, ponded, 0 to 1 percent slopes | Hondale, ponded, silty clay loam, 0 to 1 percent slopes | Hondale-Sodic Haplocambids complex, ponded, 0 to 1 percent slopes | Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes | Vado family-Agustin complex, moist, 1 to 3 percent slopes | | Typic Natrargids-Adelino-Vado family complex, 1 to 8 percent slopes |
| Soil Name | Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes | | | | | | | | | | |
| Soil Name | Vado family-Typic Petroargids complex, 1 to 10 percent slopes | | | | | | | | | | |
| Ecological Sites | Gravelly, Desert Shrub, Limy Fan, Limy Slopes, Clayey Upland, Sandy Wash, Gravelly Loam | | Gravelly, Gravelly Loam, Desert Shrub | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Gravelly, Gravelly Loam, Desert Shrub | | Saline Bottom, Loamy, Desert Shrub, Gravelly, Limy Fan, Sandy Wash |

# Chemical, Physical Properties

## Playa Center

An abbreviated list of physical and chemical properties from the Map Unit Description (MUD) (NRCS Web Soil Survey) is provided in Table 3. The land form/position is described as Playa on Toeslope, Shoreline Complex on Toeslope, and Alluvial Flat in the Highlonesome Non-saline Surface. While the other soils have Toeslope positions, the Highlonesome differs on the Alluvial Flat.

Parent materials are listed as lacustrine and alluvium. The soil profiles are described as silty clay loam, clay loam, and sandy clay loam in the surface layer, with heavier clays descending to about 60 inches. Slopes are 0-1% and up to 3% in the Highlonesome, Non-saline Surface. So once again the latter is flagged for steeper slope.

A restrictive natric layer is observed at 0-10 inches in three of the soils. There are no restrictive layers identified for Highlonesome, ponded and the Highlonesome, non-saline. This is the third factor that flags the Highlonesome, non-saline.

Drainage is described as well-drained in all units with negligible runoff. Saturated Hydraulic Conductivity (Ksat) is a measure of how easily water moves through a saturated soil. It is a key factor in soil hydrology and is used to model flow, runoff, and solute transport. It is listed as low to moderately low for all mapping units.

Depth to water table exceeds 80 inches for all mapping units. Flooding is described as none and ponding as frequent to occasional. Ponding is described as rare in the Highlonesome, non-saline surface. This is the fourth flag that the latter map unit may not be appropriate for the playa center. It is also noted that flooding does occur on occasion as witnessed in 2006 when the Lordsburg region received major flooding and the playa was flooded close to the outer extent of the NWI model which would reach to the Pleistocene berm.

Salinity is generally described as slightly to strongly saline except for the Highlonesome soil which can be non-saline. This is the fifth flag for the Highlonesome mapping unit.

Sodium Adsorption Ratio (SAR) is a value that measures the amount of sodium (Na) in water relative to the amount of calcium (Ca) and magnesium (Mg). The NRCS uses milliequivalents per liter (meq/L) as the unit of measurement for SAR. It indicates how much sodium is adsorbed onto soil particles and impacts soil structure and water infiltration; a high SAR value suggests a “sodic” soil with poor potential drainage. High SAR levels can negatively affect crop growth by causing poor soil structure, reduced water infiltration, and nutrient availability. Sandy soils are less affected by SAR than fine textured soils. The concept of SAR affects soil aggregates. Generally, SAR ratings of 3 or less (in irrigated fields) are not a problem. High SAR values indicate that the soil aggregate is easily dispersed; soils will erode/dissolve easily in water. All soils in Table 3 are easily dispersed, ranging from 30-100 meq/L across all soil mapping units.

Available water is very low to moderate in all soil units in Table 3. None of the soils are diagnosed as hydric.

*Table 3 Abbreviated List of Map Unit Descriptions for the Playa Center*

| Table 3. Abbreviated List of Map Unit Descriptions for the Playa Center | | | | | |
|---|---|---|---|---|---|
| SOIL | 1000—Hondale, ponded, silty clay loam, 0 to 1 percent slopes | 1001—Hondale-Sodic Haplocambids complex, ponded, 0 to 1 percent slopes | 1003 - Highlonesome, ponded, silty clay loam, 0 to 1 percent slopes | 1013—Hondale-Highlonesome complex, non-saline surface, 0 to 3 percent slopes | Highlonesome, Non-saline Surface |
| COMPOSITION | Hondale, ponded 100% | Hondale, ponded 79%, | 1003 Highlonesome, ponded (82%) | Hondale, non-saline surface, and similar soils:56 percent | |
| | | Sodic haplocambids, ponded 18% | 1000 Hondale, ponded (10%) | Highlonesome, non-saline surface, and similar soils:21 percent | |
| LAND FORM/ POSITION | Playas, Toeslope | Playas, Toeslope | Playas, Toeslope | Shore Complexes, Toeslope | Alluvial Flats |
| PARENT MATERIAL | Lacustrine | Lacustrine | Alluvium | Alluvium | Alluvium |
| PROFILE | AN-0-8 in: silty clay loam | AN 0-6 in: silty clay loam | An - 0 to 5 inches: silty clay loam | An - 0 to 1 inches: sandy clay loam | An - 0 to 2 inches: silty clay loam |
| | Btknz1-8-20 in: clay | Btknz1-6-30 in: silty clay loam | Bn - 5 to 24 inches: clay loam | Btkn1 - 1 to 8 inches: clay loam | Bknz1 - 2 to 22 inches: clay loam |
| | Btknz2-20-60 in: clay | Btknz2 -30-54 in: clay | Bkn1 - 24 to 37 inches: clay loam | Btkn2 - 8 to 20 inches: clay loam | Bknz2 - 22 to 35 inches: clay loam |
| | | Btknz3-54 in: clay | Bkn2 - 37 to 60 inches: loam | Bknz - 20 to 60 inches: sandy clay loam | Bknz3 - 35 to 60 inches: loam |
| SLOPE | 0-1% | 0-1% | 0-1% | 0-1% | 0-3% |
| DEPTH TO RESTRICTION | 1-9 in. natric | 1-10 in. natric | >80 in. | 0 to 7 inches to natric | > 80 in. |
| DRAINAGE | Well drained | Well drained | Well drained | Well drained | Well drained |
| RUNOFF | Negligible | Negligible | Negligible | Negligible | Negligible |
| KSAT | 0.0-.01 in/hr (very low-mod low) | 0.01-0.14 in/hr (Mod low) | 0.01-0.14 in/hr (Mod low) | .01-0.14 in/hr (Mod low) | .01-0.14 in/hr (Mod low) |
| DEPTH TO WATER TABLE | > 80 in. | >80 in. | >80 in. | >80 in. | >80 in. |
| FLOODING | None | None | None | None | None |
| PONDING | Frequent | Frequent | Occasional | Occasional | Rare |

| Table 3. Abbreviated List of Map Unit Descriptions for the Playa Center | | | | | |
|---|---|---|---|---|---|
| MAX SALINITY | 9.5-20.2 mmhos/cm (Mod - strongly saline) | 5.5-20.2 mmhos/cm (Slightly - strongly saline) | 1.2-15.6 mmhos/cm (Nonsaline - mod saline) | 7.9-15.8 mmhos/cm (Slightly - mod saline) | 1.6-20.0 mmhos/cm (Nonsaline - strongly saline) |
| SAR | 100 | 100 | 50 | 30 | 50 |
| AVAIL WATER 0-60" | 0.8 in (Very low) | 1.1 in (Low) | 6.6 in (Mod) | 0.1 in (Very low) | 3.9 in (Low) |
| ESD | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Saline Bottom 8-12: p.z. |
| HYDRIC | No | No | No | No | No |

The review of Map Unit Descriptions (MUD) characteristics indicates that the Highlonesome mapping unit may not be appropriate for the playa center. All map units have an ESD of Saline Bottom 8-12” p.z. Closer examination of the playa through NRCS field studies (NRCS Las Cruces 2025), on-going dust studies (NMDOT 2019, Van Pelt et al 2020) and habitat restoration efforts (High Desert Native Plants website) indicate that the playa center is more complex than previously understood. This discussion is continued in a review of NRCS provisional ESD work that looks carefully at clay content, shrink/swell capacity and cracking of the soil surface that provides niches for vegetation establishment in an otherwise barren surface.

## Soils Between the Pleistocene Berm and Outer Edge of the Playa

The landform/position is described as Playa Steps on Toeslopes, Playa on Footslope, Shore Complex on Backslope, Shore Complex on Footslope and Alluvial Flats on Toeslope. These positions indicate a slight rise in elevation toward the outer edges of the playa (Figure 4).

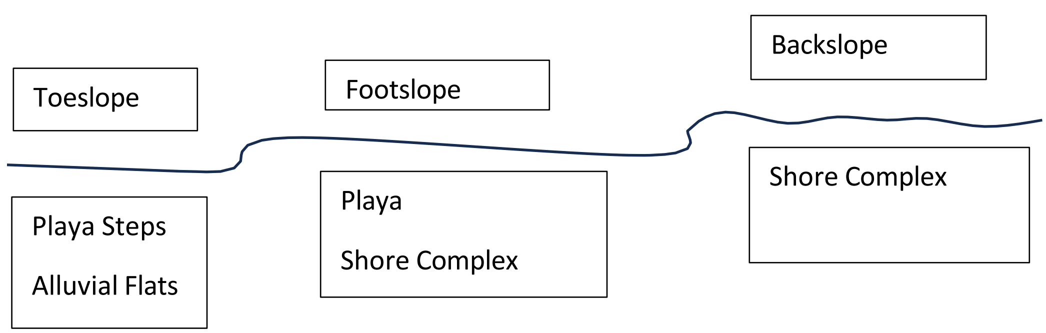



*Figure 4. Position of mapping are slightly separated in elevation.*

An abbreviated list of physical and chemical properties from the Map Unit Description (MUD) (NRCS Web Soil Survey) is provided in Table 4.

*Table 4 Abbreviated List of Map Unit Descriptions for the Units Between the Pleistocene Berm and the Outer Edge of the Playa*

| Table 4. Abbreviated List of Map Unit Descriptions for the Units Between the Pleistocene Berm and the Outer Edge of the Playa Edge | | | | | | | |
|---|---|---|---|---|---|---|---|
| SOIL | 1002—Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes | Highlonesome severely erodible | 1004 - Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes | 1011—Vado family-Agustin complex, moist, 1 to 3 percent slopes | Augustin, moist | 1012—Highlonesome-Hondale complex, non-saline surface, 0 to 1 percent slopes | Hondale |
| COMPOSITION | 1002 Highlonesome, non-saline surface, and similar soils:45 percent | | Ubar and similar soils:55 percent | Vado and similar soils:60 percent | | Highlonesome and similar soils:65 percent | |
| | Highlonesome, severely erodible, and similar soils:35 percent | | Hondale, non-saline surface, and similar soils:20 percent | Agustin, moist, and similar soils:30 percent | | Hondale and similar soils:35 percent | |
| | | | Highlonesome, ponded, and similar soils:20 percent | | | | |
| LAND FORM/ POSITION | Playa Steps, Toeslope | Playa Slopes, Toeslope | Playas, Footslope | Shore complexes, Backslope | Shore complex, Footslope | Alluvial Flats, Toeslope | Alluvial Flats, Toeslope |
| PARENT MATERIAL | Alluvium | Alluvium | Alluvium | Alluvium | Alluvium | Alluvium | Alluvium |
| PROFILE | A - 0 to 12 inches: silt loam | Anz - 0 to 4 inches: loam | A - 0 to 2 inches: clay loam | A - 0 to 2 inches: sandy loam | A - 0 to 4 inches: gravelly sandy loam | An - 0 to 2 inches: silty clay loam | An - 0 to 2 inches: loam |

| Table 4. Abbreviated List of Map Unit Descriptions for the Units Between the Pleistocene Berm and the Outer Edge of the Playa Edge | | | | | | | |
|---|---|---|---|---|---|---|---|
| SOIL | 1002—Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes | Highlonesome severely erodible | 1004 - Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes | 1011—Vado family-Agustin complex, moist, 1 to 3 percent slopes | Augustin, moist | 1012—Highlonesome-Hondale complex, non-saline surface, 0 to 1 percent slopes | Hondale |
| | Bknz1 - 12 to 24 inches: sandy clay loam | Bnz1 - 4 to 16 inches: loam | Bw1 - 2 to 6 inches: clay | Bw1 - 2 to 11 inches: sandy clay loam | Bw1 - 4 to 28 inches: gravelly sandy loam | Bknz1 - 2 to 22 inches: clay loam | Bnz - 2 to 10 inches: loam |
| | Bknz2 - 24 to 45 inches: sandy clay loam | Bnz2 - 16 to 43 inches: clay loam | Bw2 - 6 to 43 inches: clay | Bw2 - 11 to 60 inches: very gravelly sandy clay loam | Bw2 - 28 to 60 inches: gravelly sandy loam | Bknz2 - 22 to 35 inches: clay loam | Btknz - 10 to 30 inches: clay loam |
| | Bknz3 - 45 to 60 inches: sandy clay loam | Bnz3 - 43 to 60 inches: clay loam | C - 43 to 60 inches: loam | | | Bknz3 - 35 to 60 inches: loam | Bknz - 30 to 60 inches: clay |
| SLOPE | 0-1% | 1-3% | 0-1% | 1-3% | 1-3% | 0-1% | 0-1% |
| DEPTH TO RESTRICTION | >80 in. | >80 in. | >80 in. | >80 in. | >80 in. | >80 in. | 8 to 20 inches to natric |
| DRAINAGE | Well drained | Well drained | Well drained | Well drained | Somewhat excessively drained | Well drained | Well drained |
| RUN-OFF | Negligible | Negligible | Negligible | Low | Medium | Negligible | Negligible |
| KSAT | 0.01-0.14 in/hr (Mod low) | 0.01-0.14 in/hr (Mod low) | 0.01-0.14 in/hr (Mod low) | 0.14-1.42 in/hr (Mod low - mod high) | 0.14-1.42 in/hr (Mod low - mod high) | .01-0.14 in/hr (Mod low) | .01-0.14 in/hr (Mod low) |
| DEPTH TO WATER TABLE | >80 in. | >80 in. | >80 in. | >80 in. | >80 in. | >80 in. | >80 in. |
| FLOODING | None | None | None | None | Rare | None | None |

| Table 4. Abbreviated List of Map Unit Descriptions for the Units Between the Pleistocene Berm and the Outer Edge of the Playa Edge | | | | | | | |
|---|---|---|---|---|---|---|---|
| SOIL | 1002—Highlonesome, non-saline surface and Highlonesome, severely erodible association, 0 to 3 percent slopes | Highlonesome severely erodible | 1004 - Ubar-Highlonesome, ponded-Hondale, non-saline surface, complex, 0 to 1 percent slopes | 1011—Vado family-Agustin complex, moist, 1 to 3 percent slopes | Augustin, moist | 1012—Highlonesome-Hondale complex, non-saline surface, 0 to 1 percent slopes | Hondale |
| PONDING | Occasional | Rare | Rare | None | None | Rare | Occasional |
| MAX SALINITY | 5.1-20.0 mmhos/cm (Slighly to strongly saline) | 1.2-20.0 mmhos/cm (Nonsaline - strongly saline) | 4.1-9.8 mmhos/cm (Slightly - mod saline) | 0.3-1.3 mmhos/cm (Nonsaline) | 0.1-1.8 mmhos/cm (Nonsaline) | 1.6-20.0 mmhos/cm (Nonsaline - strongly saline) | 4.3-16.8 mmhos/cm (Slightly - strongly saline) |
| SAR | 100 | 148 | 6 | 3 | 3 | 50 | 50 |
| AVAIL WATER 0-60 IN | 3.0 in (Low) | 1.0 in (Very low) | 5.3 in (Low) | 4.2 in (Low) | 6.3 in (Mod) | 3.9 in (Low) | 0.6 in (Very low) |
| ESD | Saline Bottom 8-12" p.z. | Saline Bottom 8-12" p.z. | Clayey, Desert Shrub | Gravelly, Desert Shrub | Gravelly Loam, Desert Shrub | Saline Bottom 8-12: p.z. | Saline Bottom 8-12" p.z. |
| HYDRIC | No | No | No | No | No | No | No |

All parent material is listed as alluvium. The soil profiles are described as a variety of loamy surface soils over sandy loam/clay loam to a depth of about 60 inches.

Slopes are listed as 0-3% with no restrictive layers within 80 inches except for the Hondale soil with a natric layer in the surface to 20 inches.

All mapping units are listed as well drained with negligible run-off except for the Augustin, moist soil that is listed as excessively well drained with medium run-off. All soils list Saturated Hydraulic Conductivity (Ksat) as moderately-low to -moderately high. In contrast the soils occupying playa center list Ksat as very low to moderately low.

Depth to water table exceeds 80 inches for all mapping units. Flooding is described as none to rare, and ponding as none to occasional. In July, 2006 Lordsburg region experienced torrential flooding and the area looked like the Pleistocene Lake had moved back in. From the junction of the North Playa and South Playa, flood waters in Lordsburg Draw extended more than ten miles north flooding over Highway 70 at the intersection of Highway 90. Examination of Google Earth imagery indicates that the flood waters on the playa extended to the outer edge of the National Wetlands Inventory (NWI) mapping.

Maximum salinity is variable across the soil map units from non-saline to strongly saline, ranging as high as 20 mmho/cm. The Highlonesome and Hondale soils on Toeslope positions are saline. The Ubar and Vado complexes are non-saline or slightly saline and occupy Footslope and Backslope positions.

Sodium Adsorption Ratio (SAR) indicates how much sodium is adsorbed onto soil particles and impacts soil structure and water infiltration. The Highlonesome and Hondale soils have relatively high SAR ranging from 50-100. The Ubar and Vado complexes have low SAR ranging from 3-6. The higher values indicate that the soil aggregate will disperse easily in water, and therefore are more susceptible to water erosion.

Available water is low to very low in all soil units in Table 4. The soils occupying the center of the playa were rated as low to moderate in available water. None of the soils are diagnosed as hydric.

The Highlonesome and Hondale soils have an ESD of Saline Bottom 8-12" p.z. The Ubar and Vado complex soils have ESDs of Clayey, Gravelly, Gravelly Loam, and Desert Shrub.

The soils transitioning away from playa center to the berm are dynamic. Small changes in elevation of a few centimeters can make a difference in frequency of ponding and establishment of vegetation. This is discussed further in the NRCS provisional ESDs.

Soils occupying positions just below the Pleistocene berm are steeper and characterized by drainage patterns that shape contours and provide more slope for run-off.

## Soils Upslope of the Pleistocene Berm

An abbreviated list of physical and chemical properties from the Map Unit Description (MUD) (NRCS Web Soil Survey) is provided in Table 5. The land form/position is described as Fan Piedmonts and Fan Remnants on Footslopes. These positions indicate a slight rise in elevation above the Pleistocene berm and are characteristically upland.

*Table 5 Abbreviated List of Map Unit Descriptions for the Units Above the Pleistocene Berm*

| Table 5 Abbreviated List of Map Unit Descriptions for the Units Above the Pleistocene Berm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SOIL | 3003—Tres Hermanos-Vado family complex, 2 to 20 percent slopes | Vado | 3005 - Vado family-Typic Petroargids complex, 1 to 10 percent slopes | Typic Petroargids | 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes | 3010 - Typic Natrargids-Adelino-Vado family complex, 1 to 8 percent slopes | Adelino | Vado |
| COMPOSITION | Tres Hermanos and similar soils:75 percent | | Vado and similar soils:38 percent | | Calcic petrocalcids and similar soils:45 percent | Typic Natrargids and similar soils:38 percent | | |
| | Vado and similar soils:15 percent | | Typic Petroargids and similar soils:25 percent | | Tres Hermanos and similar soils:20 percent | Adelino and similar soils:22 percent | | |
| | | | | | | Vado and similar soils:20 percent | | |
| LAND FORM/ POSITION | Fan Piedmonts, Footslope | Fan Piedmonts, Footslope | Fan Piedmonts, Footslope | Fran Remnants | Fan Remnants, Footslope | Fan Piedmonts, Footslope | Fan Piedmonts, Footslope | Fan Piedmonts |
| PARENT MATERIAL | Alluvium | Alluvium | Alluvium | Gravelly alluvium derived from igneous rock | Gravelly alluvium | Alluvium | Alluvium | Gravelly alluvium |
| PROFILE | A - 0 to 2 inches: sandy loam | A - 0 to 4 inches: very gravelly sandy loam | A - 0 to 4 inches: very gravelly sandy loam | A - 0 to 1 inches: loam | A - 0 to 2 inches: sandy loam | An - 0 to 3 inches: sandy clay loam | A - 0 to 4 inches: sandy loam | A - 0 to 2 inches: sandy loam |

| Table 5 Abbreviated List of Map Unit Descriptions for the Units Above the Pleistocene Berm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SOIL | 3003—Tres Hermanos-Vado family complex, 2 to 20 percent slopes | Vado | 3005 - Vado family-Typic Petroargids complex, 1 to 10 percent slopes | Typic Petroargids | 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes | 3010 - Typic Natrargids-Adelino-Vado family complex, 1 to 8 percent slopes | Adelino | Vado |
| | Bk - 2 to 12 inches: sandy clay loam | Bk1 - 4 to 22 inches: very gravelly sandy clay loam | Bk1 - 4 to 22 inches: very gravelly sandy clay loam | Bw - 1 to 16 inches: gravelly loam | Bw - 2 to 10 inches: sandy clay loam | Btkn - 3 to 8 inches: sandy clay loam | Bw1 - 4 to 17 inches: sandy clay loam | Bw - 2 to 17 inches: gravelly sandy clay loam |
| | Btk - 12 to 16 inches: clay loam | Bk2 - 22 to 60 inches: very gravelly sandy loam | Bk2 - 22 to 60 inches: very gravelly sandy loam | Btk - 16 to 37 inches: extremely gravelly clay loam | Bk1 - 10 to 20 inches: gravelly sandy clay loam | Bkn1 - 8 to 26 inches: sandy clay loam | Bw2 - 17 to 60 inches: gravelly sandy clay loam | Bk - 17 to 60 inches: very gravelly sandy clay loam |
| | Bkk1 - 16 to 32 inches: very gravelly sandy clay loam | | | Bkm - 37 to 60 inches: cemented material | Bk2 - 20 to 26 inches: very gravelly sandy clay loam | Bkn2 - 26 to 60 inches: sandy clay loam | | |
| | Bkk2 - 32 to 60 inches: very gravelly coarse sandy loam | | | | Bkkm - 26 to 60 inches: cemented material | | | |
| SLOPE | 2-20% | 2-10% | 2-10% | 1-6% | 5-10% | 1-8% | 1-8% | 2-8% |
| DEPTH TO RESTRICTION | >80 in. | >80 in. | > 80 in. | 37 inches to petrocalcic | 22 to 37 inches to petrocalcic | 2 to 7 inches to natric | > 80 in. | > 80 in. |

| Table 5 Abbreviated List of Map Unit Descriptions for the Units Above the Pleistocene Berm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SOIL | 3003—Tres Hermanos-Vado family complex, 2 to 20 percent slopes | Vado | 3005 - Vado family-Typic Petroargids complex, 1 to 10 percent slopes | Typic Petroargids | 3006—Calcic Petrocalcids-Tres Hermanos-Adelino complex, 1 to 10 percent slopes | 3010 - Typic Natrargids-Adelino-Vado family complex, 1 to 8 percent slopes | Adelino | Vado |
| DRAINAGE | Well drained | Well drained | Well drained | Well drained | Well drained | Well drained | Well drained | Well drained |
| RUN-OFF | Very low | Very low | Very low | Medium | Medium | Low | Low | Medium |
| KSAT | .01-0.14 in/hr (Mod low) | 0.14-1.42 in/hr (Mod low - mod high) | 0.4-1.42 in/hr (Mod low - mod high) | 0.0-0.0 in/hr (Very low - low) | 0.0-0.0 in/hr (Very low - low) | 0.14-1.42 in/hr (Mod low - mod high) | 0.57-1.98 in/hr (Mod high - high) | 0.2-0.57 in/hr (Mod high) |
| DEPTH TO WATER TABLE | >80 in. | >80 in. | > 80 in. | > 80 in. | >80 in. | >80 in. | >80 in. | >80 in. |
| FLOODING | None | None | None | None | None | None | None | None |
| PONDING | None | None | None | None | None | None | None | None |
| MAX SALINITY | 0.5-3.4 mmhos/cm (Nonsaline - very sl saline) | 0.4-0.7 mmhos/cm (Nonsaline) | 0.4=0.7 mmhos/cm (Nonsaline) | 2.0-4.0 mmhos/cm (Very sl saline - sl saline) | 0.0-2.0 mmhos/cm) Nonsaline - very sl saline) | 0.0-8.0 mmhos/cm (Nonsaline - mod saline) | 0.8-1.6 mmhos/cm (Nonsaline) | 0.0-2.0 mmhos/cm (Nonsaline - very sl saline) |
| SAR | 2 | 2 | 2 | 2 | | 20 | 2 | 2 |
| AVAIL WATER, 0-60 IN | 3.7 in. (Low) | 3.2 in (Low) | 3.2 in (Low) | 2.8 in (Low) | 2.2 in (Very low) | 0.3 in (Very low) | 7.4 in (Mod) | 5.3 in (Low) |
| ESD | Gravelly, Desert Shrub | Gravelly, Desert Shrub | Gravelly, Desert Shrub | Gravelly, Desert Shrub | Gravelly, Desert Shrub | Saline Bottom 8-12" p.z. | Loamy, Desert Shrub | Gravelly, Desert Shrub |
| HYDRIC | No | No | No | No | No | No | No | No |

All parent material is listed as alluvium or gravelly alluvium.  The Typic Petroargid specifies gravelly alluvium from igneous parent material. Surface soils are primarily loams and sandy loams over increasing amounts of clay to 60 inches.  Slopes range from 1-10%.  The Tres Hermanos-Vado complex ranges up to 20% slope.

There is a distinction among soils for restrictive layer. The Typic Petroargids, and Calcic Petrocalcids complex have a petrocalcic layer ranging from 22-37 inches.  The Typic Natrargids complex has a natric layer at 2-7 inches.

All soils are rated as well drained with very low to medium run-off.  The KSAT values range from moderate to moderately high for most soils.  The Typic Petroargids and Calcic Petrocalcids complex are rated as very low to low KSAT. The KSAT measures hydraulic conductivity in saturated soils.

Depth to water table exceeds 80 inches in all soils.  There is no flooding and no ponding.

There is a distinction among soils for maximum salinity.  The Typic Natrargids complex has a natric restrictive layer and maximum salinity values up to 8 mmhos/cm (moderately saline).  The other soils have values less than 4 mmhos/cm.

Sodium Adsorption Ratio (SAR) is rated as 2 meq/L for all soils except the Typic Natrargids complex which is rated as 20 meq/L.

Available water ranges from very low to low in all soils except the Adelino complex which is rated as moderate in available water.

All soils have ESDs Gravelly, and Desert Shrub except for the Adelino soil unit identifies with ESDs Loamy, and Desert Shrub.  Also, the Typic Natrargids complex lists ESD Saline Bottom 8-12" p.z.  The latter is positioned on a Fan Piedmont in the Footslopes.  The latter map unit may need a little more work.  None of the soils identify as hydric

## Discussion of the Web Soil Survey

The soils encountered in the playa center, extending outward to the Pleistocene berm require further examination relative to the issues of concern on Lordsburg Playa.  First, no soils are listed as hydric and that does appear to be true.  The concept of a wetlands action plan tends to focus on wetlands soils. There is a small portion of the playa on the southeast corner of the playa adjacent to Interstate 10 referred to as the duck pond.  This is a designated wildlife area that is managed to promote perennial water.  There are also depressional areas and ditches that hold water for prolonged periods of time and support *Arida riparia*, a lavender-colored daisy that is riparian obligate and is an important pollinator species.  The concept of wetland for the playa includes the playa features of ponded soils and the immediate watershed influence.

An important note from Las Cruces NRCS staff working on the provisional Ecological Site Descriptions follows:

> These soils may be of a problematic hydric soil scenario, such that they may actually function as a wetland, but fail to meet the requirements of a published hydric soil indicator. Soil map unit descriptions are general and not specifically mapped to each feature of a landscape, therefore any specific playa could be ponded periodically and for a duration long enough to endure

anaerobic conditions, the fact that the soils don't display hydric morphology could be due to many reasons, most likely the alkalinity and lack of organic matter for microbial decomposition to occur enough to create redox features (Miller 2025 personal comment).

The frequently ponded area of the playa is dynamic. Surface cracks and patches of soil that are raised by a few centimeters support Alkali sacaton and halophytic species such as *Sueda*. It is not entirely barren. The inventory of Highlonesome non-saline surface soil within the center of the playa was highlighted for discussion in the section on physical and chemical properties of center playa soils. It differs from the other soils inventoried: It is positioned on Alluvial Flat rather than Toeslope, it has a steeper slope (up to 3%), it has no restrictive layer, it has no ponding, it is not saline.

As investigators have studied the playa over the last several years, they have noticed that small differences in elevation of 2-3 cm can make a difference in the presence of ponding. Cracks on the playa surface also support vegetation.

Moving outward from the playa center toward the Pleistocene berm, Saturated Hydraulic Conductivity (Ksat) values go from low to moderately high toward the berm. It is a measure of how well water moves through a saturated soil and is a key factor used to model flow, runoff and solute transport. In other words, drainage is negligible and salinity is high. These are factors that point toward classifying the playa as a mineral depression wetland. However, this classification describes that there is no connectivity to ground water. As stated in the Lordsburg Playa Wetlands Action Plan, piezometer studies to validate this assumption are needed.

The center playa soils are described as well drained with little run-off. Flooding is listed by NRCS as not occurring but we know from the July 2006 event that it does occur infrequently. Ponding is listed as frequent or occasional. Flooding and ponding are two different processes. Ponding generally occurs during monsoon rain events and produces stagnant water in a depression. This is a common occurrence on Lordsburg Playa. Flooding refers to moving water that drains and this was seen during the July 2006 event. Portions of the playa are also influenced by the Lordsburg Draw. Static well water at this intersection was recorded at 100-175 feet deep in 1917 (Schwennesen and Hare 1918) and is more shallow (90-150 feet deep) in more recent 2000's records (New Mexico State Office of Engineer, District 3 records 2025).

The central playa ESD is listed as Saline Bottom 8-12" p.z. and yet we see patches of soil that have varying amounts of halophytes and Alkali sacaton. South of Interstate 10 we see a vigorous Alkali sacaton grassland. These are factors that has led NRCS staff to review the playa soils and ESDs. Provisional ESD classification is discussed in the next section.

# Provisional Ecological Site Descriptions

## Why Develop New ESDs for Lordsburg Playa

Each of the several elements of soil health is interrelated in numerous ways to influence what we perceive as an ecosystem and the function or rangeland health. Evaluations based on these factors can help to estimate the likelihood of successful recovery where extensive soil redistribution is taking place (Burkett et al no date).

The current Ecological Site Descriptions provided by the NRCS Web Soil Survey categorize Lordsburg Playa across most of the National Wetlands Inventory (NWI) map as one large Saline Bottom 8-12" p.z. Since 2018 a team of researchers has been working on the playa to combat wind erosion and dust storms, provide for habitat restoration, and conduct assessments to better understand the playa. They have observed that the playa is very dynamic and many aspects of the soil health parameters are constantly in play. As a result, NRCS staff in Las Cruces are preparing new Ecological Site Descriptions (ESD) for the playa. In April 2025 these ESDs are still provisional and under review. Instead of one all-encompassing Saline Bottom ESD, four new ESDs have been developed that better reflect the dynamics of Lordsburg Playa based on the primary soil health factors which focus on the constant wind and water erosion of soils, deposition of new surfaces by wind and water, development of soil surface cracks, the presence of limiting natric horizons, and soil chemistry that affects soil aggregate stability.

The provisional Ecological Site Descriptions presented below are draft concepts and are subject to change as they continue to be developed. They are not currently part of an active project update but are in the queue for a future ESD update effort (Miller 2025, personal comment).

# Site Name: Saline/Sodic Dry Playa 041XB250 NM – DRAFT

The following discussion is a summary of the much longer draft Ecological Site Description (Garcia 2025a).

## Ecological Site Concept

The Saline/Sodic Dry Playa Ecological Site (ES) occurs at the lowest positions in closed basin systems. Playas are predominantly dry throughout the year with seasonal ponding during monsoon season and rain events. The site has no surfacing ground water, and no significant evaporite accumulations. Soils are saline and sodic throughout the soil profile. The site is vegetatively barren at the lowest more frequently ponded portion of the playa. Where a slight increase in elevation occurs (2-3 cm) in the topography, there may be a corresponding occurrence of vegetation. Vegetated portions of the ES will not exceed 20% foliar canopy coverage.

## Physiographic

This ES occurs at the lowest position of the closed basin system. Some basins may have a series of playas separated by elevated eolian (lunette dune) or alluvial deposit. Topographically, the lowest most frequently ponded portion is relatively flat to slightly concave with slopes < 0.10%. The less frequently ponded edges can be slightly elevated and undulating due to recent soil deposits (Figure 5).

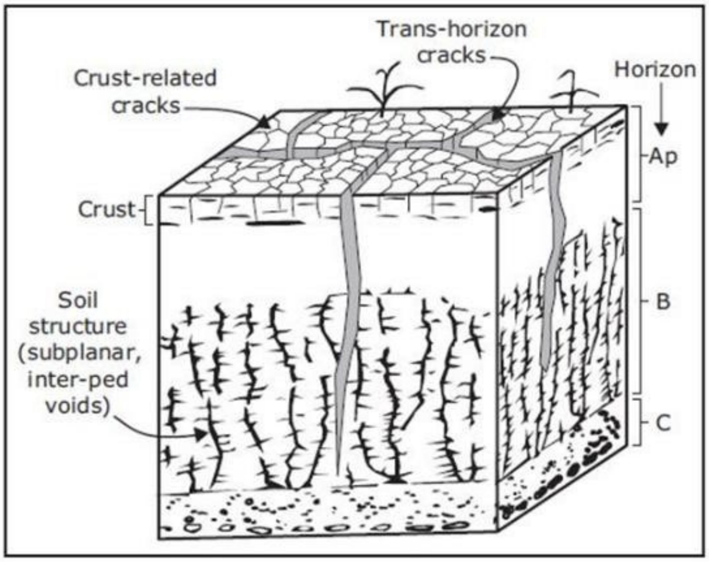
*Figure 5 The Saline/Sodic Dry Playa ES is located at the lowest position of the playa (Garcia 2025a).*

Fine textured saline soil of the playa seals when ponded. Deep soils are clayey and silty; these saline soils disperse, collapse and seal. This reduces infiltration rates and causes water to pond.

Ponded water evaporates in a few days except during monsoon when it may remain inundated for a few months. Augered soils show no soil saturation at 6 inches depth.

The Rupture Resistance Class is hard to extremely hard. When dry the surface is extremely hard and very resistant to physical impact. However, the crust can be broken through with repeated impact such as the development of cow trails or OHV roads. When the soil turns to dust it is easily dispersed.

The Soil Stability Class is variable and influenced by the presence of cracks. Bare ground is extremely unstable in water with a rating of 0. Vegetated cracks have a rating of 1. The presence or absence of surface cracks effects ecological dynamics (Figure 6, Table 6).




USDA-NRCS 2–75 September 2012

*Figure 6 Surface cracks have no influence on ponding and infiltration while trans-horizon cracks do assist with infiltration (USDA NRCS 2012)*

| Kind | Code [1] | General Description |
|---|---|---|
| ***CRUST-RELATED CRACKS*** [2] ***(shallow, vertical cracks related to crusts; derived from raindrop-splash and soil puddling followed by dewatering/consolidation and desiccation)*** | | |
| Reversible Crust-Related Cracks [3] | RCR | Very shallow (e.g., 0.1-0.5 cm); very transient (generally persist less than a few weeks); formed by drying from surface down; minimal seasonal influence on ponded infiltration (e.g., raindrop crust cracks). |
| Irreversible Crust-Related Cracks [4] | ICR | Shallow (e.g., 0.5-2 cm); seasonally transient (not present year-round nor every year); minor influence on ponded infiltration (e.g., freeze-thaw crust and associated cracks). |
| ***TRANS-HORIZON CRACKS*** [5] ***(deep, vertical cracks that commonly extend across more than one horizon and may extend to the surface; derived from wetting and drying or original dewatering and consolidation of parent material)*** | | |
| Reversible Trans-Horizon Cracks [6] | RTH | Transient (commonly seasonal; close when rewetted); large influence on ponded infiltration and $K_{sat}$; formed by wetting and drying of soil (e.g., Vertisols, vertic subgroups). |
| Irreversible Trans-Horizon Cracks [7] | ITH | Permanent (persist year-round; see *Soil Taxonomy*), large influence on ponded infiltration and $K_{sat}$ (e.g., extremely coarse subsurface fissures within glacial till; drained polder cracks). |

*Table 6. Crust-related cracks and Trans-horizon cracks are compared (USDA NRCS 2012).*

Giant desiccation cracks indicate frequency of ponding and plant distribution (Figures 7 and 8). Sediment from fluvial or aeolian sources can create new piedmonts on top of the cracks. Figure 7 shows from left to right: piedmont-supplied deposition, orthogonal cracks, Dry Saline/Sodic Playa ES (Garcia 2025a).

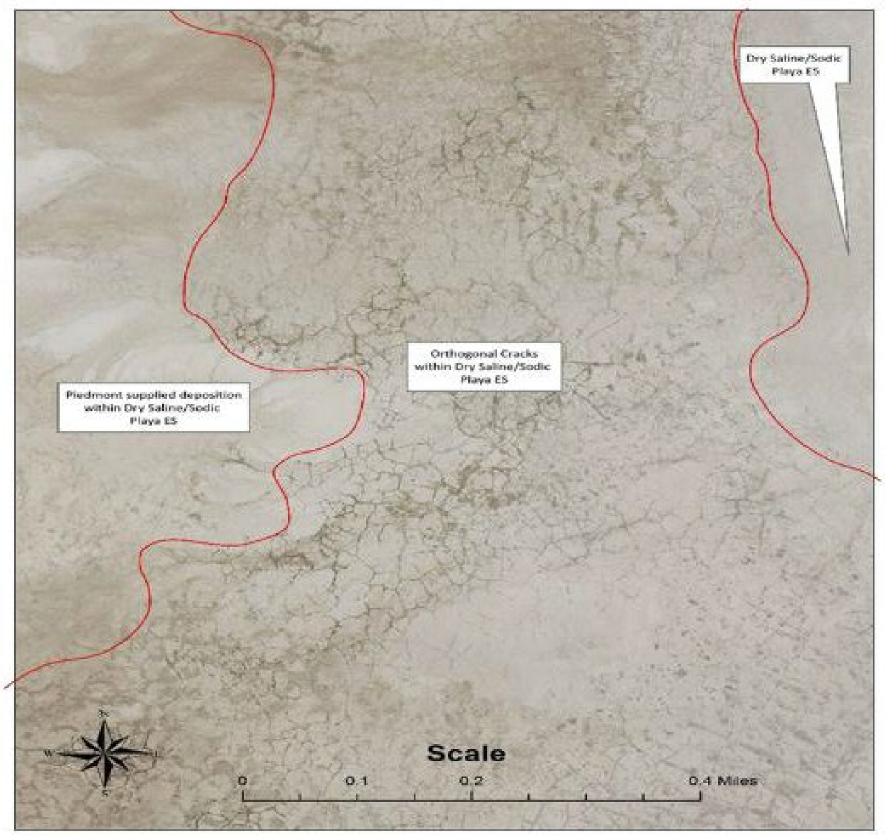



*Figure 7 Surface cracks play an important role in the main playa.*

*Figure 8 Giant Desiccation Cracks provide sites for seed establishment and retention of resources such as litter and organic matter (Garcia 2025a).*

## System Drivers

System drivers include soil chemistry, physical properties, micro-elevation changes, and surface hydrology. Giant desiccation cracks indicate frequency of ponding and correlate to plant distribution.

## Central Concept of the Reference Plant Community

The barren states occur at the lowest position of the playa, while the vegetative states occur when transitioning away from the lowest playa position. Inundation time and frequency, the hard physical property of soil crust and sub horizons determine where barren land and plant distribution occurs. One of the more discernable characteristics are soil surface characteristics. The occurrences of Crust-Related Cracks correlate well with presence or absence of vegetation.

# Site Name: Sodic Flat Alkali Sacaton 041XB252- DRAFT

The following discussion is a summary of the much longer draft Ecological Site Description (Garcia 2025b).

## Ecological Site Concept

The Sodic (Alkaline) Flat ES is created by unique circumstances. Sediments transported to the basin floor are overlaid onto a saline playa, creating an alluvial flat which is elevated from the playa floor. Due to increased elevation, the site does not pond, does not become hard packed and surface soils are non-saline. The spreading overland flow provides the additional irrigation required to support the dense stands of Alkali sacaton (*Sporobolus airoides*) (Figure 9).

*Figure 9 Alkali sacaton grassland is shown during the wet monsoon season and during the dry season (Garcia 2025b).*

Site stability (homeostasis) is governed by environmental drivers. Soil chemistry and stratification, topography, surface hydrology and plant biomass are drivers for this site.

The site will have a gradual slope of <1%. As the site transitions towards topographic low, a reduction in herbaceous vegetation occurs along with an increase in halophytes (salt-loving plants). In some instances, abrupt changes in elevation of a few feet occurs. This is usually an indication of site degradation that is anthropogenically caused.

When reference-state surface soils are lost, exposing subsurface soils erosion will cause plant pedestals and interconnected patches of bare ground. There is a corresponding loss of plant vigor, a reduction of Alkali sacaton and an increase in halophytes (Figure 10). As conditions deteriorate the process may become irreversible (Garcia 2025b).

*Figure 10. The deteriorated state of the Sodic Alkali Flat grassland has interconnected patches of bare ground.*

## Physiographic

Precipitation events transport sediments onto the basin floor; sediments are evenly distributed forming alluvial fans or deltas. Overland flows are shallow with no natural ponding. Sustaining site hydrology is dependent on sustaining site topography in conjunction with plant basal density.

A Rupture Resistance Class of 1 and 2 increases to 5 as the site degrades. The Soil Stability Class (SSC) for bare ground ranges from 3.7-4.7, and SSC for soil located under canopy coverage ranges from 4.8-5.2

## System Drivers

System drivers include saline and alkaline soil stratification, topography, surface hydrology, and plant biomass.

## Central Concept of the Reference Plant Community

The site is low in species richness and high in grass production, producing 1500 lbs. /ac air dry weight. Species composition by weight consists of 95% Alkali sacaton, 5% Mojave seablite (*Sueda nigra*), Saltbush species (*Atriplex spp.*), and Alkali aster (*Arida riparia*), with seasonal spikes of annual species such as Six weeks grama (*Bouteloua barbata*), Windmill grass (*Chloris spp*.) and Lovegrass (*Eragrostis spp.*).

## Site Name: Saline Playa Rim Slope 041XB254NM- DRAFT

The following discussion is a summary of the much longer draft Ecological Site Description (Garcia 2025c).

### Ecological Site Concept

The Saline Playa Rim Slope Ecological Site (ES) occurs on the edge of playas or relic playa lakes. The site typically has a slight grade rather than the flat topography of the main ponded playa. The site has both depositional and erosional features. Piedmont sediments are deposited into this ES with low flow events. While higher flow events transport sediments out of the site onto the playa floor. Rill erosion and drainageways are indicative of the site with drainageways being very shallow. When viewed aerially drainageways are dendritic and are highly braided. Saline levels will be high throughout the soil profile causing the soils to be highly dispersive. Soils will have a low rupture resistance class and a "fluffy" characteristic which causes them to collapse when walked upon. The site has a low vegetation density, with the drainageways and associated fans having the greatest production of vegetation. Species composition is low consisting mainly of Alkali Sacaton, Mojave Seablite, and Tubercled Saltbush (*Atriplex acanthocarpa*).

### Physiographic

The site is located within the basin floor at the upper most position of a playa rim or relic lake shoreline and just below the piedmont. It is situated just above any ponding of the playa floor and its effects. This is evident by the sheet, rill and drainageways that remain on site and are not leveled or disturbed by ponding.

In Figure 11 dendritic vegetated drainageways emanate from the upper watershed at three breach points. Also depicted is the barren phase of this ES that was previously scoured and is now slightly elevated from the drainageways and remains dry. This location is highly saline and is relatively void of vegetation (Figure 12). The soil is easily eroded with a Rupture Resistance Class of 1 on bare ground. Because there is no ponding the site does not become water packed, and there are no soil crack features on this ES. Due to the high salinity levels, soils remain "soft". When soil crust is compromised by physical impact this site becomes highly susceptible to wind erosion. Maintenance of the soil crust is necessary to protect these sites.

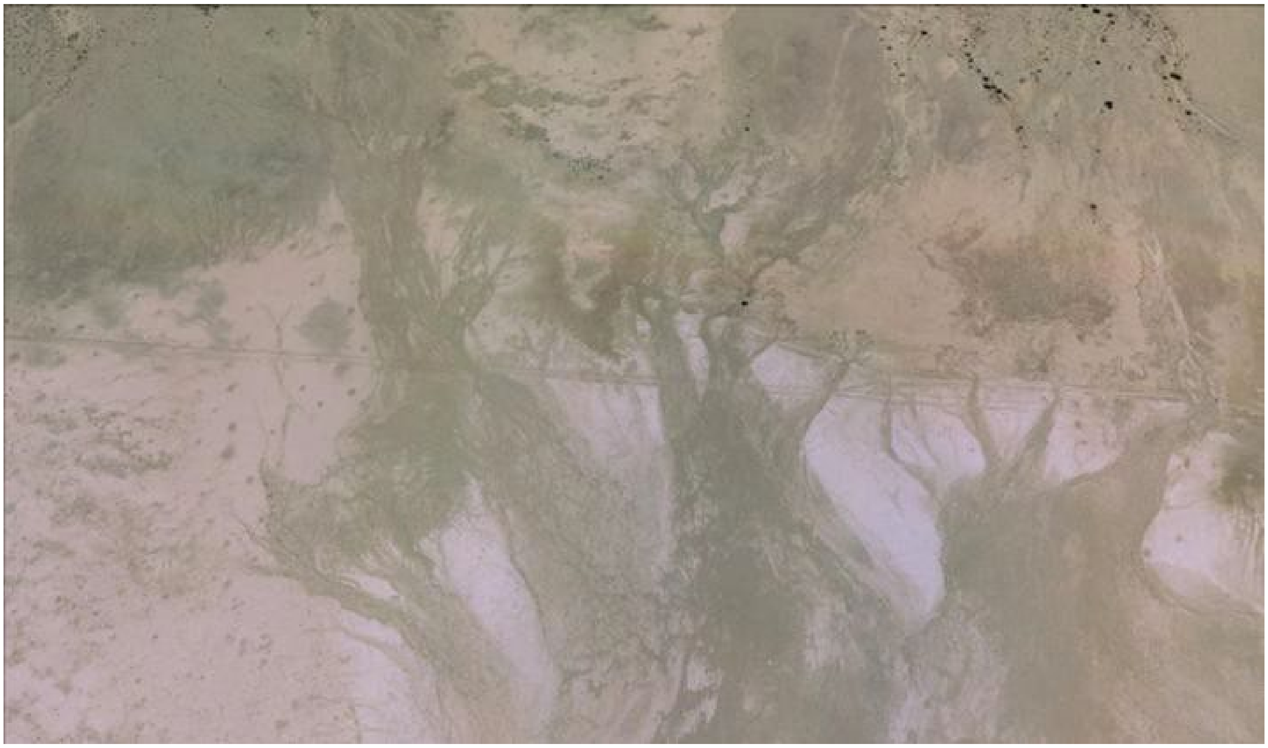


*Figure 11 The Saline Playa Rim Slope ES is characterized by shallow, braided drainages and is situated just above the ponding zone of the playa.*

*Figure 122. Reference condition ES shows Tubercled saltbush occupying slightly elevated positions.*

## System Drivers

In the drainageway section of this ESD, high soil salinity, soil deposition and erosion via water are key are system drivers for this site.

In the non-drainageway sections of this ESD, high soil salinity and lack of overland flows are key drivers. Overland flows are blocked by the playa berm.

## Central Concept of the Reference Plant Community

The plant community is dominated by a light stand of Alkali Sacaton, Mojave Seablite, and Tubercled Saltbush. Canopy coverage does not exceed 25% except during an episodic flush of short-lived annual grasses and forbs.

Figure 11 shows Reference State Phase 1 with the elevated position occupied by Tubercled saltbush. Figure 12 shows Reference State Phase 2 with shallow drainage positions. Mojave Seablite is somewhat buried in the drainageways. Seedlings of all species are more susceptible to erosional forces than are established plants. Surface cracks within the drainages in the foreground are cracking of clay skins and are not related to surface cracking discussed for the Sodic Dry Playa ES.

# Site Name: Sodic Piedmont 042XB256NM – DRAFT

The following discussion is a summary of the much longer draft Ecological Site Description (Garcia 2025d).

## Ecological Site Concept

The reference state is naturally eroded with a mix of Saltbush species and Alkali sacaton. Areas that can accumulate moisture will have more Alkali sacaton. The surface is gravelly and shallow which provides armor. Production of canopy coverage is low. The system dynamic will not typically degrade because site dynamics are minimal. When vegetation is degraded it will recover with rest.

The second reference state is located on moderately deep soil with canopy coverage 10-40% Saltbush species. When this site degrades the shrubs become pedestaled.

## Physiographic

This ES is located at the upper and lower positions of the piedmont where sodium accumulates. Slopes are 1-5% with flat to undulating cross slopes. There are numerous shallow, meandering drainageways. Surface runoff from hills will transport salts from the weathered parent material. This transported salt can accumulate at the lower piedmont slopes to produce a sodic site. Surfaces are sandy and gravelly. There is no ponding. When this site occurs on piedmont fans the site is affected by surface hydrology.

## System Drivers

The primary driver for the site is the presence of sodium and overland flows. Sodium at the surface will inhibit-most plant species. The sodium effected soils are highly erosive to water, this coupled with slope and reduced plant population allows surface water to scour. This allows for shallow, meandering waterways to develop. These accompanying waterways can form and heal, eroding and depositing soils. As slope increases the associated incisions are deeper. Steeper slopes have deeper incisions. Saltbush

(*Atriplex sp*.) canopy can have a broad range of values; some of the gravellier sites are barren and some of the finer soils have up to 30 % canopy coverage of Saltbush. The subtle side slope position to the waterway allows for increased run-on water with an incremental increase in vegetation. Alkali sacaton will increase with increased run-on water.

## Central Concept of the Reference Plant Community

The plant community is dominated by Saltbush species and Alkali sacaton. Soils with additional moisture produce more Alkali sacaton and drier soils produce more Saltbush. Honey mesquite is an invader on moist soil. Seasonal flushes of annual grasses and forbs may occur.

Figures 13 and 14 show reference states photographed at a playa south of Lordsburg near the village of Playas. The Pyramid Mountains are shown in the background. Both photos show the ES located on piedmont fan with < 2% Slope. The site is gravelly throughout the profile. Figure 13 shows Alkali sacaton on the broader drainageways where the elevated drier sites are relatively void of vegetation but do produce sparse Mound saltbush (*Atriplex obovata*). Figure 14 shows a flush of annual vegetation; the site is relatively void of perennial vegetation. Perennial vegetation is at 13% foliar coverage.

*Figure 133 Alkali sacaton occupies shallow drainages while the elevated interspaces remain bare on the Sodic Piedmont ES.*

*Figure 144 During wet years a flush of annual plant species may occupy the otherwise bare elevated areas of the Sodic Piedmont ES.*

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Appendix B - Schwennesen and Hare (1918) Surface Soil Chemistry and Static Water Table

Water-Soluble Constituents of Soil

Schwennesen, A.T. and R.F. Hare, 1918. Ground Water in the Animas, Playas, Hachita, and San Luis Basins New Mexico. Water-Supply Paper 422. US Geological Survey. With Analyses of Water and Soil by R.F. Hare.

| Water-Soluble Constituents of Soil – Table 1 (Expressed in percentage of total soil.) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Total soluble solids (total alkaliniity) | | | | | | |
| Table 3 Well # | Depth of Soil Analyzed (inches) | Avg. partial soil section | Avg total soil section | Calcium (Ca) | Magnesium (Mg) | Sodium and Potassium (Na +K) | Carbonate Radicle (CO3) | Bicarbonate Radicle (HCO3) |
| 3 | 0-1 | 0.383 | 0.653 | 0.005 | 0.004 | 0.116 | 0.03 | 0.192 |
| | 1-4 | 0.742 | | 0.004 | 0.007 | 0.251 | 0.147 | 0.186 |
| 7 | 0-1 | 0.407 | 1.134 | 0.004 | 0.003 | 0.124 | 0.018 | 0.156 |
| | 1-4 | 1.376 | | 0.015 | 0.007 | 0.398 | 0.003 | 0.128 |
| 8 | 0-1 | 0.475 | 0.908 | 0.004 | 0.002 | 0.17 | 0.114 | 0.189 |
| | 1-4 | 1.052 | | 0.002 | 0.003 | 0.419 | 0.303 | 0.287 |
| 9 | 0-1 | 1.1 | 1.262 | 0.009 | 0.001 | 0.305 | 0 | 0.186 |
| | 1-4 | 1.316 | | 0.003 | 0.004 | 0.4 | 0.053 | 0.195 |
| 10 | 0-1 | 0.896 | 0.916 | 0.002 | 0.004 | 0.321 | 0.113 | 0.186 |
| | 1-4 | 0.922 | | 0.004 | 0.004 | 0.314 | 0.117 | 0.189 |
| 11 | 0-1 | 0.781 | 1.676 | 0.009 | 0.007 | 0.24 | 0.015 | 0.162 |
| | 1-4 | 1.975 | | 0.008 | 0.01 | 0.697 | 0.222 | 0.29 |
| 12 | 0-1 | 0.862 | 0.766 | 0.006 | 0.001 | 0.294 | 0.126 | 0.159 |
| | 1-4 | 0.734 | | 0.007 | 0.003 | 0.256 | 0.114 | 0.202 |
| 13 | 0-1 | 0.72 | 0.864 | 0.006 | 0.005 | 0.227 | 0.009 | 0.201 |
| | 1-4 | 0.912 | | 0.006 | 0.002 | 0.303 | 0.032 | 0.189 |
| 14 | 0-1 | 0.3 | 1.264 | 0.009 | 0.002 | 0.075 | 0.01 | 0.164 |
| | 1-4 | 1.686 | | 0.159 | 0.014 | 0.321 | 0.005 | 0.123 |
| 16 | 0-1 | 0.411 | 1.222 | 0.004 | 0.002 | 0.142 | 0 | 0.146 |
| | 1-4 | 1.492 | | 0.063 | 0.008 | 0.139 | 0 | 0.189 |
| 17 | 0-1 | 1.195 | 0.818 | 0.004 | 0.004 | 0.397 | 0.273 | 0.092 |
| | 1-4 | 0.692 | | 0.004 | 0.001 | 0.244 | 0.111 | 0.165 |
| 18 | 0-1 | 0.183 | 0.286 | 0.005 | 0.004 | 0.047 | 0 | 0.122 |
| | 1-4 | 0.82 | | 0.025 | 0.005 | 0.08 | 0 | 0.122 |
| 19 | 0-1 | 0.912 | 1.074 | 0.024 | 0.003 | 0.243 | 0.06 | 0.098 |
| | 1-4 | 1.128 | | 0.024 | Trace | 0.285 | 0 | 0.12 |
| 20 | 0-1 | 0.44 | 0.645 | 0.009 | 0.003 | 0.13 | 0.021 | 0.1 |
| | 1-4 | 0.714 | | 0.009 | 0.003 | 0.248 | 0.063 | 0.092 |

| Water-Soluble Constituents of Soil – Table 2<br>(Expressed in percentage of total soil.) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Black alkali (Sodium Carbonate) Na2CO3 | | |
| Table 3 Well # | Depth of Soil Analyzed (inches) | Sulfate Radicle (SO4) | Chloride Radicle (Cl) | Water and undetermined constituents | Avg. partial soil sections | Avg. total soil sections | Alkali Content |
| 3 | 0-1 | 0.049 | 0.017 | 0.071 | 0.254 | 0.356 | Excessive |
| | 1-4 | 0.124 | 0.035 | 0.083 | 0.39 | | |
| 7 | 0-1 | 0.08 | 0.035 | 0.066 | 0.195 | 0.118 | Excessive |
| | 1-4 | 0.679 | 0.081 | 0.13 | 0.092 | | |
| 8 | 0-1 | 0.03 | 0.02 | 0.042 | 0.424 | 0.71 | DO |
| | 1-4 | 0.126 | 0.058 | 0 | 0.806 | | |
| 9 | 0-1 | 0.341 | 0.144 | 0.208 | 0.161 | 0.25 | DO |
| | 1-4 | 0.377 | 0.179 | 0.204 | 0.28 | | |
| 10 | 0-1 | 0.24 | 0.092 | 0.034 | 0.314 | 0.345 | DO |
| | 1-4 | 0.21 | 0.089 | 0.082 | 0.356 | | |
| 11 | 0-1 | 0.163 | 0.187 | 0.08 | 0.203 | 0.4 | DO |
| | 1-4 | 0.536 | 0.291 | 0.068 | 0.466 | | |
| 12 | 0-1 | 0.172 | 0.098 | 0.087 | 0.356 | 0.381 | DO |
| | 1-4 | 0.114 | 0.078 | 0.062 | 0.39 | | |
| 13 | 0-1 | 0.294 | 0.029 | 0.05 | 0.187 | 0.231 | Strong |
| | 1-4 | 0.407 | 0.035 | 0.024 | 0.246 | | |
| 14 | 0-1 | 0.024 | 0.012 | 0.087 | 0.178 | 0.045 | Excessive |
| | 1-4 | 0.875 | 0.095 | 0.156 | 0 | | |
| 16 | 0-1 | 0.1 | 0.072 | 0.02 | 0.11 | 0.027 | DO |
| | 1-4 | 0.337 | 0.107 | 0.343 | 0 | | |
| 17 | 0-1 | ? | 0.084 | 0.158 | 0.492 | 0.346 | DO |
| | 1-4 | 0.141 | 0.055 | 0.055 | 0.297 | | |
| 18 | 0-1 | 0.012 | 0.009 | 0.041 | 0.092 | 0.049 | Weak |
| | 1-4 | 0.142 | 0.006 | 0.002 | 0.034 | | |
| 19 | 0-1 | 0.049 | 0.262 | 0.223 | 0.034 | 0.047 | Excessive |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1-4 | 0.197 | 0.266 | 0.297 | 0.051 | | |
| 20 | 0-1 | 0.116 | 0.055 | 0.056 | 0.119 | 0.146 | Strong |
| | 1-4 | 0.26 | 0.086 | 0 | 0.195 | | |

| Location of Wells | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Table 3 Well # | Twnsh S | Range W | Sec | Qtr | Within Qtr | Lat. approx | Long. approx | Location |
| 3 | 23 | 20 | 8 | NE | NWSW | 32.321077° | -108.918561° | Level plain above alkali flat depression. |
| 7 | 23 | 20 | 3 | NW | NW | 32.338474° | -108.881771° | Plain between alkali flats. |
| 8 | 23 | 20 | 5 | SE | center of NE | 32.331754° | -108.918450° | Alkali flat. |
| 9 | 23 | 20 | 12 | SW | NWSW | 32.317473° | -108.856072° | North side of draw draining into alkali flat. |
| 10 | 23 | 20 | 23 | NW | SWNW | 32.295217° | -108.858710° | Alkali flat. |
| 11 | 23 | 20 | 25 | NW | Center of NE | 32.279505° | -108.850390° | Slope bordering alkali falts. |
| 12 | 23 | 20 | 29 | NW | | 32.279089° | -108.917248° | Alkali flat. |
| 13 | 23 | 20 (21) | 31 (36) | SW (SE) | SW (SE) | 32.256647° | -108.946005° | End of outwash slope from (?) (ridge?) |
| 16 | 24 | 20 | 1 | SE | SE | 32.241735° | -108.848477° | East side central valley plain. |

| Location of Wells | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Table 3 Well # | Twnsh S | Range W | Sec | Qtr | Within Qtr | Lat. approx | Long. approx | Location |
| 17 | 24 | 20 | 11 | SW | Near (?) (center) of (?) (west) line. | 32.227770° | -108.875183° | Near center of central valley plain. |
| 18 | 24 | 20 | 18 | NW | NESW | 32.219574° | -108.936848° | West side central valley plain. |
| 19 | 24 | 20 | 25 | SE | NW | 32.187277° | -108.851692° | Central valley plain drainage axis. |
| 20 | 24 | 20 | 33 | NE | SW | 32.175889° | -108.902698° | |

| Static Ground Water Level by Well Location | | | | | |
|---|---|---|---|---|---|
| Table 3 Well # | Depth to Ground Water (ft) 1917 | Ground Water update | Year of update | Vegetation | Surface Soil |
| 3 | 175 | 150 | | None | Sandy |
| 7 | 120 | | | Grasses | Sandy loam |
| 8 | 100 | | | Scattered tufts of Alkali sacaton | |
| 9 | 100 | 90 | 2006 | Alkali sacaton | Fine clayey sand inclined to sun bake and crack. |
| 10 | 25 | | | Scattered tufts of Alkali sacaton | Heavy clay soil; hard sun-baked surface. |
| 11 | 25 | | | Range grasses and alkali vegetation. | Fine grained, sandy, scoured surface. |
| 12 | 20 | | | None | Heavy clay soil; hard sun-baked surface. |
| 13 | 23 | 57 | 2006 | Grass, mesquite | Sandy loam |

| Static Ground Water Level by Well Location | | | | | |
|---|---|---|---|---|---|
| Table 3 Well # | Depth to Ground Water (ft) 1917 | Ground Water update | Year of update | Vegetation | Surface Soil |
| 16 | 27 | 62 | 1983 | Scattered mesquite. | DO |
| 17 | 10 | 45 | 2022 | Grass and scattered sage brush. | Heavy clayey loam; surface bakes and cracks. |
| 18 | 30 | | | Scattered tall mesquite. | ? |
| 19 | 20 | 60 | 2012 | Scattered mesquite and alkali vegetation. | Clay, sun-baked and cracked. |
| 20 | 25 | | | Tall mesquite and much sacaton. | Sandy loam, light gray at surface with reddish subsoil. |

Appendix C – High Desert Native Plants, LLC Seed Mix

| High Desert Native Plants, LLC Seed Mix | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ascension Number | | 7-03450 | 7-03474 | 7-03475 | 7-03535 | 7-03564 | 3-56412 | 1-72535 | 1-73146 | 1-73146 |
| Invoice Date | | 8/14/2020 | 9/17/2020 | 9/28/2020 | 9/28/2020 | 11/9/2020 | 11/30/2020 | 11/29/2021 | 6/8/2023 | 6/8/2023 |
| Species | Common Name | | | | | | | | | |
| Artemisia filifolia | Sand sage | x | | | | | | | | |
| Atriplex canescens | Four-wing saltbush | x | x | x | | x | x | | | |
| Atriplex confertifolia | Shadscale saltbush | | | | | | | x | | |
| Bouteloua aristidoides | Needle grama | x | x | x | | x | x | | | |
| Bouteloua barbata | Sixweeks grama | | | | | | | x | | x |
| Bouteloua curtipendula | Sideoats grama | x | x | x | | x | x | x | | x |
| Bouteloua gracilis | Blue grama | | x | x | | x | x | | | |
| Cleome serrulata | Bee balm | | | | | | | x | | |
| Dalea purpurea var. purpurea | Purple prairie clover | | | | | | | x | | |
| Dalea candida | Whtie prairie clover | | | | | | | | | x |
| Distichlis spicata | Saltgrass | x | | | | | | x | x | |
| Ephedra viridis | Mormon tea | | | | | | | x | | |
| Eragrostis trichodes | Sand lovegrass | | | | | | | x | | x |

| High Desert Native Plants, LLC Seed Mix | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ascension Number | | 7-03450 | 7-03474 | 7-03475 | 7-03535 | 7-03564 | 3-56412 | 1-72535 | 1-73146 | 1-73146 |
| Invoice Date | | 8/14/2020 | 9/17/2020 | 9/28/2020 | 9/28/2020 | 11/9/2020 | 11/30/2020 | 11/29/2021 | 6/8/2023 | 6/8/2023 |
| Eschscholzia californica | California poppy | | | | | | | x | | x |
| Eschscholzia mexicana | Mexican poppy | | | | | | | x | | x |
| Ephedra nevadensis | Nevada jointfir | | | | | | | | | |
| Oenothera pallida | Pale evening primrose | | | | | | | x | | |
| Pascopyrum smithii | Western wheatgrass | | | | | | | x | | x |
| Poa fendleriana | Muttongrass | | | | | | | x | | |
| Sporobolus airoides | Alakali sacaton | x | x | x | | x | x | x | | x |
| Sporobolus cryptandrus | Sand dropseed | | x | x | | x | x | x | | x |
| Zinnia acerosa | Desert zinnia | x | | | | | | | | |
| Sonoran desert wildflower mix | | | | | x | | | | | |
| Escholzia mexicana | Mexican Poppy | | | | | | | | | |
| Kallstroemia grandiflora | Arizona poppy | | | | | | | | | |
| Gaillardia pulchella | Blanket flower | | | | | | | | | |
| Layia | Tidy tips | | | | | | | | | |
| Lupinus aridus | Desert lupine | | | | | | | | | |
| Lupinus sp. | Arroyo Lupine | | | | | | | | | |
| | California Bluebells | | | | | | | | | |

| High Desert Native Plants, LLC Seed Mix | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Ascension Number | | 7-03450 | 7-03474 | 7-03475 | 7-03535 | 7-03564 | 3-56412 | 1-72535 | 1-73146 | 1-73146 |
| Invoice Date | | 8/14/2020 | 9/17/2020 | 9/28/2020 | 9/28/2020 | 11/9/2020 | 11/30/2020 | 11/29/2021 | 6/8/2023 | 6/8/2023 |
| Cassia sp. | Desert senna | | | | | | | | | |
| Penstemon eatonii | Firecracker penstemon | | | | | | | | | |
| Baileya multiradiata | Desert marigold | | | | | | | | | |
| Oenothera hookeri | Hooker's Evening Primrose | | | | | | | | | |
| | Desert daisy | | | | | | | | | |
| Encelia sp. | Brittlebush | | | | | | | | | |
| Lupinus arizonicus | Arizona Lupine | | | | | | | | | |

# APPENDIX D
# POSEY WELL BIRD AND WILDLIFE DATA
## Eight Years of Repeat Monitoring

1980-1984, 1989, 1998, 2006


### Abstract
Eight sample years of wildlife data, especially bird species of conservation concern, were reviewed at a constructed wetland in southeastern Arizona.



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10.15.24

# Contents

POSEY WELL BIRD AND WILDIFE DATA

## Introduction

Posey Well is an artesian well in an approximately 60-acre cattle exclosure, located about 25 miles north/northwest of Road Forks, NM, and about 11 miles north of San Simon, AZ. It is located in the NW ¼ section 1, T12S, R29E SRM (32 deg 25' 13" N x 109 deg 20' 22" W) and is managed by the Bureau of Land Management Safford Field Office.

The BLM began restoration work at the site in 2006 to ensure water for wildlife and to create a reliable small pond to be used for native fish refugia. Kingsley (2006) provided baseline wildlife monitoring for the restoration project. In addition, BLM bird records from 1981-1984, and 1998 and 2006 were examined by Cockman 2010.

Kingsley 2006 baseline monitoring included plant inventory, live trapping for small mammals, night vision scope and ultrasonic bat detector for nocturnal wildlife, mist netting for bats, point counts and incidental observations for birds, pitfall traps, observations of reptiles, and visual examination of standing water for insects, plants and vertebrates.

Cockman 2010 compiled bird data from BLM records and Kingsley 2006 to examine bird species presence, percentage riparian vs non-riparian birds, and bird species of concern. This paper provides a shorter summary of the bird data, Kingsley 2006 wildlife lists and a description of Posey Well habitat.

## Posey Well Habitat Descriptions

The Posey Well wildlife exclosure is situated on deep alluvial soil in the floodplain of the San Simon River, an approximate average elevation of 3,440 ft above mean sea level. Edaphic conditions are a mosaic of sandy and gravelly soil with few cobbles. Approximately 1/3 of the site has been historically excavated and bermed to form a pond that appears to have been approximately 10 acres in extent at one time. There is no naturally occurring water on the site (Kingsley 2006). An artesian well is present that was drilled in 1973 by oil and gas exploration (BLM records). The well was capped and water used to fill a pond in the 1980s. That pond was loosely managed by local recreationists who kept it stocked with catfish. There was enough water on the pond to support row boats and a recreational fishery. The large pond dried up sometime in the 1990s (BLM records).

The characteristic native vegetation community appears to have been grassland dominated by big sacaton (*Sporobolus wrightii*) and alkali sacaton (*Sporobolus airoides*) with four-wing saltbush (*Atriplex canescens*) and honey mesquite (*Prosopis glandulosa*) within the Chihuahuan Descrtscrub biome (153.2 of Brown, Lowe, and Pase). The surrounding area is heavily grazed by cattle and is subject to off-road vehicle activity. Vegetation planting and manipulation by BLM following completion of the exclosure, and invasion of the area by water-loving plants has altered the vegetation composition of the site to a mosaic of several distinct plant communities including:

- Grassland: Big sacaton and Alkali sacaton.
- Mesquite Hummock: Honey mesquite and Velvet mesquite (*Prosopis velutina*).
- Dead Riparian: Five-stamen tamarisk (*Tamarix chinensis*), Fremont conttonwood (*Populus fremontii)*, Goodding's willow (*Salix goodingii*), Southern cattail (*Typha domingensis*), and Prickly Russian Thistle (*Salsola tragus*)

- Riparian: This is a 2-3 acre dense riparian area dependent on water from the well. It is dominated by Southern cattail, Chairmaker's bulrush (*Schoenoplectus americanus*), and an overstory of Fremont cottonwood and Gooding's willow. As the site dries out, Mesquite and Tamarisk become the dominiant woody species (Kinglsey 2006).

## NRCS Soil Survey

The soil survey for the area is included in the Cochise County survey (NRCS online) and indicates that the general area has the potential as very productive grassland. The Posey Well exclosure straddles a soil unit delineated for the San Simon River and an adjacent grassland unit. The San Simon River unit is comprised of Glendale-Gila Association, frequently flooded with an estimated 1224 lb/acre/year forage production. Forage grasses are dominated by Wright's sacaton, Sideoats grama (*Bouteloua curtipendula*), Bush muhly (*Muhlenbergia porteri*) and Vine mesquite (*Panicum obtusum*).

The Posey Well pond was excavated on Anthony-Gila complex with an estimated 2600 lb/acre/year forage production potential. This unit is heavily influenced by alluvial fans from incoming drainages. Forage vegetation is dominated by Big galleta (*Hilaria rigida*), Three-awn (*Aristida purpurea*) and Saltbush (*Atriplex canescens*). The upland between drainages to the east is mapped as Bluepoint-Gothard complex with an estimated forage production potential of 924 lb/acre/year.

As noted by Kingsley (2006) long term drought and heavy grazing have left the areas outside of the fenced exclosure in poor condition. There is also an active quarry for zeolite just outside of the Posey Well exclosure located on the Bluepoint-Gothard complex.

The area receives 8-12 inch precipitation (rainfall), mostly during the monsoon season of July through August. The months of May and June have extremely low humidity, usually staying in the single digits. Freezing temperatures are common December through February. June through August temperatures exceed 100 F (NRCS online).

## Wildlife

### Reptiles

Kingsley (2006) recorded a small number of reptiles (Table 1) through observation and the use of pitfall traps. The actual diversity of reptiles is expected to be larger.

*Table 1. Reptiles (Kingsley 2006)*

| Reptiles (Kingsley 2006) | | | | | |
|---|---|---|---|---|---|
| Present = presence observed in this community, may also be present in others. | | | | | |
| Scientific Name | Common Name | Grassland | Mesquite Hummock | Dead Riparian | Riparian |
| Uta stansburiana | Common Side-Blotched Lizard | Present | Present | Present | Present |
| Callisaurus draconoides | Zebra-Tailed Lizard | Present | Present | | |
| Cnemidophorus sp.* | Whiptail | Present | Present | | |
| Sceloporus undulatus | Eastern fence lizard | | | | Present |

| |
|---|
| *There are several species of similar lizards that require capture of adults for positive idenfications. Only juveniles were observed. |
| Nomenclature and order from Stebbins, RC 2003. A Field Guide to Western Reptiles and Amphibians. Third Ed. Boston and New York. Houghton Mifflin. |

## Mammals

Similar to the reptiles, the list of mammals observed is a small portion of what is expected in the San Simon Valley. For example, jack rabbits are prevalent along with cottontail rabbits. This small data set does however show an abundance and diversity of mice and packrats (Table 2).

*Table 2. Mammals (Kingsley 2006)*

| Table 2. Mammals (Kingsley 2006) | | | | | | |
|---|---|---|---|---|---|---|
| Numbers for rodents are the number of individuals trapped in each vegetation type, with the total number of that species trapped given in the notes section. | | | | | | |
| Scientific Name | Common Name | Grassland | Mesquite Hummock | Dead Riparian | Riparian | Notes |
| Eptesicus fuscus | Big Brown Bat | Observed flying over the site, across all vegetation types. | | | | |
| Sylvilagus auduboni | Desert Cottontail | Most frequent | Probably range across all vegetation types. | | | |
| Ammospermophilus harrisii | Harris's Antelope Squirrel | | 1 | | | n=1 |
| Dipodomys merriami | Merriam's Kangaroo Rat | 30 | 7 | 10 | 8 | n=55 |
| Reithrodontomys fulvescens | Fulvous Harvest Mouse | 1 | | | | n=1 |
| Reithrodontomys megalotis | Western Harvest Mous | 5 | | | 5 | n=10 |
| Peromyscus eremicus | Cactus Mouse | | | 1 | 11 | n=12 |
| Peromyscus leucopus | White-footed Mouse | 5 | | 1 | 3 | n=9 |
| Onychomys torridus | Southern Grasshopper Mouse | | 2 | | | n=2 |
| Sigmodon hispidus | Hispid Cotton Rat | 1 | | | 5 | n=6 |
| Neotoma albigula | Western White-throated Woodrat | | | | 3 | n=3 |

| Table 2. Mammals (Kingsley 2006) | | | | | | |
|---|---|---|---|---|---|---|
| Numbers for rodents are the number of individuals trapped in each vegetation type, with the total number of that species trapped given in the notes section. | | | | | | |
| Scientific Name | Common Name | Grassland | Mesquite Hummock | Dead Riparian | Riparian | Notes |
| Canis latrans | Coyote | Coyotes were heard at night, and probably range throughout the site, across all vegetation types. | | | | |
| Taxidea taxus | American Badger | Possible diggings observed. | Possible diggings observed. | | | A dead Badger was reported by BLM B. Robles in 1998. |
| Pecari tajacu | Collared Peccary | Tracks observed. | Tracks observed. | | Tracks observed. | |
| Nomenclature and arrangement follows: Baker, RJ; LC Bradley, RD Bradley, JW Dragoo, MD Engstrom, RS Hoffman, CA Jones, F Reid, DW Rice,and C Jones 2003. Revised checklist of North American Mammals North of Mexico, 2003. Occasional Papers of the Museum of Texas Tech University No. 229. | | | | | | |

## Birds

Kingsley (2006) data and BLM records provide a rich list of observational data from Posey Well. In addition, Hansen 2011 contributed to the list from a broader look at bird species in the San Simon Valley. Discussion of the bird data separates riparian from non-riparian species. It is important to note that Posey Well is located less than a mile from the San Simon River which runs during monsoon season (July through August) and has intermittent pockets of standing water that last a bit longer through the year. It also provides a dense and tall overstory of mesquite trees. Ninety bird species were observed at the Posey Well site. These are shown in non-riparian and riparian categories (Tables 3 and 4).

*Table 3. Posey Well Birds – Non-Riparian (54 bird species observed in 7 sample years)*

| Table 3. Posey Well Birds – Non-Riparian (54 bird species observed in 7 sample years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Kingsley | BLM | | | | | |
| | | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | 1998 |
| *Pipilo aberti* | Abert's Towhee* | 2006 | | | | | | |
| *Anthus rubescens* | American Pipit | 2006 | | | | | | |
| *Polioptila melanura* | Black-tailed Gnatcatcher* | 2006 | | | | | | |
| *Amphispiza bilineata* | Black-throated Sparrow* | 2006 | | | | 1983 | | |
| *Spizella breweri* | Brewer's Sparrow | 2006 | | | | | | |
| *Campylorhynchus brunneicapillus* | Cactus Wren* | 2006 | | | | | | |
| *Corvus cryptoleucus* | Chihuahuan Raven | 2006 | | | | | | |
| *Spizella passerina* | Chipping sparrow | 2006 | | | | | | |

| Table 3. Posey Well Birds – Non-Riparian (54 bird species observed in 7 sample years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Kingsley | BLM | | | | | |
| | | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | 1998 |
| *Sturnella magna* | Eastern Meadowlark | 2006 | | | | | | |
| *Callipepla gambelii* | Gambel's Quail* | 2006 | | | 1982 | | | |
| *Melanaerpes uropygialis* | Gila woodpecker* | 2006 | | | | | | |
| *Bubo virginianus* | Great Horned Owl | 2006 | | | | | | 1998 |
| *Icterus cucullatus* | Hooded Oriole* | 2006 | | | | | | |
| *Carpodacus mexicanus* | House Finch | 2006 | | | | | | |
| *Troglodytes aedon* | House Wren | 2006 | | | | | | |
| *Picoides scalaris* | Ladder-backed Woodpecker* | 2006 | | | | | | |
| *Carduelis psaltria* | Lesser Goldfinch | 2006 | | | | | | |
| *Chordeiles acutipennis* | Lesser Nighthawk | 2006 | | | 1982 | | | |
| *Lanius ludovicianus* | Loggerhead shrike | 2006 | 1980 | 1981 | 1982 | | | |
| *Zenaida macroura* | Mourning dove | 2006 | | 1981 | 1982 | 1983 | 1984 | |
| *Circus cyaneus* | Northern harrier | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | |
| *Stelgidopteryx serripennis* | Northern Rough-winged Swallow | 2006 | | | | | | |
| *Buteo jamaicensis* | Red-tailed hawk | 2006 | | | 1982 | | | 1998 |
| *Regulus calendula* | Ruby-Crowned Kinglet | 2006 | | | | | | |
| *Sayornis saya* | Say's Phoebe | 2006 | | | | | | |
| *Melospiza melodia* | Song Sparrow | 2006 | | | 1982 | | | |
| *Cathartes aura* | Turkey Vulture | 2006 | | 1981 | 1982 | 1983 | 1984 | |
| *Pooecetes gramineus* | Vesper Sparrow | 2006 | | 1981 | | | | |
| *Tyrannus verticalis* | Western Kingbird | 2006 | | | | 1983 | | |
| *Dendroica petechia* | Yellow Warbler | 2006 | | | | | | |
| *Dendroica coronata* | Yellow-rumped Warbler | 2006 | | | | | | |
| *Falco sparverius* | American kestrel | | | 1981 | | | | |
| *Hirundo rustica* | Barn swallow | | | | | 1983 | | |
| *Sayornis nigricans* | Black phoebe | | | | 1982 | | | |
| *Glaucidium brasilianum cactorum* | Cactus ferruginous pygmy owl | | | | | | 1984 | |
| *Accipiter cooperii* | Cooper's hawk | | | | 1982 | | 1984 | |
| *Passerella iliaca* | Fox sparrow | | | | 1982 | 1983 | | |
| *Aquila chrysaetos* | Golden Eagle | | | | | 1983 | | |

| Table 3. Posey Well Birds – Non-Riparian (54 bird species observed in 7 sample years) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Kingsley | BLM | | | | | |
| | | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | 1998 |
| *Quiscalus mexicanus* | Great-tailed grackle | | | | | 1983 | | |
| *Eremophila alpestris* | Horned lark | | | | | 1983 | | |
| *Charadrius vociferus* | Kildeer | | 1980 | 1981 | 1982 | 1983 | | |
| *Calamospiza melanocorys* | Lark bunting | | 1980 | 1981 | 1982 | | | |
| *Mimus polyglottos* | Mockingbird | | | | | 1983 | | |
| *Falco peregrinus* | Peregrine falcon | | | | 1982 | | | |
| *Phalaropus fulicarius* | Red phalarope | | | | 1982 | | | |
| *Agelaius phoeniceus* | Red-winged blackbird | | | | 1982 | 1983 | 1984 | |
| *Geococcyx californianus* | Roadrunner | | | 1981 | 1982 | 1983 | 1984 | |
| *Stelgidopteryx serripennis* | Rough-winged swallow | | | | | | 1984 | |
| *Buteo swainsoni* | Swainson's hawk | | | | 1982 | | | |
| *Tachycineta thalassina* | Violet-green swallow | | | | 1982 | 1983 | | |
| *Sturnella neglecta* | Western meadowlark | | | 1981 | 1982 | 1983 | 1984 | |
| *Catoptrophorus semipalmatus* | Willet | | | | 1982 | 1983 | | |
| *Phalaropus tricolor* | Wilson's phalarope | | | | | 1983 | | |
| *Xanthocephalus xanthocephalus* | Yellow-headed blackbird | | | | 1982 | | 1984 | |

*Table 4. Posey Well Birds – Riparian (36 bird species observed in 8 sample years)*

| Table 4. Posey Well Birds – Riparian (36 bird species observed in 8 sample years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Kingsley | BLM | | | | | | |
| | | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | 1989 | 1998 |
| *Recurvirostra americana* | American avacet | | | 1981 | | | | | |
| *Fulica americana* | American coot | | | | 1982 | | 1984 | 1989 | |
| *Anas americana* | American wigeon | | | | 1982 | 1983 | 1984 | | |
| *Chlidonias niger* | Black tern | | | | 1982 | | | | |
| *Himantopus mexicanus* | Black-necked stilt | | | | | 1983 | | | |
| *Passerina caerulea* | Blue grosbeak | | | | | | 1984 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Anas discors* | Blue-winged teal | | | | 1982 | 1983 | 1984 | | |
| *Bucephala albeola* | Buffelhead | | | | 1982 | 1983 | | | |
| *Branta canadensis* | Canada goose | | | | 1982 | | | | |
| *Aythya valisineria* | Canvasback | | | | 1982 | | 1984 | | |
| *Anas cyanoptera* | Cinnamon teal | | | | | 1983 | 1984 | | |
| *Podiceps nigricollis* | Eared grebe | | | 1981 | 1982 | 1983 | 1984 | | |
| *Sterna forsteri* | Forster's tern | | | | 1982 | | | | |
| *Anas strepera* | Gadwell | | | | 1982 | | 1984 | | |
| *Anas crecca* | Green-winged teal | | | | 1982 | | 1984 | | |
| *Larus argentatus* | Herring gull | | | | | 1983 | | | |
| *Tachybaptus dominicus* | Least grebe | | | | 1982 | | 1984 | | |
| *Aythya affinis* | Lesser scaup | | | | 1982 | 1983 | 1984 | | |
| *Cistothorus palustris* | Long-billed marsh wren | | | | | 1983 | | | |
| *Anas platyrhynchos* | Mallard | | | 1981 | 1982 | 1983 | 1984 | | |
| *Anas clypeata* | Northern shoveler | | | | 1982 | 1983 | 1984 | | |
| *Phalacrocorax brasilianus* | Olivaceous cormorant | | | | 1982 | | | | |
| *Podilymbus podiceps* | Pied-billed grebe | | | | 1982 | 1983 | 1984 | | |
| *Anas acuta* | Pintail | | | 1981 | 1982 | 1983 | 1984 | | |
| *Aythya americana* | Redhead | | | | | | 1984 | | |
| | Red-necked duck | | | | 1982 | | 1984 | | |
| *Larus delawarensis* | Ring-billed gull | | | | 1982 | 1983 | | | |
| *Oxyura jamaicensis* | Ruddy duck | | | 1981 | 1982 | 1983 | 1984 | | |
| *Grus canadensis* | Sandhill crane | | | | 1982 | | | | |
| *Egretta thula* | Snowy egret | | | 1981 | 1982 | | | | |
| *Tringa solitaria* | Solitary sandpiper | | | | 1982 | | | | |
| *Actitis macularia* | Spotted sandpiper | | | | 1982 | | | | |
| *Cygnus columbianus* | Tundra swan | | | | | | 1984 | | |
| *Pyrocephalus rubinus* | Vermilion Flycatcher | 2006 | | | | | | | |
| *Tringa incana* | Wandering tattler | | | | 1982 | | | | |
| *Plegadis chihi* | White-faced ibis | | | 1981 | 1982 | | | | |
| *Anser albifrons* | White-fronted goose | | | | 1982 | | 1984 | | |

A number of sparrow species are of conservation concern and did not show up in the available bird data. Sparrows are difficult to identify and they are frequently overlooked or misidentified. BLM was favored by Homer Hansen in 2011 to provide a half day birding expedition in the San Simon Valley. Hansen is a well-known birder from southeastern Arizona. He observed most of the sparrow species. As interesting and valuable as athe Posey Well data set is, Hansen's expertise shed light on the species that were "missing" from the data set (Cockman 2010) (Table 5).

*Table 5. Hansen Bird Data for the San Simon Valley 2011*

| Table 5. Hansen Bird Data for the San Simon Valley 2011 | | | |
|---|---|---|---|
| | | AZ PIF | NM PIF |
| *Ammodramus bairdii* | Baird's sparrow | AZ T1B | NM BC1 |
| *Aimophila botterii* | Botteri's sparrow | AZ T1B | |
| *Aimophila carpalis* | Rufous wing sparrow | AZ Focus | |
| *Aimophila cassinii* | Cassin's sparrow | AZ Focus | |
| *Ammodramus savannarum* | Grasshopper sparrow | | NM SC1 |
| *Falco femoralis* | Northern aplomado falcon | AZ T1A | NM BC1 |

## Priority Bird Species

New Mexico Partners in Flight bird species of conservation concern was referenced for priority species. We referred to the New Mexico list because it better reflects the Chihuahuan Desert and the inclusion of the influence of the Gila and San Francisco River corridors in proximity to the San Simon Valley with the Chihuahuan Desert and Mexican Highlands biomes. We also included Arizona PIF for the Mogollon Rim. Each of these biomes has sub-biome as shown in Table 6.

*Table 6. Partners in Flight Biomes Applicable to the San Simon Valley*

| Table 6. Partners in Flight Biomes Applicable to the San Simon Valley | |
|---|---|
| Chihuahuan Desert | Desert Grassland, Shrubland, Riparian |
| Mexican Highlands | Desert Grassland, Chihuahuan Desert Scrub, Riparian |
| Mogollon Rim | Coniferous Forest, Pine-oak Woodland, Pinyon-Juniper Chapparal, Sonoran Desert Scrub and Low-Elevation Riparian, |

Discussion of the Posey Well bird data will be viewed by years. In 2006 the pond was drained for restoration work and only two riparian bird species were observed. During the years 1980-1998 (six sample years) the pond had variable amounts of water (up to 4 surface acres in the early 1980s to less than ¼ acre in the late 1990s).

## 1980-1998 With Riparian Habitat

Unexpected bird sightings do occur in the San Simon Valley. Uncommon visitors such as Snowy egrets and Tundra swans make an appearance. Although not frequent, and perhaps blown off of their normal flyways by storm events, the San Simon Valley is an important stop over for rest and even small ponds like Posey Well can provide a resting place. From the combined bird observation data 1980-1998 at

Posey Well, 72 bird species were observed. Among these 53% were riparian. Priority birds were present: 17% from the riparian category, 15% classified by AZ PIF and 8% classified by NM PIF (Cockman 2010). Priority riparian bird species are shown in Table 7. Priority non-riparian bird species are shown in Table 8.

*Table 7. Posey Well Riparian Species 1980-1998 (7 Sample Years)*

| Table 7. Posey Well Riparian Species 1980-1998 (7 Sample Years) | | | |
|---|---|---|---|
| Priority and Most Frequent Among 38 Riparian Species | | | |
| | | PIF Status | |
| | No. Years Observed | NM | AZ |
| American avocet | 1 | | T1c |
| American coot | 3 | | |
| American wigeon | 3 | | T1c |
| Blue-winged teal | 3 | | T1c |
| Lesser scaup | 3 | | |
| Northern shoveler | 3 | | T1c |
| Pied-billed grebe | 3 | | |
| Eared grebe | 4 | SC2 | T1c |
| Mallard | 4 | | |
| Pintail | 4 | | |
| Ruddy duck | 4 | | |
| Snowy egret | 2 | BC2 | T1b |
| Canvasback | 2 | | T1c |
| Canada goose | 1 | | T1c |

*Table 8. Posey Well Non-Riparian Species 1980-1989 (6 Sample Years)*

| Table 8. Posey Well Non-Riparian Species 1980-1989 (6 Sample Years) | | |
|---|---|---|
| Priority and Most Frequent Bird Observations Among 23 Non-riparian Species | | |
| | No. Years Observed | Status |
| Lark bunting | 3 | |
| Red-winged blackbird | 3 | |
| Kildeer | 4 | |
| Roadrunner | 4 | |
| Western meadowlark | 4 | |
| Cactus ferruginous pygmy owl | 1 | AZ T1a |
| Golden eagle | 1 | NM BC2 |
| Peregrine falcon | 1 | NM BC1 |
| Swainson’s hawk | 1 | NM SC2 |

## 2006 Posey Well Bird Data

In 2006 water to the Posey Well pond had been shut off to dry the site out for habitat restoration activities. There was only a small trickle of water running from the well. Among 54 bird species observed, only two are considered riparian (American pipet and Vermillion flycatcher). Posey Well is about ¾ mile from the San Simon River where water is ephemeral or interrupted throughout the year except during monsoon season (July through August). Among the 54 bird species observed, 10% were Arizona priority species and 22% New Mexico priority species. The 2006 priority bird species are shown in Table 9.

*Table 9. Posey Well Birds 2006 Priority Species*

| Table 9. Posey Well Birds 2006 Priority Species | | | |
|---|---|---|---|
| | NM Priority | NM PIF | AZ Priority |
| Abert's towhee | BC1 | NM | |
| American pipet | | | T1C |
| Black-tailed gnatcatcher | | NM | |
| Black-throat sparrow | SC2 | | |
| Cactus wren | | NM | |
| Gambel's quail | | NM | |
| Gila woodpecker | BC2 | NM | |
| Hooded oriole | BC2 | NM | |
| Ladder-backed woodpecker | | | |
| Loggerhead shrike | SC2 | | |
| Northern harrier | BC2 | | T1c |
| Ruby-crowned kinglet | | | T1c |
| Vesper sparrow | SC2 | | |

## Bird Habitats

It is important to note that small locations like Posey Well may be supporting birds that frequent more than one habitat type. The contributions made to provide refuge habitat reach beyond the local pond. Priority bird species observed at Posey Well are shown with the number of habitat types they represent in Table 10.

*Table 10. Posey Well 2006 Priority Bird Species and Their Habitats*

| Table 10. Posey Well 2006 Priority Bird Species and Their Habitats | | |
|---|---|---|
| AZ/NM Status | Species | No. PIF Habitat Types |
| NM BC1 | Abert's towhee | 3 |
| NM PIF | Black-tailed gnatcatcher | 2 |
| NM SC2 | Black-throat sparrow | 4 |
| NM PIF | Cactus wren | 1 |
| NM PIF | Gambell's quail | 2 |
| NM BC2 | Gila woodpecker | 2 |

| | | |
|---|---|---|
| NM BC2 | Hooded oriole | 4 |
| NM PIF | Ladder-backed woodpecker | 1 |
| NM SC2 | Loggerhead shrike | 6 |
| NM BC2 | Northern harrier | 3 |
| NM SC2 | Vesper sparrow | 5 |
| AZ T1C | Ruby-crowned kinglet | 3 |
| AZ T1C | American Pipet | 1 |

Similarly bird observations at Posey Well in 2006 were cross-walked with the PIF regions from which they are associated. Table 11 lists Arizona priorities and Table 12 lists New Mexico priorities.

*Table 11. Arizona Habitats Related to 2006 Priority Species*

| Table 11. Arizona Habitats Related to 2006 Priority Species | | |
|---|---|---|
| No. Bird Species | Region | Habitat |
| 1 | Chihuahuan Desert | Shrubland |
| 7 | Mexican Highland | Chihuahuan Desert Scrub |
| 2 | Mexican Highland | Desert Grassland |
| 2 | Mexican Highland | Riparian |
| 1 | Mogollon Rim | Coniferous Forest |
| 2 | Mogollon Rim | Sonoran Desert Scrub and Low Elevation Riparian |

*Table 12. New Mexico Habitats Related to 2006 Priority Species*

| Table 12. New Mexico Habitats Related to 2006 Priority Species | | | |
|---|---|---|---|
| No. Bird Species | NM PIF Habitats | No. Bird Species | NM PIF Habitats |
| 2 | Agriculture | 1 | Mixed Conifer Forest |
| 1 | Alpine Tundra | 1 | Pinyon-Juniper |
| 3 | Chihuahuan Desert Grassland | 4 | Plains-Mesa Grassland |
| 4 | Chihuahuan Desert Shrub | 3 | Plains-Mesa Sand shrub |
| 1 | Cliff/Cave | 1 | Ponderosa Pine Forest |
| 1 | Emergent Wetlands and Lakes | 1 | Spruce Fir Forest |
| 4 | Great Basin Shrub | 3 | SW Riparian |
| 1 | Middle Elev Riparian | 1 | Meadow/Montane Grassland |

It is obvious from Tables 11 and 12 that the states of Arizona and New Mexico have different strategies to prioritize species of concern. Bird priority status between the two states is examined in Table 13.

*Table 13. Criteria for Bird Priority Status*

| Table 13. Criteria for Bird Priority Status | |
|---|---|
| New Mexico | Arizona |
| Species and biodiversity conservation levels | Legal requirements, protection |

| | |
|---|---|
| Importance to NM breeding birds | Interagency stakeholders |
| Breeding threats | Funding |
| Local population trends | Does not correspond with other States' listings |

## Posey Well Birds of Prey

Birds of prey, also known as raptors, are protected by federal and state laws in the United States. These laws prohibit the capture, killing, or possession of raptors, or any parts of them, without proper permits. Some laws that protect birds of prey include:

Migratory Bird Treaty Act: Makes it illegal to kill or possess any native migratory bird or its parts

Bald Eagle Act: Makes it illegal to kill or disturb bald eagles, golden eagles, their nests, or their trees

Endangered Species Act: Protects species that are endangered or threatened

From the Posey Well data set spanning eight years (1980-2011) we see that there are several birds of prey that frequent the area (Table 14). The Northern Aplomado falcon is ESA listed as Endangered and Experimental non-essential. It is known from both Cochise County, Arizona and Hidalgo County, New Mexico.

The Cactus ferruginous pygmy owl is listed under the ESA as threatened where ever found. Its historical range included Arizona and Texas. According to USFWS it occurs in Graham and Cochise County, Arizona and is more common around the Tucson to Phoenix to Yuma triangle in the Sonoran Desert.

The Peregrine falcon was previously listed in 1970 and was delisted due to recovery of the species in 1999. Its historical range included much of the US extending from Alaska to Arizona and California to District of Columbia.

*Table 14. Posey Well Birds of Prey*

| Table 14. Posey Well Birds of Prey | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | 1998 | 2011 |
| *Falco sparverius* | American kestrel | | | 1981 | | | | | |
| *Falco femoralis septentrionalis* | Northern Aplomado falcon | | | | | | | | 2011 |
| *Glaucidium brasilianum cactorum* | Cactus ferruginous pygmy owl | | | | | | 1984 | | |
| *Accipiter cooperii* | Cooper's hawk | | | | 1982 | | 1984 | | |
| *Aquila chrysaetos* | Golden Eagle | | | | | 1983 | | | |
| *Circus cyaneus* | Northern harrier | 2006 | 1980 | 1981 | 1982 | 1983 | 1984 | | |
| *Falco peregrinus* | Peregrine falcon | | | | 1982 | | | | |
| *Buteo jamaicensis* | Red-tailed hawk | 2006 | | | 1982 | | | 1998 | |
| *Buteo swainsoni* | Swainson's hawk | | | | 1982 | | | | |
| *Cathartes aura* | Turkey Vulture | 2006 | | 1981 | 1982 | 1983 | 1984 | | |

### Migratory Birds

The Migratory Bird Treaty Act (MBTA) protects many birds, including:

Ducks, Flamingos, Grebes, Doves, Cuckoos, Swifts, Cranes, Shorebirds, Tropicbirds, and California Condor.

The MBTA protects all native North American birds, as well as species that were reintroduced to the United States after becoming extirpated. The MBTA does not protect non-native species, such as the European Starling and House Sparrow, or hunted birds, such as ducks, geese, and doves (All About Birds).

## Lessons Learned from the Posey Well Project

Conducting habitat restoration in remote areas has the challenge of unattended properties. It is important to know the local community and their perspective. Are they generally supportive of habitat restoration projects? Do they seek out remote locations (how frequently will the site be visited by the public)? Do they respect signage? Do they respect native species or do they prefer introduced species (both plants and wildlife)? Do they practice "leave no trace."

Many waters in the San Simon Valley are from developed sources. The predominant native vegetation is grassland and shrubland. However, trees and vertical structure are important for many bird species. Identify native trees and shrubs that will thrive in harsh conditions (saline, alkaline, sporadic water).

Regional water demands are increasing while the water table is dropping. Artesian wells that thrived prior to 1980 are now challenged by regional competition. Undestand when and where to drill deeper, if at all. The water table at Posey Well and throughout the San Simon Valley has dropped several hundred feet since the 1990s due to increased consumption, primarily from orchard development. It is no longer practical for BLM to refresh wildlife waters that were supported by artesian wells.

Trespass livestock is a continual nuisance where habitat restoration projects are underway. The maintenance and construction of exclosures to keep livestock out is necessary. It may be necessary to provide livestock water on the outside of the exclosure at the expense of the project. Encourage partnership with the livestock grazing permittee.

Security cameras may be needed in addition to wildlife cameras. The BLM has experienced vandalism of wildlife infrastructure at developed waters such as shooting at bat houses and the contamination of native fish waters with bait buckets of invasive species.

Maintenance of invasive species is a challenge. Once water is present and available the persistence of bull frogs (*Lithobates catesbeianus*) are frequently an issue. Male bull frogs can travel up to a mile between water sources and have been documented as moving 159 m (0.1 mile) in one night(Degenhardt et al. 1996). Eradication and maintenance of salt cedar has been a challenge. Although the salt cedar beetle (*Diorhabda sp*.) has entered the Gila River and has been documented near the mouth of the San Simon Valley (Rivers Edge West 2020). There is much work for the beetle to do in removing Salt cedar. As Salt cedar defoliation progresses, land managers need to determine how they will deal with the piles of deadwood.

When reconstructing a wetland area that has been dried out for operations acitvities, the native species relocate. As soon as the water is returned, they "magically" reappear. Native frogs, toads and turtles will benefit from swampers to work with heavy equipment and clear the way.

Long term maintenance is necessary at the habitat restoration sites. Calculate this into the project cost. Don't depend on existing work crews such as BLM Force Account to have time in their schedules. Look for shared opportunites ahead of time such as the use of school groups, summer interns and community service groups. Arbitrarily, calculate so many FTEs for BLM labor into the long term maintenance schedule.

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# APPENDIX E – WILDLIFE DOCUMENTED AT LORDSBURG PLAYA AUGUST – DECEMBER 2024

[Document subtitle]


Abstract

A wildlife survey was conducted with the bounds of Lordsburg Playa in the Alkali Flats area August through December 2024. Focus of the survey was primarily on aquatic species and flying insects. Other species observed were included.



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| Wildlife Photo-documented Within the Lordsburg Playa, Alkali Flats Area: August – December 2024<br>Jim VonLoh<br>* The status column information is from NatureServe (Global/State Conservation Status Ranks) | | | | |
|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| **Chelicerates** | Thin-legged Wolf Spider / *Pardosa* sp. | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Several individuals present foraging on water surface and shoreline |
| | Thin-legged Wolf Spider / *Pardosa* sp. | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 An individual captured a rough harvester ant consuming it on the water surface |
| | Crab Spider / Thomisidae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 An individual hiding in an aster flower where a marine blue was nectaring |
| **Crustaceans** | Clam Shrimp / Limnadiidae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Tiny, pinkish, occasionally surfaced from the cloudy water, most are carrying eggs under their dorsal carapace |
| **Insects** | | | | |

| Wildlife Photo-documented Within the Lordsburg Playa, Alkali Flats Area: August – December 2024<br>Jim VonLoh<br>* The status column information is from NatureServe (Global/State Conservation Status Ranks) | | | | |
|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| Zygentoma | Firebrat / *Thermobia domestica* Packard, 1873 | … | Alkali Flats West of the SH338 Exit, former ponded area along the abandoned SH80 roadbed | 09/23/24 A few individuals beneath a lost/discarded ~20”x20” mat using the cracks in the adobe surface underneath as habitat; there were many carcasses of harvester ants that may have provided a food base for these silverfish |
| Coleoptera | Predaceous Diving Beetles / Dytiscidae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 In sediment-laden water, surfacing to breathe/forage |
| | Soft-wing Flower Beetle / Dasytinae | … | Alkali Flats West of Fraggle Rock/Gary Exit | 08/25/24 Individuals foraging among cowpen daisy flowers and pedicels |
| | Spotless Lady Beetle / *Cycloneda sanguinea* Linnaeus, 1763 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging on a subshrub growing near a wet depression; 09/15/24 Individual hiding below an aster flower while foraging from the pedicel, along the ditch |

| Wildlife Photo-documented Within the Lordsburg Playa, Alkali Flats Area: August – December 2024<br>Jim VonLoh<br>* The status column information is from NatureServe (Global/State Conservation Status Ranks) | | | | |
|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Convergent Lady Beetle / *Hippodamia convergens* Guerin-Meneville, 1842 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 Several of them were foraging from aster stems and flowers, along the ditch; 10/13/24 Several were foraging among aster flowers and two pairs were mating |
| | Metallic Woodboring Beetle / *Aemaeodera* sp. Eschscholtz, 1829 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging from cowpen daisy flowers |
| | Soldier Beetle / *Chauliognathus omissus* Fall, 1930 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; Alkali Flats West of Fraggle Rock/Gary Exit | 09/08/24; Individual blown from perch on aster flower onto the ditch water surface where drowned; 09/15/24 Several individuals foraging from yellow asterid flowers |
| | Double-banded Bycid / *Sphaenothecus bilineatus* Gory, 1831 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/15/24 Individual foraging from yellow asterid flowers |

| **Wildlife Photo-documented Within the Lordsburg Playa, Alkali Flats Area: August – December 2024**<br>**Jim VonLoh**<br>*** The status column information is from NatureServe (Global/State Conservation Status Ranks)** | | | | |
|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| Tiger Beetle | Ocellated Tiger Beetle / *Cicindela ocellata* Klug, 1834 | G5/… | New Tank, a short distance from Summit Road and north of I-10 at Steins exit; Alkali Flats transition to gravelly uplands | 09/23/24 Mating pair perched on moist soil at the edge of a cow's footprint |
| | Carolina Metallic Tiger Beetle / *Tetracha carolina* Linnaeus, 1763 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 10/13/24 An individual was foraging on cracking but slickly muddy surface adjacent to water in the small ditch |
| Melon Beetle | Checkered Melon Beetle / *Paranapiacaba tricincta* Say, 1824 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 Two were foraging from aster stems and flowers, along the ditch |
| Diptera | Acalyptrate Flies / Acalyptratae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual landed on water surface |

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|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Hydrophorini / *Hydrophorus* sp. Fallen, 1823 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 A few individuals landed on water surface to forage; 09/08/24; Many individuals landed on water surface to forage; 09/15/24 A few individuals landed on water surface to forage; 09/29/24 Many landed on the water surface to hunt and a few were captured from the ditch by variegated meadowhawks; 10/13/24 Several were foraging on/among floating mats of aster seeds on the diminished water surface in the small ditch. |
| | Bot Flies, Blow Flies, and Allies / Unidentified | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual on aster flower stem, foraging for nutrients; 09/08/24 Individual tachinid fly perched on and foraging from aster flowers along the ditch |
| Drone Fly | Yellow-shouldered Drone Fly / *Eristalis stipator* Osten Sacken, 1877 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/01/24 Individual on aster flower, foraging for nutrients |

| **Wildlife Photo-documented Within the Lordsburg Playa, Alkali Flats Area: August – December 2024**<br>**Jim VonLoh**<br>*** The status column information is from NatureServe (Global/State Conservation Status Ranks)** | | | | |
|---|---|---|---|---|
| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| Hoverfly | Maize Calligrapher / *Toxomerus politus* Say, 1823 | G5/… | South Alkali Flats Duckpond; in the muddy ditch, covered by thick aster seeds layer, along the SH338 off-ramp from I-10 | 10/13/24 An individual was documented foraging on aster seed mat (folder with 4 images lost to computer error after opening to conduct identification) |
| Beefly | Villa Beefly / *Lepidanthrax* sp. Osten Sacken, 1886 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual warming on a twig perch at ground level |
| | Lordotus Beefly / *Lordotus* sp. Hubner, 1822 | … | Alkali Flat West of Fraggle Rock/Gary Exit | 09/15/24 Individual foraging from yellow asterid flowers |
| | Banded Beefly / *Poecilanthrax arethusa* Osten Sacken, 1886 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 Many of them perched on the ground sheltering from the wind, warming in the sun, and also foraging from aster flowers |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Banded Beefly / *Poecilanthrax californicus* Cole, 1917 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 Many of them perched on the ground sheltering from the wind, warming in the sun, and also foraging from aster flowers |
| | Beefly / *Anastoechus* sp. Osten Sacken, 1877 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 One foraged from an aster flower along the ditch |
| Fruit Fly | Fruit Fly / *Euarestoides acutangulus* Thomson, 1869 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 One sheltered from the wind within dense aster branches along the ditch |
| **Hemiptera** | | | | |
| Assassin Bug | Leafhopper Assassin Bug / *Zelus renardii* Kolenati, 1856 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 On aster flower bud, apparently stalking a nectaring marine blue |

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| Seed Bug | Redcoat Seed Bug / *Melanopleurus belfragei* Stal, 1874 | … | Alkali Flat West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging from horsetail milkweed flowers located in a small depression that retains rainwater |
| | False Chinch Bug / *Nysius* sp. Dallas, 1852 | … | Alkali Flat North of SH338 interchange with I-10 along abandoned SH80 roadbed | 10/13/24 A few individuals foraged from aster flowers along with a mating pair |
| **Hymenoptera** | | | | |
| Apidae | Squash Longhorn-cuckoo / *Triepeolus remigatus* Fabricius, 1804 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual foraging from aster flower; two unknown small, brown flower beetles also present |
| | Carpenter Bee / *Xylocopa* sp. Latreille, 1802 | … | Alkali Flats West of Fraggle Rock/Gary Exit and near Summit Road north of Steins interchange on I-10 | 09/08/24 Two females foraging from cowpen daisy flowers in arroyo; 09/23/24 A few females foraged from Mulesfat baccharis flowers in a drying stock tank along Summit Road |

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| Halictidae | Striped Sweat Bee / *Agapostemon* sp. Guerin-Meneville, 1844 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 08/25/24 Individual foraging from cowpen daisy flowers in arroyo |
| | Honey-tailed Striped Sweat Bee / *Agapostemon melliventris* Cresson, 1874 | G5/… | South Alkali Flats Duckpond; at the fence line in the nearly dry ditch along the SH338 off-ramp from I-10 | 10/13/24 Foraging from aster flowers opened along the ditch |
| | Silky Striped Sweat Bee / *Agapostemon sericeus* Forster, 1771 | G5/… | South Alkali Flats Duckpond; at the fence line in the nearly dry ditch along the SH338 off-ramp from I-10 | 10/13/24 Foraging from aster flowers opened along the ditch |
| Apine Bees | Longhorn Bees / Eucerini Latreille, 1802 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 08/25/24 Individual Foraging from cowpen daisy flowers in arroyo |

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| | Common Longhorn Bee / *Melissodes communis* Cresson, 1878 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/23/24 Individual foraging from aster flowers along the full ditch; 10/13/24 Individual foraging from aster flowers along the diminished water of the ditch |
| | Western Honey Bee / *Apis mellifera* Linnaeus 1758 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 Many of these bees foraging from aster flowers along the pond and ditch; 09/23/24 Several foraged from aster flowers along the pond and ditch and where asters have established adjacent to abandoned SH-80; 09/29/24 A few were foraging on aster flowers along the ditch |
| | Rough Harvester Ant / Pogonomyrex rugosus Emery, 1895 | | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; West of Fraggle Rock/Gary Exit | O8/25/24 Individual as prey captured by a small wolf spider and consumed on the water; 09/01/24 Foraging on bare ground among annual plant seedlings; 09/08/24 Individual with scavenged green lacewing carcass, carries it to the nest; 09/23/24 An active mound was observed on Alkali Flats north of the railroad tracks |

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| Vespidae | Arizona Spider Wasp / *Notocyphus dorsalis* Cresson, 1872 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging from horsetail milkweed flowers located in a small depression that retains rainwater |
| | New World Tarantula-hawk Wasp / *Pepsis grossa* Fabricius, 1798 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/08/24 Foraging from horsetail milkweed flowers located in a small depression that retains rainwater; 10/13/24 Two landed on the shoreline of the pond and briefly explored/foraged from the cracked mud |
| | Mexican Tarantula-hawk Wasp / *Pepsis mexicana* Lucas, 1895 | … | | 09/23/24 A few foraged from mulesfat baccharis flowers growing in a drying stock tank adjacent to Summit Road |
| | Tarantula-hawk Wasp / *Hemipepsis* sp. | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging from matchweed/snakeweed subshrubs growing around a small depression that retains rainwater; 09/23/24 Individual foraging from aster flowers along the abandoned SH-80 roadbed |

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| | Great Black Wasp / *Sphex pensylvanicus* Linnaeus, 1763 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual foraging from matchweed/snakeweed subshrubs growing around a small depression that retains rainwater; 09/08/24 Foraging from horsetail milkweed flowers located in a small depression that retains rainwater |
| | Fire-tailed Scoliid Wasp / *Triscolia ardens* Smith, 1855 | … | Alkali Flats West of Fraggle Rock/Gary Exit; South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/08/24; Two of them foraging from horsetail milkweed and cowpen daisy flowers, located in a small depression that retains rainwater (along SH80); 09/15/24 Two of them foraged from aster flowers along the ditch; 09/23/24 Several foraged from mulesfat baccharis flowers growing in a drying stock tank adjacent to Summit Road |
| | Yellow Paper Wasp / *Polistes aurifer* Saussure, 1853 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/23/24 A few foraged from mulesfat baccharis flowers growing in a drying stock tank adjacent to Summit Road; 09/29/24 An individual foraged among aster flowers along the ditch |

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| | Thread-waisted Wasp / *Prionyx atratus* Lepeletier de Saint Fargeau, 1845 | … | New Tank, a short distance from Summit Road and north of I-10 at Steins exit; Alkali Flats transition to gravelly uplands | 09/23/24 An individual landed on dried mud to forage around cattle tracks |
| | Yellow-legged Mud-dauber / *Sceliphron caementarium* Drury, 1773 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 An individual foraged from old aster flowers along the ditch and another collected mud from the ditchbank |
| | Apoidean Wasp / *Clypeadon* sp. Patton, 1897 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Foraging from horsetail milkweed flowers located in a small depression that retains rainwater |
| | Potter and Mason Wasps / Eumeninae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual foraging from aster leaves along ditch |
| | Square-headed Wasps, Sandwasps, and Allies / Crabronidae | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual blown onto water surface by wind gust and succumbed |

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| | Ichneumonid Wasp / *Compocrystus texensis* Townes, 1962 | … | South Alkali Flats Duckpond; in the muddy ditch bottom along the SH338 off-ramp from I-10 | 10/13/24 A male and female foraged on the cracking, muddy ditch bottom, which had collected a carpet of aster seeds |
| | Digger Wasp Den | … | Alkali Flats West of Fraggle Rock/Gary Exit; edge of SH80 roadbed | 09/08/24 Large hole and surrounding mound forming small crater ~15cm in diameter |
| Neuroptera | Antlion / *Brachynemurus* sp. Hagen, 1888 | … | Alkali Flats West of Fraggle Rock/Gary Exit | 09/01/24 Individual, blurred image, perched in a stand of spikerush growing in a wet pit along SH80 of Alkali Flat |
| | Green Lacewing / Chrysopidae | … | | 09/08/24 A few had blown to the water and mud surfaces and succumbed, they become organic material for scavengers |
| **Lepidoptera** | Butterflies and Moths | | | |
| Papilionidae | Black Swallowtail / *Papilio polyxenes* Fabricius, 1775 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch |

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| | Pipevine Swallowtail / *Battus philenor* Linnaeus, 1771 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 A few nectared from aster flowers along the ditch; 09/23/24 One nectared from aster flowers growing along the abandoned SH-80 roadbed |
| Pierinae | Checkered White / *Pontia protodice* Boisduval & Leconte, 1830 | G4/… | Alkali Flat West of Fraggle Rock/Gary Exit and at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individual nectaring from cowpen daisy flowers in arroyo; 09/15/24 Two nectared from cowpen daisy flowers along SH-80 and aster flowers along the ditch; 09/23/24 Several migrated throughout the site, nectared from aster flowers, and 'puddled' in the wet mud |
| Coliadinae | Orange Sulphur / *Colias eurytheme* Boisduval, 1852 | G4/… | Alkali Flat West of Fraggle Rock/Gary Exit; South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individuals nectaring from cowpen daisy flowers in arroyo; 09/01/24 Avoiding strong wind at ground level between dense plant stands; 09/08/24 Hindwing was lying on the mud along with smaller wings – likely eaten by a dragonfly; 09/15/24 An individual nectared from aster flowers along the ditch; 09/23/24 A few nectared from aster flowers, and 'puddled' in the wet mud |

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| | Sleepy Orange / *Eurema nicippe* Cramer, 1779 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit; South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individuals nectaring from morning-glory flowers and flying across the landscape; 09/15/24 Several nectared from aster flowers along the pond and ditch; 09/23/24 Several migrated throughout the site, nectared from aster flowers, and 'puddled' in the wet mud; 09/29/24 Several migrated throughout the site, nectared from aster flowers, and 'puddled' in the wet mud; 10/13/24 Two nectared from the few remaining aster flowers along the SH338 ditch and warmed in the sun perching on tamarisk branches |
| | Tailed Orange/ *Eurema proterpia* Fabricius, 1775 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch; 09/23/24 Two nectared from aster flowers along the ditch |
| | Cloudless Sulphur / *Phoebis sennae* Linnaeus, 1758 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 Several nectared from aster flowers along the pond and ditch |

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| | Marcellina Sulphur / *Phoebis marcellina* Cramer, 1779 | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 Several nectared from aster flowers along the pond and ditch; 09/23/24 One nectared from aster flowers along the ditch |
| | Dainty Sulphur / *Nathalis iole* Boisduval, 1836 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit | 09/15/24 Three of them nectared from thimble-head flowers growing at SH80 roadside where an arroyo ponds against the berm |
| | Mexican Yellow / *Eurema mexicana* Boisduval, 1836 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch |
| | Southern Dogface / *Zerene cesonia* Stoll, 1790 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch |
| Theclinae | Gray Hairstreak / *Strymon melinus* Hubner, 1818 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit; South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 Individual nectaring from thimble-head flowers growing at SH80 roadside where an arroyo ponds against the berm; 10/13/24 Two nectaring from aster flowers along the ditch |

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| | Great Purple Hairstreak / *Atlides halesus* Cramer, 1777 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit | 09/15/24 Individual nectaring from thimble-head flowers growing at SH80 roadside where an arroyo ponds against the berm |
| Polyommatinae | Marine Blue / *Leptotes marina* Reakirt, 1868 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; Alkali Flat West of Fraggle Rock/Gary Exit | 08/25/24 Individual nectaring from aster flowers along ditch; 09/23/24 Individual nectared from aster flowers along the ditch; 09/29/24 Two nectaring from aster flowers along ditch |
| | Reakirt's Blue / *Echinargus isola* Reakirt, 1867 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/29/24 Individual nectaring from aster flowers along ditch |

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| | Western Pygmy Blue / *Brephidium exilis* Boisduval, 1852 | G4/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Individuals perched on dry stems to warm and display for mates; 09/08/24 A few nectared from aster flowers along the ditch; 09/15/24 A few nectared from aster flowers along the ditch; 09/23/24 A few nectared from aster and muesfat baccharis flowers as available along the SH338 offraamp ditch and stock tanks along Summit Road; 09/29/24 Several used the dense stands of asters for protection from the wind, rarely nectaring; 10/13/24 The most common butterfly observed during this session, nectared from the few remaining aster flowers along the SH338 ditch and along the pool sites between I-10 and the abandoned SH80 roadbed |
| Pyrginae | White Checkered-skipper / *Burnsius albezens* Grishin, 2022 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit and South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp | 08/25/24 Individual nectaring from cowpen daisy flowers in arroyo; 09/15/24 One in arroyo nectaring from thimble-head flowers; 09/29/24 A few of them nectared from aster flowers |
| | Common Checkered-skipper / *Burnsius communis* Grote, 1872 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp | 09/29/24 A few of them nectared from aster flowers; 10/13/24 Individual nectared from the few remaining aster flowers along the SH338 ditch |

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| | Eufala Skipper / *Lerodea eufala* Edwards, 1869 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp | 09/29/24 One nectared from aster flowers |
| Libytheinae | American Snout / *Libytheana carinenta* Cramer, 1777 | G5/… | South Alkali Flat Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; Alkali Flat West of Fraggle Rock/Gary Exit | 08/25/24 Individuals perched among aster stems and nectaring from cowpen daisy flowers and Russian-thistle in arroyo; 09/15/24 Many individuals nectared from aster flowers along the pond and ditch, one pair exhibited courtship behavior; small butterflies they often hid in aster and alkali sacaton clumps to avoid the wind; 09/23/24 As described above, a common species; 09/29/24 As described above, a common species; 10/13/24 Three hid among leaves and stems and nectared from the few remaining aster flowers along the SH338 ditch |
| Danainae | Queen / *Danaus gilippis* Cramer, 1775 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 A few of them nectared from aster flowers along the pond and ditch; 09/23/24 A few nectared from aster flowers along the SH338 ditch and the abandoned I-80 roadbed; 09/29/24 As described above, a common large species |

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| | Monarch / *Danaus plexippus* Linnaeus, 1758 | G4/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/23/24 An individual nectared from aster flowers along the ditchbank |
| Heliconiinae | Variegated Fritillary / *Euptoieta claudia* Cramer, 1775 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; Alkali Flats West of Fraggle Rock/Gary Exit | 08/25/24 An individual puddling on moist soil at pond edge; 09/15/24 Two of them nectared from aster flowers along the ditch; 09/23/24; A few individuals sheltered from the wind and warmed in the sun, 'puddled' in wet mud, or nectared from aster flowers along the SH338 ditch and SH-80 roadbed; 09/29/24 As described above for this common species; 10/13/24 Two nectared from the few open aster flowers along the SH338 ditch |
| Nymphalidae | Gray Buckeye / *Junonia grisea* Austin & Emmel, 1998 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch in the early afternoon; 09/23/24 An individual nectared from aster flowers along the ditch, late afternoon |

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| | Bordered Patch / *Chlosyne lacinia* Geyer, 1837 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; New Tank along Summit Road north of Steins | 09/15/24 A few of them nectared from aster flowers along the pond and ditch; 09/23/24 An individual perched among cocklebur leaves at New Tank, east of Summit Road (CR A012) north of Steins |
| | Painted Lady / *Vanessa cardui* Linnaeus, 1758 | G4/… | Alkali Flats West of the I-10/SH338 Exit, former ponded area along the abandoned SH80 roadbed; South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/23/24 An individual nectared from aster flowers along abandoned SH80 west of the SH338 and I-10 interchange; an individual nectared from aster flowers along the water-filled ditch along SH338 off-ramp from I-10 |
| | Lady / *Vanessa* sp. | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers along the ditch and flew as I approached |
| | Tiny Checkerspot / *Microtia dymas chara* W. H. Edwards, 1884 | G5/… | New Tank, a short distance from Summit Road and north of I-10 at Steins exit; Alkali Flats transition to gravelly uplands | 09/23/24 An individual landed to avoid wind and sun on recently dried mud at a stock pond |

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| Sphingidae | White-lined Sphinx / *Hyles lineata* Fabricius, 1775 | G5 | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 An individual nectared from aster flowers then flew to cover out of the wind, another hovered to take water from the ditch (was blown onto the water by a wind gust, then struggled to escape from drowning) |
| | Corn Earworm / *Helicoverpa zea* Boddie, 1850 | G5/... | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp | 09/29/24 One nectared from aster flowers while the other ‘puddled’ for nutrients from wet mud |
| Crambidae | Garden Webworm Moth / *Achyra rantalis* Guenee, 1854 | NSR/... | Alkali Flats, north of Steins on Summit Road near New Tank | 09/23/24 Individual foraging from yellow asterid shrub flowers adjacent to the road |
| **Odonata** | | | | |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| Anisoptera | Variegated Meadowhawk / *Sympetrum corruptum* Hagen, 1861 | G5/… | Alkali Flats, in general (on 08/01/24) and South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; and Alkali Flats West of Fraggle Rock/Gary Exit other dates | 08/01/24; 09/01/24 Migrating in numbers throughout the area, foraging from local habitats (upland and wetland), and one pair in tandem linkage over water at the Duckpond site were observed; 09/15/24 Between 5-10 individuals, mostly males, perched on twigs and on the barbed wire fence to capture small insects among and over the aster stand; 09/29/24 From 25-50 individuals, mostly females perched on twigs and the barbed wire fence to capture small insects that were airborne or foraging among aster flowers – one mating pair was observed; 10/13/24 From 10-20 individuals, mostly females perched on aster stems to spend the night and warm in the morning light, used twigs and the barbed wire fence to perch and capture small insects that were airborne or foraging among aster flowers – one mating pair was observed |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| Zygoptera | Familiar Bluet / *Enallagma civile* Hagen, 1861 | G5/… | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Two females hunting among aster plants; 09/01/24 One male perched and hunting over water and one female hunting among aster plants; 09/08/24 An individual male perched on an aster flower bud to avoid the wind while hunting for small flying insects over the ditch near SH338 |
| Orthoptera | Grasshopper Larval Instar / Unknown Shorthorn Grasshopper | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 08/25/24 Visual only, blown onto water surface |
| Acrididae | Pallid-winged Grasshopper / *Trimerotropis pallidipennis* Burmeister, 1838 | G5/… | Alkali Flat West of Fraggle Rock/Gary Exit I-10; South Alkali Flats Duckpond | 09/01/24 Many individuals along the old highway; this species was common throughout the September survey time period in most vegetated habitats visited; 10/13/24 A few sunning near the Duckpond and along the ditch (present in the Alkali Flats from summer through early fall) |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Devastating Grasshopper / *Melanoplus devastator* Scudder, 1878 | G5/… | Alkali Flat west of SH338 exit from I-10, on the former SH80 road surface | 09/23/24 An individual landed to sun on the abandoned SH80 road surface |
| **Amphibia** | Toad Larvae (Tadpoles) / Species Unknown | | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; New Tank, a short distance from Summit Road and north of I-10 at Steins exit; Alkali Flats transition to gravelly uplands | 08/25/24 Individuals in fence line ditch cloudy water, occasionally surfacing to collect air (likely a spadefoot species); 09/23/24 tadpoles with many transitioned to juvenile Mexican spadefoot on adjacent muddy sites |
| | Mexican Spadefoot or New Mexico Spadefoot Toad / *Spea multiplicata* Cope, 1863 | G5/S5 | New Tank, a short distance from Summit Road and north of I-10 at Steins exit; Alkali Flats transition to gravelly uplands | 09/23/24 Many juveniles with long tails, recently emerged from New Tank and were foraging/hiding on the bank in moist mud |
| **Reptilia** | Plateau Striped Whiptail / *Aspidoscelis velox* Springer, 1928 | G5/S5 | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10; Alkali Flat West of Fraggle Rock/Gary Exit I-10 | 08/25/24 One adult, one juvenile hunting among aster plants and alkali sacaton clumps; 09/01/24, two adults; 09/08/24 one adult |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Common Side-blotched Lizard / *Uta stansburiana* Baird & Girard, 1852 | G5/S5 | Alkali Flat West of Fraggle Rock/Gary Exit I-10 | 09/01/24, one adult foraging among shrubs for harvester ants and other arthropods, adjacent to a small wetland depression |
| **Aves** | Semipalmated Sandpiper / *Calidris pusilla* Linnaeus, 1766 | G5/S3 | South Alkali Flats Duckpond | O8/25/24 Foraging along the eastern shoreline of the partially filled pond; 09/23/24 A pair foraged in shallow water along the shoreline |
| | Baird's Sandpiper / *Calidris bairdii* Coues, 1861 | G5/S4 | South Alkali Flats Duckpond | 09/29/24 In a mixed flock with pectorals, moved steadily around the existing shoreline foraging from the pond bottom in shallow water |
| | Pectoral Sandpiper / *Calidrus melanotos* Vieillot, 1819 | G5/S3 | South Alkali Flats Duckpond | 09/29/24 In a mixed flock with Baird's, moved steadily around the existing shoreline foraging from the pond bottom in shallow water; they would take flight occasionally |
| | Greater Yellowlegs / *Tringa melanoleuca* Gmelin, JF, 1789 | G5/S4 | South Alkali Flats Duckpond | 09/08/24 Individual waded in the pond in proximity to the dense stands of aster along the shoreline; 09/23/24 Individual rested on the pond shoreline while standing on one leg |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Unknown Shorebird / In-flight | … | South Alkali Flats Duckpond | 09/01/24 Two birds flew to the east as I drove in, one image from behind (reminds me of a yellowlegs) |
| | Killdeer / *Charadrius vociferus* Linnaeus, 1758 | G5/S4 | South Alkali Flats Duckpond | 10/13/24 Pair resting, vocalizing, and foraging along the shoreline of the E pond margin |
| | Long-billed Dowitcher / *Limnodramus scolopaceus* Say, 1822 | G5/S4 | South Alkali Flats Duckpond | 10/13/24 Individual foraging extensively along the shoreline of the NE pond margin |
| | Ibis / *Plegadis* sp. | … | South Alkali Flats Duckpond | 09/08/24 Individual landed in the pool below culverts under the SH338 off ramp to forage |
| | Ring-billed Gull / *Larus delawarensis* Ord, 1815 | G5/S5 | South Alkali Flats Duckpond | 09/23/24 Five of them rested and bathed in the shallow pond |
| | Mallard or Mexican Duck / *Anas platyrhynchos* Linnaeus, 1758 or *Anas diazi* Ridgway, 1886 | G5/S5 or G5/… | South Alkali Flats Duckpond | 09/15/24 Three large, brown-speckled ducks (one female, 2 males) rested on and fed from the pond, joined by a small, female teal |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Northern Pintail / *Anas acuta* Linnaeus, 1758 | G5/S3 | South Alkali Flats Duckpond | 09/23/24 one rested on a vegetation mat with six blue-winged teal |
| | Northern Shoveler / *Spatula clypeata* Linnaeus, 1758 | G5/S3 | South Alkali Flats Duckpond | 09/23/24 Ten of them paddled across the shallow pond, rested and preened, and tipped up to forage; Seven of them foraged from and rested at New Tank |
| | Green-winged Teal / *Anas carolinensis* Gmelin, 1789 | G5/S4 | South Alkali Flats Duckpond | 09/15/24 One small dabbling duck, I believe a female green-winged teal, joined with three mallards to rest and forage from the pond |
| | Blue-winged Teal / *Anas discors* Linnaeus, 1766 | G5/S3 | South Alkali Flats Duckpond | 09/23/24 Six of them rested on a vegetation mat, swam across the pond and foraged from the pond, at times joining the northern shovelers which were churning up the pond bottom substrate; 09/29/24 Four of them foraged along the southern Duckpond shoreline |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Chihuahuan Raven / *Corvus cryptoleucus* Couch, 1854 | G5/S4 | South Alkali Flats Duckpond | 08/25/24 Pair had landed near the shoreline; 09/01/24 An individual flew over the pond to the north |
| | Swainson's Hawk / *Buteo swainsoni* Bonaparte, 1838 | G5/S5 | Alkali Flat West of Fraggle Rock/Gary Exit I-10, between SH80 and I-10 | 09/01/24 Migrating individual hunting over the habitat between the RR tracks and I-10, near the wildlife viewing area (a few other migrating birds are visible soaring above this hawk) |
| | Black Phoebe / *Sayornis nigricans* Swainson, 1827 | G5/S5 | South Alkali Flat Duckpond | 09/08/24 Individual perched on the fence wires and hunted for small arthropods along the pond edge to the tamarisk tree near SH338 off-ramp |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Loggerhead Shrike / *Lanius ludovicianus* Linnaeus, 1766 | G4/S3 | South Alkali Flats Duckpond, SH338 right-of-way | 09/01/24 Migrating individual flew from the pond area to a fencepost at the parking area; 09/08/24 Individual avoided the wind perched in a small tamarisk tree, then perched atop the tree to scan the area and vocalized often; 09/15/24 Individual avoided the wind, perched in a small tamarisk tree and produced many vocalizations; 09/29/24 An individual continued perching and vocalizing in the tamarisk tree; 10/13/24 Probably the same individual, continues to use vocalizations and occasional perching atop the small tamarisk tree |
| | Western Kingbird / *Tyrannus verticalis* Say, 1822 | G5/S5 | Alkali Flat West of Fraggle Rock/Gary Exit I-10 | 09/01/24 Migrating individual hunting from the gate to the wildlife viewing area; blurry images may provide some information to confirm identification by an ornithologist |
| | Brewer's Sparrow / *Spizella breweri* Cassin, 1856 | G5/S3 | South Alkali Flats Duckpond, SH338 right-of-way | 10/13/24 A few individuals perching on fenceline and foraging for seeds among aster and bunchgrass plants |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Chipping Sparrow / *Spizella passerina* Bechstein, 1798 | G5/S4 | Alkali Flat West of Fraggle Rock/Gary Exit I-10, along SH80; South Alkali Flats Duckpond, SH338 right-of-way ditch | 09/08/24 these small sparrows gleaned seeds from the ground and perched in shrubs and small trees along an arroyo and adjacent to the old highway; 09/2924 An individual hunted in the calm area behind dense aster plants at the Duckpond site |
| | Savannah Sparrow / *Passerculus sandwichensis* Gmelin, JF, 1789 | G5/S2 | South Alkali Flats Duckpond, SH338 right-of-way ditch to shoreline | 09/29/24 Foraged among aster plants established around the Duckpond high shoreline; 10/13/24 Foraged among aster and bunchgrass plants established around the Duckpond high shoreline |
| | Vesper Sparrow / *Pooecetes gramineus* Gmelin, JF, 1789 | G5/S4 | South Alkali Flats Duckpond, SH338 right-of-way ditch | 09/29/24 Foraged among aster plants established around the Duckpond high shoreline. |
| | White-crowned Sparrow / *Zonotrichia leucophrys* Forster, 1772 | G5/S5 | South Alkali Flats Duckpond, SH338 right-of-way ditch and fenceline | 10/13/24 Several, mostly juveniles, perched on the fenceline and foraged for seeds among aster and bunchgrass plants |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Sparrows, Unidentified | … | Alkali Flat West of Fraggle Rock/Gary Exit I-10, along SH80 | 09/15/24 A few small sparrows were perched in taller habitat structure to hunt for small insects and glean for seeds; two images may allow an ornithologist to identify at least one species |
| | Warbler / Unknown | … | South Alkali Flats Duckpond; at the fence line in the water-filled ditch along the SH338 off-ramp from I-10 | 09/15/24 Perched in the tamarisk at the pond/ditch margin, a yellowish-green warbler hunted for small insects; there are three images that may allow an ornithologist to identify it to species |
| | Brewer's Blackbird / *Euphagus cyanocephalus* Wagler, 1829 | G5/S4 | Alkali Flats near its northwestern boundary, east of Summit Road along Tank Road | 09/23/24 A few of them foraged at the edge of a livestock pond/tank, among cattle |
| **Mammalia** | Coyote / *Canis latrans* Say, 1823 | G5/S5 | General Area from Lordsburg to the Arizona border | Carcasses of individuals struck by vehicles using I-10 viewed intermittently during the summer/fall of 2024 |
| | Black-tailed Jackrabbit / *Lepus californicus* J.E. Gray, 1837 | G5/S5 | Alkali Flat at NM338 Exit from I-10, along SH80 | 10/13/24 An individual jumped from cover among 4-wing saltbush shrubs and alkali sacaton clumps and ran east adjacent to the railroad tracks, no images acquired |

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| **Organism Class** | **Common Name / Species** | **Status*** | **General Location** | **Notes** |
| | Domestic Cattle / *Bos taurus* Linnaeus, 1758 | … | Alkali Flat area, generally | Grazing cattle and their tracks/scat occur generally within the basin and are concentrated at freshwater well/tank sites (no photographs collected) |

**Notes (Visit 1) 08/01/24**: Area (Alkali Flats) introduction to observe habitats and access routes available, particularly when the soil is saturated during monsoon rainstorms. This day was cool, overcast, and with a light wind. Due to extensive I-10 resurfacing closing some interchanges and routing traffic into one lane, it was difficult and more dangerous to use the highways/interchanges efficiently; closures also occurred as several long, wind turbine blades were escorted through the SH338/I-10 interchange, as well. Time was therefore spent at the South Alkali Flats Duckpond (SH338 interchange) and the Fraggle Rock/Gary interchange to gain area perspective. Generally, Alkali Flats is a portion of the larger Animas Valley and is an important seasonal and year-around wildlife habitat; it is crossed by several linear, east-to-west developments, including railroad tracks, the original State Highway 80, Interstate 10, and an underground pipeline (USDI-BLM 2009: New Mexico; Lordsburg Surface Management Status 1:100,000 Scale Topographic Map). The South Alkali Flats Duckpond was at a low level and no other standing water was observed; new plant growth was initiating for roadside weeds but the native plants were mostly dormant. General wildlife use was an area-wide migration of predominantly variegated meadowhawk dragonflies (dragonfly migrations may have mixed species but I only observed VMs this day) which hunted on-the-fly for small insects/arthropods as they moved through the Animas Valley; a large number were also present in and near Lordsburg.

**Notes (Visit 2) 08/25/24**: This day began cool and warmed quickly with a mostly clear sky and breezy conditions. The South Alkali Flats Duckpond was perhaps half-full with sediment-laden water within the drainage ditch adjacent to the SH338 off ramp; this ditch supported dense, linear growth of an alkali-tolerant aster species that was just beginning to flower. Dragonfly species were not observed in any habitat this day; two female familiar bluets were hunting and perching among the aster stems and photo-documented. I inspected the milky-colored water surface closely and observed occasional surfacing of predatory beetles and toad tadpoles; at the fenceline, tiny forms resembling clam shrimp would occasionally surface. I collected a water sample of ~ I pint and poured it across a white surface revealing seven clam shrimp which I photo-documented, then I transferred them to a saturated white paper towel for photographs against a slightly rougher surface. These specimens were then placed back into the water column; they are tiny, pinkish-colored organisms, and all but one carried a mass of eggs against their dorsal shell.

During this visit, a migration of butterflies was observed resting in dense foliage, taking nutrients from saturated soil “puddling”, and nectaring from various flowering plants including the spiny aster, four-wing saltbush, cowpen daisy, morning glories, Russian-thistle, alkali sacaton, and others including a few sub-shrubs. From highest-to-lowest in numbers of butterflies observed/photo-documented, they were: western pygmy blues, American snouts, sleepy oranges, orange sulphurs, marine blues, checkered whites, white checkered-skippers, and variegated fritillaries. Bird species were few during this trip, consisting of three semipalmated sandpipers and two ravens, likely Chihuahuan, all along the Duckpond shoreline. During my field session, I photo-documented other arthropod species (e.g., flies, spiders, bees, wasps, bugs, beetles, etc.) as they occurred within the available habitat.

**Notes (Visit 3) 09/01/24**: This day began cool/warming throughout, with a partially cloudy sky early, transitioning to mostly cloudy by 1pm; it was windy with some gusts throughout the time of visitation. The South Alkali Flats Duckpond was full and the shoreline was close to or under the fence, as was the small ditch at the base of the SH338 off-ramp. A dense band of alkali-tolerant asters, in moderate flower, lined the edge of these water features with predominantly alkali sacaton growing above the saturated soil. A small migration, possibly with some emergence from local water, of variegated meadowhawks was observed; individuals were perched out of the wind, hovering while foraging for small arthropods, and patrolling along shoreline vegetation to locate potential mates. One pair was seen in tandem linkage, either pre-mating and flying to dense cover to mate or post-mating seeking to deposit eggs. One each of a male and female familiar bluet were observed perching/hunting for small arthropods, while avoiding the wind along the small ditch. A single orange sulphur also perched on the ground out of the wind to sun. One or more whiptail lizards (striped plateau or desert grassland – image acquired) foraged under the established vegetation for available prey. Along the SH80/RR tracks access, a Swainson’s hawk was hunting towards I-10, after processing the images, other birds, mixed species, were visible higher above the hawk and also circling, indicating a small migration group. Bird species observed at or near ground level included a kingbird, loggerhead shrike, unidentified sparrow, a shorebird (possibly a killdeer), Swainson’s hawk, and a passing raven (probably Chihuahuan). Along this access, some rainfall had left small puddles and dampened the bottom of deeper depressions, initiating flowering of shrubs, forbs, and annual plants. A tiny patch of horsetail milkweed flowers and another of cowpen daisies attracted a few mixed arthropods ranging from beetles and bugs to bees and wasps that were strong enough fliers to forage in the windy conditions. Near the milkweed patch was a foraging lizard (possibly a common side-blotched or western fence – image acquired); several rough harvester ants were foraging on the ground surface adding an additional prey source. Additional variegated meadowhawks were observed hovering out of the wind behind vegetation and perching around a remnant puddle within a small arroyo, ponded against the SH80 embankment; this site supports several flowering forbs and a small mesquite tree.

**Notes (Visit 4) 09/08/24**: This day began warm and became hot under a clear sky; it was windy, east-to-west consistently with some gusts throughout the time of visitation. The South Alkali Flats Duckpond was full and the shoreline was close to or under the fence; the small ditch at the base of the SH338 off-ramp was partially filled. A dense band of alkali-tolerant asters, in full flower, lined the edge of these water features with predominantly alkali sacaton growing above the saturated soil. A few, mostly female variegated meadowhawks, were observed and some photo-documented; individuals were perched out of the wind, hovering while foraging for small arthropods, and rarely patrolling along shoreline vegetation to locate potential mates. One male familiar bluet was photo-documented perching/hunting for small arthropods within the dense aster stand along the small ditch. A few orange sulphurs nectared from aster flowers along the Duckpond margin; remains of one were observed under a dragonfly perch, along with wings of smaller butterflies. One whiptail lizard (striped plateau) foraged under the established vegetation for available prey. Bird species observed along or in the Duckpond included a black phoebe and loggerhead shrike; shore/wading birds included a greater yellowlegs and an ibis. Along the SH80 access, several chipping sparrows were perching in mesquite, tamarisk, and yuccas and gleaning seeds from the ground surface; a single yellowish-green bird, probably a warbler, flew near the Duckpond. Flowering shrubs and annual plants supported a few species of insects, mostly wasps and bees large enough to fly in the wind and hang onto actively moving flowerheads. A tiny patch of horsetail milkweed flowers and another of cowpen daisies attracted a few mixed arthropods, mostly tarantula-hawk and other wasps - strong enough fliers to forage in the windy conditions. One variegated meadowhawk was observed hovering out of the wind behind a tall mesquite shrub within a small arroyo.

**Notes (Visit 5) 09/15/24**: This day began warm and became hot under a partly cloudy sky; it was windy, east-to-west consistently with some gusts throughout the time of visitation. The South Alkali Flats Duckpond was lower, evaporating steadily and the shoreline was receding from the fence; the small ditch at the base of the SH338 off-ramp was partially filled. A dense band of alkali-tolerant asters, in full flower, lined the edge of these water features with predominantly alkali sacaton growing above the saturated soil. A few, mostly male variegated meadowhawks, were observed and some photo-documented; individuals were perched on low twigs and the fence wire and hovering while foraging for small arthropods. No damselflies were observed on this day. A migratory flight of ~20 butterfly species was present, attracted to the asters in full-flower and other nectar sources. By far the most numerous species was the small-sized American snout, followed by species of oranges/yellows/sulphurs, in the aggregate. The largest butterfly species included queens, black swallowtails, and pipevine swallowtails, in low numbers. Bird species observed along or in the Duckpond included a loggerhead shrike, a warbler, and a few sparrows; four ducks, three mallards and one teal, were resting on and feeding from the pond. Along the SH80 access, several sparrows were perching in mesquite, tamarisk, and yuccas and gleaning seeds from the ground surface. Yellow-flowering shrubs supported a few species of insects, mostly butterflies and beetles, particularly soldier beetles; a few wasps and bees clung to actively moving flowerheads; many western honey bees (my first observations in 2024) foraged on aster flowers around the pond and up the ditch (perhaps they were released in the Alkali Flats area by a commercial beekeeper?).

**Notes (Visit 6) 09/23/24**: This day began warm and became hot under a clear sky; it was windy, southwest-to-northeast consistently throughout the time of visitation. I joined with Dr. Jony Cockman for much of the day and we explored a more extensive area of Alkali Flats west along the abandoned SH80 and railroad linear features and north of Steins from Summit Road (CR A012). The South Alkali Flats Duckpond continues to recede, evaporating steadily as the shoreline lowers from the fence; the small ditch at the base of the SH338 off-ramp was lower yet still partially filled. A dense band of alkali-tolerant asters, in full flower, lined the edge of these water features (and formerly ponded areas adjacent to the SH80 roadbed west to the SH338/I-10 interchange) with predominantly alkali sacaton growing above the saturated soil. A few, mostly male variegated meadowhawks, were observed and some photo-documented; individuals were perched on low twigs and the fence wire and hovering while foraging for small arthropods. No damselflies were observed on this day. A continued migratory flight of ~20-25 butterfly species was present, attracted to the asters in full-flower and other nectar sources. By far the most numerous species was the small-sized American snout, followed by species of oranges/yellows/sulphurs, in the aggregate. The largest butterfly species included queens and pipevine swallowtails in moderate numbers and a single monarch. Bird species observed along or in the Duckpond included overflying insectivores, a falcon, a warbler, and a few sparrows; five ring-billed gulls rested and a greater yellowlegs stood on one foot, while several northern shoveler and blue-winged teal swam in, fed from, and rested on the shallow water. Along the SH80 access, some sparrows were foraging; yellow-flowering shrubs supported a few species of insects, but asters in full-flower around former ponded sites attracted many butterflies, bees, wasps, and other insects to forage. These same species occurred along Summit Road, using flowering plants for forage, also included were moderate flower density on creosotebush shrubs. Water tanks were teaming with insects and New Tank supported a large population of Mexican spadefoot (aka, New Mexico spadefoot toad) in the juvenile stage of development (still had tails from the larval stage (tadpoles). An unnamed water tank further north supported a dense patch of fully-flowered mulesfat baccharis which was heavily visited by queen and other butterflies and several bee and wasp species.

**Notes (Visit 7) 09/29/24**: This day began cool and became mildly hot under a clear sky; it was windy, east-to-west consistently with some gusts throughout the time of visitation. The South Alkali Flats Duckpond was continuing to lower, evaporating steadily and the shoreline was receding far from the fence; the small ditch at the base of the SH338 off-ramp contained a narrow pool of turbid water. A dense band of alkali-tolerant asters, still flowering but with fewer blossoms, lined the edge of these water features with predominantly alkali sacaton growing above the saturated soil (the sacaton is beginning to dry). Several, mostly female variegated meadowhawks, were observed and some photo-documented; individuals were perched on low twigs and the fence wire and hovering while foraging for small arthropods; one mating pair was observed. No damselflies were observed on this day. Butterfly species numbered about 10-12 and attracted to the still-flowering asters and the dense vegetation blocking wind gusts. The most numerous butterfly species were sleepy oranges, American snouts, and variegated fritillaries; a migration of 3 species, mostly of the banded bee flies group - represented the most numerous insect species. There was greater diversity in wasp species, visiting the aster flowers and the water edge. Bird species observed along or in the Duckpond included a loggerhead shrike, several sparrows; four ducks (teal) and ~10 sandpipers were feeding from the pond while a few swallows circled over it. Along the SH80 access, a few sparrows (vesper, savannah, chipping) were perching in small trees/tall shrubs, catching arthropods and gleaning seeds from the ground surface. Asters were in flower around the elongate dry ponds formed along the old SH-80 roadbed west of the SH338/I-10 interchange and attracted a few butterflies and wasps.

**Notes (Visit 8) 10/13/24**: This day began cool and became mildly hot under a clear sky; it was calm until about 1pm when wind picked up, east-to-west. The South Alkali Flats Duckpond was continuing to lower, evaporating steadily and the shoreline continued receding far from the fence; the small ditch at the base of the SH338 off-ramp contained a short, narrow pool of turbid water with much debris from alkali aster seeds floating on the remaining water and stuck like a carpet on muddy sites. A dense band of alkali-tolerant asters with very few flowers lined the edge of these water features with predominantly alkali sacaton growing above the saturated soil (the sacaton is dry). Several, female and male variegated meadowhawk dragonflies, were observed and some photo-documented; individuals were hanging from aster plants to warm in the morning sunshine, perched on low twigs and the fence wire, and hovered while foraging for small arthropods; one mating pair was observed. No damselflies were observed on this day. Butterfly species numbered 6 and were attracted to the sparse aster flowers and muddy sites to collect nutrients. The most numerous butterfly species was western pygmy blue. There were newly recorded wasp species with bright orange Ichneumonid wasps notable. Bird species observed along or in the Duckpond included a loggerhead shrike (likely a summer resident individual), three sparrows (Brewer's, savannah, white-crowned); a long-billed dowitcher and 2 killdeer were foraging along the pond margin. Along the

SH80 access, a black-tailed jackrabbit bounded from cover (4-wing saltbush and alkali sacaton) near the railroad track. Asters had few flowers around the elongate dry ponds formed along the old SH-80 roadbed west of the SH338/I-10 interchange and attracted very few butterflies, bees, wasps, and a few true bugs.

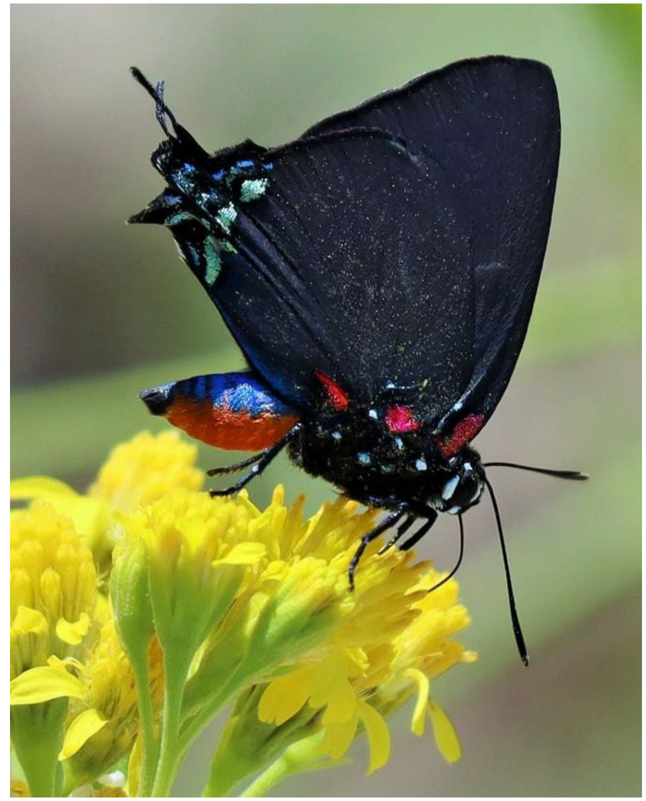
All photos are by Jim VonLoh

Queen female

Queen mother

Monarch

Great Purple Hairstreak



Maize Calligrapher

Loggerhead Shrike

# Sands Draw Grassland Restoration Part II

## AN EXAMINATION OF SURFACE FLOW TRANSPORT USING SEDIMENT TRAPS: YOUTH OUTDOOR EDUCATION

JONEEN S COCKMAN AND DAVID J HENSON

# ACKNOWLEDGEMENTS

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# Contents

## Figures

## Tables

# INTRODUCTION

The Bureau of Land Management Safford Field Office manages a large area of highly eroded and erodible land in the San Simon Valley of southeastern Arizona. These fragile areas of deep sandy loams and silty soils parallel the course of the San Simon River. The heart of the San Simon Valley in Arizona north of Interstate 10 occupies an area of about 253 square miles (161,828 acres or 65,490 ha) (Google Earth Pro estimate). The authors estimate that at least 25-50 % of this area is in highly eroded condition (Figure 1). This land was once characterized by highly productive grasslands. Today vast open areas of completely denuded land are marked by gullies and deep arroyos. Piping and gullying is common and during heavy rain fall events sheet erosion can be dramatic. This creates a vast area of non-point source pollution running into catchment areas. Some of these areas are saline.

In the 1950s the US Government built large earthen structures to hold back surface flow. Tracts of land were scraped to mine soil in order to construct earth dams across the landscape. The native grass seed plots occupy one of the scraped areas.

The Sands Draw Wildlife Exclosure Habitat Restoration: Grassland Seeding Project was officially initiated in April 2013 with the collection of pre-treatment baseline data. This project is one of several conducted by Arizona Bureau of Land Management (BLM) Safford Field Office in partnership with Eastern Arizona College (EAC). These partners joined through a Financial Assistance Agreement (FA) in 2012 to provide outdoor biology experiences and internships for college interns. College, high school and middle school students participated in this project from 2013 through 2017 assisting in installation of research plots and collection of data.

The native grass seed project was funded by National Environmental Education Foundation (NEEF) and National Fish and Wildlife Foundation (NFWF). The research examines two tillage methods (imprinting versus drilling) and three mulch applications (gravel, pecan branches, and gravel/pecan branch mix).

In 2015 sediment traps were added within each plot in response to a Bureau of Land Management (BLM) request to examine non-point source pollution associated with salinity and surface water flow.

# LOCATION AND SETTING

## Geography and Soils

The study area is located in the San Simon Valley of southeastern Arizona approximately 8 miles north of the town of Bowie (Figure 1). The project area in the Sands Draw wildlife exclosure is situated on a landscape characterized by abundant seasonal overland flow of surface water (Figure 2). The research plots are situated on ground that was scraped to mine soil for surface water catchments and dam construction. One of the surface water flow catchments can be seen in Figure 3 just below the research plots.

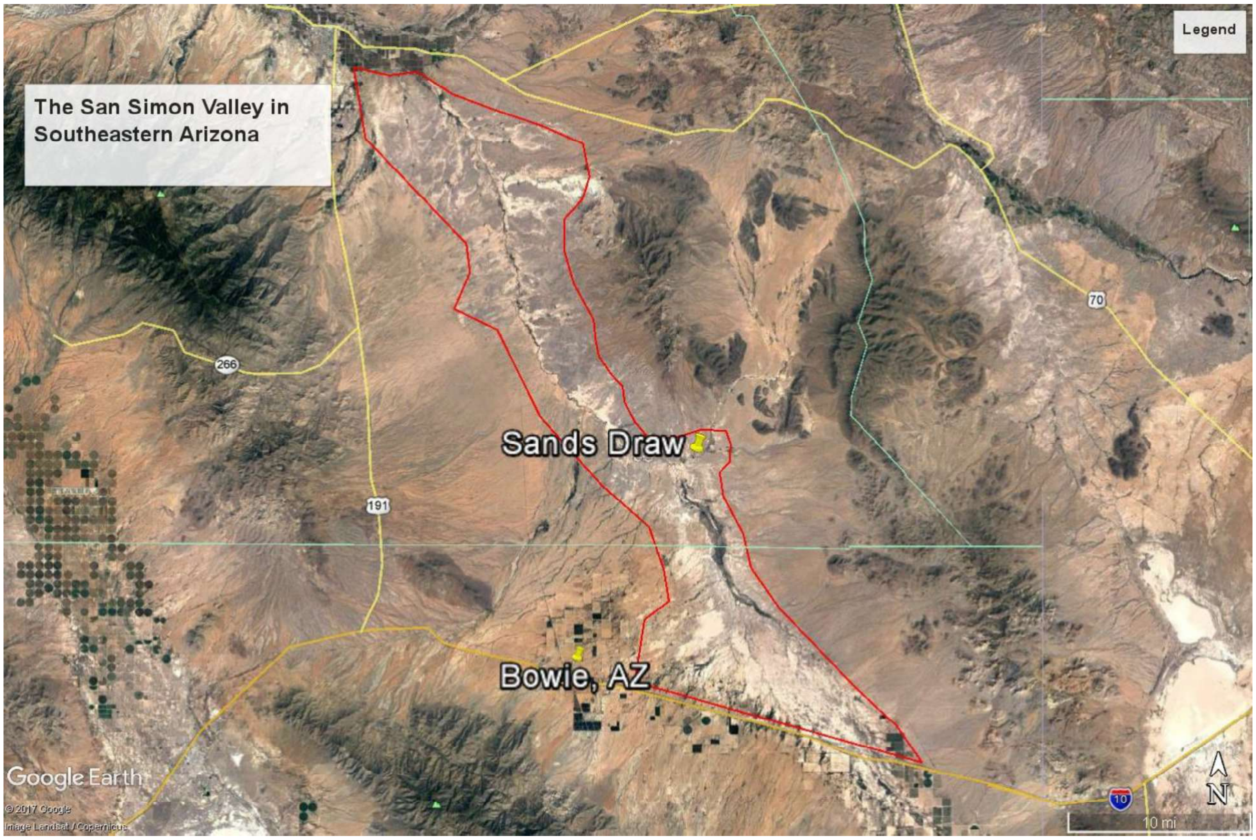



*Figure 1. The heart of the San Simon Valley is outlined in red. It occupies an area of about 253 square miles north of Interstate 10.*

Elevation is about 3400 feet, precipitation is less than 12 inches per year and soils are silt loams. Most of the soil is mapped as Glendale-Gila complex eroded. Mean annual air temperature is 63-72 degrees Fahrenheit and the number of frost-free days ranges from 210-240 days (NRCS web soil survey). The setting is flat, less than one percent slope and occupies alluvial fans and flood plains comprised of alluvium from mixed sources. The Glendale component restrictive layers are deeper than 80 inches and the soil is well-drained. The Glendale soil profile is stratified layers of silty clay loam to about 60 inches. The Gila component is loamy to 60 inches (NRCS Web Soil Survey Custom Soil Resource Report for San Simon Area Parts of Cochise Graham and Greenlee Counties, Arizona). The Glendale soil component is related to the Glendale Ecological site: Clay Loam Upland 8-12" p.z. (R041XB204AZ). The Gila soil component is related to the Gila Ecological site: Loamy Upland 8-12" p.z. (R041XB210AZ). Rainfall during the study period ranged from 8.6 inches to 12.6 inches (Weather Underground).


*Figure 2. General location of the native grassland research plots in the Sands Draw wildlife exclosure.*

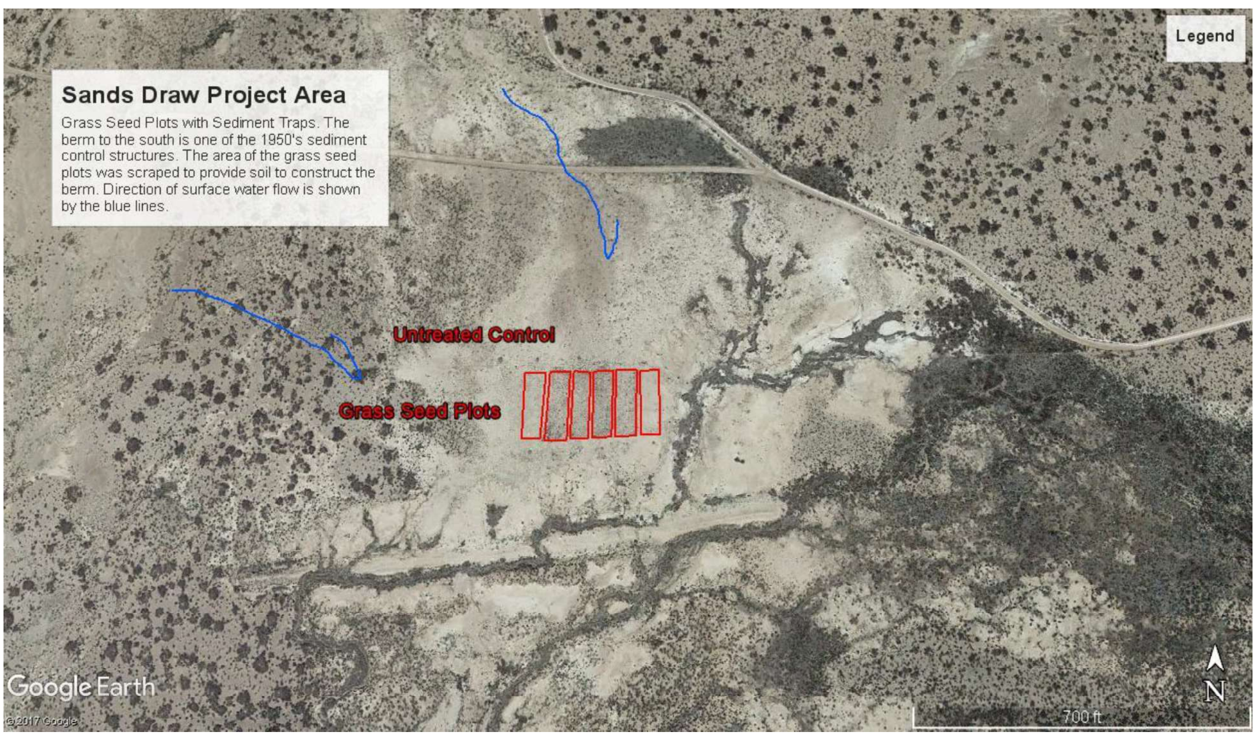



*Figure 3. Orientation of the research plots relative to surface flow. They are situated in an area that was scraped to provide soil for construction of a berm (visible south of the plots) to slow down surface flow.*

## Climate

Precipitation data from the Safford, Arizona rain gauge show that most precipitation is received during the summer months of July, August and September. The climate for this area is influenced by the Chihuahua Desert ecoregion which has primarily one rainy season. Rainfall for the study period 2013 through 2017 are shown in Figure 4. Total annual precipitation for this time period ranged from 8.6 inches in 2013 to 12.7 inches in 2016. Rainfall to date in 2017 (January through October) totaled 7.86 inches (Weather Underground website). The Bureau of Land Management Tanque recording rain gauge was operational from 1981 through 2013. The long term average rainfall at Tanque is 11.5 inches per year (BLM data). Rangeland vegetation is characterized by saltbush (*Atriplex spp*.), mesquite (*Prosopis glandulosa*) and bunchgrasses except in surface eroded areas that are void of vegetation (Figure 5).

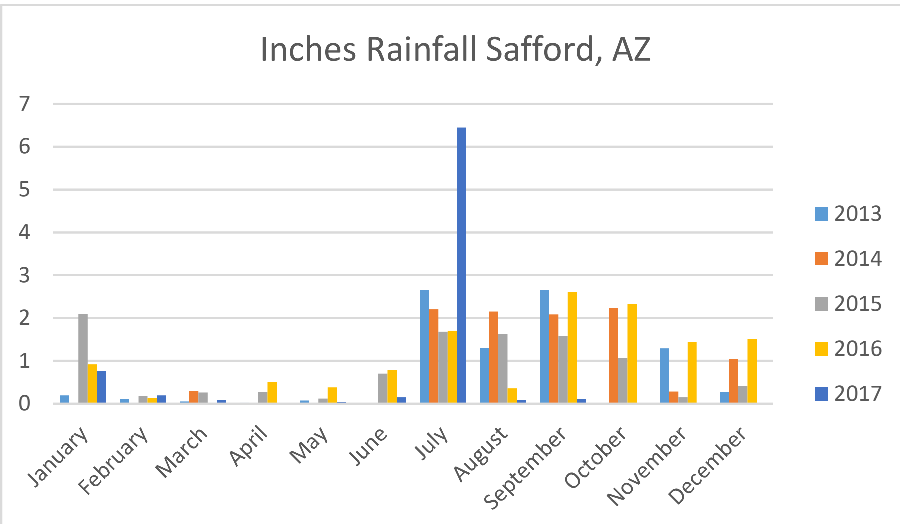



*Figure 4. Annual precipitation recorded by the USGS Safford rain gauge 2013-2107.*

*Figure 5. STEM Partnership interns stand near a sediment trap in the San Simon Valley. The sediment trap is located in an untreated control plot near the grass seed plots. This landscape is typical of the San Simon Valley.*

# MATERIALS AND METHODS

## Grass Seed Plots Design

To investigate the potential of grassland restoration using native seed sources, the Bureau of Land Management Safford Field Office established grass seed monitoring plots in 2013. Funds were acquired to explore two tillage treatments and three mulch treatments. The two tillage treatments include 1) Drill seeding and 2) Imprinting followed by broadcast seeding. Mulch treatments include 1) pea gravel 2) pecan branches 3) pea gravel and pecan branches. Tillage was implemented with a small farm tractor pulling the respective equipment. The three mulch treatments were applied over each of the tillage treatments resulting in six plots. Plot size is 15 m x 50 m. (Figure 6).

A split plot, randomized complete block design was used; one would normally test between the two tillage treatments. If no differences were detected, then further analyses would not be considered. In this study no consistent differences were found between tillage treatments. Additional analyses was conducted among mulch treatments.

Much of the labor for this project was provided by the Science, Technology, Engineering and Math (STEM) Partnership shared by Safford Field Office and Eastern Arizona College. Application of mulch over tillage and grass seed plots was conducted through staging a youth day event with outreach to local high school and middle school students (Figures 7 and 8). Results of that study are presented in Cockman 2017.


*Figure 6. Grass seed plots are 15 m x 50 m in size. From left to right the treatments include: drill/gravel, imprint/pecan, drill/pecan and gravel, imprint/pecan and gravel, drill/pecan and imprint/gravel.*

*Figure 7. Pecan branch and gravel mulch were applied to a native grass seed plot. The view looks north toward a fence line. The bare control plots are located on the north side of the fence. Sediment traps were staged to capture surface water flow coming from north to south and from west to east. Note: the sediment trap at left center in the photo is sitting just outside of the plot. It was relocated to within plot.*

*Figure 8. High school and middle school students assisted with application of gravel mulch and pecan branch mulch onto grass seed plots during a youth day event. In this photo students work to apply gravel onto an imprinted plot.*

## Sediment Traps Construction

Sediment traps were installed within each treatment plot in a configuration to capture overland flow from two different directions perpendicular to one another. Sediment traps were designed by Dave Henson, biology chairman at Eastern Arizona College (Henson 2017). The sediment traps are constructed of inexpensive materials and are easy to install. Description of the trap design is provided in Appendix A. Installation of sediment traps was incorporated into one of several youth day events co-hosted by the Safford Field Office and Eastern Arizona College through their STEM Partnership (Figures 9, 10, 11, 12).

*Figure 9. Students gather at a STEM Partnership youth day event to learn about sediment traps and construct two traps in each of the grass seed plot treatments and in an untreated control plot.*

*Figure 10. STEM Partnership interns took the lead in construction of sediment traps (Jeremy Gillette (left) and Dillon Hancock (right)). The base is plyboard anchored by rebar pegs. Three sides are built around the plyboard out of anchored cinder blocks.*

*Figure 11. The anchored cinder blocks are filled with pea gravel to further secure the contraption. During monitoring the plyboard floor is swept clean of debris with a whisk broom and dust pan. This debris is the sample which is taken back to the lab for weighing and laboratory analyses. The designer of the sediment trap, Dave Henson, is shown in the green sweatshirt.*

*Figure 12. A sediment trap installed on a treatment with pecan branch mulch shows no accumulation of sediment.*

## Rainfall Events and Sample Periods

The closest Bureau of Land Management recording rain gauge located at Tanque is about 19.4 miles northwest of the project location. Unfortunately it was not operational during the time of the study. A USGS rain gauge maintained for Safford, AZ is located about 25 miles northwest of the study area. Precipitation data for the study period was captured for the Safford rain gauge from Weather Underground web site.

Sediment collections took place on 9/16/2016, 11/22/2016, 5/2/2017 and 9/8/2017. The ideal time to collect sediment samples is immediately following an intense rain. Access to the project location is not always possible immediately after large rainfall events due to roads being washed out. Sediment data were collected by the biology classes at Eastern Arizona College. Class schedule also constrained mobility and efforts to sample immediately following large rainfall events. A summary of rainfall events just prior to each sample period is provided.

### 9/16/2016

August 2016 precipitation at the Safford rain gage totaled 0.36 inches. Sixteen thunderstorms were detected with only six producing measurable precipitation. September 1-16 produced 2.39 inches of precipitation, five detectable thunderstorms with four days producing measurable precipitation. The last measurable precipitation prior to sample collection day on 9/16 was 9/12 and 9/13 with 0.04 inches and 0.21 inches rain, respectively. On 9/7 rain fell 2.1 inches.

### 11/22/2016

The month of October 2016 produced 2.33 inches rain with rain or thunderstorms on fourteen days and measurable precipitation on three days. November 1-22 produced 1.26 inches rain with detectable rain or thunderstorms on eight days and measurable precipitation on five days. Precipitation ranged from 0.01 inch to 0.43 inches on 11/4. The last rain detected prior to sample day was on 11/21 with 0.09 inches rain. October 8 recorded 1.48 inches rain and October 9 recorded 0.84 inches rain.

## 5/2/2017

The month of April 2017 through May 2 is recorded as dry at the Safford rain gauge. Five rainfall events were detected but none produced measurable precipitation.

## 9/8/2017

The month of August 2017 recorded 0.08 inches of rain at the Safford rain gauge. No rain fell the first week of September 2017 and on 9/8, the sample collection day, another 0.08 inches of rain was recorded at the Safford rain gauge. During this time nineteen thunderstorms or rain fall events were detected but only five produced measurable precipitation. The last measurable precipitation prior to sample day was on August 1 with 0.01 inches of rain.

## Effect of Rainfall Events and Collection Times on Sediment Data

The two fall 2016 sample periods were both preceded by substantial rainfall events. The 9/16/16 sample period was preceded by a 2.1 inch rainfall event on 9/7.

The 11/22/16 sample period was preceded by two days of substantial rain on 10/8 and 10/9 (1.48 inches and 0.84 inches respectively).

The May 2017 and September 2017 sample days had essentially no rainfall activity for a month or more prior to the sample day.

When does the wind not blow in the San Simon Valley? The 9/16/16 sample day was within ten days of the last substantial rainfall event. It is probable that the samples collected represented real conditions. The 11/22/16 sample day was at least one month out from heavy rains on 10/8 and 10/9. The likelihood of sediments drying out and being blown out of the sediment traps is possible. This was observed in spring 2017. On March 1, 2017 a visit to the plots revealed a large amount of sediment in the control plot outside of the exclosure. February data from the Safford rain gage recorded seventeen detectable rainfall events with three days of measurable precipitation totaling 0.19 inches. Two months lapsed before the biology class could sweep the traps. On collection day they reported near zero sediment in the control trap which was contrary to field observations made on March 1 when the control trap was full of sediment.

The possibility of fine sediments being blown out of the traps prior to sample collection must be considered when interpreting the data.

## Total Sediment

Sediment traps were swept with a whisk broom and dust pan. Samples were returned to the lab for weighing and sorting by particle size (Table 1). Particle size distribution ranged from gravel to silt/clay components.

| Table 1. Soil Sieve Mesh Size and Textural Correlation | | |
|---|---|---|
| Soil Sieve Mesh Label | Mesh Size Opening (inches) | Textural Equivalent |
| # 5 | 0.51” | Gravel |
| # 10 | 0.07125” | Fine gravel |
| # 35 | 0.0173” | Coarse sand |
| # 60 | 0.0092” | Medium sand |
| # 120 | 0.0047” | Fine sand |
| # 230 | 0.0029” | Silt/Clay |

*Table 1. Soil sieve mesh size and textural correlation.*

## East Trap versus South Trap and 2016 versus 2017

Sediment traps were located within each treatment plot, two traps per plot. One sediment trap was located on the east side of the plot to capture sediment from the westerly direction. The second sediment trap was located on the south end of the plot to capture sediment coming in from the northerly direction. Sediment trap data were collected on four dates in 2016 and 2017: 9/16/16, 11/22/16, 5/2/17, 9/8/17. There was a reduction in sediment capture in 2017 compared to 2016 and east traps captured more sediment than south traps (Figure 13 and Table 2).

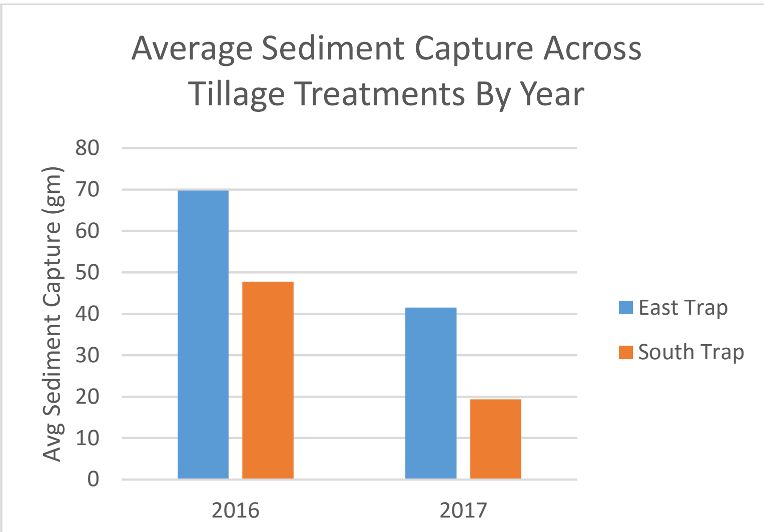


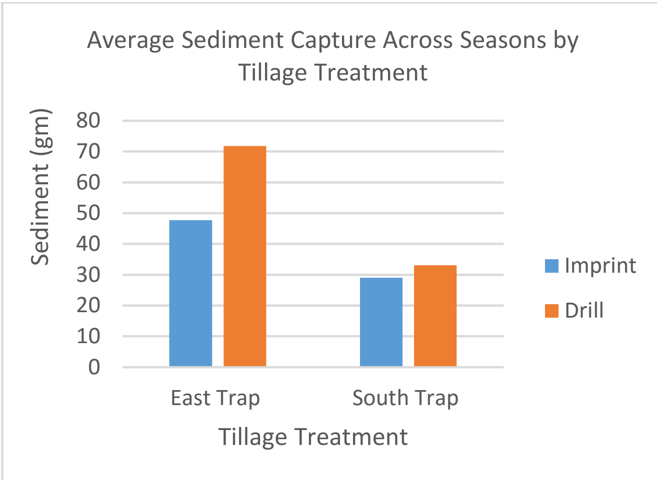

*Figure 13. A reduction in sediment capture was seen in 2017 and east traps captured more sediment than south traps.*

| Table 2. P Values for Fig. 13 | |
|---|---|
| Student's T | P |
| 2016 East > 2017 East | 0.242 |
| 2016 South > 2017 South | 0.125 |
| 2016 East > 2016 South | 0.148 |
| 2017 East > 2017 South | 0.134 |
| 1 tail, unequal variance | |

*Table 2. P values for Figure 13.*

## Imprinting Versus Drilling

The imprinting versus drilling treatment was examined by comparing the average sediment capture across all sample sessions within tillage treat and stratified by east versus south sediment trap as shown in Figure 14 and Table 3. Sediment traps located on drilled plots captured more sediment than traps located on imprinted plots and east traps captured more sediment than south traps. There is an inverse relationship between sediment capture in the trap and function of the treatment to capture sediment.




| Table 3. P Values for Figure 14. | |
|---|---|
| Student's T | P |
| Imprint East > Drill East | 0.230 |
| Imprint South > Drill South | 0.423 |
| Imprint South > Imprint East | 0.094 |
| Drill South > Drill East | 0.141 |
| 1 tail, unequal variance | |

*Table 3. P values for Figure 14.*

*Figure 14. South sediment traps captured more sediment than east traps.*

## Within Tillage and Mulch Treatment Comparisons

A closer look at sediment capture by individual treatment plot is shown in Figure 15. A pattern of east traps capturing more sediment than south traps is seen. There is also a pattern of Imprint-Gravel and Drill-Pecan capturing the most sediment in traps within each of the sample sessions. Treatments with combined mulch (gravel and pecan) tended to capture less sediment than treatments with gravel alone or pecan alone. The relationship of sediment capture to treatment effectiveness is inverse so it appears that the more complex mulches did a better job of mitigating surface flow than single mulch applications.

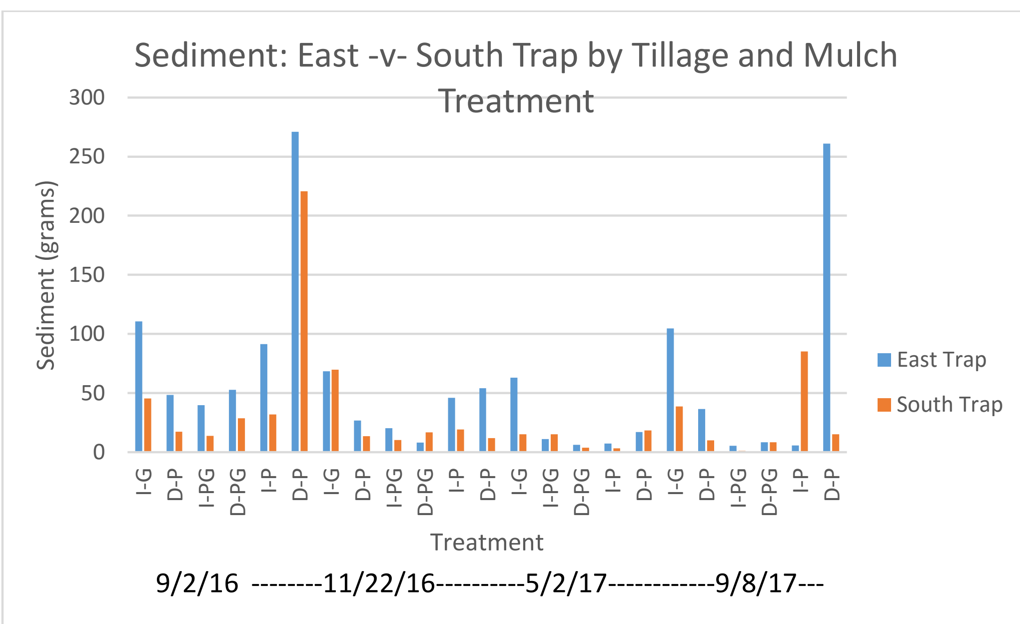



*Figure 15. Sediment capture within treatment indicates that more complex mulches capture more sediment.*

## Particle Size Distribution

Total sediment trapped across all treatments within year/season showed that sediment traps located on the east side of the plots consistently captured more sediment than traps located on the south end for all four collection periods (P<= .098, .083, .018, .043 respectively). The same pattern was seen within particle size category. Data are displayed from September 2016 and 2017 data in Tables 4 and 5 and Figures 16 and 17.

| Table 4. Sediment Particle Size Distribution 9/16/2016 | | | | |
|---|---|---|---|---|
| Soil Sieve Mesh Size # | East Traps Average (gm) | East Traps % of Portion | South Traps Average (gm) | South Traps % of Portion |
| 5 - Gravel | 13.35 | 12.93 | 11.95 | 20.06 |
| 10 - Fine gravel | 4.73 | 4.58 | 2.12 | 3.56 |
| 35 - Coarse sand | 31.87 | 30.88 | 8.83 | 14.82 |
| 60 -Medium sand | 29.00 | 28.10 | 17.92 | 30.08 |
| 120- Fine sand | 17.47 | 16.93 | 12.57 | 21.10 |
| 230- Silt/Clay | 6.80 | 6.59 | 6.18 | 10.37 |
| Total (gm) | 103.22 | | 59.57 | |
| East traps captured more sediment than south traps (P<= .098) Student's T 1 tail, unequal variance. | | | | |

*Table 4. Sediment particle size distribution 9/16/16.*

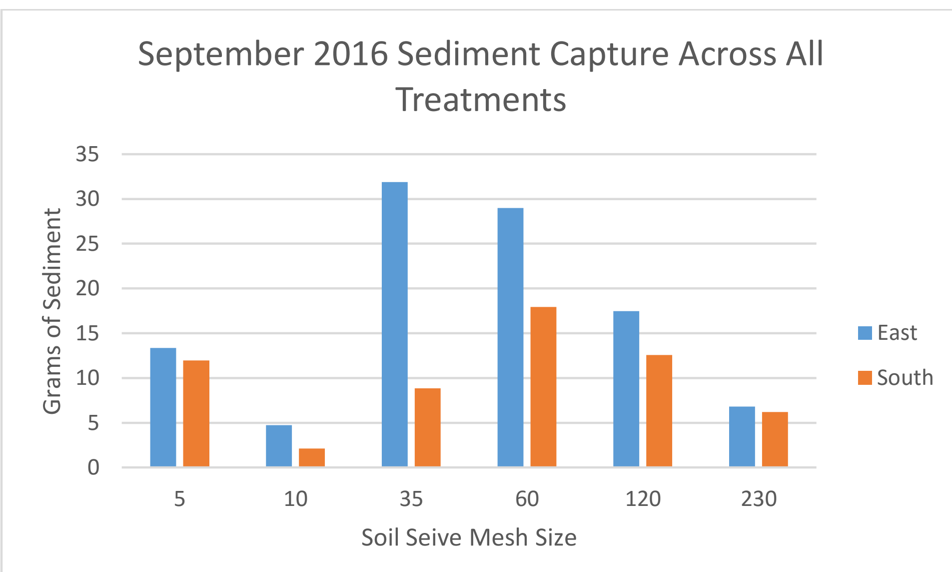



*Figure 16. Sediment traps on the east of each plot captured more sediment than the south plots in 2016.*

| Table 5. Sediment Particle Size Distribution 9/8/2017 |
|---|

| Soil Sieve Textural Correlation | East Traps Average | East Traps % of Portion | South Traps Average | South Traps % of Portion |
|---|---|---|---|---|
| Gravel | 10.35 | 15.34 | 9.30 | 28.64 |
| Fine gravel | 11.38 | 16.86 | 5.42 | 16.69 |
| Coarse sand | 24.57 | 36.41 | 8.77 | 27.01 |
| Medium sand | 12.93 | 19.16 | 4.27 | 13.15 |
| Fine sand | 6.73 | 9.97 | 3.16 | 9.73 |
| Silt/Clay | 1.53 | 2.27 | 1.55 | 4.77 |
| Total (gm) | 67.49 | | 32.47 | |
| East traps captured more sediment than south traps (P<= .043) Student's T 1 tail, unequal variance. | | | | |

*Table 5. Sediment particle size distribution 9/8/2017.*

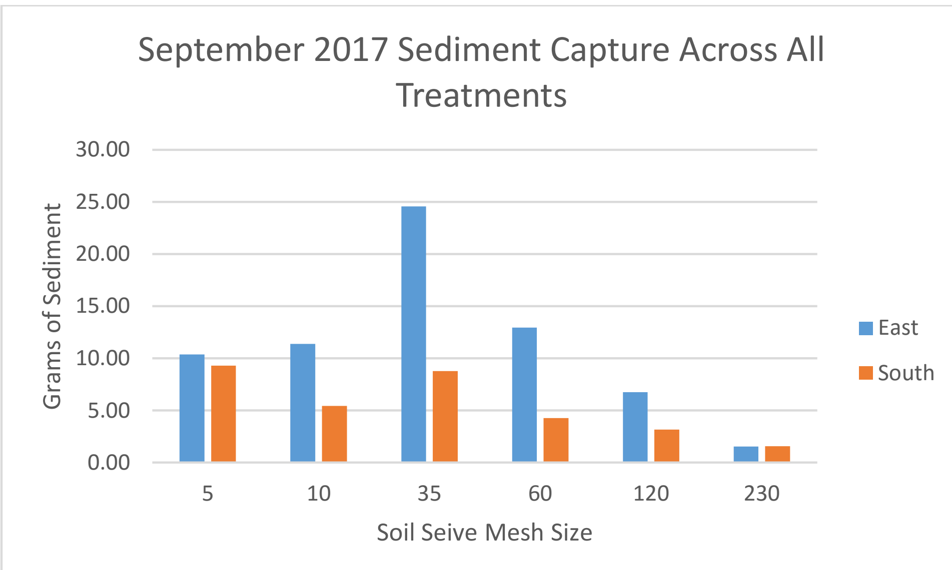



*Figure 17. Sediment traps located on the east of each plot captured more sediment than south plots in 2017.*

Comparison of east sediment traps versus south sediment traps was examined further for each treatment and each sampling period. The pattern remained consistent as shown in Table 6 with east sediment traps capturing more sediment than south sediment traps.

| Table 6. Comparison of East Trap Versus South Trap Within Treatment for All Seasons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Plot # | Treatment | East Trap Sediment (gm) | South Trap Sediment (gm) | Within Plot Avg. | P, 2 tails, unequal var. | East > South | South > East |
| 9/2/2016 | 1 | I-G | 110.5 | 45.3 | 77.9 | 0.07 | * | |
| | 2 | D-P | 48.4 | 17.2 | 32.8 | 0.08 | * | |
| | 3 | I-PG | 39.7 | 13.8 | 26.75 | 0.05 | * | |
| | 4 | D-PG | 52.6 | 28.5 | 40.55 | 0.149 | * | |
| | 5 | I-P | 91.4 | 31.9 | 61.65 | 0.097 | * | |
| | 6 | D-P | 271 | 220.7 | 245.85 | 0.736 | | |
| 11/22/2016 | 1 | I-G | 68.4 | 69.8 | 69.1 | 0.96 | | |
| | 2 | D-P | 26.6 | 13.4 | 20 | 0.16 | * | |
| | 3 | I-PG | 20.1 | 10.2 | 15.15 | 0.14 | * | |
| | 4 | D-PG | 8.1 | 16.6 | 12.35 | 0.2 | | * |
| | 5 | I-P | 46 | 19.2 | 32.6 | 0.056 | * | |
| | 6 | D-P | 54 | 11.9 | 32.95 | 0.005 | * | |
| 5/2/2017 | 1 | I-G | 63 | 15 | 39 | 0.063 | * | |
| | 2 | D-P** | 1998 | 9 | 1003.5 | 0.044 | * | |
| | 3 | I-PG | 11 | 15 | 13 | 0.359 | | |
| | 4 | D-PG | 6 | 3.8 | 4.9 | 0.599 | | |
| | 5 | I-P | 7.1 | 3.2 | 5.15 | 0.052 | * | |
| | 6 | D-P | 17 | 18.3 | 17.65 | 0.93 | | |
| 9/8/2017 | 1 | I-G | 104.5 | 38.7 | 71.6 | 0.25 | | |
| | 2 | D-P | 36.3 | 9.77 | 23.035 | 0.685 | | |
| | 3 | I-PG | 5.4 | 0.9 | 3.15 | 0.05 | * | |
| | 4 | D-PG | 8.4 | 8.4 | 8.4 | 1 | | |
| | 5 | I-P | 5.6 | 85.1 | 45.35 | 0.01 | | * |
| | 6 | D-P | 261 | 15.05 | 138.03 | 0.01 | * | |
| * Significant difference between paired values. | | | | | | | | |
| ** Aberrant data point not explained (values are up to 100 fold larger). | | | | | | | | |

*Table 6. Comparison of east trap versus south trap sediment within treatment for all seasons.*

Data show similar trends between years with particle size dominated by the 35 and 60 mesh size (coarse sand and medium sand) for the east sediment trap in 2016 and 2017. The south trap captured proportionately more gravel than the east trap (nearly double) (Tables 2 and 3). Slope was calculated at 0% in the east-west gradient for each of the plots. For the north-south gradient, slope was calculated at 0% for the three plots on the west half of the study, and at 0.6% for two of the plots on the east half and 1.3% for the remaining plot (Table 5). Essentially the treatment plots are flat and velocity of surface flow is expected to be uniform across the plots.

| Table 7. Percentage Slope Within Treatment Plot | | |
|---|---|---|
| | N-S Slope | E-W Slope |
| Imprint-Gravel | 0% | 0% |
| Drill – Pecan | 0% | 0% |
| Imprint – Pecan Gravel | 0% | 0% |
| Drill – Pecan Gravel | 0.67% | 0% |
| Imprint – Pecan | 1.3% | 0% |
| Drill - Pecan | 0.67% | 0% |

*Table 7. Percentage slope within treatment plot.*

The gravel treatments (imprint/gravel and drill/gravel) showed a greater mass of sediment being captured in each of the textural (particle size) classes than the other treatments. Treatments with pecan branches had lower sediment captures indicating the effectiveness of pecan branches to slow down surface flow and settle sediment across the plot. Data also show the finer size particles (medium sand, fine sand, silt/clay) as the smaller portion of the captured sediment. More gravel (mesh size 5) was captured than silt/clay (mesh size 230) in September 2016 ($P<= .01$) and September 2017 ($P<= .14$). Data are displayed in Tables 8 and 9 and Figures 18 and 19. Total sediment captured within treatment was not significantly different in 2016 than in 2017 ($P<= 0.43$).

| Table 8. Particle Size Distribution by Treatment September 2016 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Grams of Sediment in Each Treatment | | | | | |
| Soil Sieve Mesh # | Texture | I-G | D-P | I-PG | D-PG | I-P | D-G |
| 5 | Gravel | 20.5 | 10.45 | 12.3 | 11.5 | 6.7 | 14.45 |
| 10 | Fine gravel | 7.65 | 2.5 | 1.75 | 2.8 | 1.5 | 4.35 |
| 35 | Coarse sand | 23.45 | 6.5 | 4.15 | 5.35 | 9.35 | 73.3 |
| 60 | Medium sand | 13.3 | 5.55 | 3.15 | 5 | 18.55 | 95.2 |
| 120 | Fine sand | 7.65 | 5.55 | 4.3 | 8.7 | 16.5 | 47.4 |
| 230 | Silt/Clays | 5.35 | 2.25 | 3.95 | 7.2 | 9.05 | 11.15 |
| | Totals | 77.9 | 32.8 | 26.75 | 40.55 | 61.65 | 245.85 |

*Table 8. Particle size distribution by treatment September 2016.*

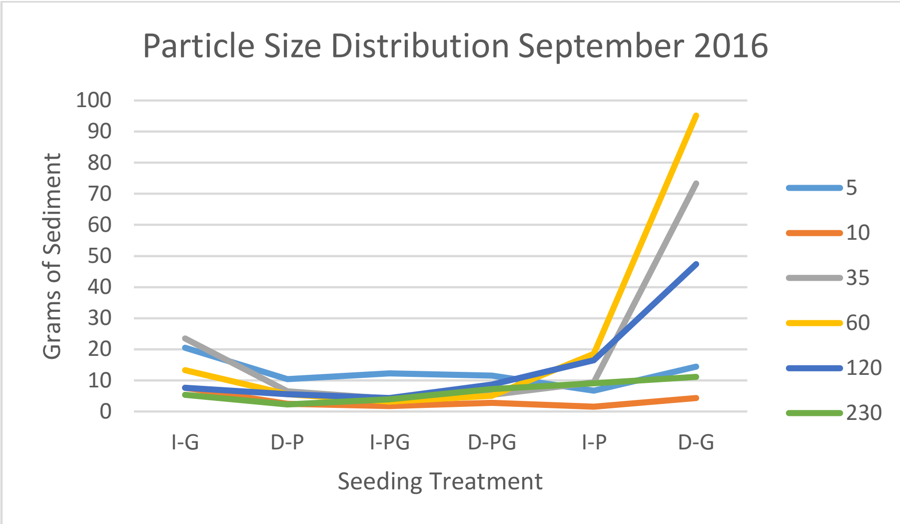



*Figure 18. September 2016 data show the imprint/gravel and drill/gravel treatments with more of all sediment sizes than other treatments.*

| Table 9. Particle Size Distribution by Treatment September 2017 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Grams of Sediment in Each Treatment | | | | | |
| Soil Sieve Mesh # | Texture | I-G | D-P | I-PG | D-PG | I-P | D-G |
| 5 | Gravel | 3.2 | 0.6 | 0.3 | 1.2 | 7.65 | 29.8 |
| 10 | Fine gravel | 2.9 | 1.3 | 0.6 | 0.8 | 11.1 | 33.7 |
| 35 | Coarse sand | 36.7 | 8.1 | 1.1 | 3.25 | 13.1 | 37.75 |
| 60 | Medium sand | 20.7 | 1.45 | 0.65 | 1.8 | 5.85 | 21.15 |
| 120 | Fine sand | 6.75 | 2.8 | 0.4 | 0.85 | 6.6 | 12.275 |
| 230 | Silt/Clay | 1.35 | 2.9 | 0.1 | 0.5 | 1.05 | 3.35 |
| | Totals | 71.6 | 23.035 | 3.15 | 8.4 | 45.35 | 138.025 |

*Table 9. Particle size distribution by treatment September 2017.*

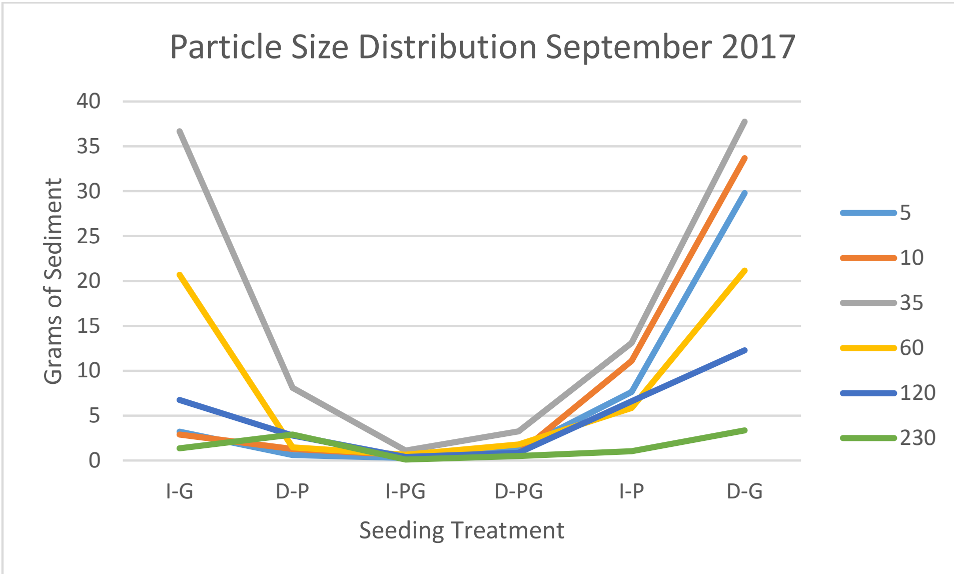



*Figure 19. September 2017 data show the imprint/gravel and drill/gravel treatments with more of all sediment sizes than the other treatments, followed by imprint/pecan and drill/pecan. The more complex the mulch treatment, the more sediment is captured.*

Figure 20 (column) displays the same data as Figure 19 (line). Where the line graph shows the gravel treatments capturing a range of sediment sizes because they were not sorted out by the treatments, the column graph reveals a bell-shaped distribution for the gravel treatments (and the imprint/pecan treatment), indicating the same ratios of particle size as pre-treatment. The other treatments have flattened out or shifted in particle size concentration showing the treatment at work to capture sediment.

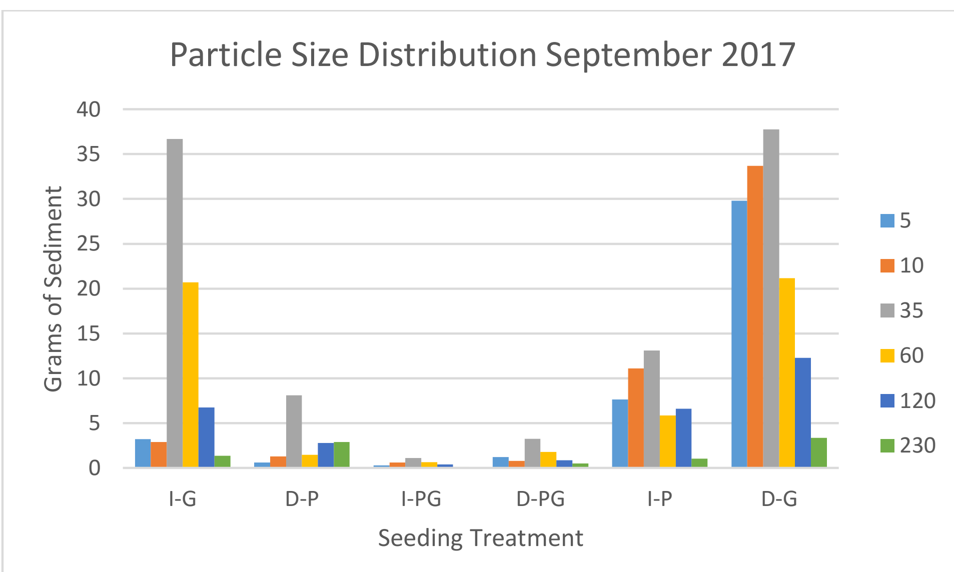



*Figure 20. The September 2017 data shown in Figure 15 are displayed as a column graph. In this visual the dominant sediment size classes can be seen for each treatment.*

The 5/2/2017 data collection included the control plot located outside the wildlife exclosure. Total sediment captured for the control was 637 grams of sediment. Sediment capture for the treatments ranged from 4.9 to 39 grams of sediment (Figure 21). The drill/pecan data point was exceedingly high (1003.5 gm) and was not explained and prevented graphing of this data in a meaningful way. There were no rainfall events within several weeks of the data collection date. The particle size distribution of the control plot sediment is shown in Figure 22. The distribution pattern is similar to that seen on the treatments but the amount of sediment is many times greater.

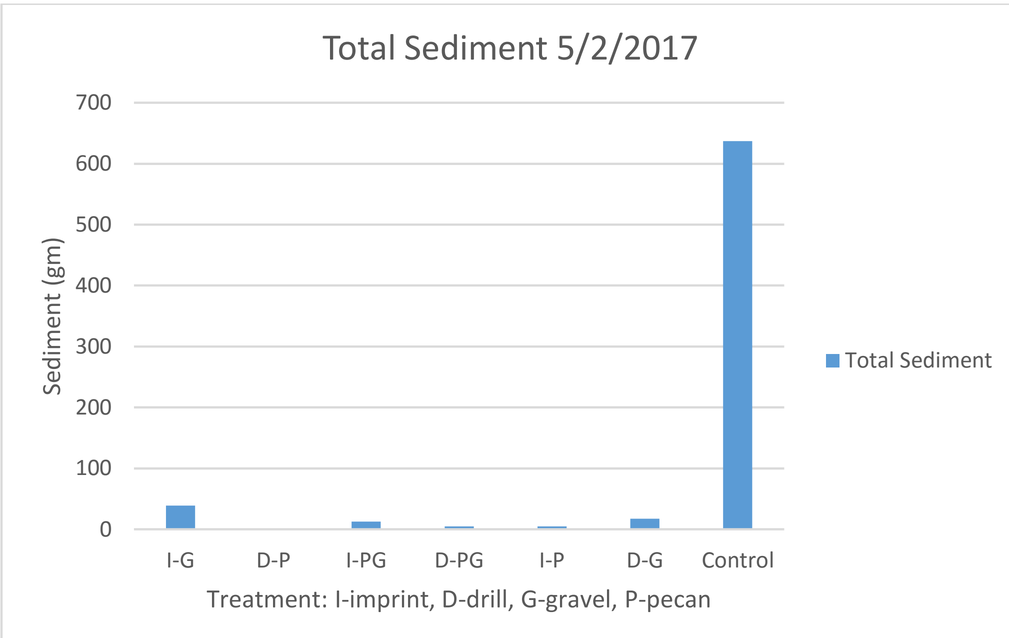



*Figure 21. The control plot was sampled in May 2017 to compare total sediment among treatment.*

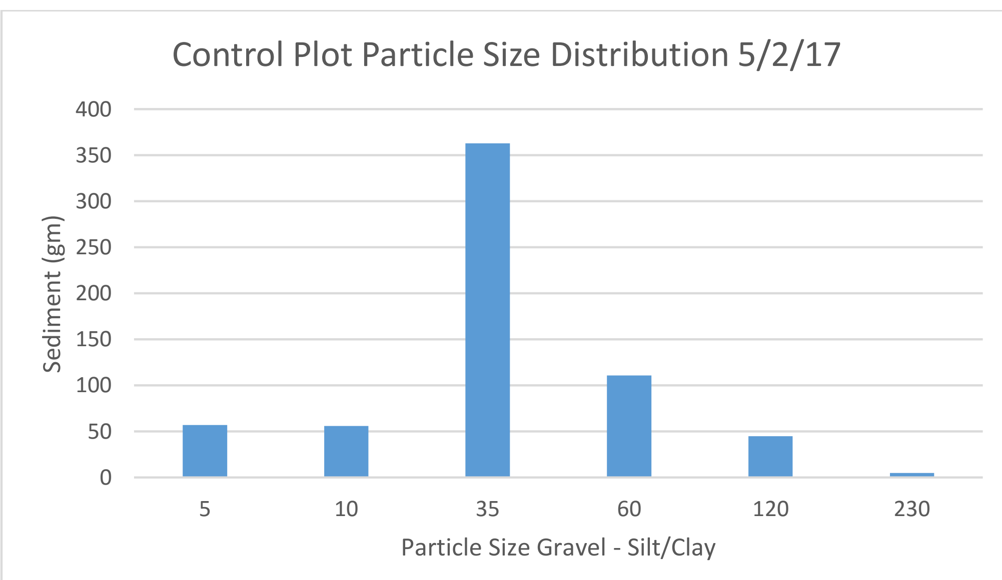



*Figure 22. Control plot sediment was dominated by coarse sand.*

## Comparison of Treatments

The average sediment capture (all particle sizes combined) for each treatment and sampling period is displayed in Table 8. Data were compared across years to examine treatment effects. Note that one data point is in question due to the extremely large values. Sampling periods were used as a subsample to construct paired comparisons in Table 9. The Student's T Test utilized 2 tails and unequal variances.

| Table 10. Total Sediment Capture by Treatment by Year | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Plot 1 Avg. | Plot 2 Avg. | Plot 3 Avg. | Plot 4 Avg. | Plot 5 Avg. | Plot 6 Avg. | Control |
| | I-G | D-P | I-PG | D-PG | I-P | D-G | |
| 9/16/2016 | 77.9 | 32.8 | 26.75 | 40.55 | 61.65 | 245.85 | |
| 11/22/2016 | 69.1 | 20 | 15.15 | 12.35 | 32.6 | 32.95 | |
| 5/2/2017 | 39 | * | 13 | 4.9 | 5.15 | 17.65 | 637 |
| 9/8/2017 | 71.6 | 23.035 | 3.15 | 8.4 | 45.35 | 138.025 | |
| | | | | | | | |
| 5/2/2017 | | 1003.5* | | | | | |
| *Aberrant data point; # appears to be real but is so much larger than the rest of the data set that it cannot be graphed. | | | | | | | |

*Table 10. Total sediment capture by treatment by year.*

| Table 11. Comparison Between Paired Treatments | | | | |
|---|---|---|---|---|
| Comparison | | P, 2 tails, unequal var. | Result | Interpretation |
| Imprint - Gravel | Imprint - Pecan | 0.108 | I-G>I-P | Pecan is more efficient on imprinted plots. |
| Drill - Gravel | Drill - Pecan | 0.214 | D-G>D-P | Pecan is marginally more efficient on drilled plots. |
| Drill – Gravel Pecan | Imprint – Gravel Pecan | 0.83 | No Dif. | No difference detected between drilled and imprinted treatments when both mulches are used. |
| Imprint - Gravel | Drill - Gravel | 0.47 | No Dif. | No difference detected between drilled and imprinted treatments when gravel mulch is used. |
| Imprint - Pecan | Drill - Pecan | 0.438 | No Dif. | No difference detected between drilled and imprinted treatments when pecan branch mulch is used. |

*Table 11. Comparison between paired treatments.*

These data indicate that there is no advantage between drilling and imprinting. When examined within tillage treatment, pecan branch mulch performed significantly better on imprinted plots ($P <= 0.108$) and somewhat better on drilled plots ($P <= 0.21$).

# SUMMARY

## Total Sediment

Data analyses showed more sediment being captured in the east traps than in the south traps. Overland flow comes in from both north and west directions. The surface flow coming from the north is impeded by a two-track road on the north side. There was less sediment capture in 2017 than in 2016; July 2017 included an extraordinarily large rainfall event. The reduced sediment capture in 2017 indicates that the treatments overall are working and sheet flow is being reduced.

Sediment traps located on imprinted plots captured more sediment than traps located on drilled plots and south traps captured more sediment than east traps. There is an inverse relationship between sediment capture in the trap and function of the treatment to capture sediment. Therefore the data indicate that drilled plots may function more efficiently than imprinted plots to reduce surface flow.

Treatments with combined mulch (gravel and pecan) tended to capture less sediment than treatments with gravel alone or pecan alone. The relationship of sediment capture to treatment effectiveness is inverse so it appears that the more complex mulches did a better job of mitigating surface flow than single mulch applications.

The 5/2/2017 data collection included the control plot located outside the wildlife exclosure. Total sediment captured for the control was 637 grams of sediment. Sediment capture for the treatments ranged from 4.9 to 39 grams of sediment. So, compared to the control, any effort to mitigate surface flow is better than doing nothing.

## Particle Size Distribution

September 2016 and September 2017 data were compared to examine particle size. For each sample period the east sediment traps collected more sediment than the south sediment traps in each particle size category. Sediment in the east traps was dominated by particle sizes 35 (coarse sand) and 60 (medium sand) while sediment in the south traps was dominated by the 60 and 120 (fine sand) mesh size. The south traps captured nearly twice as much gravel as the east traps.

Both imprint/gravel and drill/gravel treatments captured more sediment in each particle size category than the other treatments indicating that they were the least efficient in mitigating surface flow. Treatments with pecan branches had lower sediment captures indicating the effectiveness of pecan branches to slow down surface flow and settle sediment across the plot. Treatments with both gravel and pecan branches were even more efficient in slowing down surface flow.

Data also show the finer size particles as the smaller portion of the captured sediment. More gravel (mesh size 5) was captured than silt/clay (mesh size 230) in September 2016 and September 2017. These results are counter intuitive because one would expect gravel to drop out of surface flow pathways first. The September sample sessions follow post monsoon rainfall events that were large enough to carry gravel in surface flow. Hence, gravel would end up in the sediment traps along with finer sediments.  If the sediment traps are not monitored in a timely manner, the samples dry out and the finer sediments blow away leaving a concentration of gravel.

## Final recommendations:

- Even though plots were mostly 0% slope we still saw an effect of north/south versus east/west placement of sediment traps with the east traps capturing more flow.  This is likely because the north/south flow was cut off by a two-track road.
- Drilled plots appear to be more efficient in mitigating surface flow than imprinted plots.
- The more complex mulches provided better mitigation for surface flow.
- All treatments performed vastly better than the control for mitigating surface flow.

Observations gathered from this study and combined with observations from the partner grass seed study (Cockman 2017) indicate that a simple practice like distributing tree branches on bare ground will contribute significantly to slowing surface water flow and sheet erosion.  The woody material also has the benefit of hosting termites which are the decomposers in desert ecosystems (MacKay et al. 1989.).

## REFERENCES CITED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MacKay WP, Zak JC, Whitford WG. 1989. The natural history and role of subterranean termites in the northern Chihuahuan Desert. Special Biotic Relationships in the Arid Southwest. :53-77. https://jornada.nmsu.edu/biblio/natural-history-and-role-subterranean-termites-northern-chihuahuan-desert.

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Weather Underground. https://www.wunderground.com for Safford, AZ. Data compiled from queries by the month and year.

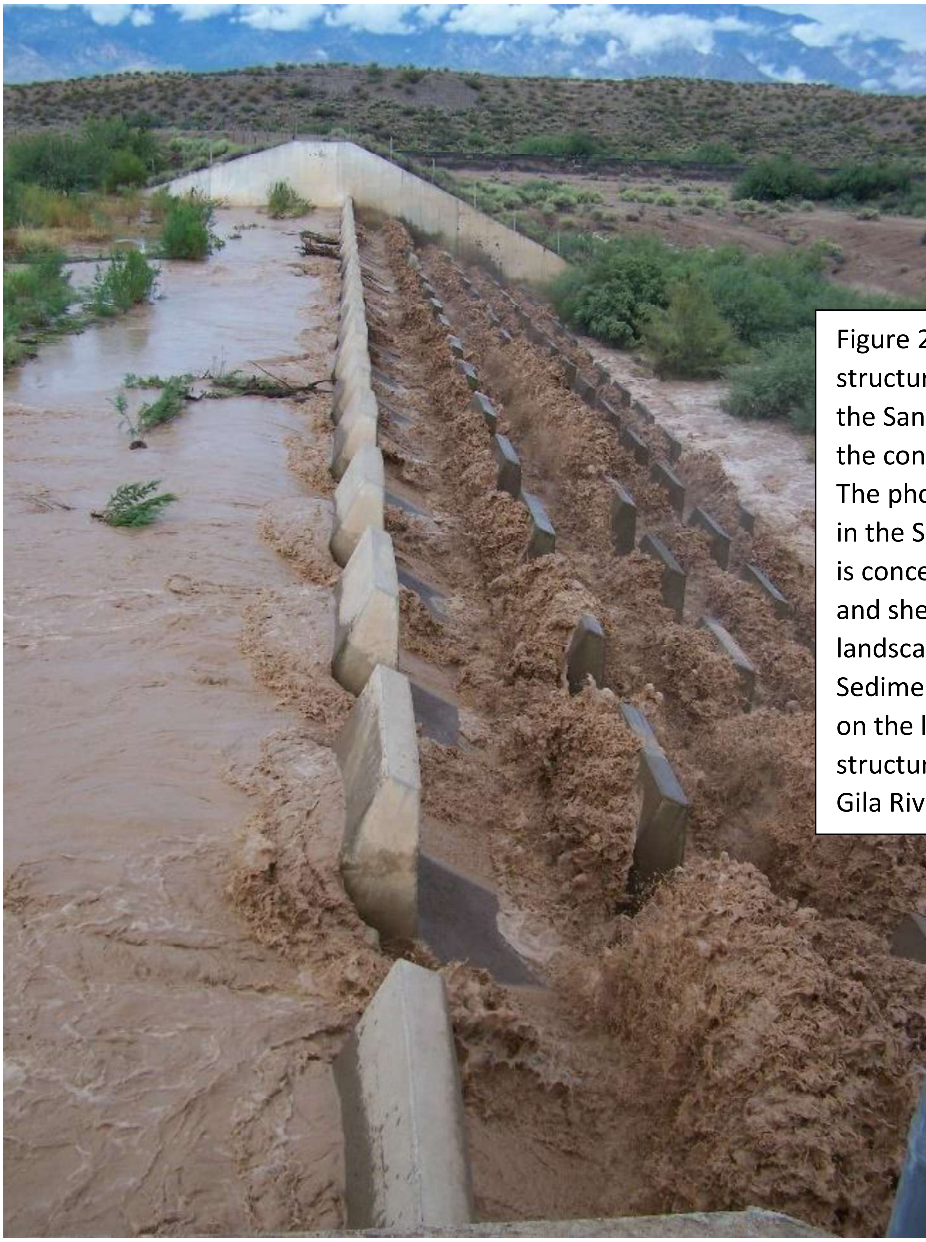

Figure 23. This water control structure sits at the lower end of the San Simon Valley just above the confluence with the Gila River. The photo shows ephemeral flow in the San Simon River. This flow is concentrated from surface flow and sheet erosion from across the landscape in the San Simon Valley. Sediments that are not captured on the land or by upstream structures, are deposited into the Gila River.

*Figure 23. Just one more.*

# APPENDIX A

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## Henson Sediment Trap (HST) Protocol

Henson Sediment Traps (HST) are designed to slow down a portion of moving channel flow and the sediment they carry from upland run-off. The HST can also be used to monitor erosion amounts running off treated plots within a project site. The results produced will be by particle size and mass. When used with fixed rain gauges with in the project dimensions, ratios can be established between amounts of different particle mass and volume of precipitation.

HSTs must be firmly anchored in the wash beds or flow channels so as not to be moved or stripped from their designated monitoring position. There original position should be related to physical evidence that the flow will pass into the HST.

Needed for each HST are the following materials: Six 2' screed stakes, four 8"x 8" x 16" cinder blocks, one piece of 4' x 1.5' plywood or exterior paneling for catchment base, 3" wood screws and large nails, two 4' long boards (2"x 4"). Approximate cost for each trap is $28.

Sediment traps can be set based upon a time factor or by precipitation events/amounts. The sediment trap catchment is very close to being the same volume per trap (1.185 cubic feet). To measure results, the sediment is carefully removed from the trap using shovel, whisk broom and dust pan. The catchment base should be cleaned of material the best it can. Sediment materials are stored in any container that is labeled with the site, trap #, and date. Sediment containers are then emptied into a sieve with various mesh sizes to determine size and amounts of each. Once separated each mesh size can be weighed using a digital spring scale in grams.

Sieve mesh openings are as followed: #5 mesh.. gravel.. .51" opening
#10 mesh..fine gravel... .07125" opening
#35 mesh..coarse sand... .0173" opening
#60 mesh..medium sand...0092" opening
#120 mesh..fine sand... .0047" opening
#230 mesh.. silt/clay.. .0029" opening

When traps have been out in the sun for a period of time without a local precipitation event, sediments removed would not need to be dried. The collector will be able to observe lack of moisture in the catchment base. However, if one is collecting sediments with noticeable dampness, it would be best to allow the samples to dry or placed in a drying oven before weighing.