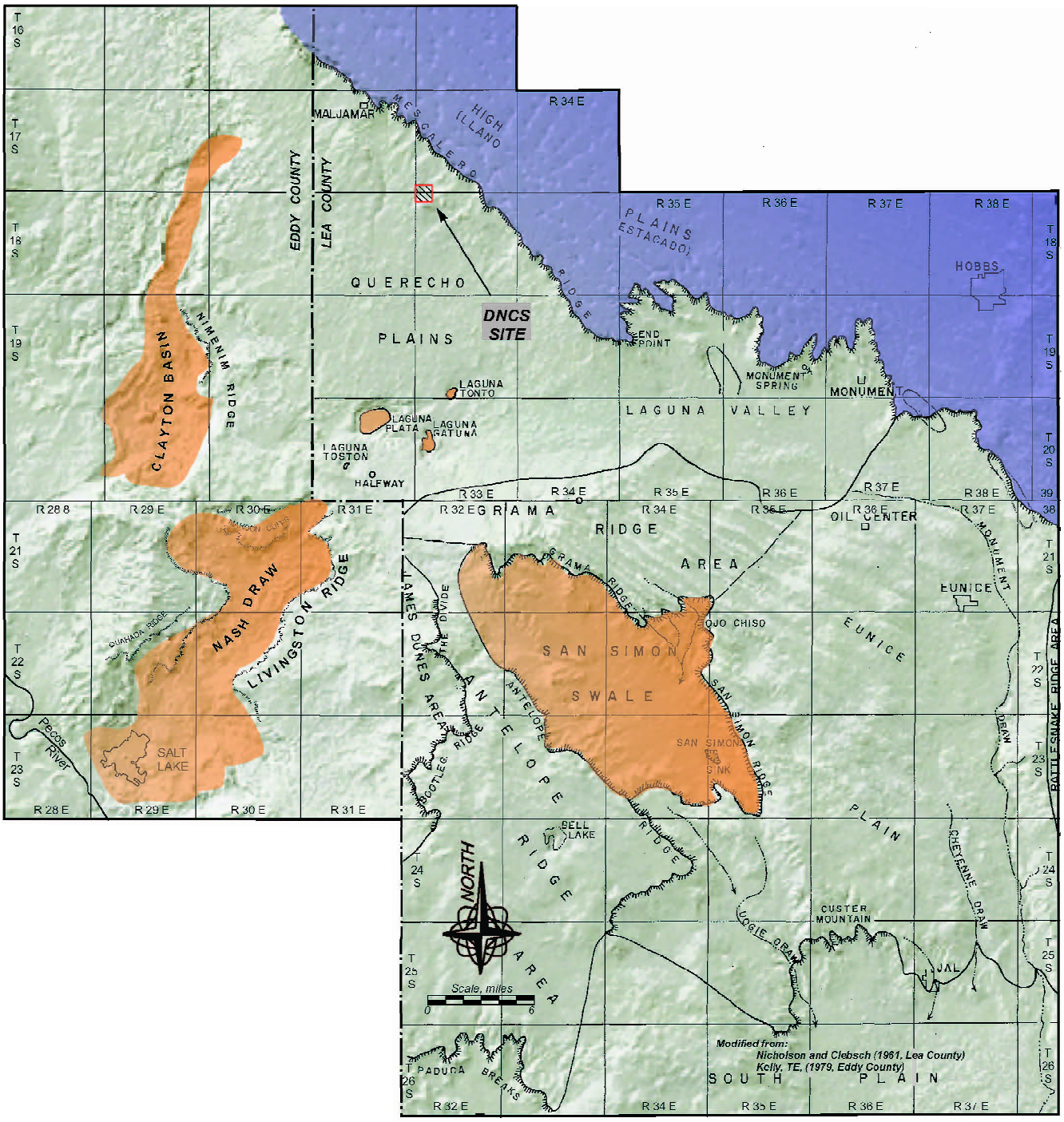
NM1-57

Revised Permit Application

June 2014

Volume 4, Part 2 of 3: Siting and Hydrogeology



PHYSIOGRAPHY OF SOUTHERN LEA COUNTY AND EASTERN EDDY COUNTY

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/31/2013	CAD: PHYSIOGRAPHY.dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.1.9
APPROVED BY: IKG	gei@gordonenvironmental.com	

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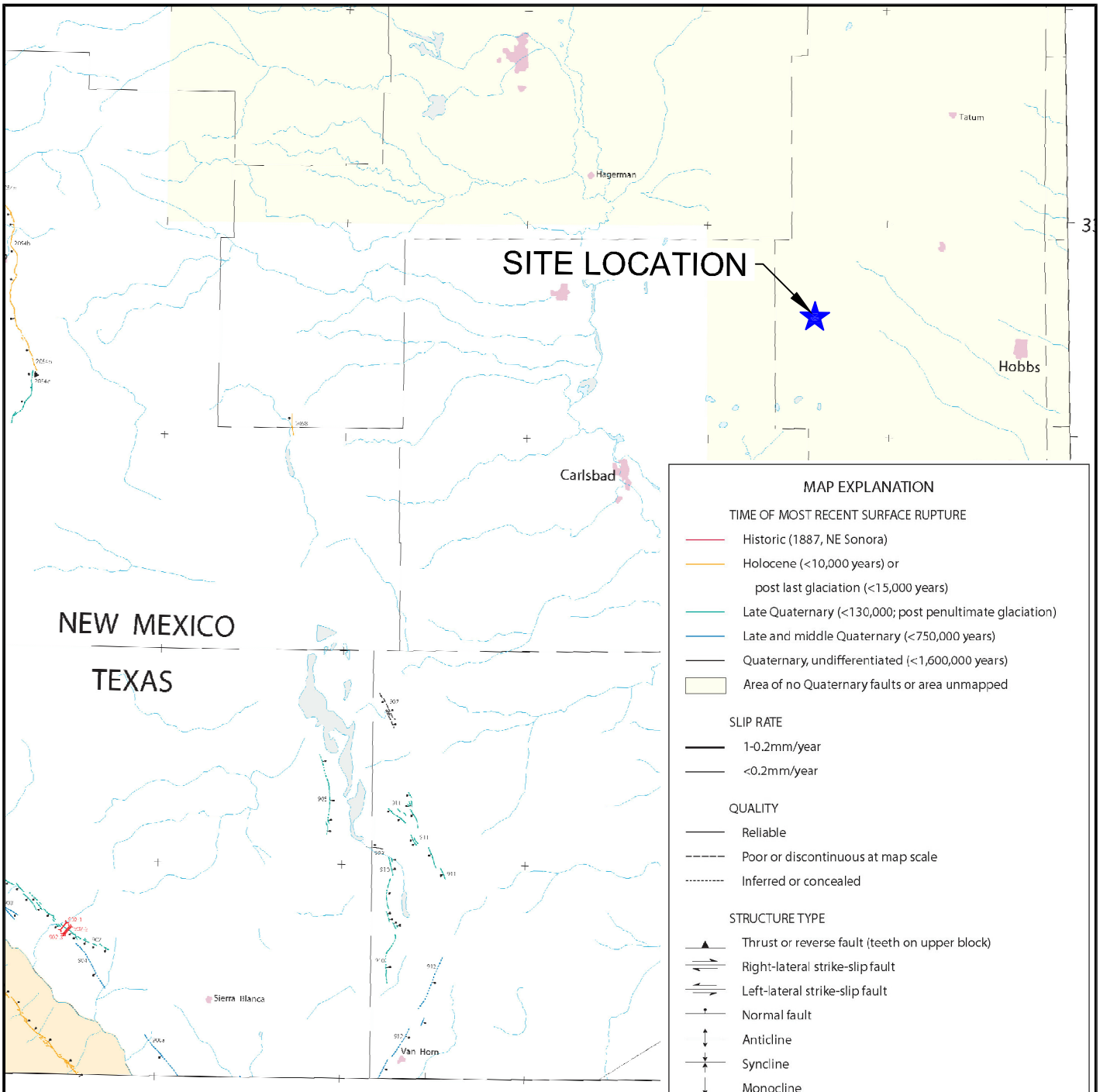

MAP EXPLANATION

TIME OF MOST RECENT SURFACE RUPTURE

- Historic (1887, NE Sonora)
- Holocene (<10,000 years) or post last glaciation (<15,000 years)
- Late Quaternary (<130,000; post penultimate glaciation)
- Late and middle Quaternary (<750,000 years)
- Quaternary, undifferentiated (<1,600,000 years)
- Area of no Quaternary faults or area unmapped

SLIP RATE

- 1-0.2mm/year
- <0.2mm/year

QUALITY

- Reliable
- Poor or discontinuous at map scale
- Inferred or concealed

STRUCTURE TYPE

- Thrust or reverse fault (teeth on upper block)
- Right-lateral strike-slip fault
- Left-lateral strike-slip fault
- Normal fault
- Anticline
- Syncline
- Monocline
- Plunge direction

OTHER SYMBOLS

- 913-1 Site of trench across fault
- Location of fault section boundary

★ SITE LOCATION

FAULT DATA FROM:
USGS Open File Report OFR 98–521 (digital version)
Map of Quaternary faults and folds in New Mexico and adjacent areas, 1998, by Michael N. Machette, Stephen F. Personius, Keith I. Kelson. Kathleen M. Haller, and Richard L. Dart.

NORTH

0 12 24 MILES

QUATERNARY FAULTS MAP

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

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213 S. Camino del Pueblo
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Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/11/2013	CAD: FAULTS.dwg	PROJECT #: 542.01.01
DRAWN BY: MLH	REVIEWED BY: DRT	FIGURE IV.1.10
APPROVED BY: IKG	gei@gordonenvironmental.com	

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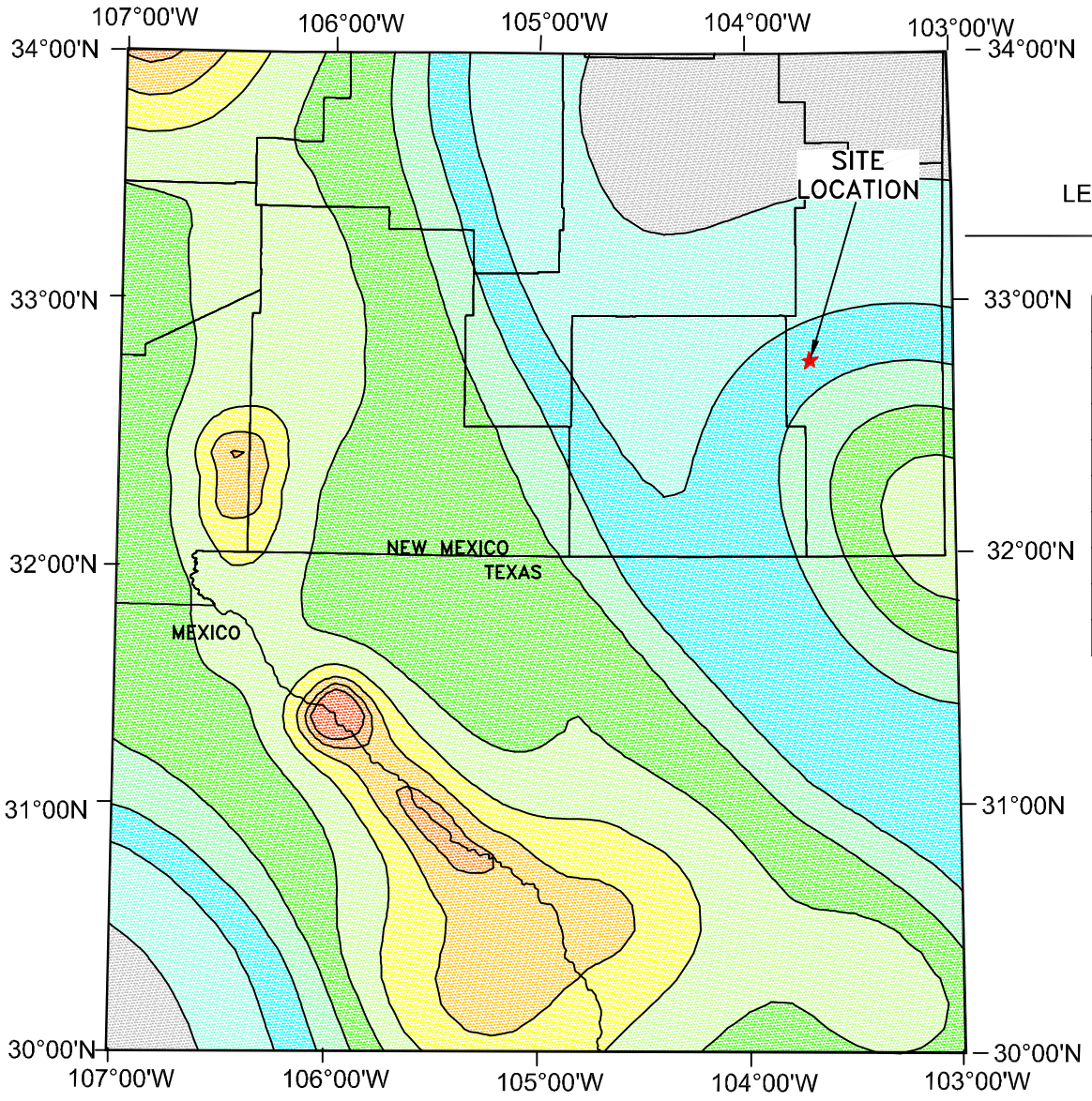
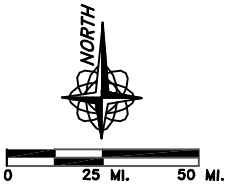


Peak Horizontal Ground Acceleration (g) with 10% Probability of Exceedance in 250 Years



NOTES:

1. SEISMIC DATA FROM: USGS NATIONAL HAZARD MAPPING PROJECT GIS DATA and Petersen, Mark D., Frankel, Arthur D., Harmsen, Stephen C., Mueller, Charles S., Haller, Kathleen M., Wheeler, Russell L., Wesson, Robert L., Zeng, Yuehua, Boyd, Oliver S., Perkins, David M., Luco, Nicolas, Field, Edward H., Wills, Chris J., and Rukstales, Kenneth S., 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008-1128, 61.

2. GEOGRAPHIC COORDINATES FOR THE CENTER OF THE SITE: 32.7828° N, 103.7026° W

3. Peak Horizontal Ground Acceleration (g) with 10% Probability of Exceedance in 250 Years For the Site = 0.0704 (g)

SEISMIC IMPACT ZONES MAP

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/11/2013	CAD: SEISMIC.dwg	PROJECT #: 542.01.01
DRAWN BY: MLH	REVIEWED BY: DRT	FIGURE IV.1.11
APPROVED BY: IKG	gei@gordonenvironmental.com	

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APPLICATION FOR PERMIT
DNCS ENVIRONMENTAL SOLUTIONS

VOLUME IV: SITING AND HYDROGEOLOGY
SECTION 1: SITING CRITERIA

ATTACHMENT IV.1.A

WATERCOURSES, FLOODPLAINS, AND WETLANDS INVESTIGATION

(ROCKY MOUNTAIN ECOLOGY 05/09/2013)

WATERCOURSES, FLOODPLAINS, AND WETLANDS INVESTIGATION

FOR A SURFACE WASTE MANAGEMENT FACILITY ON 562 ACRES IN PORTIONS OF SECTION 31, TOWNSHIP 17 SOUTH, RANGE 33 EAST, AND SECTION 6, TOWNSHIP 18 SOUTH, RANGE 33 EAST, LEA COUNTY, NM FOR DNCS PROPERTIES, LLC

PREPARED FOR:

GORDON ENVIRONMENTAL, INC.
213 S. CAMINO DEL PUEBLO
BERNALILLO, NM 87004

PREPARED BY:

ROCKY MOUNTAIN ECOLOGY, LLC
5 ALCALDE ROAD
SANTA FE, NM 87508

WATERCOURSES, FLOODPLAINS, AND WETLANDS INVESTIGATION

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213 S. CAMINO DEL PUEBLO
BERNALILLO, NM 87004

PREPARED BY:

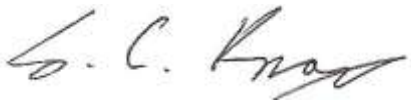
ROCKY MOUNTAIN ECOLOGY, LLC
5 ALCALDE ROAD
SANTA FE, NM 87508

PREPARATION DATE:

MAY 9, 2013

INVESTIGATOR/S:

SHAWN C. KNOX, M.S., C.W.B
DIRECTOR, ROCKY MOUNTAIN ECOLOGY, LLC



Signature

Table of Contents

1.0. INTRODUCTION

This document describes results of an investigation for presence and extent of watercourses, floodplains and wetlands on a ± 562-acre a tract of land in Lea County, New Mexico (NM). The property is owned by DNCS Properties, LLC (DNCS Site). DNCS plans to pursue a permit, issued by the Oil Conservation Division of the New Mexico Energy, Minerals, and Natural Resources Department (OCD), for a "Surface Waste Management Facility" per the Oil & Gas Rules (19.15.2.7.S(11) NMAC). The permit would authorize establishment of an oil and gas waste landfill, and processing facilities. As a proposed Surface Waste Management Facility, the DNCS Site would be subject to the siting requirements set forth in 19.15.36.13(A-C) NMAC. This report specifically addresses those requirements in 19.15.36.13.B, excluding "existing wellhead protection areas."

> *SITING AND OPERATIONAL REQUIREMENTS APPLICABLE TO ALL PERMITTED SURFACE WASTE MANAGEMENT FACILITIES: Except as otherwise provided in 19.15.36 NMAC.*
>
> *B. No surface waste management facility shall be located:*
> *(1) within 200 feet of a watercourse, lakebed, sinkhole or playa lake;*
> *(2) within an existing wellhead protection area or 100-year floodplain;*
> *(3) within, or within 500 feet of a wetland.*

The DNCS Site is located in portions of Section 31, Township 17 South, Range 33 East, and Section 6, Township 18 South, Range 33 East. The project area occurs on the Dog Lake, NM U.S. Geological Survey (USGS) 7.5-minute quadrangle map (Figures 1-3).

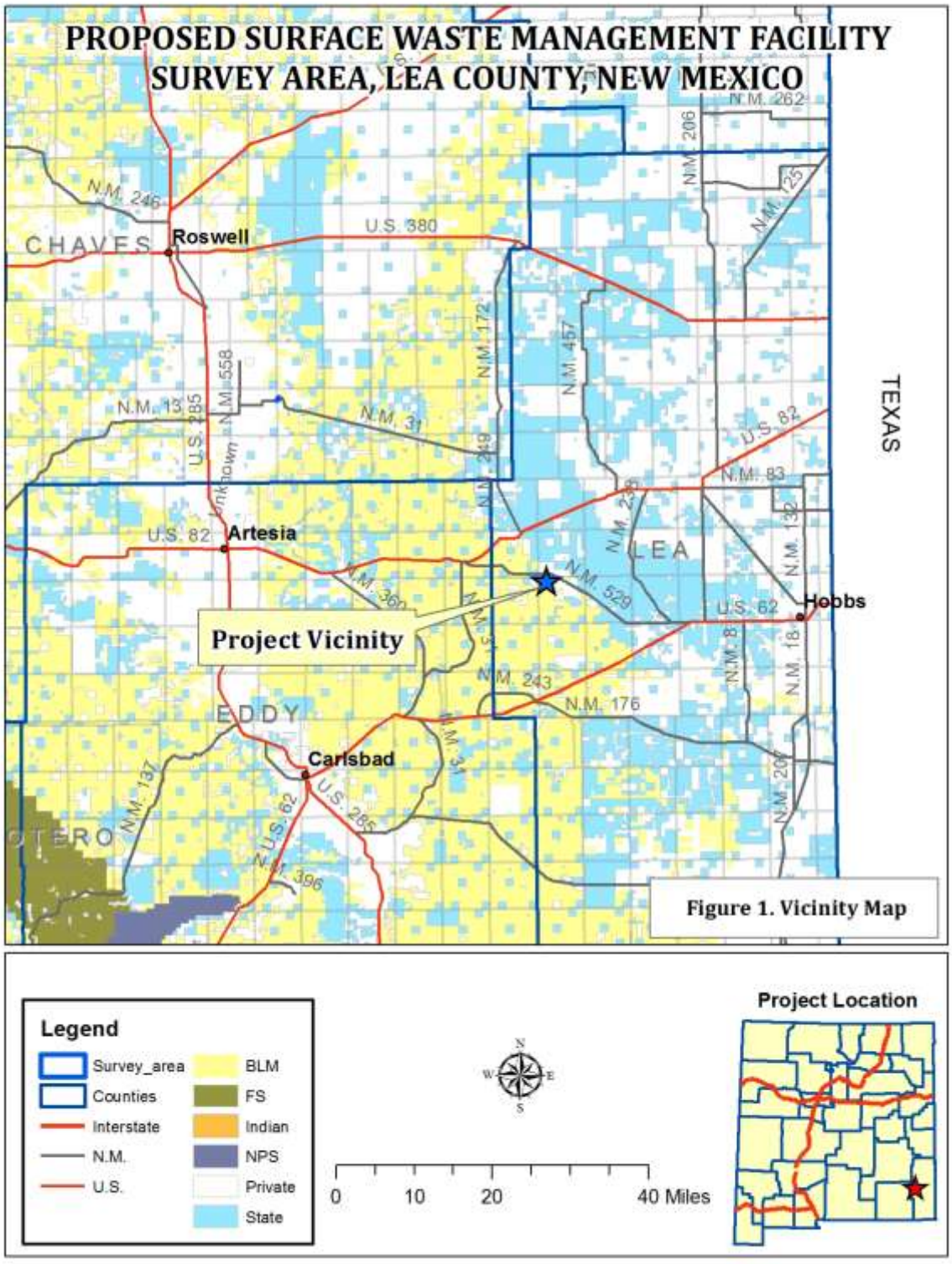


Figure 1. Vicinity Map

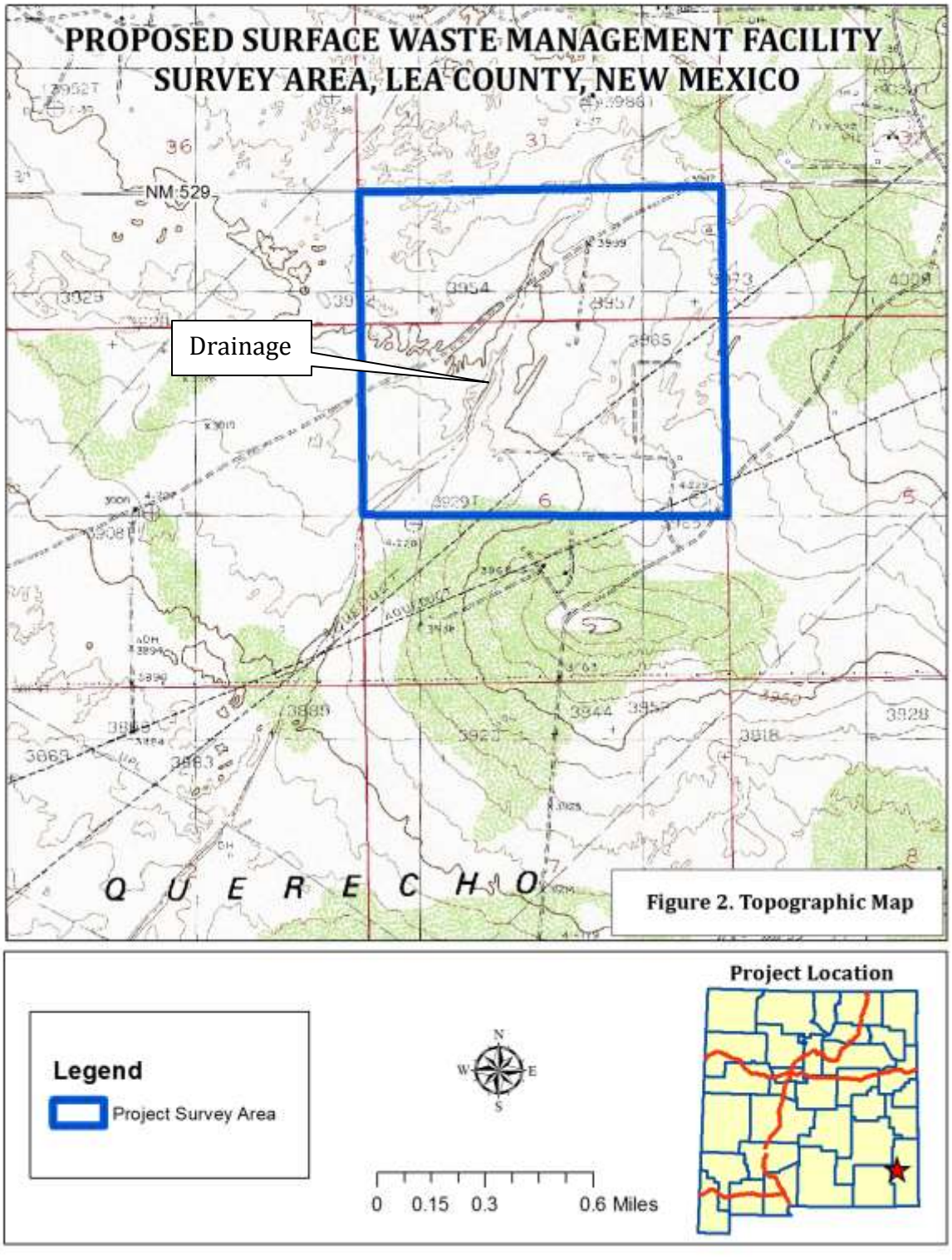


Figure 2. Topographic Map

Figure 3. Aerial Photo

2.0 METHODS

Shawn C. Knox, from Rocky Mountain Ecology, LLC (RME) conducted a field survey of the DNCS Site on 29-30 April 2013. Portions of the property were inspected through vehicular survey and others via a pedestrian survey (Appendix A. Photos). Prior to the field survey, topographic maps and US Department of Agriculture (USDA) National Agricultural Imagery Program (NAIP) ortho-photography were evaluated to ascertain where depressions exist on the landform which could channel or pond water. Further, the National Wetland Inventory (NWI) (http://www.fws.gov/wetlands/data) and USDA Natural Resource Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov) databases were queried to gather existing data on potential wetlands and wetland soils that could occur. Moreover, the National Hydrography Dataset (NHD)(USGS 1999) was assessed in a Geographical Information System (GIS) to gather data regarding watercourses in the project area. Finally, the Federal Emergency Management Agency (FEMA) Map Service Center database (https://msc.fema.gov) (FEMA 2013), and Lea County Floodplain Administrator were consulted for information regarding the 100-year floodplain. A search for watercourses, lakebeds, sinkholes, playa lakes, wetlands and floodplains was conducted in the field.

3.0 GENERAL ENVIRONMENTAL SETTING

The project area occurs within the Shinnery Sands subregion of the High Plains Ecoregion (Griffith, et. al 2006). "The Shinnery Sands subregion includes sand hills and dunes as well as flat sandy recharge areas. These sand beds lie at the western edge of the High Plains where winds rising onto the plateau drop the heavier sand grains and carry the finer material further east onto the flat expanse of the Llano Estacado (25i). These dunes serve as a major recharge area for the Pecos River" (Griffith et al 2006).

The project area is located within the eight-digit Hydrologic Unit Code (HUC) #13010005 (USGS 1999). The specific twelve-digit watershed that encompasses the DNCS Site is the Williams Sink basin, HUC # 130600111501. This is a closed basin watershed according to the NHD (USGS 1999) (Figure 4). Water within the Williams Sink basin percolates into the groundwater table and does not directly exit the watershed boundary via surface runnoff. Surface runnoff through the DNCS Site flows in a southwestern direction.

The DNCS Site is located within the Plains-Mesa Scrub vegetation type as defined by Dick-Peddie (1993). Dominant plant species include shin oak (*Quercus havardii*), sand sage (*Artemesia filifolia*) and various species of dropseeds (*Sporobolus* spp.).

The project area is located on slopes ranging from 0 to 15 percent. Elevation above sea level within the project area ranges from 3,995 to 3,917 ft above sea level in the Northeast and Southwest portions, respectively. The warmest average daily maximum temperature in Maljamar, NM occurs in July at 98.0 degrees Fahrenheit (°F); while the coldest average daily minimum temperature of 59.0 °F occurs in December and January. Annual precipitation averages 16.27 inches (in) (The Weather Channel 2013).

The soil map units represented in the project area are the SR—Simona-Upton association(0-3% slopes), PY—Pyote soils and dune land (0-3% slopes), and PU—Pyote and maljamar fine sands (0-3%), . MN—Midessa and wink fine sandy loams (0-3%), KM—Kermit soils and dune land, (0 to 12%

slopes), and BE—Berino-Cacique loamy fine sands (0-3% slopes) (USDA-NRCS 2013). No hydric soils are present; nor is ponding probable on any of the soils in the project area (Appendix B). All soils within the project area are labeled as excessively drained or well drained. Moreover, depth to water table across the project area is greater than 200 centimeters (USDA-NRCS 2013). Detailed information regarding soil characteristics is located in Appendix B.

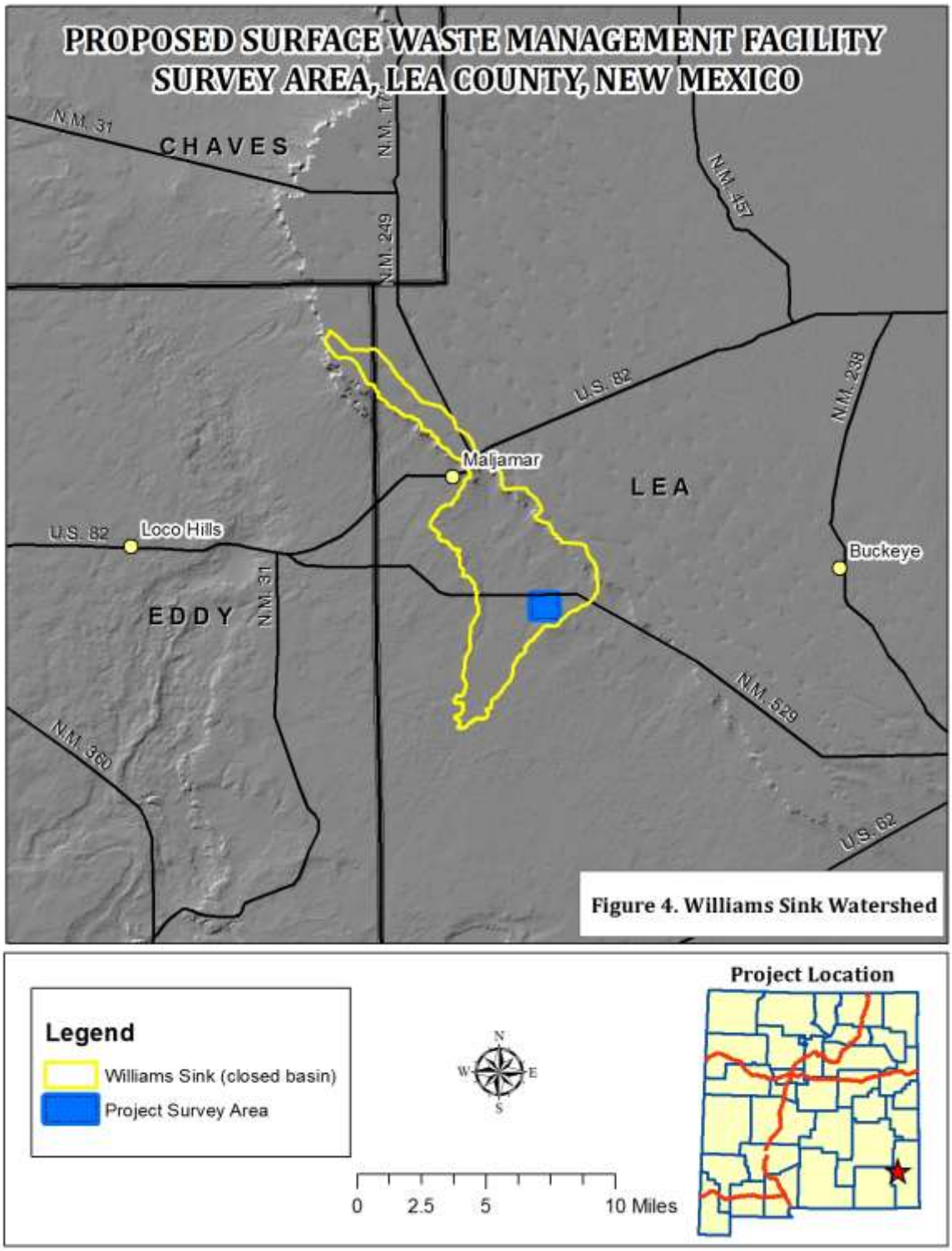


Figure 4. Williams Sink Watershed

4.0 RESULTS

4.1 Watercourses

One noteworthy, un-named ephemeral drainage flows from the Northeast, to the Southwest corner of the DNCS Site (Figure 2). No surface water was located within this drainage during the field survey. The Oil & Gas Rules define a "watercourse" as a "*river, creek, arroyo, canyon, draw or wash or other channel having definite banks and bed with visible evidence of the occasional flow of water*" (19.15.27.W(4) NMAC). Based on the field investigation, the un-named ephemeral drainage identified within the site may be a defined as a watercourse, as it does have definite banks and a bed with visible evidence of occasional water flow.

The U.S. Army Corps of Engineers (USACE) was not consulted regarding a preliminary jurisdictional determination (PJD) via this scope of work. However, it appears there is no possibility that any Waters of the U.S., as defined by the USACE, occur within the project boundary. There is no possibility that the subject drainage described above, could provide "interstate commerce."

A pipeline is located on the surface in the bottom of this drainage. Based on the USGS (1999), the DNCS Site is located entirely within the Williams Sink closed basin. Accordingly, runnoff from this site drains to the Southwest, beyond the property boundary, ultimately percolating into the ground within the basin boundary (Figure 4). Further, two aqueducts are located across the southeast portion of the DNCS property, as depicted in Figure 2.

4.2 100-Year Floodplain

The FEMA Map Service Center database indicated that the project area has not been mapped for floodplain occurrence. However, the Lea County Floodplain Administrator, Cassie Corely, indicated that the DNCS Site does is not located within a floodplain (Lea County 2013) (Appendix C).

4.3 Lakebeds

No lakebeds were observed on the property during the field survey.

4.4 Playa lakes

No playa lakes were observed on the property during the field survey. The region contains thousands of playa lakes, though the DNCS Site does not contain any based on NHD data (USGS 1999) and the field survey.

4.5 Sinkholes

No sinkholes were observed on the property during the field survey.

4.6 Wetlands

The DNCS Site was evaluated in the field for the presence of some wetland indicators (i.e., hydrophytic vegetation and wetland hydrology) by RME during the field surveys. The NWI database, pre-survey review indicated that the main drainage (described in Section 4.1 and depicted in Figure 2) is classified as a "dry wash/ arroyo"(USDI-FWS 2013). Jim Dick, from the

USFWS, indicated on 6 May 2013, that this drainage is not a wetland (USDI-FWS 2013b) (Appendix C).

A formal, wetland delineation was not conducted on the DNCS property because it did not show signs of wetland occurrence, which could warrant a more detailed assessment. No signs of wetlands exist within the proposed area. No Facultative Wetland or Obligate Wetland plant species, as defined by the USACE (2012), were observed during the field survey, within the DNCS Site. One minor depression (~ 60 x 60 ft), was observed near the eastern project boundary (Appendix B - Photo 6). This depression contained a stand of vine mesquite (*Panicum obtusum*), rated as a "Facultative" species, according to the 2012 National Wetland Plant List (USACE 2012). However, this site did not show any signs of wetland occurrence, as described above, and does not warrant further assessment.

5.0 Discussion & Recommendations

The DNCS Site is located within the Williams Sink closed basin, according to the USGS (1999), and all surface runnoff percolates into the groundwater table within the basin boundary (Figure 4). From NHD data, it appears the basin is not connected to any other drainages. One main ephemeral wash drains in a southwesterly direction across the DNCS Site (Figure 2). To the best of my knowledge, based on field surveys and analysis of topographic maps and aerial photography, I (Shawn Knox) believe that no Waters of the U.S., as defined by the USACE, are located within the DNCS Site. If a definitive determination is desired, it is recommended that the USACE be contacted regarding an official PJD or Jurisdictional Determination (JD).

Based on the definition of a "watercourse", as defined by the Oil & Gas Rules (19.15.27.W(4) NMAC), the un-named ephemeral drainage identified within the site may be a defined as a watercourse. This drainage does have definite banks and a bed with visible evidence of occasional water flow.

No floodplains are located within the DNCS Site, based on the field survey and determination by the Lea County Floodplain Administrator (Appendix C).

No lakebeds or playa lakes were observed within the DNCS Site boundary, based on the field survey, and analysis of NHD data.

No sinkholes were observed on the property during the field survey.

No evidence of wetlands, as defined by the USACE, was observed during the field survey, or detected from the pre-survey soil analysis in the USDA-NRCS Web Soil Survey database.

6.0 REFERENCES

Dick-Peddie, W.A. 1993. New Mexico Vegetation: Past, Present, and Future. UNM Press.

Griffith, G.E., Omernik, J.M., McGraw, M.M., Jacobi, G.Z., Canavan, C.M., Schrader, T.S.,Mercer, D., Hill, R., and Moran, B.C., 2006. Ecoregions of New Mexico (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Lea County. 2013. Floodplain Administrator, Cassie Corely. Letter of Floodplain Determination. May 2013.

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USDA-FSA. 2011. Farm Service Agency. National Agricultural Imagery Program. NAIP 2011.

USDA-NRCS. 2013. Natural Resource Conservation Service Web Soil Survey database. Accessed May 2013.

USDI-FWS. 2013. US Fish and Wildlife Service. Personal communication with Jim Dick, Regional Wetlands Coordinator. May 6, 2013.

USDI-FWS. 2013b. US Fish and Wildlife Service National Wetland Inventory. Database accessed May 2013.

USGS 1999. National Hydrography Dataset. US Geological Survey.

APPENDICES
APPENDIX A - PHOTOS

Photo 1. View of drainage, facing to the Southwest from the North-Central portion of the property.

Photo 2. View of drainage from the central portion of the property.

Photo 3. View of pipeline, located in bottom of the subject drainage.

Photo 4. Representative view of the property, facing to the Northwest from the central portion of the property.

Photo 5. Typical view of a small sand blowout depression in the southeast portion which likely channels water during runnoff events.

Photo 6. View of minor depression with vine mesquite in the bottom, located near the western boundary.

Photo 7. View of the northeast portion of the property.

Photo 8. View of the south-central portion of the property, facing southeast.

Photo 9. View of the east-central portion of the property, facing east.

APPENDIX B – NRCS SOILS DATA

Lea County, New Mexico

BE—Berino-Cacique loamy fine sands association

Map Unit Setting

Landscape: Uplands
Elevation: 3,000 to 3,400 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 195 to 205 days

Map Unit Composition

Berino and similar soils: 50 percent
Cacique and similar soils: 40 percent

Description of Berino

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7c
Hydrologic Soil Group: B
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 6 inches: Loamy fine sand
6 to 60 inches: Sandy clay loam

Description of Cacique

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: Sandy (R042XC004NM)

Typical profile

0 to 12 inches: Loamy fine sand
12 to 28 inches: Sandy clay loam
28 to 38 inches: Cemented material

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Lea County, New Mexico

KM—Kermit soils and dune land, 0 to 12 percent slopes

Map Unit Setting

Landscape: Sandhills
Elevation: 3,000 to 4,400 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 195 to 205 days

Map Unit Composition

Dune land: 45 percent
Kermit and similar soils: 45 percent

Description of Kermit

Setting

Landform: Dunes
Landform position (two-dimensional): Shoulder, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex
Parent material: Calcareous sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 5 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very high (20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Sandhills (R042XC022NM)

Typical profile

0 to 8 inches: Fine sand
8 to 60 inches: Fine sand

Description of Dune Land

Setting

Landform: Dunes
Landform position (two-dimensional): Shoulder, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8e
Hydrologic Soil Group: A

Typical profile

0 to 6 inches: Fine sand
6 to 60 inches: Fine sand

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Lea County, New Mexico

MN—Midessa and wink fine sandy loams

Map Unit Setting

Landscape: Uplands
Elevation: 3,100 to 3,400 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Midessa (ratliff) and similar soils: 45 percent
Wink and similar soils: 40 percent

Description of Midessa (ratliff)

Setting

Landform: Plains
Landform position (three-dimensional): Dip
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Moderate (about 8.1 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability classification (irrigated): 4e
Land capability (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: Loamy (R042XC007NM)

Typical profile

0 to 4 inches: Fine sandy loam
4 to 22 inches: Clay loam
22 to 60 inches: Clay loam

Description of Wink

Setting

Landform: Plains
Landform position (three-dimensional): Dip
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous sandy alluvium and/or calcareous sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance
Land capability (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: Sandy (R042XC004NM)

Typical profile

0 to 12 inches: Fine sandy loam
12 to 23 inches: Sandy loam
23 to 60 inches: Sandy loam

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Lea County, New Mexico

PU—Pyote and maljamar fine sands

Map Unit Setting

Landscape: Uplands
Elevation: 3,000 to 3,900 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 200 days

Map Unit Composition

Maljamar and similar soils: 45 percent
Pyote and similar soils: 45 percent

Description of Pyote

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 30 inches: Fine sand
30 to 60 inches: Fine sandy loam

Description of Maljamar

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 40 to 60 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 5.6 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 24 inches: Fine sand
24 to 50 inches: Sandy clay loam
50 to 60 inches: Cemented material

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Lea County, New Mexico

PY—Pyote soils and dune land

Map Unit Setting

Landscape: Sandhills
Elevation: 3,000 to 4,400 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Dune land: 45 percent
Pyote and similar soils: 45 percent

Description of Pyote

Setting

Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 30 inches: Fine sand
30 to 60 inches: Fine sandy loam

Description of Dune Land

Setting

Landform: Dunes
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8e
Hydrologic Soil Group: A

Typical profile

0 to 6 inches: Fine sand
6 to 60 inches: Fine sand

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Lea County, New Mexico

SR—Simona-Upton association

Map Unit Setting

Landscape: Tablelands
Elevation: 3,000 to 4,000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Simona and similar soils: 50 percent
Upton and similar soils: 35 percent

Description of Simona

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 1.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: Shallow Sandy (R042XC002NM)

Typical profile

0 to 8 inches: Gravelly fine sandy loam
8 to 16 inches: Fine sandy loam
16 to 26 inches: Cemented material

Description of Upton

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 75 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 0.9 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: Shallow (R042XC025NM)

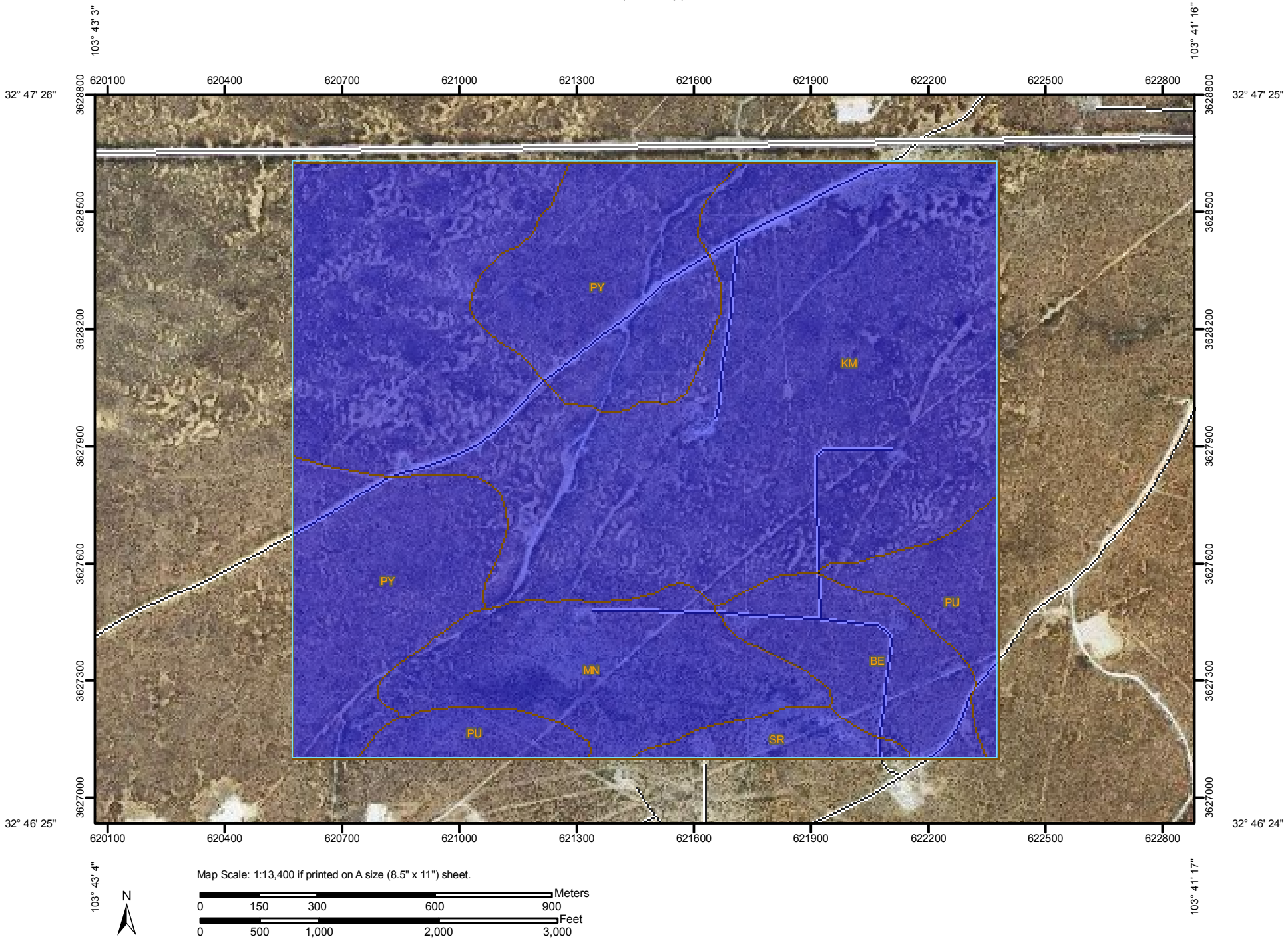
Typical profile

0 to 8 inches: Gravelly loam
8 to 18 inches: Cemented material
18 to 60 inches: Very gravelly loam

Data Source Information

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Depth to Water Table—Lea County, New Mexico
(Soil Map)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — Lea County, New Mexico (NM025)				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	>200	43.7	6.4%
KM	Kermit soils and dune land, 0 to 12 percent slopes	>200	363.4	53.4%
MN	Midessa and wink fine sandy loams	>200	73.3	10.8%
PU	Pyote and maljamar fine sands	>200	40.2	5.9%
PY	Pyote soils and dune land	>200	145.4	21.4%
SR	Simona-Upton association	>200	14.2	2.1%
Totals for Area of Interest			**680.2**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

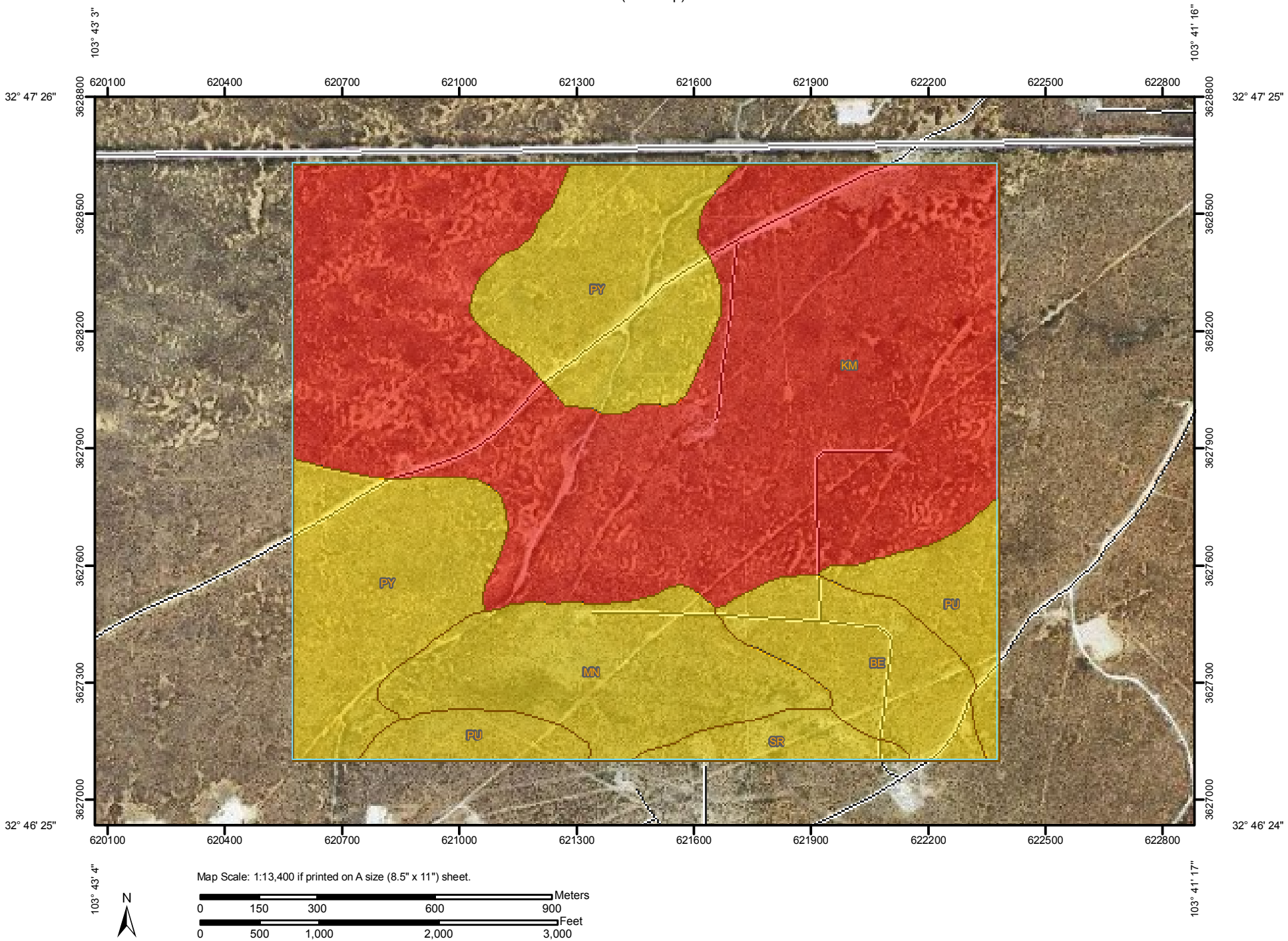
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Drainage Class—Lea County, New Mexico
(Soil Map)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Drainage Class

Drainage Class— Summary by Map Unit — Lea County, New Mexico (NM025)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	Well drained	43.7	6.4%
KM	Kermit soils and dune land, 0 to 12 percent slopes	Excessively drained	363.4	53.4%
MN	Midessa and wink fine sandy loams	Well drained	73.3	10.8%
PU	Pyote and maljamar fine sands	Well drained	40.2	5.9%
PY	Pyote soils and dune land	Well drained	145.4	21.4%
SR	Simona-Upton association	Well drained	14.2	2.1%
Totals for Area of Interest			**680.2**	**100.0%**

Description

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

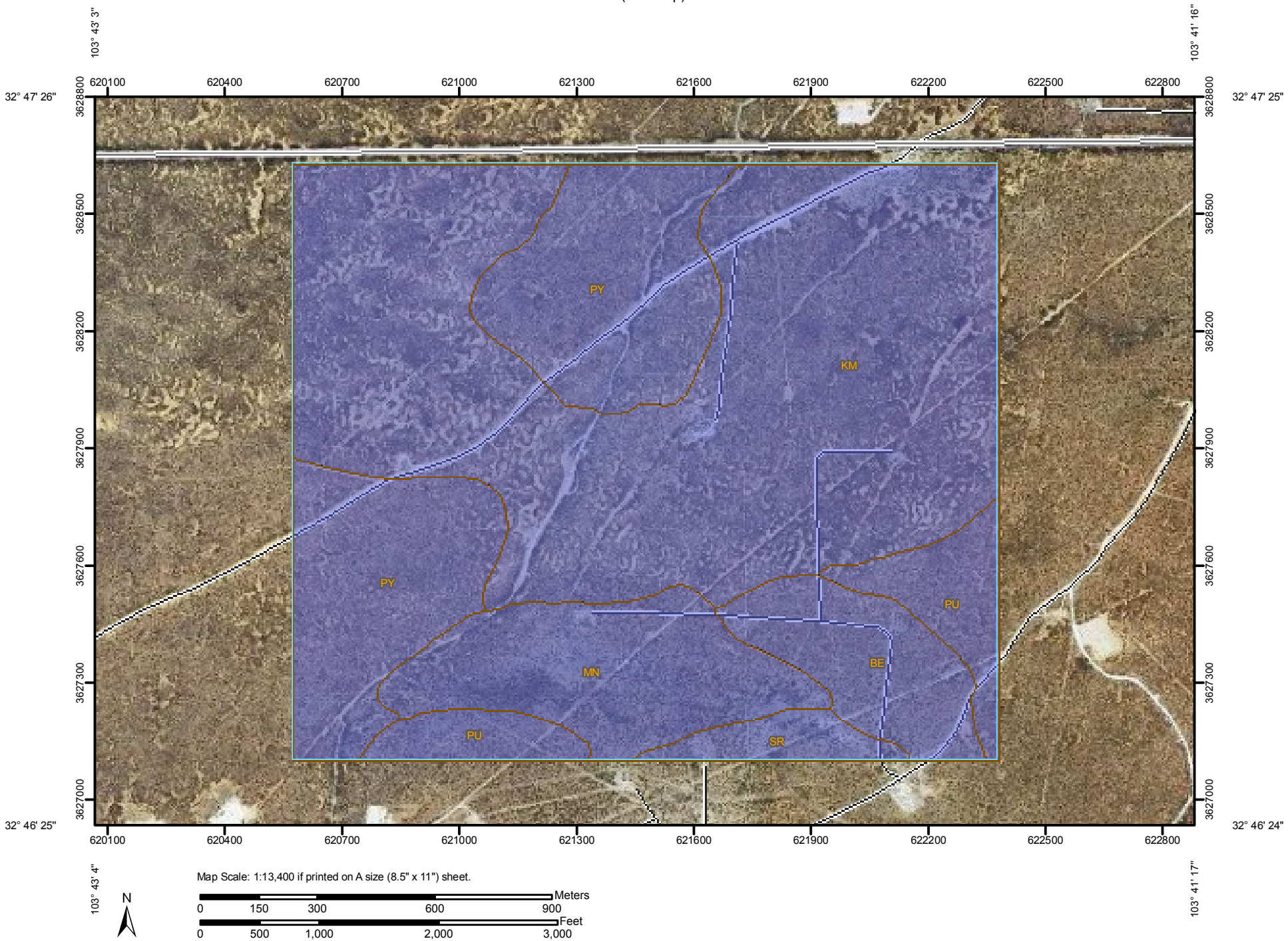
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydric Rating by Map Unit—Lea County, New Mexico
(Soil Map)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- All Hydric
- Partially Hydric
- Not Hydric
- Unknown Hydric
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydric Rating by Map Unit

Hydric Rating by Map Unit— Summary by Map Unit — Lea County, New Mexico (NM025)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	Not Hydric	43.7	6.4%
KM	Kermit soils and dune land, 0 to 12 percent slopes	Not Hydric	363.4	53.4%
MN	Midessa and wink fine sandy loams	Not Hydric	73.3	10.8%
PU	Pyote and maljamar fine sands	Not Hydric	40.2	5.9%
PY	Pyote soils and dune land	Not Hydric	145.4	21.4%
SR	Simona-Upton association	Not Hydric	14.2	2.1%
Totals for Area of Interest			**680.2**	**100.0%**

Description

This rating indicates the proportion of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is designated as "all hydric," "partially hydric," "not hydric," or "unknown hydric," depending on the rating of its respective components.

"All hydric" means that all components listed for a given map unit are rated as being hydric, while "not hydric" means that all components are rated as not hydric. "Partially hydric" means that at least one component of the map unit is rated as hydric, and at least one component is rated as not hydric. "Unknown hydric" indicates that at least one component is not rated so a definitive rating for the map unit cannot be made.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.

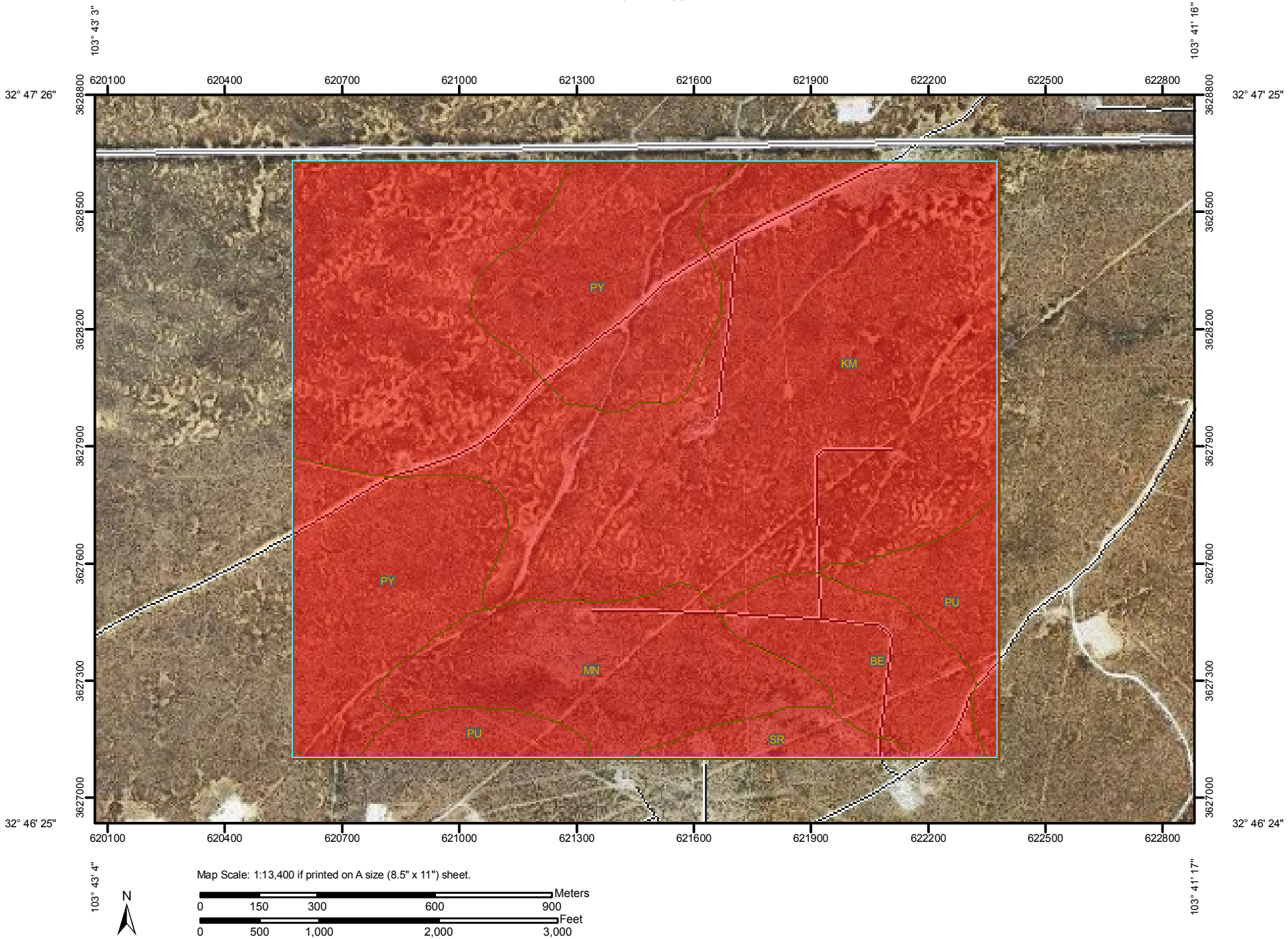
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

Rating Options

Aggregation Method: Absence/Presence

Tie-break Rule: Lower

Ponding Frequency Class—Lea County, New Mexico
(Soil Map)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- None
- Rare
- Occasional
- Frequent

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Ponding Frequency Class

Ponding Frequency Class— Summary by Map Unit — Lea County, New Mexico (NM025)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	None	43.7	6.4%
KM	Kermit soils and dune land, 0 to 12 percent slopes	None	363.4	53.4%
MN	Midessa and wink fine sandy loams	None	73.3	10.8%
PU	Pyote and maljamar fine sands	None	40.2	5.9%
PY	Pyote soils and dune land	None	145.4	21.4%
SR	Simona-Upton association	None	14.2	2.1%
Totals for Area of Interest			**680.2**	**100.0%**

Description

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

"Rare" means that ponding is unlikely but possible under unusual weather conditions. The chance of ponding is nearly 0 percent to 5 percent in any year.

"Occasional" means that ponding occurs, on the average, once or less in 2 years. The chance of ponding is 5 to 50 percent in any year.

"Frequent" means that ponding occurs, on the average, more than once in 2 years. The chance of ponding is more than 50 percent in any year.

Rating Options

Aggregation Method: Dominant Condition

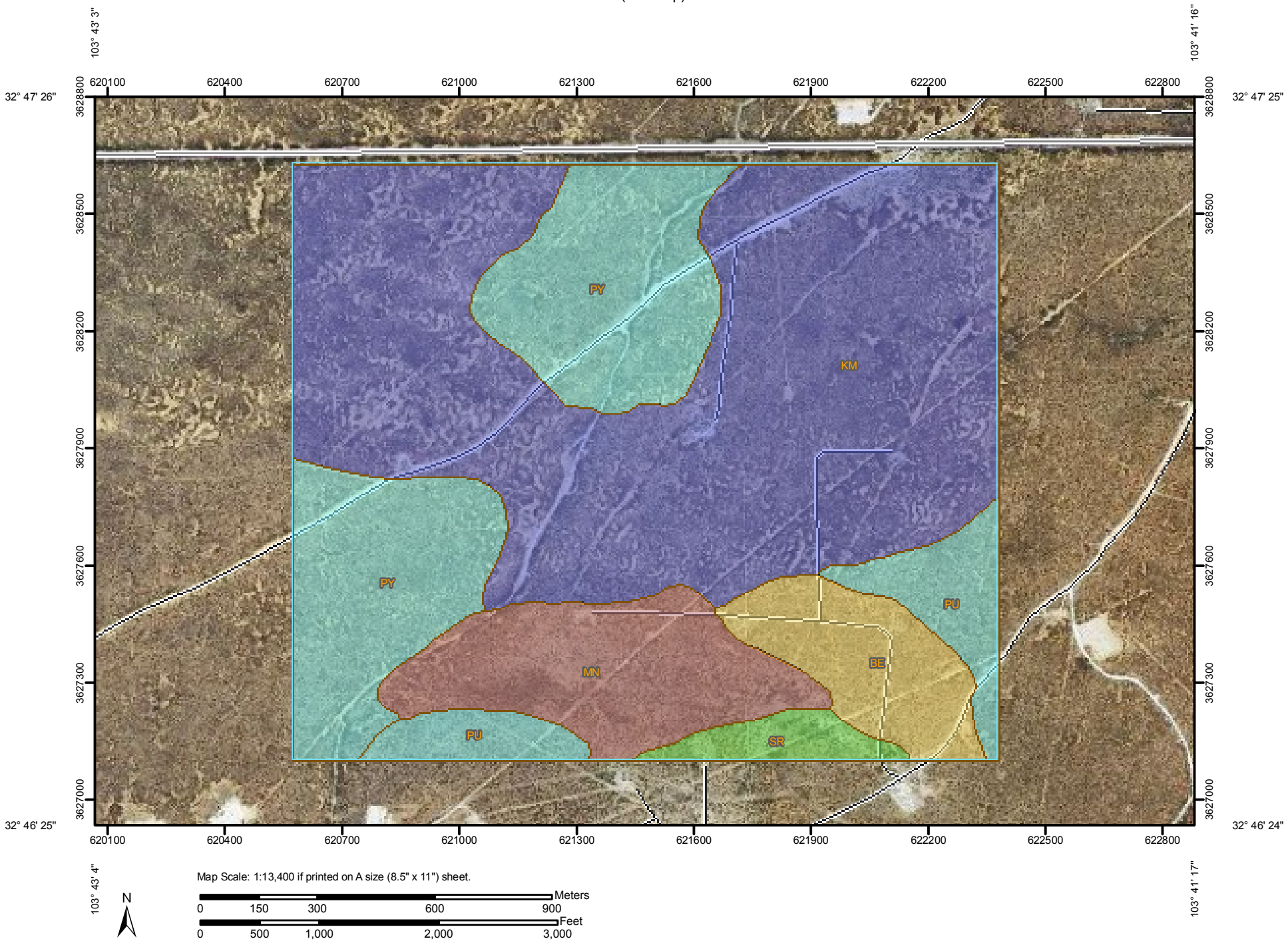
Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Parent Material Name—Lea County, New Mexico
(Soil Map)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- calcareous alluvium and/ or calcareous eolian deposits derived from sedimentary rock
- calcareous eolian deposits derived from sedimentary rock
- calcareous sandy eolian deposits derived from sedimentary rock
- sandy eolian deposits derived from sedimentary rock
- sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock
- Not rated or not available

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,400 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Parent Material Name

Parent Material Name— Summary by Map Unit — Lea County, New Mexico (NM025)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock	43.7	6.4%
KM	Kermit soils and dune land, 0 to 12 percent slopes	calcareous sandy eolian deposits derived from sedimentary rock	363.4	53.4%
MN	Midessa and wink fine sandy loams	calcareous alluvium and/or calcareous eolian deposits derived from sedimentary rock	73.3	10.8%
PU	Pyote and maljamar fine sands	sandy eolian deposits derived from sedimentary rock	40.2	5.9%
PY	Pyote soils and dune land	sandy eolian deposits derived from sedimentary rock	145.4	21.4%
SR	Simona-Upton association	calcareous eolian deposits derived from sedimentary rock	14.2	2.1%
Totals for Area of Interest			**680.2**	**100.0%**

Description

Parent material name is a term for the general physical, chemical, and mineralogical composition of the unconsolidated material, mineral or organic, in which the soil forms. Mode of deposition and/or weathering may be implied by the name.

The soil surveyor uses parent material to develop a model used for soil mapping. Soil scientists and specialists in other disciplines use parent material to help interpret soil boundaries and project performance of the material below the soil. Many soil properties relate to parent material. Among these properties are proportions of sand, silt, and clay; chemical content; bulk density; structure; and the kinds and amounts of rock fragments. These properties affect interpretations and may be criteria used to separate soil series. Soil properties and landscape information may imply the kind of parent material.

For each soil in the database, one or more parent materials may be identified. One is marked as the representative or most commonly occurring. The representative parent material name is presented here.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

APPENDIX C – AGENCY RESPONSES

USFWS Correspondence re: Wetlands

From: Dick, Jim <jim_dick@fws.gov>
To: Shawn Knox <knox@rockymountainecology.com>
Sent: Mon 5/6/2013 10:35 AM

Re: Request from Shawn Knox re: review and email verification

Hi Shawn,
The feature in question is a linear feature generated from other data sources (probably USGS NHD data) as part of a national effort to "fill-in" NWI data gaps. We call this "scalable" data. Since it was not created through standardized NWI mapping processes, this data may or may not meet national wetland mapping standards. This is a new data layer for us, and is still "under construction". Probably way there's no classification description or metadata yet. I can tell you the feature is representative of a section of a dry wash or arroyo, which would have no regular flow. It is very unlikely that this feature would meet U.S. Army Corps of Engineers (USACE) jurisdictional criteria for legally defined wetlands. Any official decision concerning the status of this feature would need to come from the USACE, though. Let me know if you need more info, or any further explanation.

Please see official disclaimer for NWI data below;

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.
.

On Mon, May 6, 2013 at 9:44 AM, Shawn Knox <knox@rockymountainecology.com> wrote:

Hi Jim:

Attached is a map of the project area we discussed, along NM 529 southeast of Maljamar, NM, in Lea County.

The ephemeral drainage (depicted with a purple line) is of interest. This was noted in the Google Map function of NWI as a wetland of some sort, though I could not pull up the metadata. I

conducted a thorough field survey and absolutely no evidence of wetlands as defined by the USACE was observed.

*Anyway, could you please confirm via email, per our conversation that this is not a wetland?

I sincerely appreciate your assistance.

Best,

Shawn Knox

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Shawn C. Knox

Co-owner/ Director

Rocky Mountain Ecology LLC

5 Alcalde Rd. | Santa Fe, NM 87508

505.992.6150

www.rockymountainecology.com

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

LEA COUNTY FLOODPLAIN MANAGEMENT

Lorenzo Velasquez CFM Director
Cassie Corley CFM Coordinator
1923 N. Dal Paso Suite A
Hobbs, NM 88240

Phone (575) 391-2983
Phone (575) 391-2976
Fax (575) 397-7413
lvelasquez@leacounty.net
ccorley@leacounty.net

FLOODPLAIN DETERMINATION

Date: May 9, 2013

Physical Address: NM Hwy 529 Mile Marker 10-11 on the South Side

Owner: DNCS Properties LLC **Agent:** Dacia R. Tucholke, Gordon Environmental, Inc.

Mailing Address: 2028 E Hackberry **Phone:** (505)867-6990

PlaceChandler, AZ 85286

[X] NON-SFHA [ ] PROPERTY PARTIAL SFHA AREA-STRUCTURE NON SFHA

[ ] PROPERTY IN SFHA: ZONE D BFE _____

FIRM PANEL 1075 DATED 12/16/08 Map Index _____

S/T/R _____ BLD PERMIT _____ DOI _____

[ ] SITE BUILT [ ] MOBILE HOME [X] COMMERCIAL [ ] MOD [ ] GEN. MAINT

[ ] INSURANCE [ ] REAL ESTATE [ ] OWNER [ ] BANK [ ] ADDRESSING [X] BUILDING [ ] MH CO

COMMENTS: PROPERTY IS NOT IN FLOOD ZONE

County Floodplain Manager Cassie Corley, CFM Date 5-9-13

FLOODPLAIN PERMIT ISSUE DATE: _____ PERMIT NUMBER _____

APPLICATION FOR PERMIT
DNCS ENVIRONMENTAL SOLUTIONS

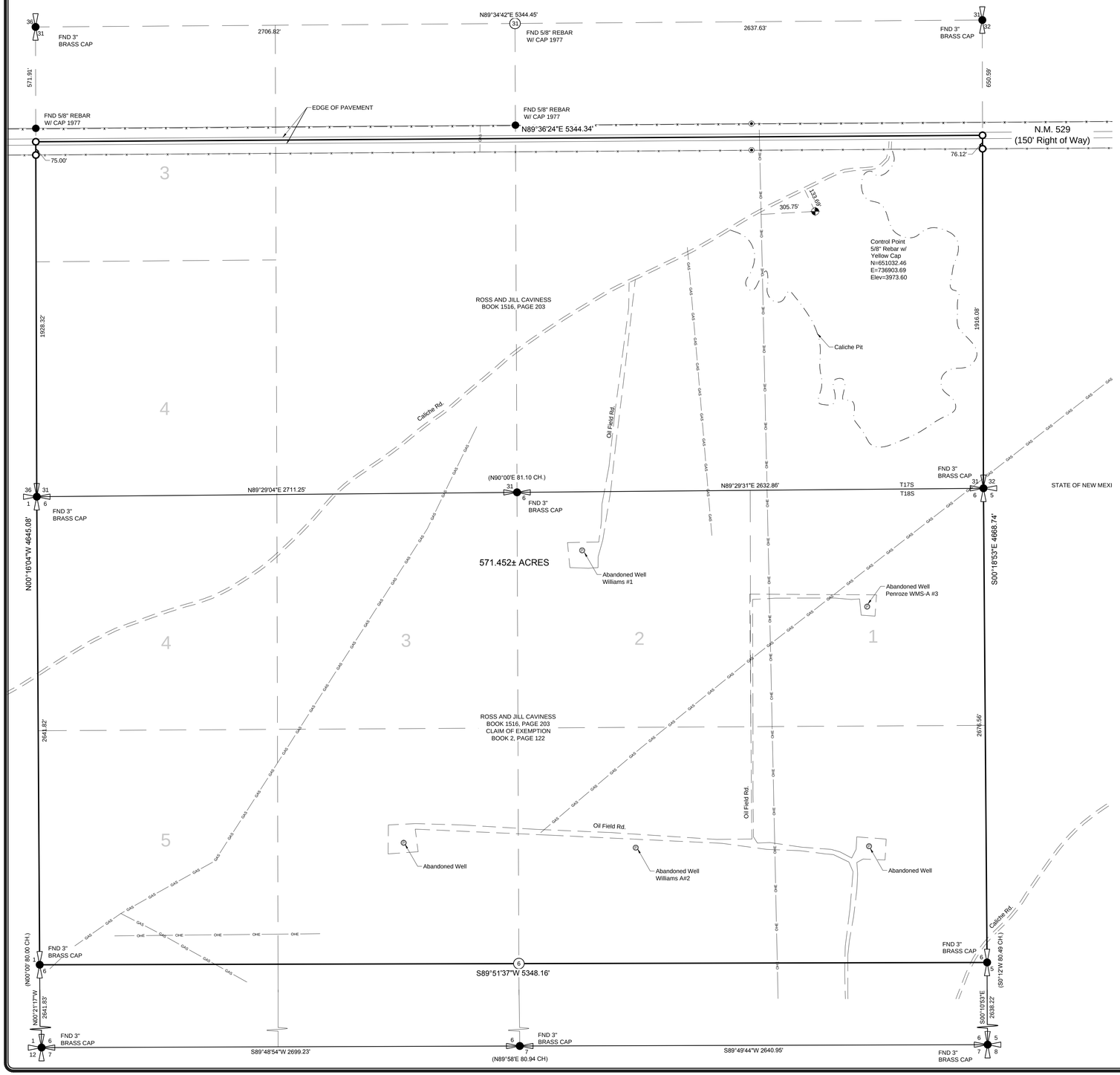
VOLUME IV: SITING AND HYDROGEOLOGY
SECTION 1: SITING CRITERIA

ATTACHMENT IV.1.B

BOUNDARY SURVEY (PETTIGREW & ASSOCIATES PA, 12/13/2012)

BOUNDARY SURVEY

LOCATED IN PART OF THE S1/2, OF SECTION 31, T17S, R33E, AND N1/2 SECTION 6, T18S, R33E, N.M.P.M., LEA COUNTY, NEW MEXICO



RECORD DESCRIPTION AS RECORDED IN BOOK 1516, PAGE 203, LEA COUNTY RECORDS

The Southwest Quarter of the Southwest Quarter (SW/4SW/4), the Northwest Quarter of the Northwest Quarter (NW/4NW/4), the East Half of the Northwest Quarter (E2NW/4), the West Half of the Northeast Quarter (W/2NE/4) of Section 15 and All of Section 16, all in Township 18 South, Range 33 East, N.M.P.M., Lea County, New Mexico.

The East Half (E/2), the Southwest Quarter (SW/4) and the South Half of the Northwest Quarter (S/2NW/4) of Section 1; the Southwest Quarter (SW/4) of Section 14; the Northeast Quarter (NE/4) of Section 22; the Northwest Quarter (NW/4) of Section 23; and the East Half of the Northeast Quarter (E/2NE/4) of Section 34, all in Township 18 South, Range 32 East, N.M.P.M., Lea County, New Mexico.

The North Half (N/2) of Section 9; all of Section 6, all in Township 18 South, Range 33 East, N.M.P.M., Lea County, New Mexico.

Section 31,32 & 33, Township 17 South, Range 33 East and Section 3, 4, 10 &11, Township 18 South, Range 33 East, N.M.P.M., Lea County, New Mexico, lying South of the pavement centerline of State Highway #529.

SURVEYED DESCRIPTION

A tract of land located in the Section 31, T17S, R33E, and Section 6, T18S, R33E, N.M.P.M., Lea County, New Mexico and being more particularly described as follows:

That part of the S1/2 of Section 31, T17S, R33E, lying south of the centerline of the pavement in New Mexico State Highway 529 and the North 1/2 of Section 6, T18 S, R33 E, N.M.P.M., Lea County, New Mexico, as shown on an exemption plat recorded in Book 2, Page 122, Lea County Records, and containing 562.367 acres, more or less.

BASIS OF BEARING

The basis of bearing for this survey is Grid North based on the New Mexico State Plane Coordinate System East Zone, as determined by an OPUS solution at the control point shown on survey plat. Coordinates are based on the New Mexico State Plane Coordinate System East Zone. Ground coordinates are modified by scaling about a control point located at N32°47'17.17235", W103°41'49.02833" by a combined scale factor of 0.99976629. All drawing coordinates are scaled to ground. Elevations shown hereon are referenced to NAVD 1988. This map complies with the National Map Accuracy Standards.

CERTIFICATE OF SURVEY

I, William M. Hicks III, New Mexico Professional Surveyor, hereby certify that this Boundary Survey Plat was prepared from an actual ground survey performed by me or under my supervision, that this survey is true and correct to the best of my knowledge and belief, that this Boundary Plat and the field survey upon which it is based meet the Minimum Standards for Surveying in New Mexico.

William M. Hicks, III NMPS #12348

December 13, 2012
Date

NOTE

Boundary Survey was performed without Title Commitment.

LEGEND

- Found as noted
- Set 5/8" rebar with red plastic cap marked "HICKS NMPS 12348"
- Calculated point
- Section corner
- Quarter section corner
- Found section corner
- Found quarter section corner
- (#) Section section corner
- Right of way marker
- x Barbed wire fence
- XX°XX'XX" XX.XX' Measured bearing and distance
- (X°XX' XX.XX CH.) Record GLO bearing and distance

State of New Mexico, County of _____
I here by certify that this instrument was filed for record on:

The _____ Day of _____,
20 _____ A.D.
At _____ O'Clock _____.M.
Cabinet _____ Slide _____
Book _____ Page _____

By _____
County Clerk

By _____
Deputy

PETTIGREW & ASSOCIATES PA
ENGINEERING | SURVEYING | TESTING
DEFINING QUALITY SINCE 1965
100 E. Navajo, Suite 100 Hobbs New Mexico 88240
T 575 393 9827 F 575 393 1543
Pettigrew.us

WILLIAM M. HICKS III — NEW MEXICO — 12348 — REGISTERED PROFESSIONAL SURVEYOR

PROJECT SURVEYOR: M. Ivey
DRAWN BY: C. Johnson

NORTH
SCALE 1" = 300'
0' 150' 300' 600'

INDEXING INFORMATION FOR COUNTY CLERK

OWNER:
ROSS CAVINESS

LOCATION:
PART OF THE S1/2, SECTION 31, T17S, R33E, SOUTH OF HWY. 529, AND N1/2, SECTION 6, T18S, R33E, N.M.P.M., LEA COUNTY, NEW MEXICO

REVISIONS

No.	DATE	DESCRIPTION

BOUNDARY SURVEY
OF
Part of the S1/2, Sec 31 T17S, R33E, & N1/2, Sec6 T18S, R33E, N.M.P.M.
FOR
DNCS PROPERTIES

PROJECT NUMBER: 2012.1258

SHEET: 1 of 1

SU - 101

APPLICATION FOR PERMIT
DNCS ENVIRONMENTAL SOLUTIONS

VOLUME IV: SITING AND HYDROGEOLOGY
SECTION 2: HYDROGEOLOGY

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DNCS ENVIRONMENTAL SOLUTIONS

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APPLICATION FOR PERMIT
DNCS ENVIRONMENTAL SOLUTIONS

VOLUME IV: SITING AND HYDROGEOLOGY
SECTION 2: HYDROGEOLOGY

1.0 INTRODUCTION

DNCS Environmental Solutions (DNCS Facility) is a proposed Surface Waste Management Facility for oilfield waste processing and disposal services. The proposed DNCS Facility is subject to regulation under the New Mexico Oil and Gas Rules, specifically 19.15.36 NMAC, administered by the Oil Conservation Division (OCD). The Facility is designed in compliance with 19.15.36 NMAC, and will be constructed and operated in compliance with a Surface Waste Management Facility Permit issued by the OCD. The Facility is owned by, and will be constructed and operated by, DNCS Properties, LLC.

1.1 Site Location

The DNCS site is located approximately 10.5 miles east of the US 82/NM 529 intersection and 6.3 miles southeast of Maljamar in unincorporated Lea County, New Mexico (NM). The DNCS site is comprised of a 562-acre ± tract of land located south of NM 529 in portions of Section 31, Township 17 South, Range 33 East; and in the northern half of Section 6, Township 18 South, Range 33 East, Lea County, NM (**Figure I.1**). Site access will be provided via the south side of NM 529.

1.2 Facility Description

The DNCS Facility is a proposed new Surface Waste Management Facility that will include two main components; a liquid oil field waste Processing Area (177 acres ±), and an oil field waste Landfill (318 acres ±). Oil field wastes are anticipated to be delivered to the DNCS Facility from oil and gas exploration and production operations in southeastern NM and west Texas. The Site Development Plan provided in the **Permit Plans**, **Sheet 3**, identifies the locations of the Processing Area and Landfill facilities.

2.0 REGIONAL GEOLOGY AND HYDROGEOLOGY

The DNCS site is situated in a mature oil and gas producing province in the Permian Basin of southeastern New Mexico. The site is also in proximity to a mature potash mining and refining province, as well as to the Waste Isolation Pilot Project (WIPP) site. Pursuant to these activities, the regional geology and hydrogeology in the vicinity of the DNCS site has been studied by numerous entities.

2.1 Climate

The climate at the DNCS site is typical of a semi-arid region with generally mild temperatures, low precipitation and humidity, and a high evaporation rate. The nearest weather station (i.e., Maljamar 4 SE) is located approximately 6.3 miles northwest of the DNCS site in Maljamar, NM. Climate data for the Maljamar station are provided in **Table IV.2.1**. The climate is hot during summer months when the daytime temperatures are typically in the high 70's; and cool to cold during winter months when temperatures are typically in the low 40's. The warmest month of the year is July with an average maximum temperature of 92.4 degrees Fahrenheit (°F), while the coldest month of the year is January with an average minimum temperature of 25.8 °F. The annual average precipitation in Maljamar is 14.18 inches (in.). The majority of the precipitation falls July through September. The wettest month of the year is September with an average rainfall of 2.42 in. Annual snowfall averages 6.4 in. for the area.

2.2 Physiographic Setting

The proposed DNCS disposal facility is located on the Querecho Plains near the boundary between the Southern High Plains Section (Llano Estacado) and the Pecos Valley Section of the Great Plains Physiographic Province (Hawley, 1993b). The Great Plains Physiographic Province is characterized by low relief and lightly deformed Permian and Triassic sedimentary bedrock units overlain by variable thicknesses of late Tertiary and Quaternary age unconsolidated to semiconsolidated deposits of sand, silt, clay, gravel and calcrete (caliche) of the Ogallala Formation and younger Quaternary deposits of unconsolidated or aeolian sands and silts.

TABLE IV.2.1
Climate Data
DNCS Environmental Solutions

Station:(295370) MALJAMAR 4 SE[1]							
From Year=1942 To Year=2012							
Month	Precipitation			Total Snowfall		Temperature (Monthly Averages)	
	Mean	High	Low	Mean	High	Max.	Min.
Unit	in.	in.	in.	in.	in.	°F	°F
January	0.42	2.55	0	1.7	14	56.1	25.8
February	0.4	1.86	0	1.4	12	61.7	29.7
March	0.4	1.83	0	0.7	13.3	68.7	35.2
April	0.44	2.34	0	0.2	8.5	77.9	43.2
May	1.59	7.69	0	0	0	85.8	52.3
June	1.59	7.38	0	0	0	93.3	60.6
July	2.37	10.26	0	0	0	94.3	64.1
August	2.3	10.88	0	0	0	92.4	62.9
September	2.42	7.71	0	0	0	86.3	56.3
October	1.17	5.99	0	0.1	2	77.1	45.6
November	0.52	3.9	0	0.5	9.5	65.1	33.8
December	0.57	3.7	0	1.9	15.7	57.5	27.1
Annual	14.18	27.54	5.78	6.4	23.8	76.3	44.7

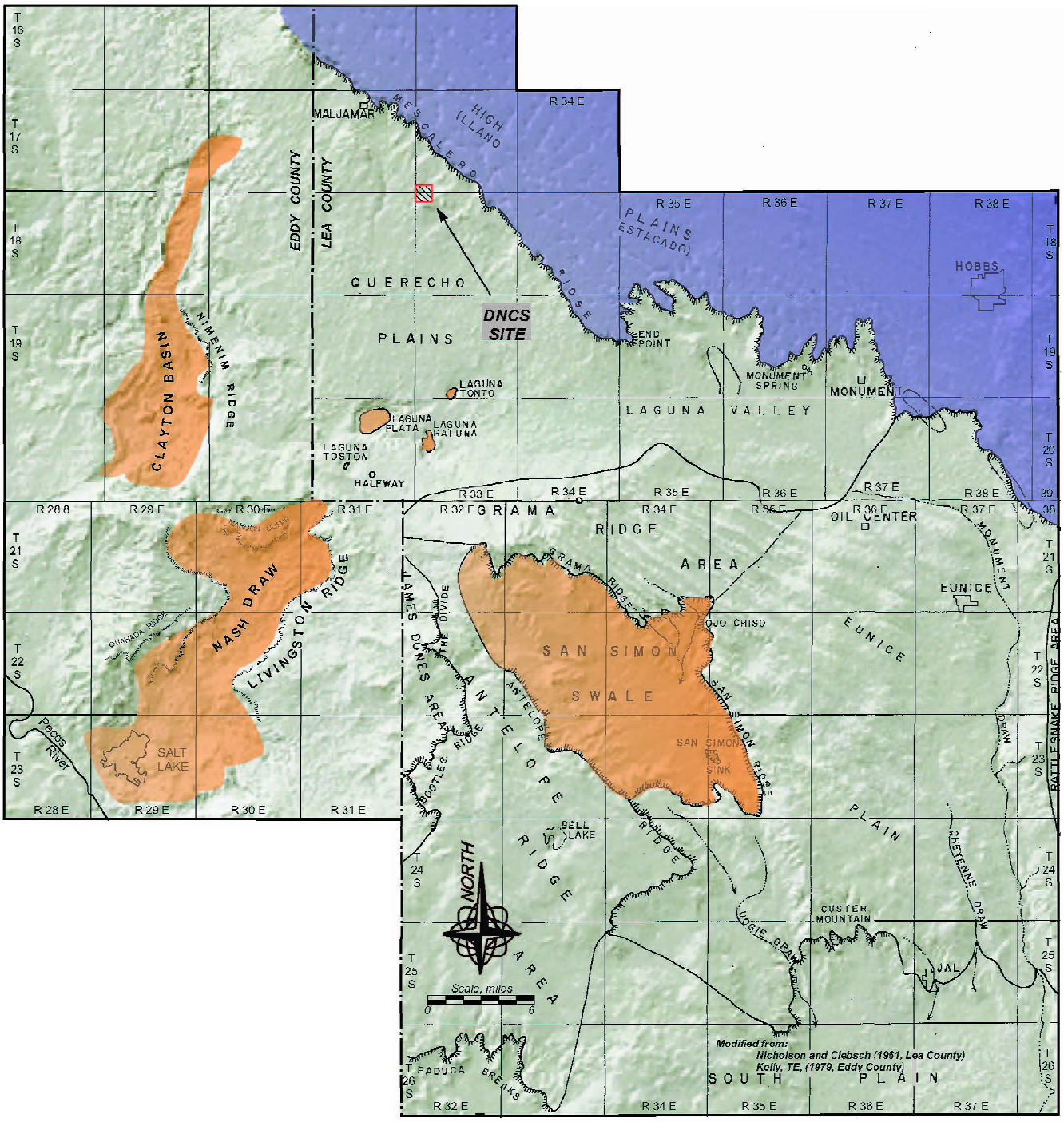
Note:

[1] *Data obtained from the Western Regional Climate Center (http://www.wrcc.dri.edu/)*

Physiography of the DNCS site vicinity in southern Lea County and eastern Eddy County was described by Nicholson and Clebsch (1961) and Kelly (1979) and is summarized in the physiographic map in **Figure IV.2.1**. The site is situated in the Upper Pecos-Black watershed (USGS cataloging Unit 1306001), near the western boundary of the Monument-Seminole Draws watershed (USGS cataloging unit 12080003). The boundary between the Upper Pecos-Black and Monument-Seminole Draws is formed by the Mescalero Ridge (alternately called "the Caprock"), which trends north-south along the Chaves and Lea County line from northwest Lea County approximately to Maljamar, where it turns southeast, passing approximately 1.75 miles east of the DNCS site, continuing southeast past the Texas state line east of Eunice. Mescalero Ridge is also the boundary between the Southern High Plains Section of the Great Plains Province to the east and the Querecho Plains area of the Pecos Valley Section of the Great Plains Province to the west.

Mescalero Ridge is the western terminus of the Tertiary Ogallala Formation, which is a thick sequence of unconsolidated to semiconsolidated sand, silt and gravel which were deposited on an erosional surface incised into Triassic Chinle shale in much of southeastern New Mexico. In the Querecho Plains area, the Ogallala has been removed by erosion west of Mescalero Ridge and a veneer [generally less than 100 feet (ft)] of Quaternary age unconsolidated Ogallala detritus and aeolian sands mantle the Triassic Chinle in this area. Well-cemented sections (caliche) of the Ogallala Formation are the ledge-forming units of the Caprock bluffs.

The Querecho Plains terminate to the west and south toward the Pecos River in a series of subsidence features, including San Simon Swale, Nash Draw, Clayton Basin and a series of playas, including Laguna Plata, Laguna Gatuna, Laguna Tonto and Laguna Toston (**Figure IV.2.1**). The subsidence features principally result from groundwater dissolution of evaporates in the Permian bedrock units in the Rustler and Salado Formations. Dissolution occurs in areas where the Permian evaporates outcrop, or are very near land surface.



PHYSIOGRAPHY OF SOUTHERN LEA COUNTY AND EASTERN EDDY COUNTY

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/31/2013	CAD: PHYSIOGRAPHY.dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.1
APPROVED BY: IKG	gei@gordonenvironmental.com	

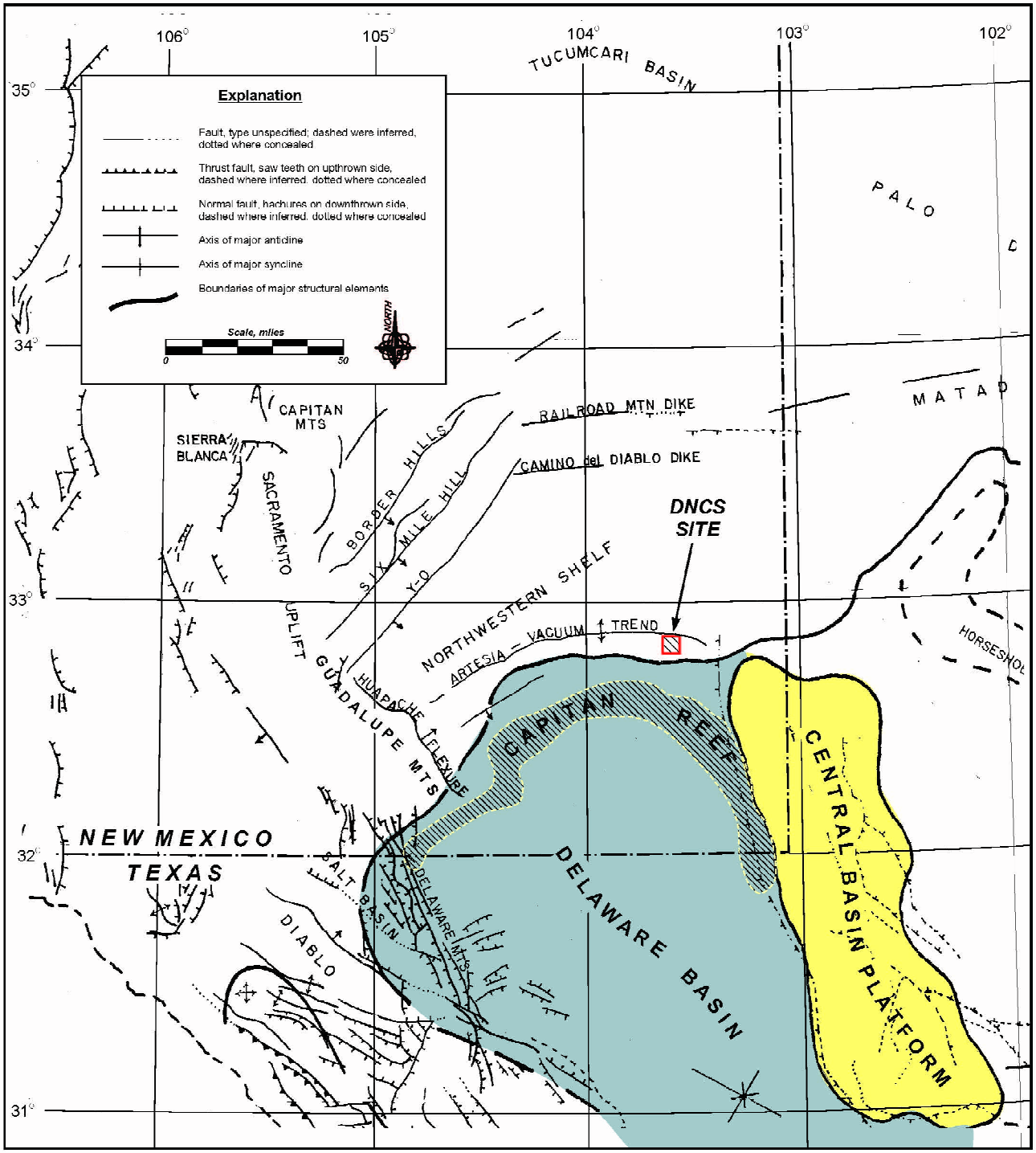
Drawing:P:\acad 2003\542.01.01\PERMIT FIGURES\PHYSIOGRAPHY.dwg
Date/Time:Nov. 01, 2013-08:56:46 ; LAYOUT: A (P)

2.3 Structural Setting

The DNCS site is situated on the northern margin of a deep sedimentary basin feature known as the Delaware Basin. During most of the Permian period, the Delaware Basin was the site of a deep marine canyon that extended across southeastern New Mexico and west Texas. Major structural elements of the Delaware Basin area are shown in **Figure IV.2.2** (Powers, 1978). The major structures of the basin include the Guadalupe Mountains on the west side, the Central Basin Platform on the east side, and the Capitan Reef Complex on the west and north side of the basin.

The Central Basin Platform forms an abrupt eastern terminus to the Delaware Basin; it is a steeply fault-bound uplift of basement rocks that grew through the early and middle Paleozoic period such that most of the pre-Permian sedimentary section is missing from its apex. Great thickness of organic-rich marine deposits in the basin and the presence of abrupt structural thinning in the Capitan Reef Complex and Central Basin Platform combined to result in a prolific oil and gas producing province. These areas have been the focus of intense petroleum exploration and development activities since approximately 1920.

Surficial geology and generalized stratigraphy across the Delaware Basin and at the DNCS site are depicted in the map and cross section in **Figure IV.2.3** (New Mexico Bureau of Geology and Minerals, 2003 and Duchene and Cunningham, 2006). Tectonic development of the Delaware Basin began by the late Pennsylvanian period and major basin subsidence took place during the late Pennsylvanian period and early Permian period. Basin development ended in the late Permian period (Brokaw, et al, 1972). Thickness of sediments in the basin exceeds 20,000 ft, and Permian strata alone account for more than 13,000 ft of basin fill materials (Oriel, et al., 1967). During the Triassic period, the area was uplifted, resulting in deposition of clastic continental shales (redbeds). Continuing uplift resulted in erosion and/or non-deposition until the middle to late Cenezoic period, when regional eastward tilting completed structural development of the basin as it exists today (Stipp, 1954). Locations of reef deposits which form the northern structural terminus of the Delaware Basin, as well as stratigraphic units present in the area of the DNCS site are shown on the stratigraphic cross section in **Figure IV.2.4** (Roswell Geological Society, 1956 and Brokaw and Others, 1972).



Major Regional Structural Features of Southeastern New Mexico
Modified from Powers, 1978

MAJOR STRUCTURAL FEATURES OF SOUTHEASTERN NEW MEXICO

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/31/2013	CAD: STRUCTURAL.dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.2
APPROVED BY: IKG	gei@gordonenvironmental.com	

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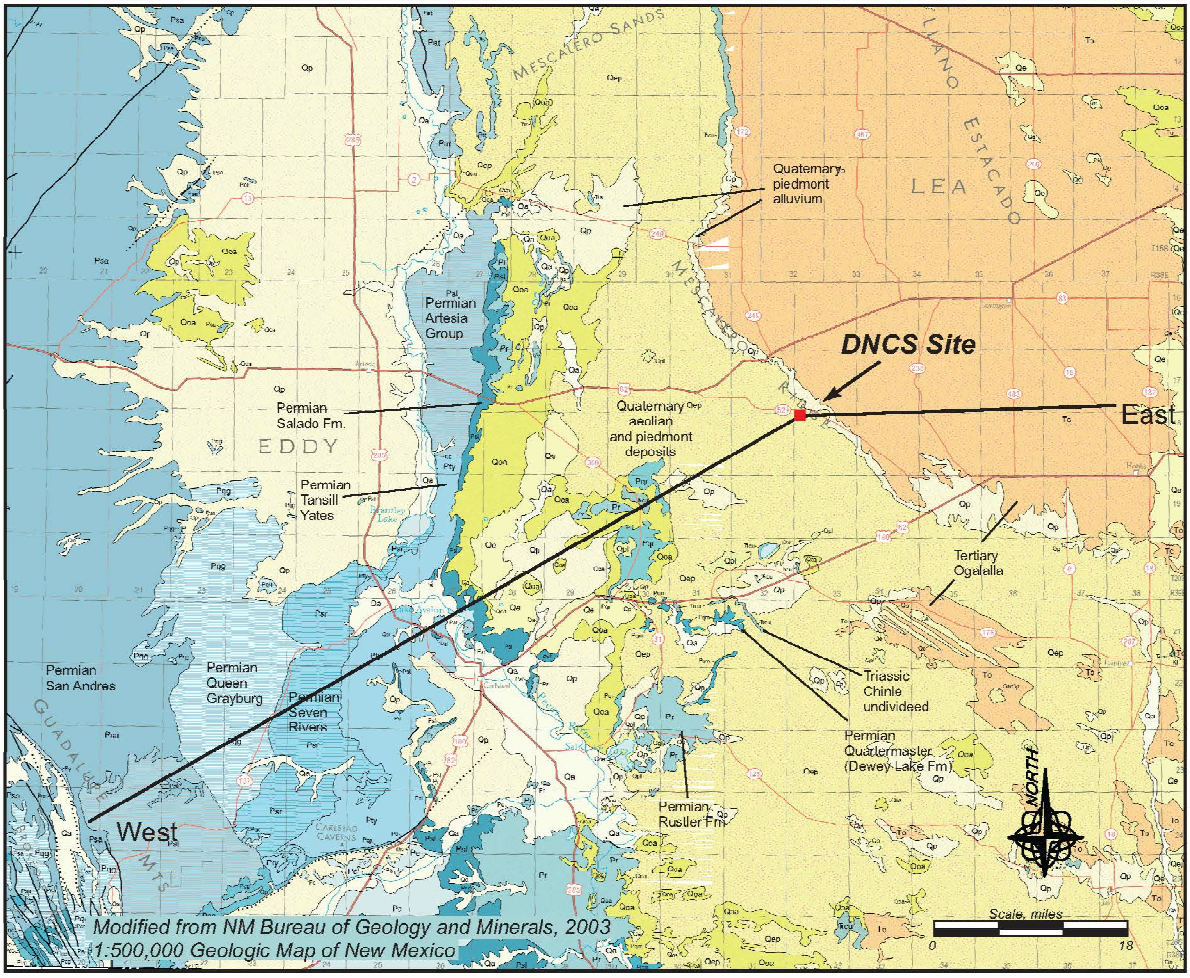
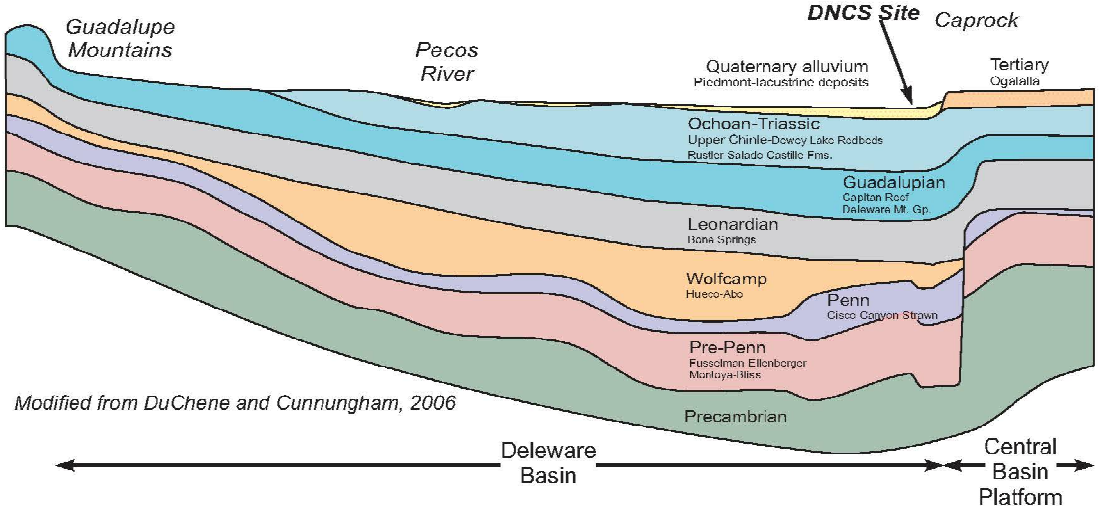


West East



REGIONAL SURFACE GEOLOGY AND GENERAL STRATIGRAPHY OF SOUTHEASTERN NEW MEXICO

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

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Fax: 505-867-6991

DATE: 10/31/2013	CAD: SURFACE GEOLOGY.dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.3
APPROVED BY: IKG	gei@gordonenvironmental.com	

Drawing:P:\acad 2003\542.01.01\PERMIT FIGURES\SURFACE GEOLOGY.dwg
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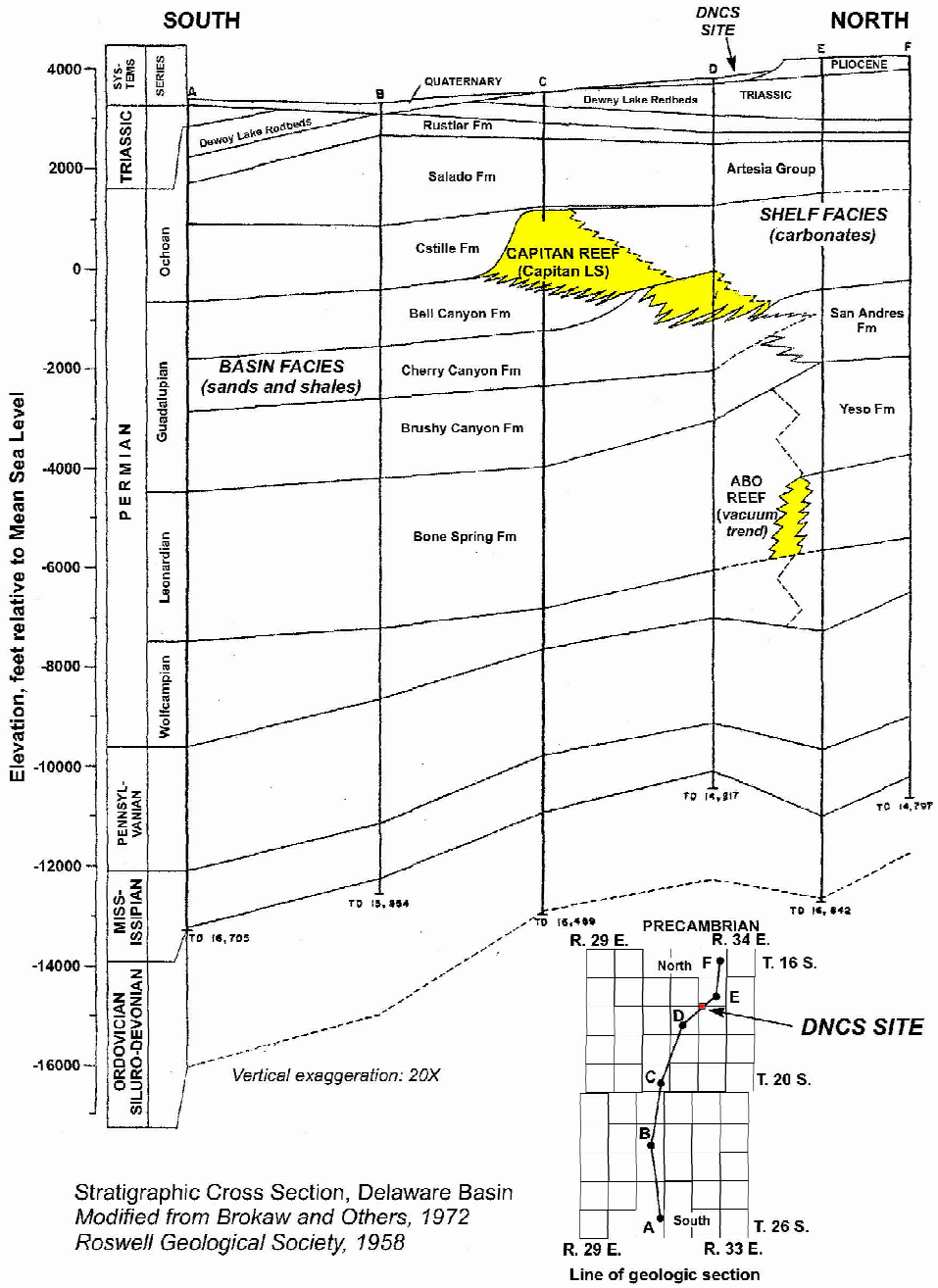

Stratigraphic Cross Section, Delaware Basin
Modified from Brokaw and Others, 1972
Roswell Geological Society, 1958

STRATIGRAPHIC CROSS SECTION, NORTHERN DELAWARE BASIN

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

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Consulting Engineers
213 S. Camino del Pueblo
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Phone: 505-867-6990
Fax: 505-867-6991

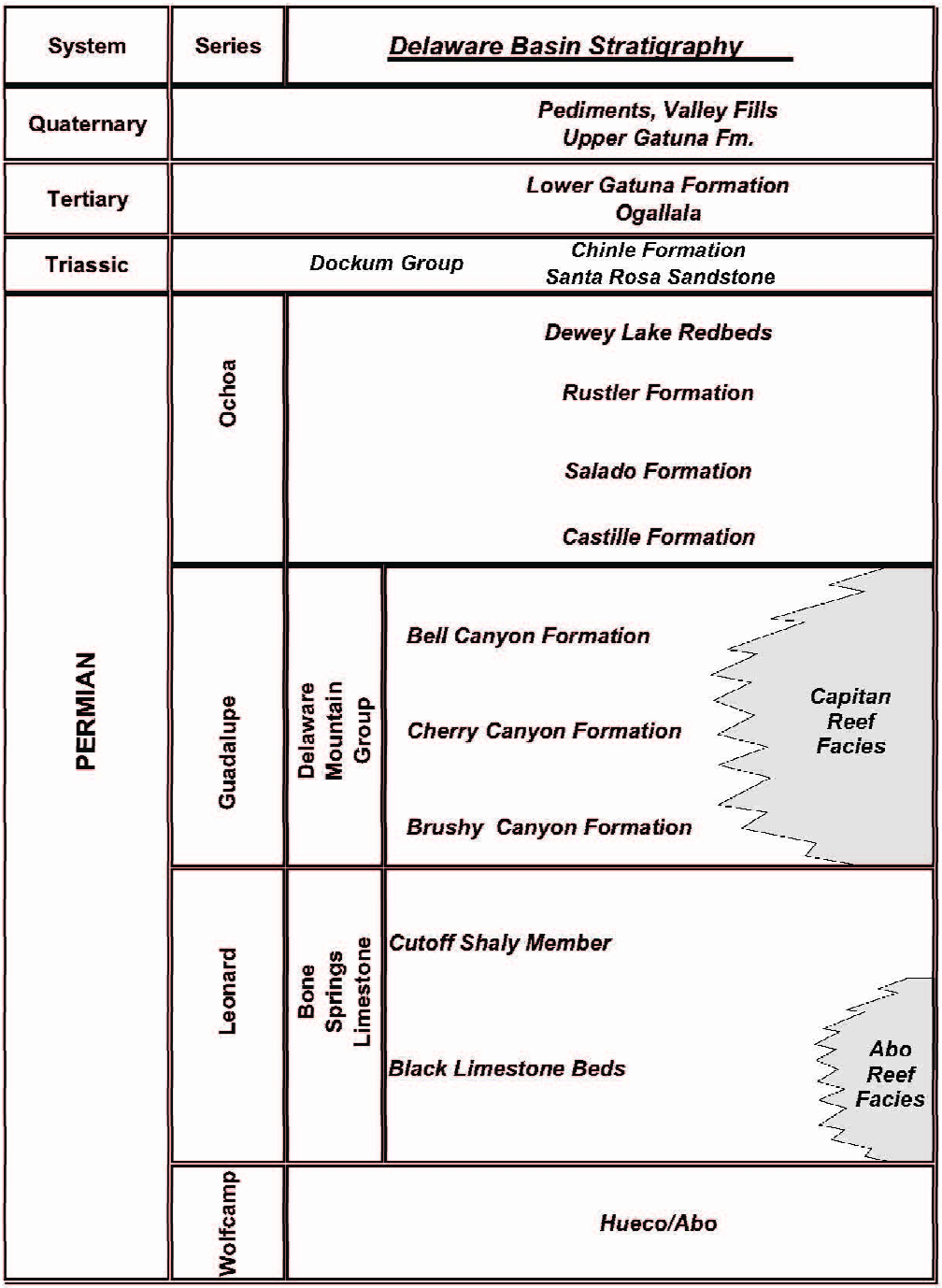
DATE: 10/31/2013	CAD: DELAWARE X SEC.dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.4
APPROVED BY: IKG	gei@gordonenvironmental.com	

Drawing:P:\acad 2003\542.01.01\PERMIT FIGURES\DELAWARE X SEC.dwg
Date/Time:Nov. 01, 2013-10:54:39 ; LAYOUT: A (P)

2.4 Surface Geology and Stratigraphy

Geologic units that are present at land surface or in the shallow subsurface in the vicinity of the DNCS site include unconsolidated Quaternary alluvial and aeolian deposits, semiconsolidated clastics of the Tertiary Ogallala Formation, Triassic bedrock shale and sandstone units of the Chinle/Dockum Group. Post-Pennsylvanian stratigraphic units of the Delaware Basin are summarized in the stratigraphic nomenclature chart in **Figure IV.2.5** (Hendrickson and Jones, 1952, and Hawley, et al, 1993). The Ogallala Formation was deposited across an erosional surface incised into Triassic shale bedrock deposits of the Chinle Formation/Dockum Group in the vicinity of the DNCS site, as well as across much of southeastern New Mexico. West of Mescalero Ridge on the Querecho Plains in the vicinity of the DNCS site, the Ogallala was subsequently removed by erosion and a veneer (generally less than 100 ft) of Quaternary age unconsolidated Ogallala detritus and aeolian sands mantle the Triassic in this area. Well-cemented sections (i.e., caliche or calcrete) of the Ogallala Formation are the ledge-forming units of the Caprock bluffs. Shallow stratigraphic units in the vicinity of the DNCS site are described below.

- ***Piedmont Alluvial Deposits*** (Qp, Holocene to lower Pleistocene) - Unconsolidated sands, silts and gravels deposited in alluvial veneers on piedmont slopes and alluvial fans.
- ***Aeolian and Piedmont Deposits*** (Qep, Holocene to middle Pleistocene) - Unconsolidated sands, silts and gravels deposited as Interlayered aeolian sands and piedmont slope detritus derived from nearby salients.
- ***Ogallala Deposits*** (To, lower Pliocene to Middle Miocene) - Semiconsolidated fluvial and aeolian sands, silts, gravels and clays deposited on unconformable Permian or Triassic surfaces. Commonly contains well cemented to petrocalcic soils which are ledge-forming units.
- ***Upper Chinle/Dockum Group Deposits*** (Trcu, upper Triassic) - Red indurated shales with minor siltstones and sandstone stringers.
- ***Lower Chinle/Dockum Group Deposits*** (Trs, lower Triassic) - Santa Rosa Formation, lenticular cross-bedded grey to red sandstone with interbedded red shale, locally conglomeratic.



Post-Pennsylvanian stratigraphy of the Delaware Basin
from Hendrickson and Jones, 1952, Nicholson and Clebsch, 1961 and Hawley, et al., 1993

POST PENNSYLVANIAN STRATIGRAPHY OF THE DELAWARE BASIN

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 10/31/2013	CAD: DELAWARE STRAT.DWG	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.5
APPROVED BY: IKG	gei@gordonenvironmental.com	

Drawing:P:\acad 2003\542.01.01\PERMIT FIGURES\DELAWARE STRAT.dwg
Date/Time:Nov. 01, 2013-10:59:05 ; LAYOUT: A (P)

2.5 Hydrogeology

Water-bearing geologic units in southern Lea County and Eastern Eddy County in the vicinity of the DNCS site include the Tertiary Ogallala Aquifer, shallow Quaternary alluvial aquifers, and the Santa Rosa Sandstone unit of the lower portion of the Triassic Chinle/Dockum Group. The Ogallala Aquifer is locally a prolific water-bearing unit in the region east of Mescalero Ridge, but it is absent west of Mescalero Ridge in the area of the DNCS site. In the Querecho Plains area, thin laterally discontinuous groundwater saturations are occasionally present in the basal alluvium overlying the Triassic shale bedrock units. The Santa Rosa Sandstone is present at depth below the DNCS site and throughout much of southern Lea County and eastern Eddy County, and this unit can locally produce modest quantities of groundwater. The Santa Rosa Sandstone is a significant source of groundwater for domestic and livestock wells in portions of Lea County (Leedshill-Herkenhoff, et, al, 1999) where drilling depths are feasible; however in much of the area, the unit has not been tapped by wells due to prohibitive depth, or to the availability of shallower aquifers.

Based upon review of available water well and oil well information in the vicinity of the DNCS site, as well as information obtained from site characterization borings performed on the DNCS tract, only the Santa Rosa Sandstone is considered to be a potential aquifer at the site. Oil well drilling logs of wells in the immediate vicinity of the DNCS site indicate that numerous wells penetrated sandstones interpreted to be the Santa Rosa Sandstone at more than 500 ft below land surface. No water wells in the vicinity of the DNCS site have been completed in the Santa Rosa Sandstone; however based upon regional projections of potentiometric head values in the Lower Dockum Group (Santa Rosa Sandstone) made by Dutton and Simkins (1986), the head value in the Santa Rosa Sandstone at the DNCS site is approximately 3,450 ft above mean sea level, or approximately 500 ft below land surface.

Water quality in the Santa Rosa Sandstone is poorly documented in southern Lea County and eastern Eddy County (Leedshill-Herkenhoff et al, 1999). Nicholson and Clebsch (1961) reported total dissolved solids (TDS) values ranging from 635 to 1,950 milligrams per liter (mg/L) for water samples collected from wells completed in the Santa Rosa Sandstone. Sulfate concentrations in samples from these wells ranged from 71 mg/L to 934 mg/L; higher

concentrations were noted in the deeper wells. Dutton and Simkins (1986) prepared a projection of TDS of waters from the Lower Dockum Group (Santa Rosa Sandstone); this projection indicates that the TDS concentration of water in the Santa Rosa Sandstone in the vicinity of the DNCS site is expected to exceed 3,000 mg/L.

3.0 SITE GEOLOGY AND HYDROGEOLOGY

3.1 Site Investigations

Investigations were performed on the DNCS property to characterize geologic and hydrogeologic conditions of the site in conformance with provisions set forth in 19.15.36.8.C.15 NMAC. Hydrogeologic site characterization on the DNCS site was performed in accordance with Subsurface Investigation Workplans submitted to the New Mexico (NM) Energy, Minerals and Natural Resources Department (EMNRD) Oil Conservation Division (OCD) in January 2013 and May 2013 (Gordon Environmental, Inc.). The January 2013 workplan was developed using published resources on shallow stratigraphy of the area, as well as results of two preliminary soil borings that were drilled on the DNCS property in February 2012 to determine the presence or absence of shallow groundwater within 150 ft of land surface at the site. Three additional soil borings were advanced at the site (B-3, B-4 and B-5) in accordance with the January 2013 Investigation Workplan and OCD approval letter is provided in **Attachment IV.2.A**; a final boring (B-6) was drilled in accordance with the May 2013 Investigation Workplan.

Subsurface hydrogeologic investigations were performed at the DNCS site using hollow-stem auger and air rotary drilling. Data that was accumulated during boring and testing at the DNCS site, as well as published and agency file data on local geology and groundwater were compiled into a *Proposal for Vadose Zone Monitoring, DNCS Environmental Solutions, Lea County, NM* (Golder Associates, Inc., 2013). Gordon Environmental, Inc. (GEI), on behalf of DNCS Properties, LLC., directed the site drilling operations. Precision Sampling Company (Precision) of Albuquerque, NM was contracted by GEI to perform the drilling.

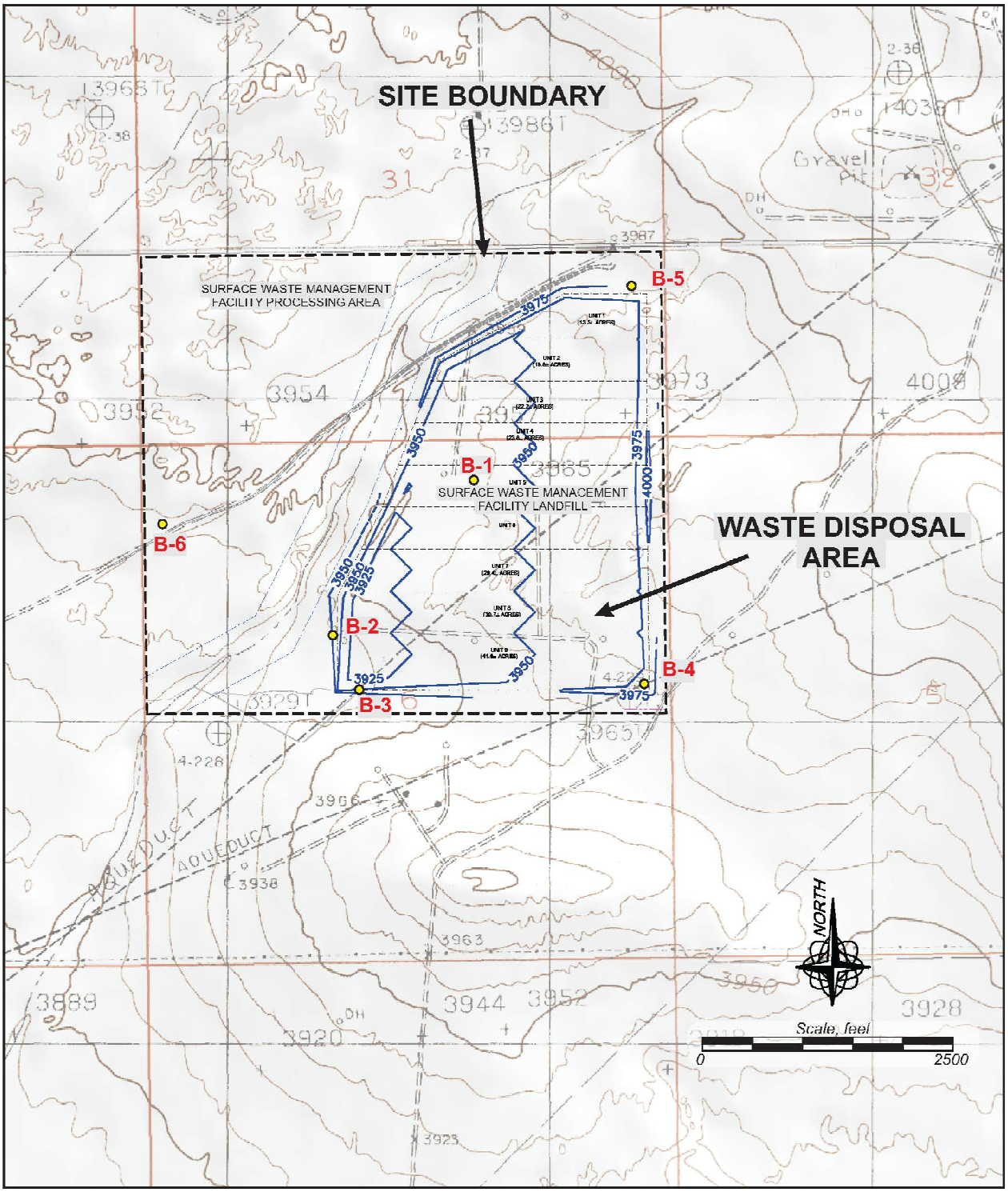
Six soil borings were advanced on the DNCS property at locations shown on the map in **Figure IV.2.6.** Two borings were drilled in February 2012, three additional borings were drilled in February 2013 and a sixth boring was drilled in June 2013. The six borings (B-1 through B-6) were drilled using a CME 75 drill rig capable of drilling using hollow stem auger (HSA) and air rotary drilling methods. Generally, HSA methods were used to penetrate and sample unconsolidated alluvium to the top of the Triassic Chinle shale bedrock, where auger refusal was encountered; air rotary drilling methods were used to complete borings into the Chinle shale to final depths of 150 ft. During HSA drilling, a core barrel was run in the lead auger to provide a continuous core of the penetrated materials; a split spoon drive sampler was run inside the augers on five-foot intervals to provide penetration blow counts, as well as to provide brass ring samples for geotechnical analysis. Upon auger refusal, drilling was switched to air rotary and circulated cutting samples were collected in a cyclone and split spoon samples were collected on five foot intervals. Depth-referenced formation samples collected during drilling were visually examined in the field to determine the lithology, texture color, degree of lithification, plasticity, moisture content of penetrated materials. Borings were generally left overnight after penetrating the Chinle shale bedrock and sounded the next morning for water; holes were also left overnight after reaching total depth in the Chinle Shale and sounded the next morning for water. No groundwater was detected in any of the site borings. Logs of borings B-3, B-4, B-5 and B-6 and are included in **Attachment IV.2.B**.

3.2 Geotechnical Evaluation

Table IV.2.2 provides the results of site-specific soils laboratory testing, which demonstrate the dramatic change in soils characteristics between the near-surface (i.e., 0-50 ft) coarse-grained deposits; and the thick and dense impermeable redbed deposits below. This site-specific characterization of the onsite soils is entirely consistent with other focused site studies in the area; as well as the documented regional database.

The surface soils consist of dune sands and caliche materials, suited for specific environmental applications:

- PSL – protective soil layer
- Vegetative layer – final cover establishment of erosion control
- Caliche – ideal for temporary road base construction and permanent road subgrade.



LEGEND

B-5 — Location and designation of site hydrogeologic characterization boring

3950 — Landfill basegrades

Permit property boundary

LOCATION OF SITE CHARACTERIZATION BORINGS

DNCS ENVIRONMENTAL SOLUTIONS
LEA COUNTY, NEW MEXICO

Gordon Environmental, Inc.
Consulting Engineers
213 S. Camino del Pueblo
Bernalillo, New Mexico, USA
Phone: 505-867-6990
Fax: 505-867-6991

DATE: 06/11/2014	CAD: SITE BORINGS,dwg	PROJECT #: 542.01.01
DRAWN BY: DMI	REVIEWED BY: GEI	FIGURE IV.2.6
APPROVED BY: IKG	gei@gordonenvironmental.com	

Drawing:P:\acad 2003\542.01.01\RAI 1\SITE BORINGS.dwg
Date/Time:Jun. 12, 2014-13:17:01 ; LAYOUT: A (P)

TABLE IV.2.2
Soils Laboratory Analyses Summary
DNCS Environmental Solutions

Sample Number[1]	Sample Depth (ft bgs)	USCS Class[2]	Grain Size Distribution			Atterberg Limits[3]	Natural Dry Density (PCF)	Natural Moisture[4] (%)	Standard Proctor		Permeability (cm/sec)	Porosity[5] (%)
			Pass #4 (%)	Pass #40 (%)	Pass #200 (%)	LL - PI			Max. Dry Density (PCF)	Optimum Moisture (%)		
B3-5	5-6.5	SP-SM	100	98	9.0	NP		2.8				
B3-20	20-25	SM	100	93	13.0			4.7				
B3-35SS	35-36.5	SC	100	97	14.0			4.6				
B3-35CC	35-40	SP-SM	99	95	11.0	NP		2.2	121.1	11.7		
B3-50.25BR	50.25-50.75	SC	100	94	47.1	32-18	112.3	7.6			9.72E-07	32.1
B3-65	65-70	SC	100	77	18.0			11.6				
B3-85	85-90	CL	100	88	82.1	38-24	112.3	3.3			1.01E-07	32.1
B3-115	115-120	SC	100	66	21.0			12.8				
B3-130	130-135	SC	100	62	20.0			8.7				
B3-145	145-150	SC	100	75	31.0			7.4				
B4-0	0-5	SP-SM	99	92	8.0	NP		11.4				
B4-15	15-20	SP-SM	100	98	7.3	NP		6.8				
B4-30CC	30-35	SP-SM	100	98	7.9	NP		4.8	119.9	12.1		
B4-30SS	30-31.5	SP-SC	100	98	8.9	NP		4.9				
B4-55BR	55-55.75	CL	100	88	85.0	42-19	100.8	9.7			7.89E-07	39.1
B4-80	80-85	SC	100	80	27.0			13.9				
B4-100	100-105	SC	100	83	34.0			13.8				
B4-120	120-125	CL	100	95	93.7	38-23	100.9	2.9				39.0
B4-145	145-150	SC	100	83	34.0			7.9				

Notes:

Blank field indicates test not conducted.

[1] *See* ***Figure IV.2.6*** *for locations of borings and* ***Attachment IV.2.A*** *for boring logs.*

[2] *Unified Soil Classification System: SM = silty sand; SP = poorly graded sand; SC = clayey sand; ML = low-plasticity silt; CL = low-plasticity clay; CH = high-plasticity clay.*

[3] *LL = liquid limit; PI = plasticity index; NP = non plastic.*

[4] *Gravimetric basis.*

[5] *For Porosity, a Specific Gravity of 165.4 PCF (i.e., 2.65) was used; where 1 - (Natural Dry Density / Specific Gravity) = Apparent Porosity.*

TABLE IV.2.2
Soils Laboratory Analyses Summary
DNCS Environmental Solutions

Sample Number[1]	Sample Depth (ft bgs)	USCS Class[2]	Grain Size Distribution			Atterberg Limits[3]	Natural Dry Density (PCF)	Natural Moisture[4] (%)	Standard Proctor		Permeability (cm/sec)	Porosity[5] (%)
			Pass #4 (%)	Pass #40 (%)	Pass #200 (%)	LL - PI			Max. Dry Density (PCF)	Optimum Moisture (%)		
B5-10	10-15'	SM	98	87	13.0			4.2				
B5-25	25-26.5	SM	98	92	11.0			0.7				
B5-30CC	30-35	SM	100	97	8.8	NP		4.3	123.3	9.9		
B5-30SS	30-31.5	SP-SC	99	88	11.0	NP		4.8				
B5-45	45-50.6	SM	100	85	7.2	NP		6.1				
B5-70SS	70-70.5	CL	100	93	84.4	41-22	90.6	13.1				45.2
B5-80	80-85	SC	100	66	19.0			12.2				
B5-90	90-95	SC	100	69	22.0			12.5				
B5-105	105	SC	100	67	21.0			14.4				
B5-125	125-130	SC	100	59	27.0			6.6				
B5-145	145-150	CL	100	90	85.5	36-21	107.2	8.4			7.54E-07	35.2
B6-0	0-5	SP	100	99	3.7	NP		2.1				
B6-7	07-13'	SM	100	93	15.0			7.0				
B6-13	13-27	SM	88	70	21.0			3.5				
B6-20	20-40	SM	95	83	14.0			4.1	118.2	11.0		
B6-27	27-48	SM	97	86	16.0			4.0				
B6-60	60-75	SC	100	90	32.9	25-11	106.2	3.1			1.13E-05	35.1

Notes:

Blank field indicates test not conducted.

[1] *See* ***Figure IV.2.6*** *for locations of borings and* ***Attachment IV.2.A*** *for boring logs.*

[2] *Unified Soil Classification System: SM = silty sand; SP = poorly graded sand; SC = clayey sand; ML = low-plasticity silt; CL = low-plasticity clay; CH = high-plasticity clay.*

[3] *LL = liquid limit; PI = plasticity index; NP = non plastic.*

[4] *Gravimetric basis.*

[5] *For Porosity, a Specific Gravity of 165.4 PCF (i.e., 2.65) was used; where 1 - (Natural Dry Density / Specific Gravity) = Apparent Porosity.*

The lower soils, horizons (i.e., 40-50 ft) are effective aquitards to vertical flow, and represent the selected positions for vadose monitoring points.

3.3 Site Geology

The site borings confirmed that site conditions are consistent with understanding of shallow stratigraphy and hydrogeology in the area based upon published literature and previous drilling performed in the vicinity. **Figure IV.2.6** is a map showing the locations of site characterization borings. **Table IV.2.3** contains a summary of the DNCS site boring locations, elevations, total depths and depths at which Triassic shale bedrock was penetrated in each boring. The site borings penetrated various thicknesses of alluvial deposits above the Triassic Chinle shale bedrock ranging from 45 ft to 67 ft. Shallow alluvium penetrated by the site borings was poorly graded fine sand with fragments of calcrete (caliche) and minor gravel. Based upon the lithologic logs, as well as drive blow counts for split spoon samples, the alluvium is moderately indurated and up to two caliche zones were identified within the alluvium near land surface and near the shale bedrock interface. Basal gravels were typically penetrated along the unconformity above the shale bedrock. The Chinle shale, penetrated by all site borings, was variegated reddish brown, purple and green claystone and siltstone. No sandstones or sandy zones were identified in the Chinle shale in any of the site borings.

Surficial terrain and geology in the vicinity of the DNCS site are shown on the map in **Figure IV.2.7**. Locations of the DNCS site and site characterization borings, as well as locations of nearby oil wells and water wells with significant available lithologic or hydrogeologic data are also shown within one mile of the site. Hydrogeologic well data included in **Figure IV.2.7** was obtained from several sources, including: information on nearby wells published by Nicholson and Clebsch (1961) and Geohydrology Associates, Inc, (1978), and Well Records obtained from New Mexico Office of the State Engineer (NMOSE) files. Copies of applicable portions of the Geohydrology Associates (1978) data, as well as the NMOSE Well Records are included in **Attachments IV.2.C** and **IV.2.D**, respectively. Records of wells obtained from listed sources are included in **Table IV.2.4**.

TABLE IV.2.3
Summary of DNCS Site Soil Boring Locations, Total Depths, Drill Dates, and Chinle Shale Depths
DNCS Environmental Solutions

Boring Number	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**	**B-6**
Northing	649096.52	647595.88	646949.6	646996.15	651053.32	648645.35
Easting	735916.89	734481.08	734727.7	737635.78	737531.4	732760.38
*Latitude	32.7828	32.778703	32.77692	32.77700	32.78815	32.7816102
*Longitude	-103.7002	-103.704897	-103.7042	-103.69465	-103.69491	-103.7104799
Elevation (ft above MSL)	3957.32	3942.76	3940.23	3968.2	3979.03	3939.5
Date	Feb-12	Feb-12	2/8/2013	2/9/2013	2/11/2013	6/12/2013
Total Depth (ft)	150	50	150	150	150	75
Depth to top of Chinle	--	--	45	50	65	67

Notes:

**coordinates in WGS-84*

State plane coordinates in NAD83 and NAVD88