United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties

Section 11/12 Mine, T 14N., R 10W.

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

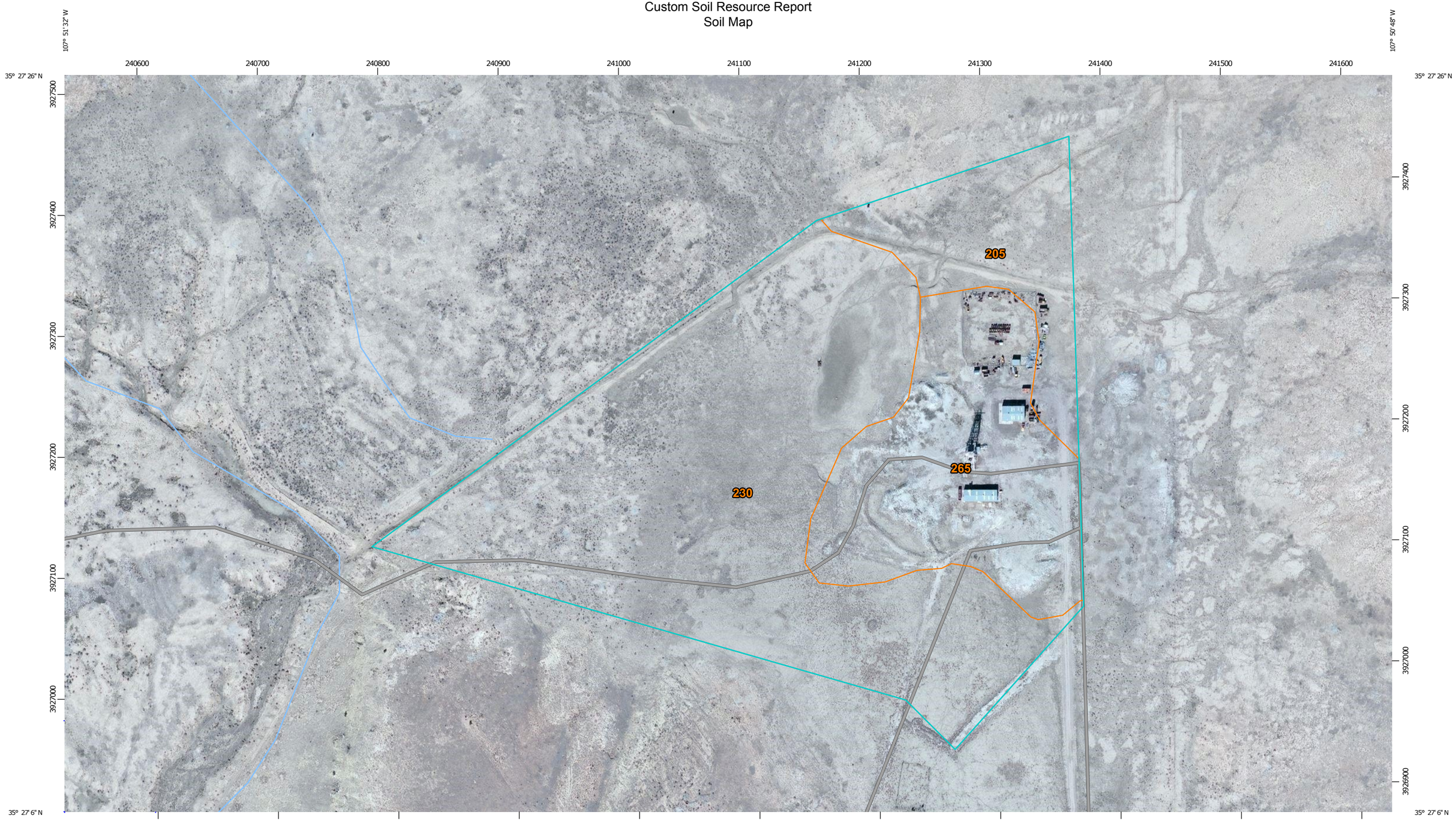
The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means

for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



Map Scale: 1:2,970 if printed on B landscape (17" x 11") sheet.

N

0 40 80 160 240 Meters

0 100 200 400 600 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties
Survey Area Data: Version 11, Sep 26, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 21, 2010—Nov 7, 2010

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.

Map Unit Legend

McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties (NM692)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
205	Penistaja-Tintero complex, 1 to 10 percent slopes	5.2	12.9%
230	Sparank-San Mateo-Zia complex, 0 to 3 percent slopes	25.0	62.6%
265	Uranium mined lands	9.8	24.4%
Totals for Area of Interest		**39.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If

intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties

205—Penistaja-Tintero complex, 1 to 10 percent slopes

Map Unit Setting

National map unit symbol: 1xk1
Elevation: 6,200 to 7,100 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 49 to 53 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Penistaja and similar soils: 45 percent
Tintero and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Penistaja

Setting

Landform: Dip slopes on cuestas, mesas, fan remnants on valley sides
Landform position (three-dimensional): Side slope, tread, talf
Down-slope shape: Convex, concave
Across-slope shape: Concave, linear, convex
Parent material: Eolian deposits and slope alluvium derived from sandstone and shale

Typical profile

A - 0 to 3 inches: sandy loam
Bt - 3 to 19 inches: sandy clay loam
Bk - 19 to 65 inches: sandy loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: B
Ecological site: Loamy (R035XA112NM)

Description of Tintero

Setting

Landform: Fan remnants on valley sides, mesas, dip slopes on cuestas
Landform position (three-dimensional): Side slope, tread, talf
Down-slope shape: Convex, concave
Across-slope shape: Convex, concave, linear
Parent material: Eolian deposits and slope alluvium derived from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
Bt - 4 to 16 inches: fine sandy loam
Bk1 - 16 to 48 inches: fine sandy loam
Bk2 - 48 to 65 inches: loamy fine sand

Properties and qualities

Slope: 1 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Sandy (R035XA113NM)

230—Sparank-San Mateo-Zia complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 1xk8
Elevation: 6,300 to 6,900 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 49 to 54 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Sparank and similar soils: 40 percent
San mateo and similar soils: 35 percent
Zia and similar soils: 20 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sparank

Setting

Landform: Flood plains on valley floors, valley sides
Landform position (three-dimensional): Side slope, tread, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Stream alluvium derived from calcareous sandstone

Typical profile

A - 0 to 2 inches: silty clay loam
C1 - 2 to 25 inches: clay
C2 - 25 to 65 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low (0.01 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: D
Ecological site: Clayey Bottomland (R035XA119NM)

Description of San Mateo

Setting

Landform: Valley sides, valley floors on flood plains
Landform position (three-dimensional): Side slope, tread, talf
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Stream alluvium derived from calcareous sandstone

Typical profile

A - 0 to 2 inches: clay loam
C1 - 2 to 15 inches: clay loam
C2 - 15 to 30 inches: sandy clay loam
C3 - 30 to 39 inches: clay loam
C4 - 39 to 45 inches: sandy loam
C5 - 45 to 65 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: C
Ecological site: Bottomland (R035XA118NM)

Description of Zia

Setting

Landform: Stream terraces on valley floors, alluvial fans on valley sides
Landform position (three-dimensional): Side slope, tread, rise
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Eolian deposits over fan and stream alluvium derived from calcareous sandstone

Typical profile

A - 0 to 3 inches: fine sandy loam
Bw - 3 to 12 inches: fine sandy loam
2C1 - 12 to 20 inches: fine sandy loam
2C2 - 20 to 28 inches: sandy loam
2C3 - 28 to 70 inches: fine sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6c
Hydrologic Soil Group: A
Ecological site: Sandy (R035XA113NM)

Minor Components

Escawetter

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Bottom 6-10" p.z. Perennial (Provisional) (R035XB273AZ)

265—Uranium mined lands

Map Unit Composition

Uranium mined lands: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Uranium Mined Lands

Typical profile

C - 0 to 60 inches: variable

Soil Information for All Uses

Ecological Site Assessment

Individual soil map unit components can be correlated to a particular ecological site. The Ecological Site Assessment section includes ecological site descriptions, plant growth curves, state and transition models, and selected National Plants database information.

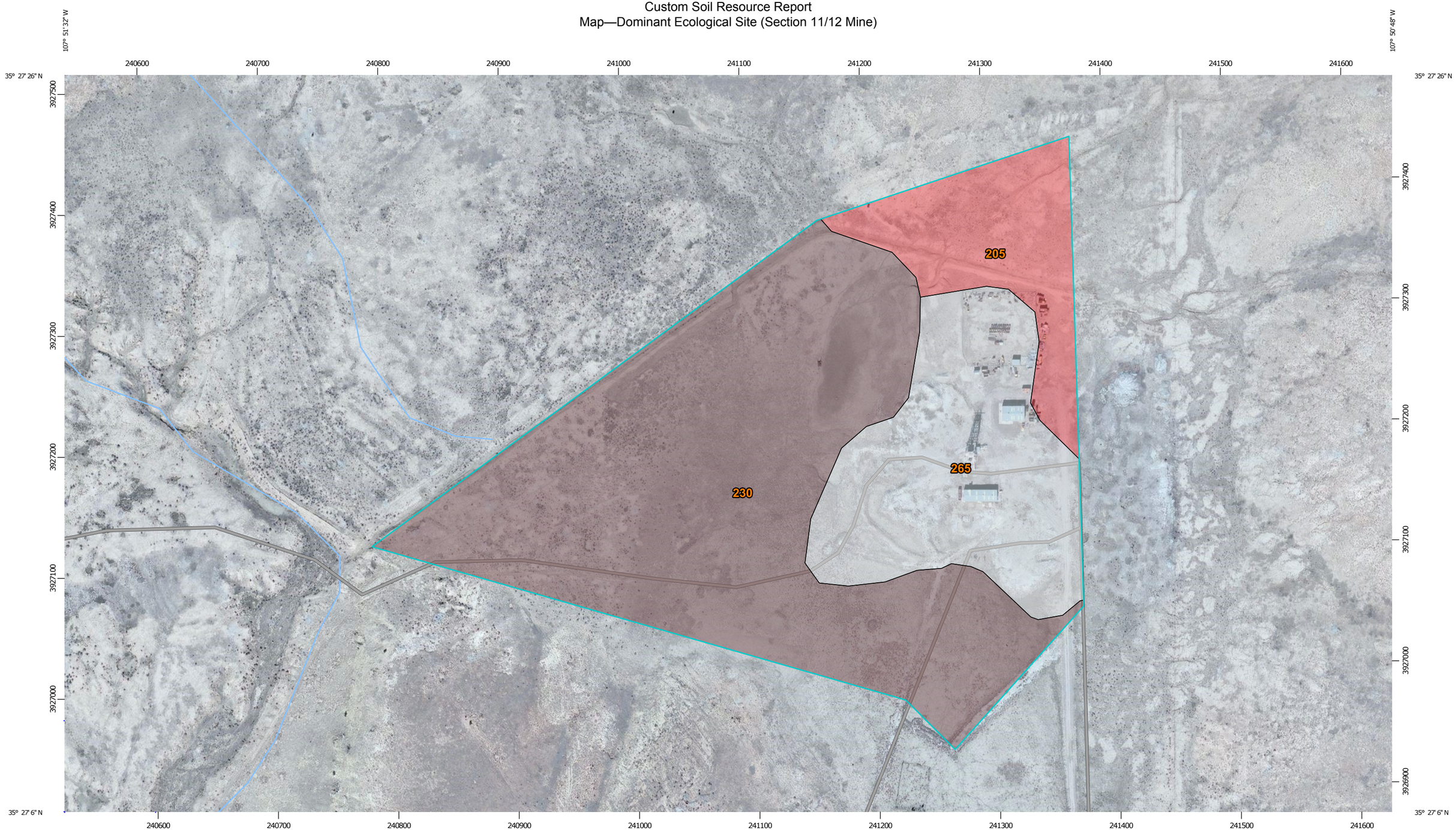
All Ecological Sites — Rangeland (Section 11/12 Mine)

An "ecological site" is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. For example, the hydrology of the site is influenced by development of the soil and plant community. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production.

An ecological site name provides a general description of a particular ecological site. For example, "Loamy Upland" is the name of a rangeland ecological site. An "ecological site ID" is the symbol assigned to a particular ecological site.

The map identifies the dominant ecological site for each map unit, aggregated by dominant condition. Other ecological sites may occur within each map unit. Each map unit typically consists of one or more components (soils and/or miscellaneous areas). Each soil component is associated with an ecological site. Miscellaneous areas, such as rock outcrop, sand dunes, and badlands, have little or no soil material and support little or no vegetation and therefore are not linked to an ecological site. The table below the map lists all of the ecological sites for each map unit component in your area of interest.

Map—Dominant Ecological Site (Section 11/12 Mine)



Map Scale: 1:2,970 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- R035XA112NM
- R035XA119NM
- Not rated or not available

Soil Rating Lines

- R035XA112NM
- R035XA119NM
- Not rated or not available

Soil Rating Points

- R035XA112NM
- R035XA119NM
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties
Survey Area Data: Version 11, Sep 26, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 21, 2010—Nov 7, 2010

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.

Table—Ecological Sites by Map Unit Component (Section 11/12 Mine)

McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties					
Map unit symbol	**Map unit name**	**Component name (percent)**	**Ecological site**	**Acres in AOI**	**Percent of AOI**
205	Penistaja-Tintero complex, 1 to 10 percent slopes	Penistaja (45%)	R035XA112NM — Loamy	5.2	12.9%
		Tintero (40%)	R035XA113NM — Sandy		
230	Sparank-San Mateo-Zia complex, 0 to 3 percent slopes	Sparank (40%)	R035XA119NM — Clayey Bottomland	25.0	62.6%
		San Mateo (35%)	R035XA118NM — Bottomland		
		Zia (20%)	R035XA113NM — Sandy		
		Escawetter (1%)	R035XB273AZ — Sandy Bottom 6-10" p.z. Perennial (Provisional)		
265	Uranium mined lands	Uranium mined lands (95%)		9.8	24.4%
Totals for Area of Interest				**39.9**	**100.0%**

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

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.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

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. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

R035XA112NM — Loamy Ecological Site

Plant Community Photos

MLRA 36; WP-2; Loamy

Grassland


•Blue grama, sand dropseed, bottlebrush squirreltail, western wheatgrass, winterfat, and 4-wing saltbush.
•Grass cover fairly uniform with some large (>1m) bare patches.
•Penistaja fine sandy loam, Cibola Co., NM.

Juniper-Invaded


•Blue grama with some galleta, 3-Awns, ring muhly, and juniper
•Grass cover fairly uniform to patchy.
Penistaja fine sandy loam, Cibola Co., NM.

Shrub-Dominated

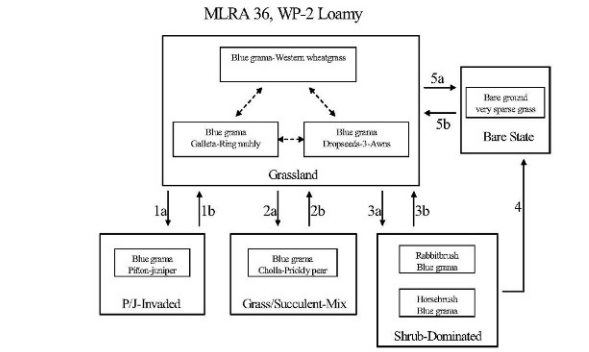

•Rubber rabbitbrush, low-vigor blue grama, ring muhly.
•Sparce grasscover in shrub interspaces.
•Penistaja fine sandy loam, Cibola Co., NM.

Bare State


•Isolated plants of blue grama and ring muhly with a few cholla and 4-wing saltbush.
•Bare ground interconnected and isolated grass patches.
•Remnants of blue grama pedestalled.
•Penistaja fine sandy loam, Cibola Co., NM.

Historic Climax Plant Community

Plant Communities and Transitional Pathways (diagram)



1a. Loss of grass cover, resource competition, seed dispersal, lack of fire. 1b. Brush control, prescribed fire, prescribed grazing.

2a. Drought, overgrazing, dispersal of succulent propagules, lack of fire. 2b. Brush control, prescribed grazing, prescribed fire.

3a. Loss of grass cover, resource competition. 3b. Brush control, prescribed grazing, seeding?

4. Brush control without grass recovery.

5a.Severe loss of grass cover, soil sealing and decreased infiltration, erosion. 5b.Break up physical soil crusts, range seeding, prescribed grazing.

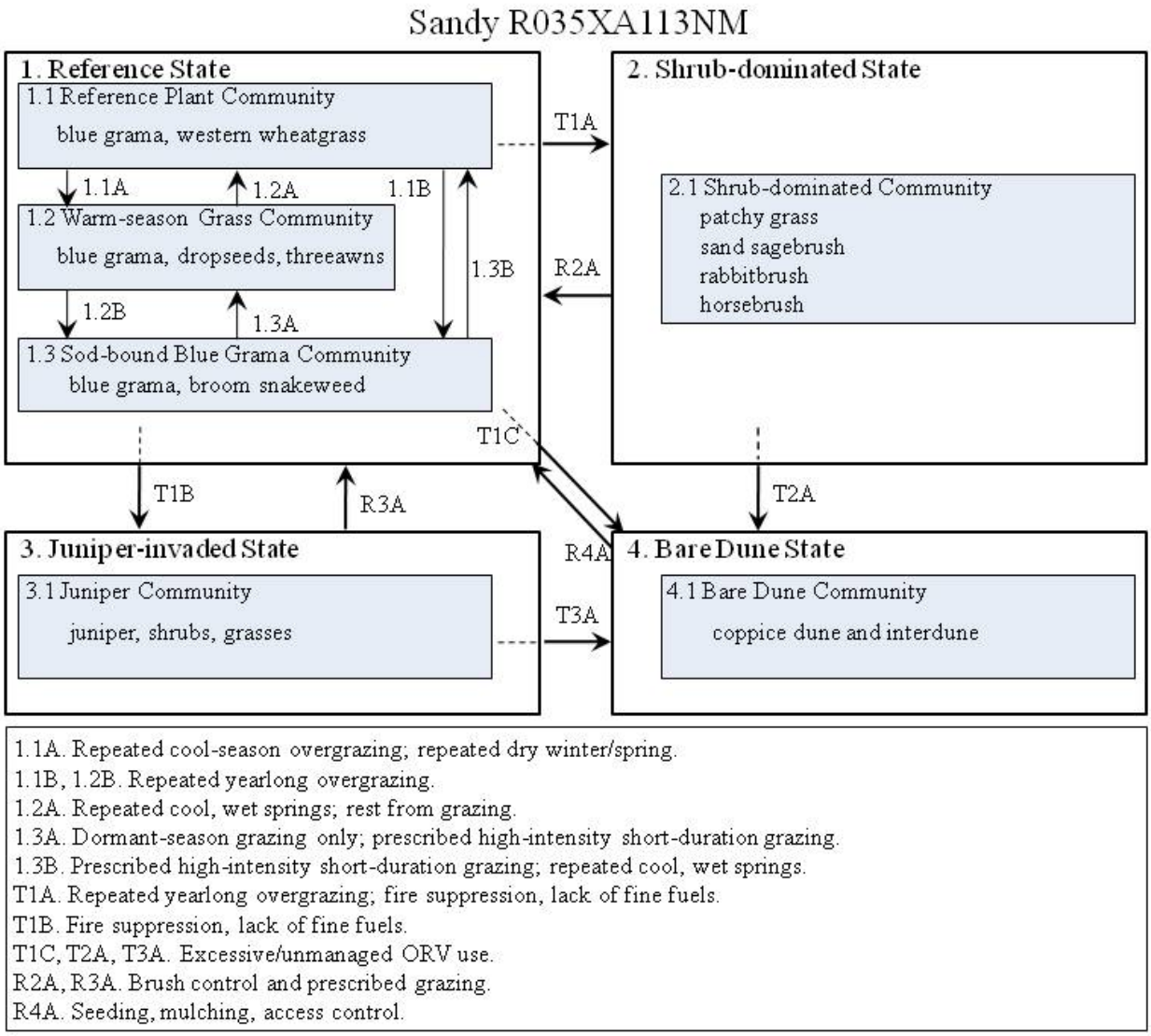
State Transition Diagram for R035XA112NM — Loamy Ecological Site

Ecological Dynamics Description

Overview

The Loamy site is one of the broadest ecological sites in WP-2 encompassing a wide range of soil series. It is associated with Sandy, Shallow Sandstone, Malpais, Limy, Shallow, Swale, and Savannah sites. Loamy sites occur as distinct units adjacent to or as part of complex or association with soil map units correlated to the above sites. The historic plant community of the Loamy site is a grassland characterized by a mixture of cool and warm-season grasses, and occasional shrubs and forbs. Blue grama and western wheatgrass are the dominant grasses. Fourwing saltbush and winterfat are characteristic shrubs. Loss of herbaceous cover and resulting decreased competition by grasses may favor piñon/juniper invasion or the encroachment of shrubs, typically, rabbitbrush or horsebrush. Seed dispersal and the reduction of natural fire frequency may also contribute to the invasion of piñon/juniper. Decreased available soil moisture due to drought and overgrazing, seed dispersal, and decreased fire frequency may promote the transition to a Grass/Succulent state. A severe loss of herbaceous cover, soil sealing, and reduced infiltration may cause the transition to a Bare state. While Piñon/Juniper-Invaded, Grass Succulent-Mix, and Shrub-Dominated may result from similar transitional drivers, it is unclear what factor or combination of factors ultimately determine the transition pathway.

R035XA113NM — Sandy Ecological Site



State Transition Diagram for R035XA113NM — Sandy Ecological Site

Ecological Dynamics Description

Overview

The Sandy Ecological Site typically occurs on upland plains, adjacent to or in a mosaic with Deep Sand or Loamy Ecological Sites. The reference plant community of the Sandy site has a grassland aspect characterized by warm- and cool-season grasses, scattered shrubs, and forbs. Blue grama is the dominant grass species accompanied by subdominant western wheatgrass. Fourwing saltbush and winterfat are the dominant shrubs. This site is susceptible to juniper invasion and shrub encroachment. Loss of grass cover and lack of fire may facilitate the transition to the Juniper State. Decreased grass cover due to overgrazing and drought in conjunction with resource competition may cause the transition to the Shrub-dominated State.

Catalog of states and community pathways

Reference State

Reference Plant Community: In the reference plant community, blue grama is the dominant grass species accompanied by subdominant western wheatgrass. Other species that occur in significant numbers include Indian ricegrass, sand dropseed, and spike dropseed. In addition to western wheatgrass and Indian ricegrass, other species such as needle and thread, bottlebrush squirreltail, and New Mexico feathergrass contribute to an important cool-season grass component on this site. Principal shrubs include fourwing saltbush, winterfat, and sand sagebrush. Rocky Mountain beeplant is often the most noticeable forb. Continuous heavy grazing will cause a decrease in cool-season grasses, especially western wheatgrass. The Warm-season Grass Community, dominated by blue grama with subdominant dropseeds, threeawns, and galleta, may result. Western wheatgrass is adapted to fine- to medium-textured soils, and may be naturally less dominant on coarser textured soils (7). Conversely, dropseeds are adapted to coarse- to medium-textured soils and may be naturally more dominant on soils with loamy sand surface textures (7). The Sod-bound Blue Grama Community may occur in response to increased fall/spring moisture following drought (2, 5) or continuous heavy grazing.

Diagnosis: Grass cover is relatively uniform; however, bare ground makes up a large percent of the total ground cover, and grass production during unfavorable years may only average 250 pounds per acre. Shrubs are scattered with canopy cover averaging 5%. Evidence of erosion such as rills and gullies is infrequent.

Additional States:

Shrub-Dominated State: This state is characterized by the predominance of shrubs, especially sand sagebrush, horsebrush, or rabbitbrush. Perennial grasses are subordinate. The grass component is typically a low-vigor, blue grama community with more threeawns, dropseeds, ring muhly, sandhill muhly, and bare ground than in the Reference State.

Diagnosis: Grass cover is patchy, usually dominated by low-vigor blue grama. Shrub cover averages 20% or more. Evidence of wind erosion, such as pedestalling of plants, blowouts, and soil deposition, may be common.

Transition to the Shrub-Dominated State (T1A). Loss of grass cover due to overgrazing or extended drought may facilitate the transition to the Shrub-Dominated State.

Key indicators of approach to transition:

—Loss of cool season grasses

—Decrease in grass and litter cover

—Increases in cover of bare ground

—Increases in shrub seedlings

Restoration Pathway to the Reference State (R2A). Brush control is necessary to reduce the competitive influence of shrubs and reestablish grass dominance. Chemical control or mowing for 2 consecutive years is effective in controlling sand sagebrush. Root plowing and other mechanical control methods that sever the plant below the sprouting zone may reduce horsebrush and rabbitbrush densities. Some positive results have been reported in controlling rabbitbrush with herbicides (1, 8). Follow-up spraying after the initial treatment is necessary to control horsebrush (9). Single treatments may actually increase horsebrush densities. Complete shrub removal should be attempted only after erosion hazard is evaluated. Seeding may be necessary if adequate seed source is not present. Rest from grazing followed by prescribed grazing afterward will help ensure grass establishment.

Juniper-invaded State. This state is characterized by the presence of juniper. Blue grama, dropseeds, galleta, Indian ricegrass, and threeawns are the primary grass species. Western wheatgrass may be present.

Diagnosis: Juniper is present. Grass cover is variable, ranging from relatively uniform to patchy with large, interconnected bare areas.

Transition to Juniper-invaded State (T1B). Loss of grass cover, resource competition, and lack of fire are believed to facilitate juniper invasion. Climatic periods of mild winters and wet summers may produce conditions favorable to juniper establishment, and result in episodic events of juniper expansion (6). Seed dispersal by wildlife and livestock may contribute to the spread of juniper. Birds, rodents, deer and other small mammals may eat the fruits of juniper and aid in spreading juniper seed (3). Sheep and goats may browse juniper and can act as dispersal agents in some areas. Overgrazing and competition for resources in conjunction with drought may favor juniper invasion. During years of limited rainfall, good grass cover may suppress juniper seedling survival by competing directly for soil moisture. Resource competition is more important during juniper seedling establishment when their roots are in the same zone as the grasses (3). Overgrazing may facilitate the establishment of juniper seedlings by providing competition-free areas, but livestock exclusion alone would not prevent juniper establishment. During wet years, competition for available soil moisture is reduced, and juniper seedlings may even establish in good stands of grass (3). Additionally, the natural spatial variability of ground cover may allow woody species to establish on bare areas within good grass stands when adequate moisture is available (4). Where fire was historically important in the development of plant communities on Sandy Ecological Sites by suppressing juniper seedlings, then overgrazing and fire suppression can disrupt natural fire frequencies and may facilitate juniper invasion.

Key indicators of approach to transition

—Decrease or change in composition or distribution of grass cover

—Increase in size and frequency of bare patches

—Increase in amount of juniper seedlings

Restoration Pathway to the Reference State (R3A). Mechanical or chemical brush control can be used to remove juniper and facilitate grass recovery. After brush control, rest from grazing followed by prescribed grazing will assist in grass reestablishment and persistence.

References

1. Cluff, G.J., B.A. Roundy, R.A. Evans, and J.A. Young. 1983. Herbicidal control of greasewood (Sarcobatus vermiculatus) and salt rabbitbrush (Chrysothamnus nauseosus ssp. consimilis). Weed Science. 31: 275-279.

2. Jameson, D.A. 1970. Value of broom snakeweed as a range condition indicator. Journal of Range Management. 23: 302-304.

3. Johnsen, T.N., Jr. 1962. One-seeded juniper invasion of northern Arizona grasslands. Ecological Monographs. 32:187-207.

4. Jurena, P.N. and S. Archer. 2003. Woody plant establishment and spatial heterogeneity in Grasslands. Ecology 84: 907-919.

5. McDaniel, K.C., L.A. Torell, and J.W. Bain. 1993. Overstory-understory relationships for broom snakeweed-blue grama grasslands. Journal of Range Management. 46: 506-511.

6. Miller, R.F., and R.J. Tausch. 2001. The role of fire in pinyon and juniper woodlands: a descriptive analysis. Pages 15–30 in K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

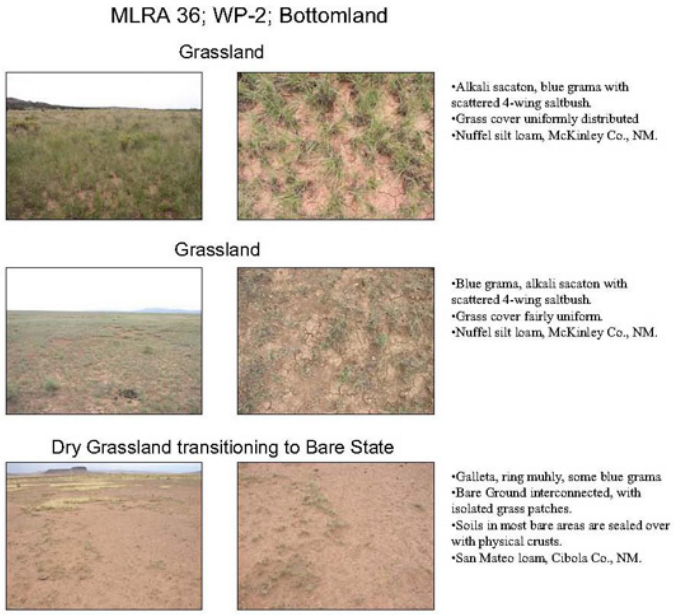
7. USDA, NRCS. 2002. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

8. Whisenant, S.G. 1988. Control of threadleaf rubber rabbitbrush with herbicides. Journal of Range Management. 41: 470-472.

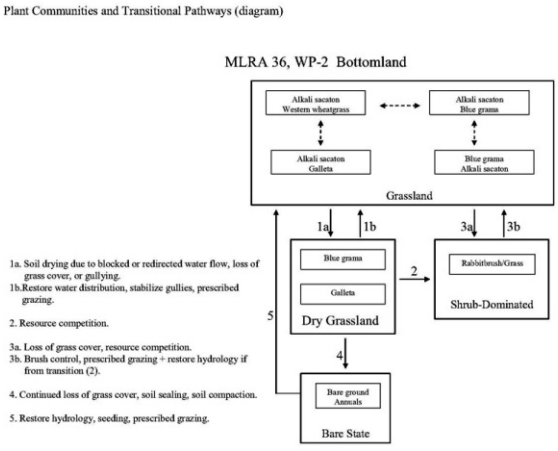
9. William, R.D., D Ball, T.L. Miller, [and others], compilers. 2001. Pacific Northwest weed management handbook. Corvallis, OR: Oregon State University. 408 p.

R035XA118NM — Bottomland Ecological Site

Plant Community Photos



Historic Climax Plant Community



State Transition Diagram for R035XA118NM — Bottomland Ecological Site

Ecological Dynamics Description

Overview

This site occurs on floodplains or stream terraces on valley floors. It occurs as a distinct unit or as part of a mosaic with Clayey Bottomland sites. The historic plant community of the Bottomland site is a highly productive grassland characterized by both warm and cool-season grasses, scattered shrubs, and forbs. Alkali sacaton is the dominant grass species with western wheatgrass occurring as the sub-dominant. Fourwing saltbush and rabbitbrush are common shrubs. Decreased available soil moisture due to changes in hydrology can cause a transition to a less productive Dry Grassland State. Continued loss of grass cover, soil surface sealing, or continuous disturbance may result in a state with extensive areas of bare ground (Bare State). Loss of grass cover and decreased soil moisture can increase competition by shrubs, facilitating shrub encroachment and result in a Shrub-Dominated state.

R035XA119NM — Clayey Bottomland Ecological Site

Plant Community Photos

MLRA 36; WP-2; Clayey Bottomland

Grassland Transitioning to Dry-Grassland


•Alkali sacaton, blue grama, galleta, with few scattered 4-wing saltbush
•Grass cover relatively uniform to patchy with large bare areas
• Sparank clay loam, Cibola Co., NM.

Shrub-Dominated

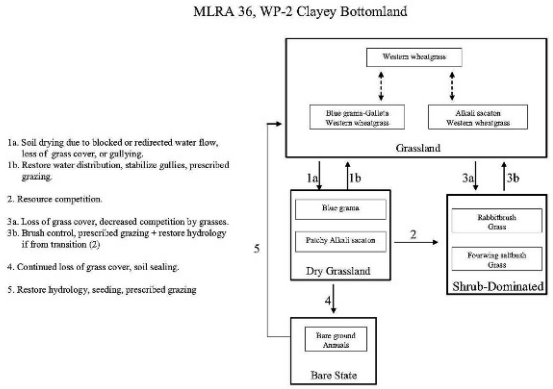

•Fourwing saltbush, blue grama.
•Grass cover patchy, low vigor blue grama.
•Note small gully starting to form.
•Grasses and shrubs pedestalled, bare areas deflated.
•Sparank clay loam, Cibola Co., NM.

Shrub-Dominated


•Fourwing saltbush, sparse western wheatgrass.
•Grass cover sparse.
•Limited evidence of erosion.
•Venadito clay, Cibola Co., NM.

Dry-Grassland Transitioning to Bare Stare

•Very patchy alkali sacaton, galleta, blue grama with few scattered 4-wing saltbush.
•Grass cover very patchy with large bare areas.
•Bare areas sealed by physical crusts.
• Sparank clay loam, Cibola Co., NM.



State Transition Diagram for R035XA119NM — Clayey Bottomland Ecological Site

Ecological Dynamics Description

Overview

This site occurs on swales, depressions, and flood plains on valley floors. It occurs as a distinct unit or as part of a mosaic with Bottomland sites. The historic plant community of the Clayey Bottomland site is a productive grassland characterized by both warm and cool-season grasses, scattered shrubs, and forbs. Western wheatgrass is the dominant grass species. Fourwing saltbush and rabbitbrush are the more common shrubs. Decreased available soil moisture due to blocked or redirected flow of run-on water, loss of grass cover, or gullying can cause a transition to a less productive Dry Grassland State. Continued loss of grass cover and soil surface sealing may result in a state with extensive areas of bare ground. Alternatively, loss of grass cover and soil drying can decrease competition by grasses, facilitating shrub encroachment and result in a Shrub-Dominated state.