USDA Natural Resources Conservation Service

Ecological site GX070A01X005
Limy

Last updated: 10/01/2021
Accessed: 05/17/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 070A–High Plateaus of the Southwestern Great Plains

This site is confined to the Canadian Plateaus LRU of MLRA 70A.

LRU notes

This site is confined to the Canadian Plateaus LRU of MLRA 70A.

Please use the following Key:
1a. The site exists on a landform of volcanic origin, such as a basalt plateau, or is part of an escarpment system that rises directly to a volcanic structure. These escarpments are included if they have volcanic alluvium or colluvium (i.e., basalt, rhyolite, tuff, cinders) overlying non-volcanic residuum or bedrock (i.e., sandstone, shale). → VOLCANIC PLATEAUS LRU (VP)
User tip: Other alluvial or colluvial landform features extending below the escarpments are not included unless they have a predominance of volcanic fragments at the surface. Also, note that playas atop volcanic plateaus are included within the VP-LRU.
1b. All other sites. → 2
2a. The site exists in the annulus or floor of a playa1. → CANADIAN PLATEAUS LRU (CP)
User tip: Small islands of playas occur within large areas of HP-LRU. These sites may be far from the nearest CP landform but will still key-out to the CP-LRU. The playa rim components, however, may key out to either LRU, so it is important to properly identify their soil properties.
2b All other sites. → 3
3a. The site is part of an escarpment landscape complex (defined below) or is within a canyon, valley, or small basin confined by such escarpments. At the upper boundary of the LRU, the soil surface meets at least 4 of the following 5 criteria:
I. Shallow or very shallow soils are present in at least 50% of the landform area;
II. Soils are underlain by sandstone bedrock of the Cretaceous Dakota Formation or older;
III. Presence or historical evidence of a conifer stand (≥ 2% canopy cover);
IV. The ground surface has a slope of at least 10%;
V. The landforms drain towards steep-walled escarpments or canyons below the Dakota sandstone (older Jurassic and Triassic Formations underlie this sandstone mesa cap).
→ MESOZOIC CANYONS AND BREAKS LRU (MCB)
User tip: The MCB sites also occur on any colluvial or alluvial bottomlands confined within escarpments or canyons. Some valleys transition from CP to MCB, or back to CP, and the turning point can be difficult to determine. Generally, the landforms are part of the MCB when confined between Dakota sandstone breaks or escarpments on both sides. Much of the acreage in the MCB is aproned by colluvial debris fans—composed of sandy materials with large sandstone fragments visible on the soil surface, including large stones or boulders. The soils in the bottoms of these confined valleys will also be in the MCB. When the valley opens, or there is only a single escarpment opening to the plains, the landforms below the steeper, rockier escarpments will be members of the CP-LRU.
3b. Fewer than 4 of the above criteria are met. → 4

4a. The soil is on a plateau summit position (tread) and is within 50 cm to contact with either plateau bedrock (non-soil bedrock of cemented sandstone, limestone, or shale) or strath terrace cobbles2, but not a petrocalcic contact (caprock or caliche of cemented calcium carbonate). → CANADIAN PLATEAUS LRU (CP)
4b. No plateau bedrock or strath terrace cobbles within 50 cm. → 5
5a. Fragments (>2 mm) are visible within the soil profile and/or on the surface. If fragments cannot be found in the profile, it is acceptable to look nearby on ant mounds or around burrows. If site is in a drainageway, one can look for fragments on landforms immediately upslope.→ 6
5b. Fragments are entirely absent. → 7
6a. Fragments are mostly petronodes3 or High Plains gravels4. → HIGH PLAINS LRU (HP)
6b. Fragments are mostly plateau bedrock fragments5. → CANADIAN PLATEAUS LRU
7a. All horizons in the upper 100 cm of soil have textures of sandy clay loam or sandier.
→ CANADIAN PLATEAUS LRU (CP)
7b. At least one horizon in the upper 100 cm of soil has a texture that is less sandy than sandy clay loam. → HIGH PLAINS LRU (HP)

Classification relationships

NRCS and BLM: Limy Canadian Plateaus LRU Major Land Resource Area 70A, High Plateaus of the Southwestern Great Plains Land Resource Region G, Western Great Plains Range and Irrigated Region (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS: Limy Sandy Smooth High Plains Subsection Southern High Plains Section Great Plains-Palouse Dry Steppe Province (Cleland, et al., 2007).

EPA: Limy <26l Upper Canadian Plateau<26 Southwestern Tablelands (Griffith, et al., 2006).

Ecological site concept

The Limy ecological site occurs on plateau landscapes in the Canadian Plateaus LRU which occupies the western portion of MLRA 70A. This LRU extends from Las Vegas, NM at the southern end to beyond Raton, NM at its northern end. Elevation for the Canadian Plateau LRU ranges from 5,000 to 7,500 feet.

The central concept for this site is a soil that ranges from 20 inches (50 centimeters[cm]) to over 80 inches (200 cm) to Cretaceous aged bedrock and has free carbonates throughout the profile. Surface textures range from loam to clay with at least 5 percent rock fragments on the surface. This differentiates this site from its most common associated site, the Clayey Uplands.

Associated sites

GX070A01X004	**Shallow Loamy** This site occurs where soils have paralithic contact within 20 inches (50 cm), and their surfaces lack one or both of the following: strong or violent effervescence and ≥ 5 percent calcareous rock fragments.
GX070A01X002	**Clayey Uplands** This site occurs in soils that lack a combination of free carbonates and ≥ 5 percent calcareous fragments at the surface, and contain horizons with ≥ 35 percent clay in the upper 50 cm.
GX070A01X014	**Lithic Limestone** This site occurs where soils are ≤ 20 inches (50 centimeters) to lithic contact with limestone bedrock, whereas Limy sites may be shallow or have a lithic contact at some depth, but not both.
GX070A01X003	**Loamy Uplands** This site occurs in soils that lack a combination of free carbonates and ≥ 5 percent calcareous fragments at the surface, and lack horizons with ≥ 35 percent clay in the upper 20 inches (50 cm).
GX070A01X007	**Limy Escarpments** This site differs from Limy sites in that it occurs on escarpments with slopes of 10 percent or more, and contains some amount of rock outcrop. These escarpments often contribute water to Limy sites via run-on and through-flow.

GX070A01X012	**Low Terraces** This site occurs on terraces above perennial streams where the flooding frequency interval is ≥ 10 years. This site is often used for hay and small grain production. Adjacent Limy sites contribute water to this site via run-on and through-flow.
GX070A01X013	**Lithic Sandstone** This site occurs where soils are ≤ 20 inches (50 cm) to lithic contact with sandstone bedrock, and often supports oneseed juniper savannahs.
GX070A01X017	**Playas** This site occurs in playas. Limy sites often provide water to adjacent Playa sites via through-flow and run-on.
GX070A01X008	**Ephemeral Drainageways** This site occurs on the channels and floodplains of ephemeral streams. Adjacent Limy sites contribute water to this site via run-on and through-flow.

Similar sites

R070AY001NM	**Loamy Upland** The Limy ecological site is currently correlated to the legacy ecological site Loamy Upland (R070AY001NM) in several locations. However, the former concept is quite broad, and does not distinguish potential New Mexico feathergrass habitat from other, less limy sites. This new Limy ecological site is a subset of the former.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R070AA005NM

Physiographic features

The Canadian Plateaus LRU exists on a plateau unit of the Great Plains Province landscape. The landforms that occur on this landscape include both erosional and depositional surfaces of plateaus and consist of alluvial fans, ridges, benches, playas, breaks, terraces, and floodplains. The Canadian River Valley, primarily to the east, is the base level towards which much of the LRU is eroding and draining. As the plateau grades towards the Canadian River, the elevation drops from heights as much as 7,500 feet to below 5,000 feet over a distance ranging from 20 to 40 miles. Because of this erosional gradient, the exposed strata are generally older as you move from west to east across this LRU. In the west younger bedrock, such as the late Cretaceous shales and limestones, remain intact, a testament to their distance from the Canadian River Valley. To the east, the early Cretaceous Dakota sandstone serves as a caprock that forms the plateau rim.

The Limy ecological site occurs on fan remnants and the shoulders and risers of plateaus in the Canadian Plateaus LRU. Elevation ranges from 5,000 to 7,500 feet. Soil depth ranges from 20 inches (50 cm) to over 80 inches (200cm) to lithic contact, but is occasionally shallower to paralithic shale. Slope gradient ranges from 0 to 10 percent, but is usually less than 5 percent. Aspect has very little effect on site dynamics.

The Limy site is moderately extensive, and is by no means the only ecological site that occurs on the noted landform positions in the Canadian Plateaus LRU. Other ecological sites that occupy fan remnants are the Clayey Flats and Clayey Uplands. Other ecological sites that occupy plateau shoulders and risers are the Lithic Sandstone, Loamy Uplands, Clayey Uplands, and Limy Escarpments.

Associated sites that occur on landforms and landform positions adjacent to the Limy site are the Limy Escarpments, Clayey Uplands, Loamy Uplands, and Gravelly Terraces. Limy Escarpments often occurs on steeper slopes (greater than or equal to 10 percent)—either above or below the Limy site—where limestone outcrop or shale

bedrock are exposed. Clayey Uplands and Loamy Uplands often occur upslope of the Limy site—where the soil at the surface is lower in effervescence and/or calcareous fragments. The Limy site can also occupy toes and fan remnants at the bases of ancient strath terraces—the escarpments of which are home to the Gravelly Terraces site.

Where the Limy site grades down into steep escarpments that are capped with Dakota sandstone, the soils have historically supported stands of pinyon and juniper, and drain into canyons, this site is associated with sites in the Mesozoic Canyons and Breaks (MCB) LRU of MLRA 70A.

For more detail on how the Limy site contrasts with and relates to other sites in the Canadian Plateaus, see the Ecological Site Key and Associated Sites section below.

Landscape: Plateaus
Landform: Plateau shoulders and risers, and fan remnants below escarpments
Slope: 0 to 10 percent but mostly under 5 percent
Aspect: Aspect does not exert much influence on this ecological site.

Geology
The geology of the Canadian Plateaus consists primarily of Cretaceous sedimentary plateau rocks: shale, limestone and sandstone of the Dakota, Graneros, Greenhorn, Pierre, and Niobrara Formations, which began a regional uplift during late Laramide Orogeny of the Tertiary Period. The Canadian River Valley, primarily to the east, is the base level towards which the entire plateau is eroding. As plateaus grade towards the Canadian River, the elevation drops from above 7,500 feet to below 5,000 feet over a distance of 30 to 40 miles. Because of this erosional gradient, the exposed strata are generally older as you move from west to east across this LRU. In the west, the younger rocks, such as the late Cretaceous shales and limestones, remain intact, a testament to their distance from the Canadian River Valley. To the east, the early Cretaceous Dakota Sandstone provides a caprock that serves as the plateau rim.

Being widely distributed across this LRU, the Limy site occurs on mostly shale surfaces. Soils typically form in one of two settings: where shale and limestone alluvium/residuum are the dominant parent materials for subsurface horizons, or where loess is the dominant parent material over weathered shale. A strong reaction to weak acid should be seen at the surface and increasing with depth.

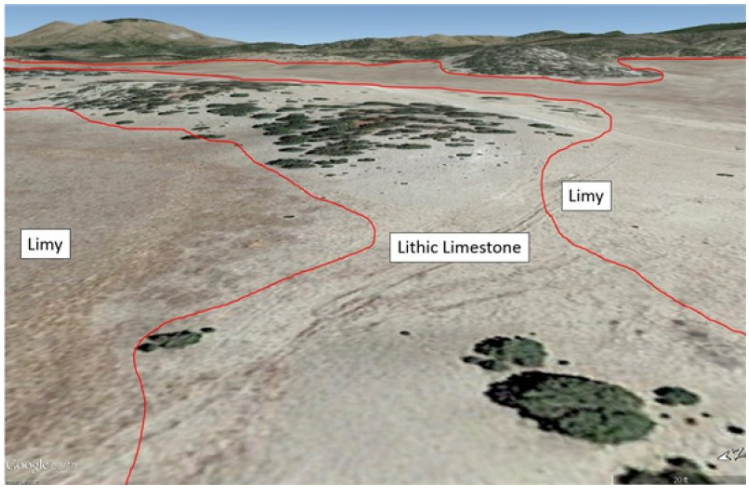


Figure 1. The Limy site in a typical landscape

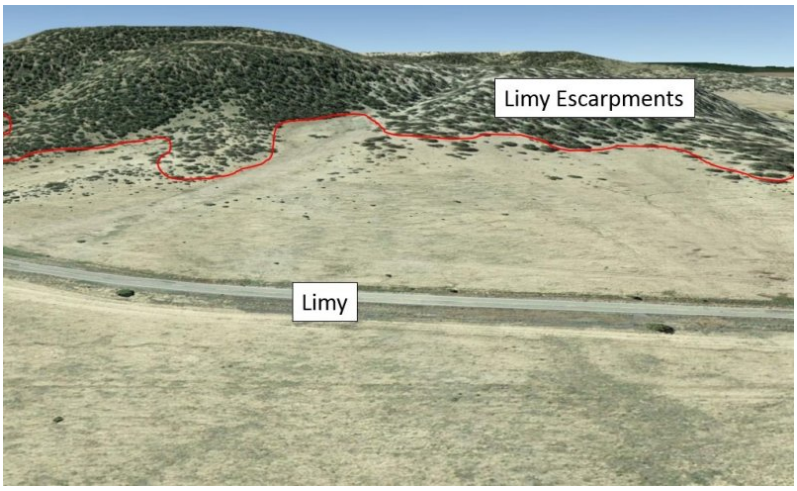


Figure 2. A photo diagram showing the Limy site on fan remnants associated with an herbaceous-dominated plant community, in contrast to the neighboring Limy Escarpment sites above with pinyon and juniper in the plant community.

Table 2. Representative physiographic features

Landforms	(1) Plateaus or tablelands > Fan remnant (2) Plateaus or tablelands > Plateau
Flooding frequency	None
Ponding frequency	None
Elevation	1,524–2,286 m
Slope	0–10%
Water table depth	203–251 cm
Aspect	Aspect is not a significant factor

Climatic features

The Canadian Plateaus are currently described as having an aridic-ustic and mesic soil climate regime. The estimated average annual soil temperature ranges from 49 to 58 F, supported by soil temperature measurements taken from May 2014 to July 2015. Rainfall occurs mostly during the summer months and ranges from 15 to 18 inches annually. An annual average range of 130 to 170 cumulative frost free days is common, with 150 days or fewer occurring above 7,000 feet.

Table 3. Representative climatic features

Frost-free period (characteristic range)	130-170 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	381-457 mm
Frost-free period (average)	150 days
Freeze-free period (average)	
Precipitation total (average)	406 mm

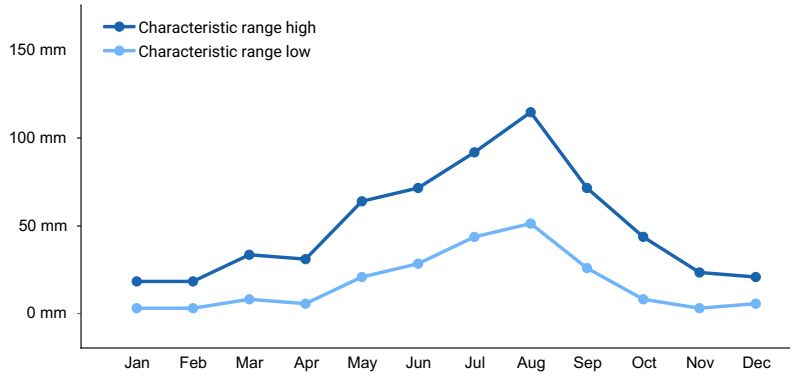


Figure 3. Monthly precipitation range

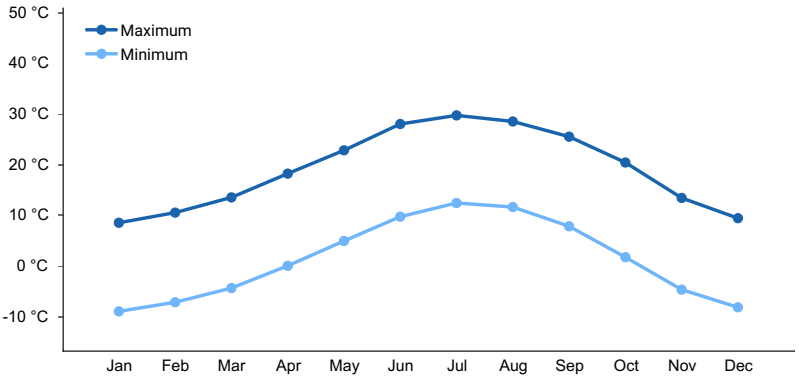


Figure 4. Monthly average minimum and maximum temperature

Climate stations used

- (1) CIMARRON 4 SW [USC00291813], Cimarron, NM
- (2) DES MOINES [USC00292453], Des Moines, NM
- (3) SPRINGER [USC00298501], Springer, NM
- (4) VALMORA [USC00299330], Valmora, NM
- (5) ROY [USC00297638], Roy, NM
- (6) LAS VEGAS WWTP [USC00294862], Las Vegas, NM
- (7) MAXWELL 3 NW [USC00295490], Maxwell, NM
- (8) LAS VEGAS MUNI AP [USW00023054], Las Vegas, NM

Influencing water features

The Limy ecological site is not associated with a wetland or riparian system; it is an upland ecological site. Because this site occurs on linear or convex portions of plateau summits, it tends to shed water (via through-flow or run-off) to sites lower in the catena.

Soil features

Every ecological site and associated soil component has static soil properties that help define the physical, chemical, and biological characteristics that make the site unique. The following soil profile information is a description of those unique soil properties for the Limy ecological site. To learn about the dynamic properties of the soil components tied to this site, refer to the "plant communities" section of this ESD.

The Limy ecological site is correlated to the components of numerous map units in the Canadian Plateaus LRU of 70A. These components are tied to the following soil series: Litle and Mion. These soils typically form in loess or alluvium over residuum derived from Cretaceous shale or limestone. Because of limitations in the scale and accuracy of soil mapping, this site occurs at locations where these soils—or other similar soils—have not been mapped. Thus, for site-specific planning purposes, please refer to the ecological site key for the Canadian Plateaus LRU.

It should be noted that the Limy concept covers a wide range of soil properties—surface texture, depth to bedrock, fragment content, etc. Defining characteristics are upland hydrology, a combination of calcareous fragments and free carbonates at the surface, lack of lithic bedrock in the upper 20 inches (50 cm), and slope of less than 10 percent. In the reference state, calcareous fragments and free carbonates at the surface select for species such as New Mexico feathergrass, and the lack of shallow lithic contact selects against tree species.

In normal years these soils are driest during the winter. They are dry in some or all parts for over 90 cumulative days, but are moist in some or all parts for either 180 cumulative days or 90 consecutive days, during the growing season. The soil moisture regime is ustic bordering on aridic. The mean annual soil temperature is 49 to 55 degrees F; this range falls in the mesic temperature regime.

Soils associated with the Limy site are characterized by a combination of strong effervescence and at least 5 percent calcareous (or carbonate-coated) fragments at the surface. These soils are well drained with medium runoff potential at the surface and a moderately slow saturated hydraulic conductivity. The B horizons typically have between 18 and 35 percent clay, have low EC values throughout. While these soils can be as shallow as 20 inches (50 cm) to root-restrictive layers and are generally very deep.

TYPICAL PEDON: Litle series from NM 630
The soils in the Litle series are classified as fine, mixed, active, mesic Ustic Haplocambids. These moderately deep, well drained soils are on uplands and fans. The soils formed in material derived from shale and limestone. Slope is 1 to 9 percent. Mean annual precipitation is about 16 inches, and mean annual air temperature is about 50 degrees F. Location DD: 35.60942, -104.87297. This pedon does not actually meet the Limy ecological site criteria due to its lack of surface fragments.

Typical pedon of a Litle clay in an area of Penrose-Litle-Mion association, undulating; about 20 miles east of Las Vegas in the NE 1/4 of sec. 24, T. 16 N., R. 19 E

A—0 to 5 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; hard, firm, very plastic; many fine and very fine roots; many fine interstitial pores; calcareous; moderately alkaline; clear smooth boundary.

Bk1—5 to 11 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, very plastic; many fine and very fine roots; common fine tubular pores; common pressure faces; calcareous; moderately alkaline; clear smooth boundary.

Bk2—11 to 23 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; very hard, firm, very plastic; common fine and very fine roots; common tubular pores; 10 percent shale chips; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—23 inches; gray shale that has calcium carbonate deposits between the plates.

The solum is 20 to 30 inches thick. Shale is at a depth of 20 to 40 inches. The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 when dry and 3 or 4 when moist, and chroma of 2 to 4. It is clay or clay loam. The B horizon has hue of 10YR or 2.5Y, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. It is clay or clay loam.

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone and shale (2) Eolian deposits
Surface texture	(1) Silt loam (2) Sandy clay loam (3) Clay loam
Family particle size	(1) Clayey (2) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow

Soil depth	51–251 cm
Surface fragment cover <=3"	5–20%
Surface fragment cover >3"	0–10%
Available water capacity (0-152.4cm)	17.78–25.4 cm
Calcium carbonate equivalent (0-152.4cm)	3–20%
Electrical conductivity (0-152.4cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-152.4cm)	0–2
Soil reaction (1:1 water) (0-152.4cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

Plant tables have not been developed for this site. Until such time as they can be updated, use the plant tables in the referenced literature that correlates to this concept (refer to the Correlation to Current Ecological Sites sub-section at the bottom of this narrative). With respect to the imperfect alignment of such correlations, be aware of these shortcomings in their applicability to conservation planning.

Early work by Kuchler (1964) identified the potential natural vegetation type for the Canadian Plateaus LRU as that of the grama/buffalograss short grass prairie. The Limy ecological site is dominated by short grasses, but also contains a mix of shrubs, forbs, and succulents. As is typical of plant communities, pronounced annual variations in precipitation translate to considerable short-term fluctuations in annual production within a given plant community phase.

There are numerous variables which affect the range of characteristics for this ecological site. Variables such as elevation, latitude, and orographic effects create a climatic gradient which influence the distribution of C3 and C4 plants. Soil properties such as surface texture, depth to clay layer, parent material, and accumulated salts affect species diversity and composition. Natural disturbances such as drought and wildfire affect species density and cover.

The climate gradient across the Canadian Plateaus LRU shows a greater distribution of C3 plants such as western wheatgrass and bottlebrush squirreltail where temperatures are cooler, and moisture is more abundant. Where surface texture trends toward clay loam, western wheatgrass, galleta, and vine mesquite grass increase. In areas of sandier surface textures, sideaoats grama, and sand dropseed are more likely to occur. Refer to Appendix C to see scientific names and plant codes alongside common names.

Fire is a disturbance regime that reduces succulents and shrubs while stimulating grasses and forbs. Not all fires are equal. According to Gebow (2001), fire effects in the same location will vary, especially with fire timing, both seasonally and within the scheme of year-to-year moisture variation. Precipitation during seasons before and after fire has a major effect on recovery of plants. Fire promotes rhizomatous plant species, such as western wheatgrass, that can take advantage of below-ground rhizomes from which tillering is rapidly initiated.

Grazing pressure will tend to favor grasses such as blue grama and purple threeawn as well as shrubs such as broom snakeweed and prairie sagewort.

Correlation to Current Ecological Sites:
The Limy ecological site is currently correlated to the Loamy Upland (R070AY001NM) site in several locations. However, the former concept is quite broad, and does not distinguish potential New Mexico feathergrass habitat

from other, less limy sites. This new Limy site is a subdivision of the former.

(From the Loamy Upland ecological site description, R070AY001NM): Approximately 90 percent of the total yield is from species that furnish forage for grazing. Continuous grazing during the growing season will cause the more desirable forage plants such as western wheatgrass, bottlebrush squirreltail, galleta, sideoats grama, and winterfat to decrease. Species most likely to increase are blue grama, ring muhly and buffalograss. As the ecological condition deteriorates, it is accompanied by a sharp increase of blue grama. Continuous heavy grazing will cause blue grama to form a low, dense turf, which is low in productivity. A system of deferred grazing, which varies the time of grazing and rest in the pastures during successive years is needed to maintain or improve the plant community. Grazing western wheatgrass during the months of May and June will cause a sharp decrease; therefore, rest during this period will allow western wheatgrass to grow and reproduce.

Annual production by plant type
Plant Type-------Low(Lb/Acre) -------RV(Lb/Acre)-------High(Lb/Acre)
Grass/Grasslike -------610----------860----------1100
Forb----------130----------130----------140
Shrub/Vine----------130----------130----------130
Total----------870----------1120----------1370

Community 1.1 plant community composition
Common Name----------Symbol-------Scientific Name-------Annual Production (Lb/Acre)
GRASS/GRASSLIKE
1-------blue grama----------BOGR2-------*Bouteloua gracilis*---------312–357
2-------western wheatgrass----PASM-------*Pascopyrum smithii*-------178–223
3-------squirreltail----------ELEL5-------*Elymus elymoides*---------89–133
4-------James' galleta----------PLJA-------*Pleuraphis jamesii*----------43–89
5-------sideoats grama----------BOCU-------*Bouteloua curtipendula*---43–89
6-------threeawn----------ARIST-------Aristida----------25–44
7-------ring muhly----------MUTO2------*Muhlenbergia torreyi*-----25–44
8-------buffalograss----------BODA2------*Bouteloua dactyloides*-----25–44
9-------common wolfstail--------LYPH---------*Lycurus phleoides*----------25–44
10-------sand dropseed----------SPCR---------*Sporobolus cryptandrus*----25–44
FORB
12-------*Forb, annual*----------2FA---------- *Forb, annual*----------10–48
13-------*Forb, perennial*----------2FP---------- *Forb, perennial*----------10–48
14-------Cuman ragweed----------AMPS---------*Ambrosia psilostachya*------10–25
15-------scurfpea----------CULLE---------Cullen----------5–25
16-------prairie clover----------DALEA-------Dalea----------5–25
17-------dotted blazing star---------LIPU----------*Liatris punctata*----------5–25
18-------locoweed----------OXYTR-------Oxytropis----------5–25
19-------upright prairie coneflower-RACO3------*Ratibida columnifera*-------5–25
20-------scarlet globemallow--------SPCO--------*Sphaeralcea coccinea*-------5–25
SHRUB/VINE
21-------winterfat----------KRLA2-------*Krascheninnikovia lanata*---29–48
22-------prairie sagewort----------ARFR4-------*Artemisia frigida*----------29–48
23-------*Shrub, deciduous*----------2SD---------- *Shrub, deciduous*----------29–48

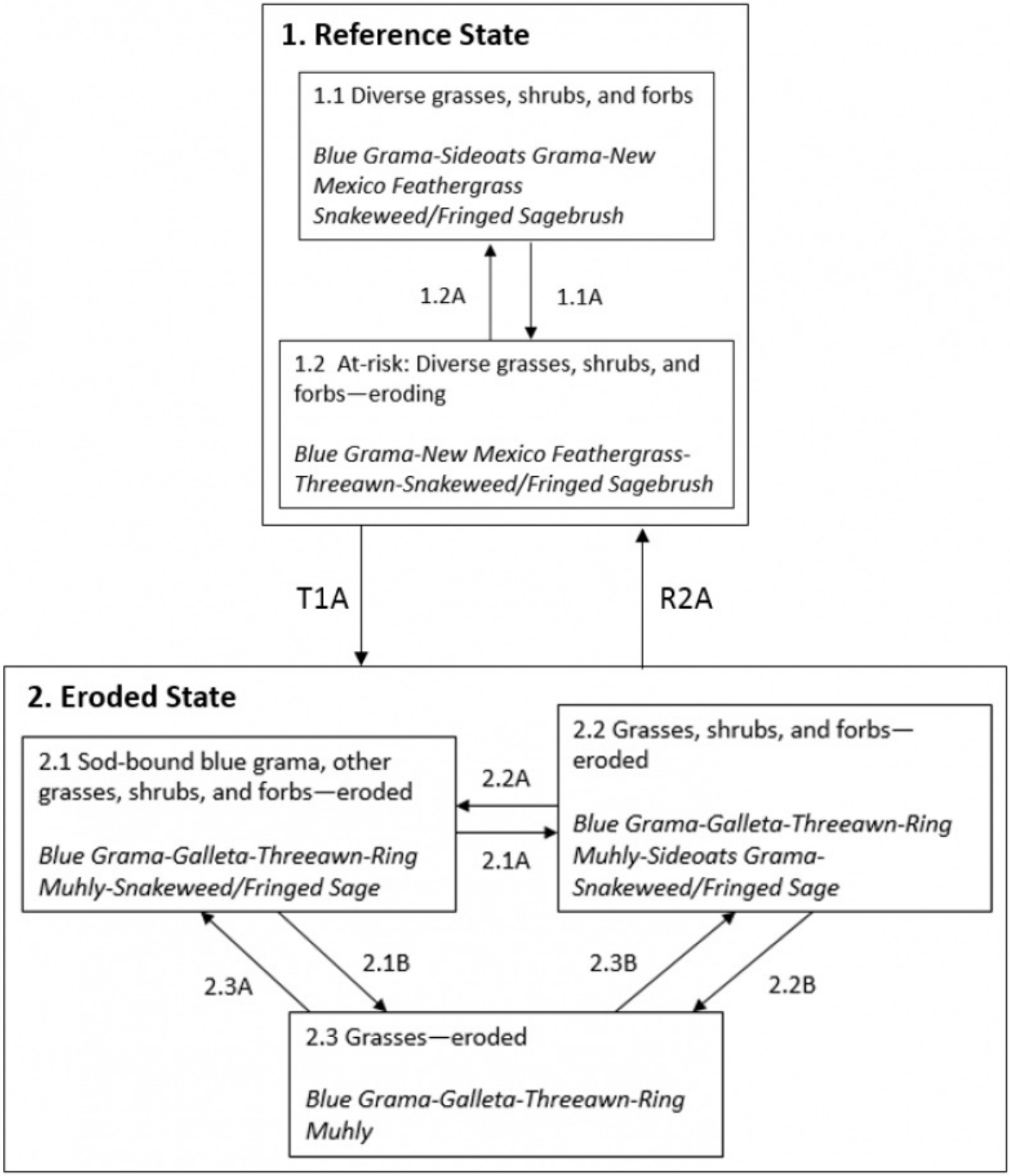
(From the San Miguel County Soil Survey) The potential plant community is mainly blue grama, western wheatgrass, sideoats grama, and galleta. As the range deteriorates, the proportion of these forage plants decreases, the proportion of ring muhly and threeawn increases, and blue grama forms a dense turf that is low in productivity. Grazing management should be designed to increase the productivity and reproduction of western wheatgrass, vine mesquite, and fourwing saltbush. Annual production averages 1,200 pounds per acre in favorable years and 700 pounds per acre in normal years.

(From Union County Soil Survey) Clayey Range Site--Litle clay loam is the only soil in this range site. This soil has a clay loam surface layer and a clay subsoil. It is well drained and has slopes of 1 to 9 percent. Permeability is slow, runoff is rapid, and the water-supplying capacity is low to moderate. Decreasers make up about 40 percent of the vegetation when this site is in excellent condition. The main decreaser plants are western wheatgrass and alkali

sacaton. Increasers make up about 60 percent of the vegetation when the site is in excellent condition. The main increasers are blue grama, buffalograss, galleta, ring muhly, mat muhly, four wing saltbush, and winterfat. In poor condition, the site supports nearly solid stands of galleta in many places and some low, sodlike blue grama, buffalograss, mat muhly, and ring muhly. The soil in this site is suitable for contour furrowing, pitting, and range seeding. If the range is in excellent condition, the total annual production of all plants is 1,600 pounds per acre air-dry weight in favorable years, and is 500 pounds in dry years. On range in excellent condition, the total annual production of plants that provide forage for cattle is 1,524 pounds, air-dry weight, in favorable years and 400 pounds in dry years.

Plants that commonly occur on this site include:
Grasses: blue grama, western wheatgrass, galleta grass, New Mexico feathergrass, sideoats grama, buffalograss, ring muhly, and threeawn.
Forbs: western wallflower, curlycup gumweed, groundsel, scarlet globemallow, and fleabane.
Shrubs/succulents: broom snakeweed, prairie sagewort, and winterfat.

State and transition model



State 1
Reference State

This state represents the most ecologically stable state in terms of resistance to erosion. Moreover, this state has the highest potential for productivity and plant diversity.

Community 1.1
Diverse grasses, shrubs, and forbs (diagnostic plant community)

Figure 5. Community 1.1 on a plateau shoulder in Colfax County, August 2018. The Ephemeral Drainageways site is visible in the background. New Mexico feathergrass is not always so dominant in this phase.

This plant community occurs on eroded soils—where productive potential and species diversity have been lost with topsoil and the seedbank it held. This community is a mix of grass, shrub, and forb species; with grasses usually being dominant. However, shrubs are much more abundant than in Community 1.2, and reach codominance at some locations. Among the grasses, warm-season species—particularly blue grama in a sod-bound state—are dominant, but cool-season grasses are at least well-represented. While one or more decreaser species (sideoats grama and/or western wheatgrass) is often present, New Mexico feathergrass is notably absent. Conversely, increaser species such as purple threeawn and ring muhly are often quite abundant. If topsoil remains, its thickness has been reduced considerably. Foliar cover is between 50 and 75 percent, and bare ground ranges from 10 to 40 percent. Total canopy cover of warm-season grasses is between 30 and 60 percent. Cool-season grass cover is typically 5 percent or less. Shrubs and forbs account for up to 35 percent and 5 percent cover, respectively. Encroaching oneseed juniper has been observed on this phase, and is especially likely where this site lies directly below the Limy Escarpments site. Annual production averages around 650 pounds per acre, but can range between 450 and 1,000 pounds per acres, depending mostly on annual weather patterns. This community exists where season-long grazing has been practiced, thus it has experienced an increase in shrub vigor and a decrease in grass vigor. Under heavy, continuous herbivory, the depth of grass roots decreases—giving shrubs a competitive advantage in acquiring water and nutrients. As the turnover of grass roots diminishes, energy flow begins to lessen due to a decrease in soil organic matter. The loss of organic matter in situ, coupled with a loss in topsoil that occurs during transition T1A, translate to reduced water-holding capacity and nutrient availability. While prolonged grazing would have been uncommon prior to the introduction of livestock, fire was an important factor in keeping shrub species from gaining a competitive advantage and stimulating the growth of grasses.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 1.2
At risk: Diverse grasses, shrubs, and forbs—eroding

Figure 6. Community 1.2 on a gentle plateau riser in Colfax County, September 2017. New Mexico Feathergrass, sideoats grama, and wolfstail are all well-represented here.

This community is a mix of grass, shrub, and forb species; with grasses being dominant. However, shrubs are much more abundant than in Community 1.1, and approach codominance at some locations. Among the grasses, warm-season species are dominant, but cool-season grasses are at least well-represented. Decreasers such as New Mexico feathergrass, sideoats grama, and western wheatgrass are present, but with lesser abundance than in the reference community. Some topsoil remains, but its thickness has been reduced considerably. Foliar cover is between 55 and 80 percent, and bare ground ranges from 10 to 40 percent. Total canopy cover of warm season grasses is between 30 and 65 percent. Cool-season grass cover is typically 5 percent or less, but can range as high as 20 percent. Shrubs and forbs account for up to 25 percent and 5 percent cover, respectively. Encroaching oneseed juniper has been observed on this phase, and is especially likely where this site lies directly below the Limy Escarpments site. Annual production averages around 700 pounds per acre, but can range between 500 and 1,100 lbs/ac, depending mostly on annual weather patterns. This community exists where season-long grazing has been practiced, thus it has experienced an increase in shrub vigor and a decrease in grass vigor. Under heavy, continuous herbivory, the depth of grass roots decreases—giving shrubs a competitive advantage in acquiring water and nutrients. As the turnover of grass roots diminishes, energy flow begins to lessen due to a decrease in soil organic matter. The loss of organic matter in situ, coupled with a loss in topsoil that occurs during pathway 1.2A, translate to reduced water-holding capacity and nutrient availability. While prolonged grazing would have been uncommon prior to the introduction of livestock, fire was an important factor in keeping shrub species from gaining a competitive advantage and stimulating the growth of grasses.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Pathway P1.1A
Community 1.1 to 1.2

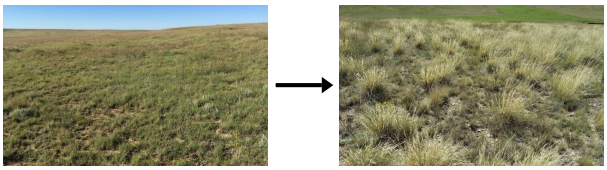
Diverse grasses, shrubs, and forbs (diagnostic plant community)

At risk: Diverse grasses, shrubs, and forbs—eroding

This pathway represents a period of heavy grazing, typically season-long, which advantages the growth and reproduction of shrubs and suppresses herbaceous species that are more palatable and/or less resilient under grazing pressure. Under such a grazing regime, and in the absence of fire and/or chemical treatments, broom snakeweed and fringed sage increase in abundance and vigor. Early seral grasses such as purple threeawn and

ring muhly also increase under continuous grazing. Conversely, western wheatgrass, sideoats grama, and New Mexico feathergrass will diminish unless given significant periods of rest during their growing seasons. Despite having significant gravel cover, this site is quite susceptible to erosion. As grass cover diminishes and soils are trampled during continuous grazing, soils become even more vulnerable to the effects of wind, raindrop impact, and runoff. Thus, significant amounts of soil are lost in this pathway.

Pathway P1.2A
Community 1.2 to 1.1



At risk: Diverse grasses, shrubs, and forbs—eroding

Diverse grasses, shrubs, and forbs (diagnostic plant community)

This pathway represents prescribed grazing or rest from grazing. In either case, herbaceous plants that are palatable and/or sensitive to grazing increase in vigor and abundance, and shrubs are at a competitive disadvantage.

State 2
Eroded State

Community 2.1
Sod-bound blue grama, other grasses, shrubs, and forbs—eroded

Figure 7. Community 2.1 on a fan remnant in Mora County, October 2018. Shrub dominance is rather moderate for this phase.

Figure 8. A plant community transitioning from phase 2.1 to phase 2.3 in San Miguel County, November 2017. Most of the broom snakeweed here is dead, and most of the blue grama is sod-bound.

This plant community occurs on eroded soils—where productive potential and species diversity have been lost with topsoil and the seedbank it held. This community is a mix of grass, shrub, and forb species; with grasses usually being dominant. However, shrubs are much more abundant than in Community 1.1, and reach codominance at some locations. Among the grasses, warm-season species are dominant, but cool season grasses are at least well-represented. While one or more decreaser species (sideoats grama and/or western wheatgrass) is often present, New Mexico feathergrass is notably absent. Conversely, increaser species such as purple threeawn and ring muhly are often quite abundant. If topsoil remains, its thickness has been reduced considerably. Foliar cover is between 50 and 75 percent, and bare ground ranges from 10 to 40 percent. Total canopy cover of warm season grasses is between 30 and 60 percent. Cool-season grass cover is typically 5 percent or less. Shrubs and forbs account for up to 35 percent and 5 percent cover, respectively. Encroaching oneseed juniper has been observed on this phase, and is especially likely where this site lies directly below the Limy Escarpments site. Annual production averages around 650 pounds per acre, but can range between 450 and 1,000 lbs/ac, depending mostly on annual weather patterns. This community exists where season-long grazing has been practiced, thus it has experienced an increase in shrub vigor and a decrease in grass vigor. Under heavy, continuous herbivory, the depth of grass roots decreases—giving shrubs a competitive advantage in acquiring water and nutrients. As the turnover of grass roots diminishes, energy flow begins to lessen due to a decrease in soil organic matter. The loss of organic matter in situ, coupled with a loss in topsoil that occurs during transition T1A, translate to reduced water-holding capacity and nutrient availability. While prolonged grazing would have been uncommon prior to the introduction of livestock, fire was an important factor in keeping shrub species from gaining a competitive advantage and stimulating the growth of grasses.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- purple threeawn (*Aristida purpurea*), grass
- ring muhly (*Muhlenbergia torreyi*), grass

Community 2.2
Blue grama, other grasses, shrubs, and forbs—eroded

Figure 9. Community 2.2 in Colfax County, September 2017. Note the cespitose habit of blue grama. While this grass species has recovered to some degree, New Mexico Feathergrass and topsoil remain absent.

This plant community occurs on eroded soils—where productive potential and species diversity have been lost with topsoil and the seedbank it held. This community is a mix of grass, shrub, and forb species; with grasses being dominant. However, shrubs are typically quite abundant. While at least one cool-season grass species generally remains, warm-season grasses—particularly blue grama with a sod-bound habit—are quite dominant. Decreasers such as sideoats grama and western wheatgrass are often low in abundance, and New Mexico feathergrass is absent. Conversely, increaser species such as purple threeawn and ring muhly are often quite abundant. The original topsoil is either gone or very thin. The most notable difference between communities 2.2 and 2.1 is that in the former, blue grama has recovered to a cespitose (bunchgrass) habit. Foliar cover is between 55 and 80 percent, and bare ground ranges from 10 to 40 percent. Total canopy cover of warm-season grasses is between 35 and 70 percent. Cool-season grass cover is typically 5 percent or less. Shrubs and forbs account for up to 20 percent and 5 percent cover, respectively. Annual production averages around 700 pounds per acre, but can range between 500 and 1,000 pounds per acre, depending mostly on annual weather patterns. While this community has not experienced season-long grazing in a number of years, it still shows evidence of such management in the past. Most notably, topsoil is either absent or else quite thin. Thus, water-holding capacity and nutrient availability are both lower in the soils here than in State 1. Since the turnover of grass roots is the main driver of decomposition in grassland soils, this community can be expected to exhibit greater rates of nutrient cycling and accumulation of soil organic matter than community 2.1. While prolonged grazing would have been uncommon prior to the introduction of livestock, fire was an important factor in keeping shrub species from gaining a competitive advantage and stimulating the growth of grasses. Without this variable, shrubs will remain competitive.

Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- blue grama (*Bouteloua gracilis*), grass
- purple threeawn (*Aristida purpurea*), grass
- ring muhly (*Muhlenbergia torreyi*), grass

Community 2.3
Grasses—eroded

Figure 10. Community 2.3 in Colfax County, August 2018. Blue grama is sod-bound and dominant, and shrubs are nearly absent.

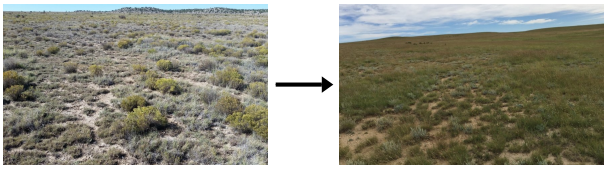
Figure 11. Figure 10. Community 2.3 in San Miguel County, November 2017. This site was chemically treated 5 years prior. Note that shrubs have already re-established, and the community is transitioning to phase 2.2.

This plant community typically occurs where herbicides have recently been applied to suppress shrubs. Thus, grasses are dominant. However, species richness among grasses is no higher than in communities 2.1 and 2.2; and total species richness is quite low. While decreasers such as sideoats grama and western wheatgrass are present, their abundance is generally low, and New Mexico feathergrass is absent. Foliar cover is between 60 and 90 percent, and bare ground ranges from 5 to 30 percent. Total canopy cover of warm-season grasses is between 50 and 80 percent. Cool-season grass cover is typically 5 percent or less. Shrubs and forbs each account for less than 5 percent and 5 percent cover. Annual production averages around 800 pounds per acre, but can range between 600 and 1,000 pounds per acre, depending mostly on annual weather patterns.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- purple threeawn (*Aristida purpurea*), grass
- ring muhly (*Muhlenbergia torreyi*), grass

Pathway P2.1A
Community 2.1 to 2.2

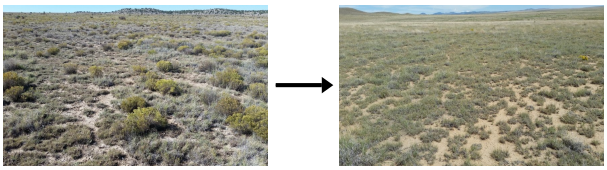


Sod-bound blue grama, other grasses, shrubs, and forbs—eroded

Blue grama, other grasses, shrubs, and forbs—eroded

Community Pathway: This pathway represents prescribed grazing or rest from grazing. In either case, herbaceous plants that are palatable and/or sensitive to grazing increase in vigor and abundance, and shrubs are at a competitive disadvantage. The most obvious change is that blue grama recovers from its sod-bound habit and begins to assume the habit of a bunchgrass.

Pathway P2.1B
Community 2.1 to 2.3

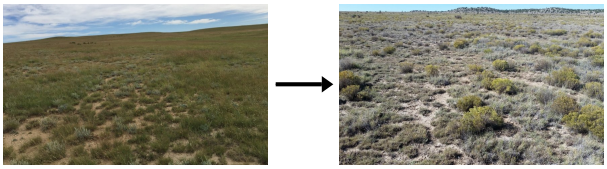


Sod-bound blue grama, other grasses, shrubs, and forbs—eroded

Grasses—eroded

This pathway represents the suppression of shrubs. This can result from a dry period during late summer, or from chemical treatments. Since fire requires significant biomass, this disturbance is probably quite rare in Community Phase 2.1.

Pathway P2.2A
Community 2.2 to 2.1

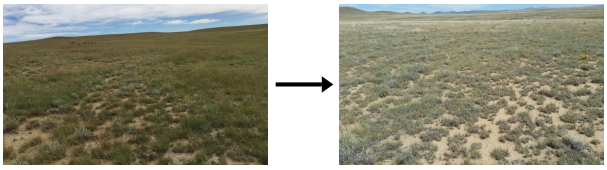


Blue grama, other grasses, shrubs, and forbs—eroded

Sod-bound blue grama, other grasses, shrubs, and forbs—eroded

This pathway represents a period of heavy grazing, typically season-long, which advantages the growth and reproduction of most shrubs, and suppresses herbaceous species that are more palatable and/or less resilient under grazing pressure. Blue grama responds to grazing pressure by assuming a sod-bound habit.

Pathway P2.2B
Community 2.2 to 2.3

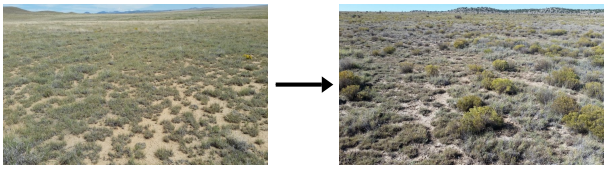


Blue grama, other grasses, shrubs, and forbs—eroded

Grasses—eroded

This pathway represents phenomena which suppress shrubs as well as many forbs. This pathway could involve fire, chemical treatments, or a late summer drought. Since significant biomass is required to carry a fire, a period of deferred grazing is probably a necessary precursor.

Pathway P2.3A
Community 2.3 to 2.1

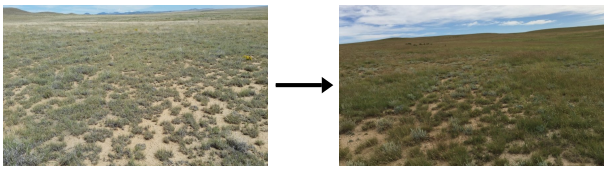


Grasses—eroded

Sod-bound blue grama, other grasses, shrubs, and forbs—eroded

This pathway represents a resurgence of shrubs and forbs following herbicide treatments. Concurrent season-long grazing forces blue grama into a sod-bound state and gives shrubs a competitive advantage over grasses. Additionally, shrubs enjoy a competitive advantage in the eroded, calcareous soils of State 2.

Pathway P2.3B
Community 2.3 to 2.2



Grasses—eroded

Blue grama, other grasses, shrubs, and forbs—eroded

This pathway represents a resurgence of shrubs and forbs following herbicide treatments. Concurrent prescribed grazing maintains some vigor among palatable grass species and allows blue grama to maintain a cespitose habit. However, shrubs remain at a competitive advantage in the eroded, calcareous soils of State 2.

Transition T1A
State 1 to 2

Slow variables: Continued encroachment by shrubs, coupled with the loss of herbaceous plant production, leads to decreases in total canopy cover and soil organic matter. The result is an increase in the rate of wind and water erosion—leading to the loss of topsoil and an associated decrease in available water and nutrients. Trigger event: A severe drought kills already-weakened perennial grasses, resulting in a loss in canopy cover. This, in turn, accelerates erosion. Threshold: The vigor and cover of perennial grasses is reduced to a point at which some perennial grasses die, and soil surfaces become highly susceptible to erosion.

Restoration pathway R2A
State 2 to 1

An increase in the competitive advantage of various perennial grass species through physical, chemical, and biological management practices. This restoration pathway will likely require long-term, multifaceted approaches and high-energy inputs. In order to return to State 1, erosion will have to be reversed, grazing will have to be tightly-controlled, and the re-introduction of extirpated plant species may be required. Favorable weather patterns may also be necessary.

Additional community tables

Animal community

(From R070AY001NM) This site provides habitat which supports a resident animal community that is characterized by pronghorn antelope, badger, black-tailed jackrabbit, black-tailed prairie dog, thirteen-lined ground squirrel, prairie pocket gopher, marsh hawk, burrowing owl, horned lark, meadowlark, scaled quail, prairie rattlesnake, Great Plains toad and ornate box turtle. The prairie falcon hunts yearlong over these habitats. These short grass sites are breeding areas for the long-billed curlew, upland plover, and lark bunting.

Hydrological functions

The Limy ecological site is not associated with a wetland or riparian system; it is an upland ecological site. Because this site occurs on linear or convex portions of plateau summits, it tends to shed water (via through-flow or run-off) to sites lower in the catena.

Wood products

The Limy site does not typically produce many trees, although oneseed juniper do encroach on degraded areas.

Other information

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Other references

Cleland, D.T.; Freeouf, J.A.; Keys, J.E., Jr.; Nowacki, G.J.; Carpenter, C; McNab, W.H. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States.[1:3,500,000], Sloan, A.M., cartog. Gen. Tech. Report WO-76. Washington, DC: U.S. Department of Agriculture, Forest Service.

Gebow, B. S., 2001. Search, Compile, and Analyze Fire Literature and Research Associated with Chihuahuan Desert Uplands, Tuscon: The University of Arizona.

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).

Kuchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographical Society, Special Publication

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.

United States Department of Agriculture, Natural Resources Conservation Service. 1977. Soil survey of San Miguel County, New Mexico.
https://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/

United States Department of Agriculture, Natural Resources Conservation Service. 1971. Soil survey of Union County, New Mexico.
https://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/

Contributors

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Approval

Curtis Talbot, 10/01/2021

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	05/17/2024

Approved by	Curtis Talbot
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
