USDA Natural Resources
Conservation Service

# Ecological site GX070A01X007
# Limy Escarpments

Last updated: 10/01/2021
Accessed: 05/13/2025

## 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 (70A.1) of MLRA 70A.

## LRU notes

This site is confined to the Canadian Plateaus LRU (70A.1) 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 playa. → 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 cobbles, 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 petronodes or High Plains gravels. → HIGH PLAINS LRU (HP)
6b. Fragments are mostly plateau bedrock fragments. → 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: Shallow Limy Escarpments 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: Shallow Limy Escarpments Sandy Smooth High Plains Subsection Southern High Plains Section Great Plains-Palouse Dry Steppe Province (Cleland, et al., 2007).

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

### Ecological site concept

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

This concept covers the entire escarpment—from the shoulder position at the top to the point at which the escarpment grades into an alluvial fan apron or alluvial flat below.

Soil depth for the Limy Escarpments ranges from 4 inches (10 centimeters [cm]) to over 40 inches (100 cm) to lithic contact with limestone or paralithic contact with weathered shale. Shallow, lithic soils are typically found toward the top of the escarpment, and deeper, shale-dominated soils are found below. Slope gradient is at least 10 percent. Bedrock outcroppings should be visible in some places as small areas of exposed angular limestone benches that typically contour the slope. Where the slope inflection changes from convex to concave, at the lower part of the escarpment, alluvial fans will begin as a transition from shallow to deep soils, with some elements of both Limy Escarpments and Limy ecosites. Because of the relatively steep slope gradient, aspect has a significant effect on microclimate.

There is considerable overlap between the soils on the Limy Escarpments ecological site and soils on other sites. Additionally, soil properties vary considerably within this site depending on slope position. Thus, geomorphology and the presence of limestone rock outcrop are the most reliable indicators of this site. Unlike other steep sites in the Canadian Plateaus LRU, the Limy Escarpments provides ideal habitat for tree species on its truly lithic soils (typically found toward the top of the escarpment). This makes the lower slope positions particularly vulnerable to encroachment by trees. For this reason, the Limy Escarpments concept includes multiple soil types that are inextricable linked—much like the stream channel and floodplains of a riparian system.

Despite considerable variability in soil properties, there are some common themes. First, the soil surface is draped with a great deal of calcareous rock fragments—typically composed of limestone, and almost always covering more than half of the surface area. Second, soils react strongly or violently to dilute hydrochloric acid (HCl), indicating considerable free carbonates. The combination of free carbonates and calcareous surface fragments provides critical habitat for New Mexico feathergrass. The high concentration of surface fragments protects soils from erosion.

## Associated sites

| | |
|---|---|
| GX070A01X005 | **Limy**<br>This site is similar to Limy Escarpments but is on slopes less than 10% and contains no shallow bedrock. Limy often occupies fans emanating from the base of Limy Escarpments. Thus, Limy Escarpments frequently contributes run-on moisture to the Limy site. |
| GX070A01X006 | **Slopes**<br>This site differs from Limy sites in that it occurs on escarpments with slopes of 10% or more, and its soils are ≤ 50 cm to bedrock. These escarpments can contribute water to Limy sites via run-on and through-flow. |
| GX070A01X017 | **Playas**<br>This site occurs in playas. Nearby Limy Escarpments sites contribute water to this site via run-on and through-flow. Typically, there are alluvial landforms (fan remnants or alluvial flats) between escarpments and playas, so the Limy and Clayey Alluvium sites typically act as conduits between the latter. |
| GX070A01X003 | **Loamy Uplands**<br>This site occurs in soils that lack a combination of free carbonates and ≥ 5% calcareous fragments at the surface, and lack horizons with ≥ 35% clay in the upper 50 cm. |
| GX070A01X008 | **Ephemeral Drainageways**<br>This site occurs on the channels and floodplains of ephemeral streams. Adjacent Limy Escarpment sites contribute water to this site via run-on and through-flow. |
| GX070A01X014 | **Lithic Limestone**<br>This site occurs where soils are ≤ 50 cm to lithic contact with limestone bedrock, whereas Limy sites may be shallow or have a lithic contact at some depth, but not both. |

## Similar sites

| | |
|---|---|
| R070AY014NM | **Hills**<br>This site occurs on complex landscape of hills, mesa sides, bajada and narrow valleys. They formed in calcareous old alluvium and eolian sediments from limestone and sandstone. The slopes are usually smooth and soils are shallow to moderately deep. |
| R070AY003NM | **Shallow Upland**<br>This occurs on nearly level to rolling upland sites as low rounded ridges, hill slopes, mesas or as low hills (on the convex position of the landscape). Steep-sided canyons frequently dissect the landscape.These are well-drained shallow soils. The parent material or root restriction layer is at depths of 20 inches or less and is limestone or indurated caliche. |
| R077BY033NM | **Loamy**<br>The Laporte component of the Shallow Limy Slopes is currently correlated to the Loamy site, which was designed in another MLRA. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | Not specified |

## Legacy ID

R070AA007NM

## 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 the entire LRU is eroding and draining. 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.

The Limy Escarpments ecological site occurs on plateau escarpments in the Canadian Plateaus LRU. Elevation ranges from 5,000 to 7,500 feet. Soil depth ranges from 4 inches (10 cm) to over 40 inches (100 cm) to lithic contact with limestone bedrock or weakly-cemented paralithic shale. Slope gradient ranges from 10 to 100 percent, but is usually less than 50 percent.

The Limy Escarpments site is not extensive, nor is it the only ecological site that occurs on plateau escarpments in the Canadian Plateaus LRU. Other ecological sites that occupy this landform position are the Shallow Loamy Slopes and Loamy Slopes.

Associated sites that occur on landforms and landform positions adjacent to the Limy Escarpments site are the Lithic Limestone, Limy, Loamy Uplands, Ephemeral Drainageways, and Saline Drainageway Bottoms.

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

Geology:
The geology of the Canadian Plateaus consists primarily of Cretaceous rocks: shale, limestone and sandstone of the Dakota, Graneros, Greenhorn, Pierre, and Niobrara Formations. The Limy Escarpments site generally occurs on interbedded layers of limestone and shale from the Graneros, Greenhorn, and Niobrara Formations. Soils form in colluvium and slope alluvium derived from limestone and shale over residuum derived from limestone and/or shale.

As is typical in plateau systems, the upper end of the escarpments are armored by more erosion-resistant materials—in this case, limestone. These hard strata are underlain by relatively soft marine shale. Were it not for the protection of limestone—both as a caprock at the top of the escarpment and as a surface lag on lower slopes—these landforms would be much more subdued and dissected.

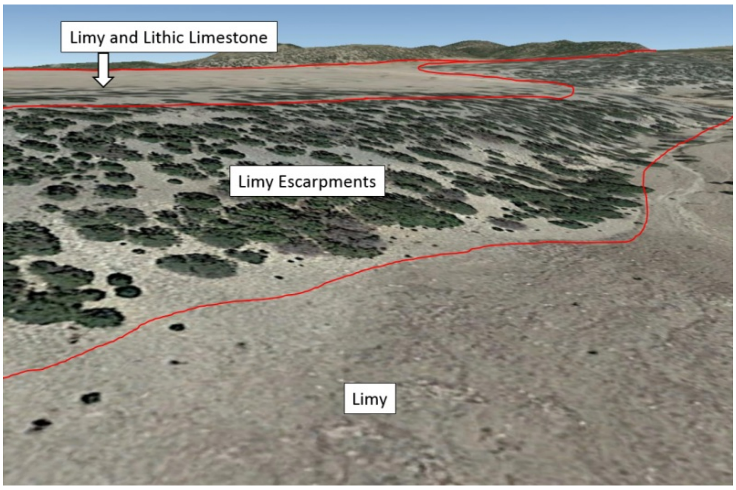



**Figure 1. A Landscape diagram showing the Limy Escarpments site in relation to commonly-associated sites.**

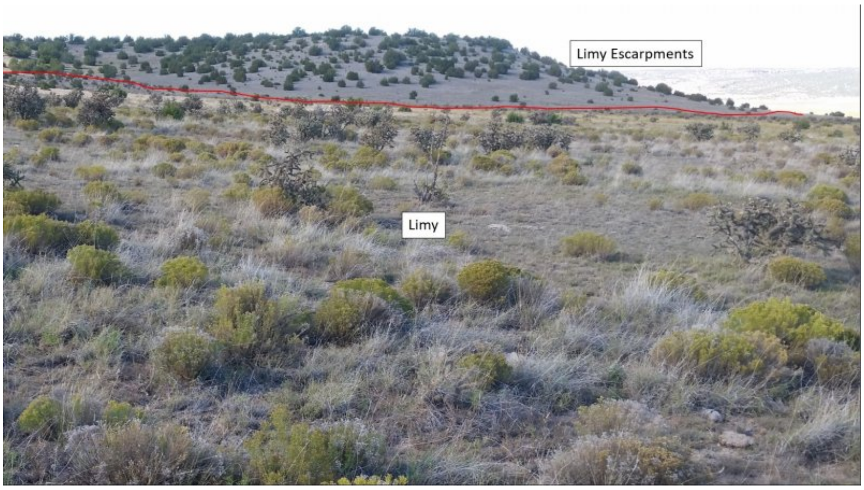



**Figure 2. The Limy and Limy Escarpments sites in a typical landscape**

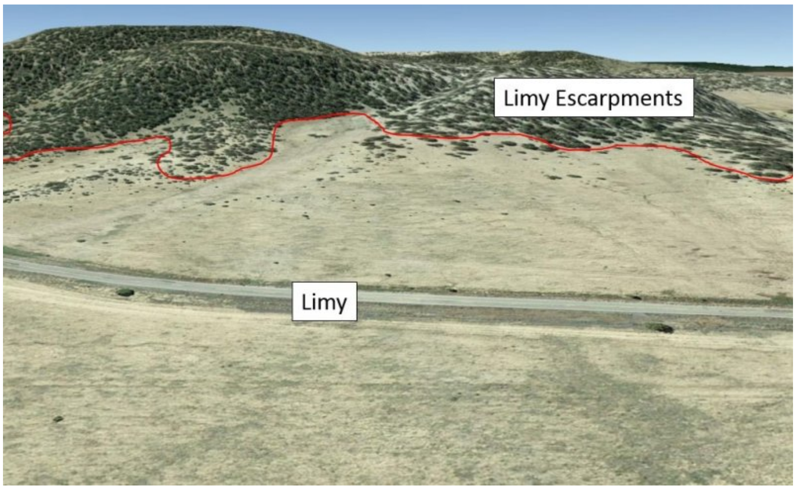



**Figure 3. Diagram showing the woody plant community on the Limy Escarpments site, in contrast to the alluvial fan in the foreground (Limy site) dominated by herbaceous plants. A great degree of tree encroachment has occurred on the lower escarpment positions here.**

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Plateaus or tablelands > Escarpment |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 5,000–7,500 ft |
| Slope | 10–100% |
| Water table depth | 80–99 in |
| 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 soil temperature ranges from 49 to 55 degrees F, supported by soil temperature measurements taken from May 2014 to June 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) | 15-18 in |
| Frost-free period (average) | 150 days |
| Freeze-free period (average) | |
| Precipitation total (average) | 16 in |

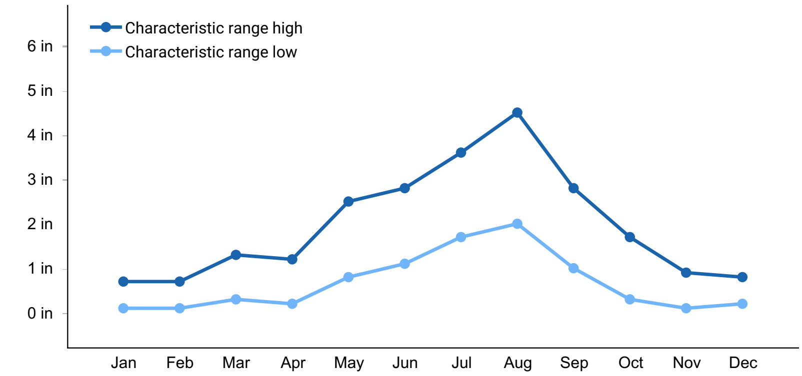



**Figure 4. Monthly precipitation range**

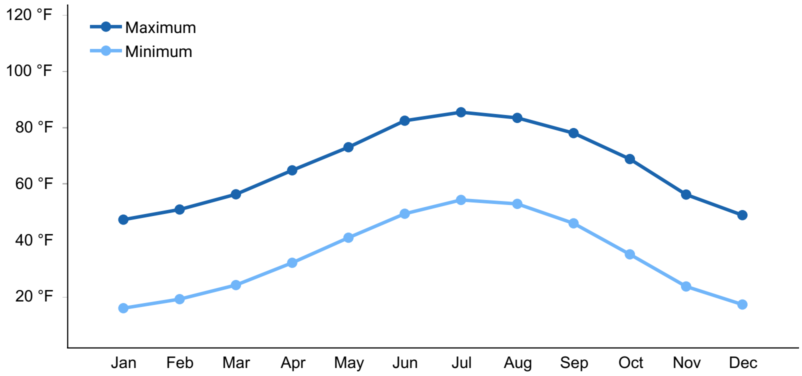



**Figure 5. Monthly average minimum and maximum temperature**

## Climate stations used

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

## Influencing water features

The Limy Escarpments ecological site is not associated with a wetland or riparian system; it is an upland ecological site. Because this site occurs on plateau escarpments, it readily sheds water (via run-off and through-flow) to sites lower in the catena. Small isolated areas of seeping water may be discharging from the bottoms, or footslope positions, of these slopes. The Limy, Playas, and Ephemeral Drainageways are the sites that most commonly receive additional moisture from this site.

## 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 Escarpments ecological site.

The Limy Escarpments ecological site currently correlates to major soil components of several map units in the Canadian Plateaus LRU of 70A. The soil series correlated to these components are Penrose, Mion, and Laporte. These soils form in colluvium and/or slope alluvium derived from limestone and often shale over residuum derived from limestone and/or shale.

While soil properties are quite variable, all soils in this ecological site share two properties at the surface. First, the soil surface is draped with a great deal of calcareous rock fragments—typically composed of limestone, and almost always covering more than half of the surface area. Second, soils react strongly or violently to dilute hydrochloric acid (HCl), indicating considerable free carbonates.

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.

Most components have base textures of loam or clay loam at the surface—usually with a channery or very channery modifier (greater than 15 percent or 35 percent fragments, respectively). Subsurface horizon base textures are typically clay loam or clay, with channery or very channery modifiers, as well. In general, coarser textures are found in limestone-dominated soils on the upper slope, while finer soil textures are found in the shale-dominated soils below.

Unlike many sites in the CP LRU, Mollisols are quite rarely encountered on Limy Escarpments, and there is no apparent correlation between topsoil thickness and/or color and ecological state. The apparent lack in topsoil dynamics can be attributed, at least in-part, to the protective qualities of surface fragments.

The following description of a Penrose component correlates to the lithic, limestone-dominated soils typically found on shoulders and upper escarpments:

From the Mora County (NM638) soil survey manuscript, with horizon designations modernized:
TYPICAL PEDON: Penrose variant, Mora County, New Mexico; about 4 miles southeast of Red River Ranch headquarters; in the NW ¼ of the NE ¼ of sec. 24, T. 23 N., R. 22 E.

A1—0 to 3 inches; grayish brown (10YR 5/2) very channery loam, dark grayish brown (10 YR 4/2) moist; moderate fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium roots; 45 to 55 percent limestone channery fragments; strongly effervescent; 8 percent calcium carbonate equivalent; moderately alkaline; clear smooth boundary.

A2—3 to 8 inches; grayish brown (10YR 5/2) very channery loam, dark grayish brown (10 YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots and common medium roots; common medium tubular pores; 45 to 55 percent limestone channery fragments; violently effervescent; 10 percent calcium carbonate equivalent; moderately alkaline; clear wavy boundary.

Ck—8 to 18 inches; light brownish gray (10YR 6/2) very channery loam, grayish brown (10 YR 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common medium tubular pores; 40 percent limestone channery fragments; violently effervescent; 12 percent calcium carbonate equivalent; moderately alkaline; abrupt wavy boundary.

R—18 inches; light grayish brown and grayish brown limestone that has thin beds of shale between layers.

Parent Material Kind: limestone and shale
Parent Material Origin: colluvium and/or slope alluvium over residuum.
Surface Texture Group: channery loam and very channery loam.
Subsurface Texture Group: very channery loam, extremely channery loam, and parachannery clay loam.

**Figure 6. A relatively typical Mion component in Colfax County. The subsoil grades into paralithic shale near the butt of the knife.**

**Figure 7. The Penrose component. Though not clear in the photo, limestone bedrock was encountered at the bottom of this shallow pit—at a depth of roughly 12 feet.**

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Colluvium–limestone and shale<br>(2) Residuum–limestone and shale |
| Surface texture | (1) Very channery loam<br>(2) Clay loam |
| Family particle size | (1) Loamy |
| Drainage class | Well drained |
| Permeability class | Slow to moderate |
| Soil depth | 2–60 in |
| Surface fragment cover <=3" | 50–90% |
| Surface fragment cover >3" | 0–40% |
| Available water capacity (0-60in) | 0.5–1.5 in |
| Calcium carbonate equivalent (0-60in) | 5–13% |
| Electrical conductivity (0-60in) | 0–2 mmhos/cm |
| Sodium adsorption ratio (0-60in) | 0–1 |

| | |
|---|---|
| Soil reaction (1:1 water) (0-60in) | 7.4–8.4 |
| Subsurface fragment volume <=3" (Depth not specified) | 15–60% |
| Subsurface fragment volume >3" (Depth not specified) | 0–30% |

## 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 plant tables from legacy sites later in this section). With respect to the imperfect alignment of such correlations, be aware of these shortcomings in their applicability to conservation planning.

The Limy Escarpments ecological site is often dominated by warm-season grasses (mostly short- and mid-grasses), but also contains a mix of shrubs, forbs, succulents, and trees. New Mexico feathergrass is the one cool-season grass species that appears capable of achieving codominance here. As is typical of plant communities in this region, 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 and type of bedrock, parent material, and slope landform position affect the composition of plants. Natural disturbances such as drought and wildfire affect species density and cover.

The climate gradient across the CP LRU shows a greater distribution of C3 plants such as western wheatgrass and bottlebrush squirreltail where temperatures are cooler, and moisture is more abundant. Species such as hairy grama, Hall's panicum, and yellow Indiangrass are much more common at lower elevations and more eastern longitudes.

Within this site, the dominant species of short grasses are inherently drought- and grazing-tolerant (Lauenroth, 1994). Across the western parts of the U.S., blue grama is one of the most extensively distributed grasses and occurs in a wide variety of different ecosites ranging from grasslands to shrubland and woodland sites. This grass evolved with grazing by large herbivores and, when grazed continuously, tends to form a short sod. When allowed to grow under lower grazing pressures, the plants develop the upright physiognomy of a bunchgrass. If blue grama is eliminated from an area by extended drought (3 to4 years) or disturbance such as plowing, regeneration is slow because of very slow tillering rates (Samuel, 1985), low and variable seed production, minimal seed storage in the soil (Coffin, 1989) and limited seedling germination and establishment due to particular temperature and extended soil moisture requirements for successful seedling establishment (Hyder, 1971) (Briske, 1978). Buffalograss, which is more abundant at warmer, lower elevations of this site, is often found occupying swale or depression positions across the landscape. Buffalograss is less drought-tolerant than blue grama but re-establishes more quickly following disturbance due to higher seed abundance and viability and more effective above-ground tillering (Peters, 2008).

Large-scale processes such as climate, fire and grazing influence this site. During years with favorable growing seasons, the effects of grazing may be mitigated. During years of low precipitation, grazing can magnify degradation of the site (Milchunas D.G., 1989). Fire is a natural disturbance regime that suppresses succulents and shrubs while stimulating grasses and forbs, however, in contrast to mid-grass and tall-grass prairie sites, fire is less important (Wright, 1982). This is because the drier conditions produce less vegetation/fuel load, lowering the relative fire frequency. However, historically, fires that did occur were often very expansive, especially after a series of years where above average precipitation built enough litter/fine fuels. Currently, fire suppression and more extensive grazing in the region have decreased the fire frequency, and it is unlikely that these processes could occur at a natural scale (USNVC, 2017)-G144. According to (Gebow, 2001), fire effects in the same location will vary, especially with fire timing, where seasonality can either hinder or benefit plants depending on their growing stage. Precipitation events occurring before and after fire will also influence the 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, galleta, and purple threeawn; shrubs such as broom snakeweed and prairie sagewort; and tree species such as oneseed juniper and twoneedle pinyon.

As noted in the Representative Soil Features section, there is no apparent correlation between readily-observable dynamic soil properties and ecological state on this site. Rather, the plant communities are the best indicators of an area's position on the state and transition model.

Correlation to Legacy Information:

From the Hills (R070AY014NM) ESD – currently correlated to one of the Penrose variant components:
Historic Climax Plant Community -The site is a grassland with an aspect dominance of pinyon-juniper with an understory of grasses, forbs and browse. Approximately 50 percent of the total vegetative production are made up of grasses. Grass species are dominated by warm-season mid-grasses. Woody species make up approximately 35 percent of the vegetative production. A variety of perennial and annual forbs make up approximately 10 percent of the vegetative production. North and east facing slopes typically produce a denser vegetative cover and produce more vegetative growth than the south or west facing slopes

The following information comes from initial soil survey manuscripts that correlates to the Limy Escarpments ecological site. Note that there is not a 1:1 relationship between the Limy Escarpments site and these legacy ecological site concepts. Much of the ecological information from the manuscripts is tied to a single component rather than to entire escarpment complexes. While Shale Breaks was correlated to multiple soil series/components on escarpments, current linework suggests that initial soil surveyors had different geomorphic concepts than those applied to the Limy Escarpments site.

The Laporte component of the Limy Escarpments is currently correlated to the Loamy (R077BY033NM) site, which was designed in another MLRA. The two Penrose variant components are correlated to different sites: Hills (R070AY014NM) and Shallow Upland (R070AY003NM); it is unclear why they these components were assigned different ecological sites, as they are nearly identical. Of the three, Hills comes closest to characterizing the plants, soils, and physiography of this site. However, it doesn't take into account the ecological differences between soils with accumulated carbonate salts in the profile from soils that do not.

From Hills (R070AY014NM) Tables
Annual production by plant type
Plant Type---------Low(Lb/Acre)---------Representative Value(Lb/Acre)---------High(Lb/Acre)
Grass/Grasslike---------212--------------------------557-----------------------------------901
Shrub/Vine--------------132--------------------------347-----------------------------------561
Forb-------------------------32----------------------------84-------------------------------------136
Total----------------------376--------------------------988-----------------------------------1598

Community 1.1 plant community composition
Common Name------------Symbol--------Scientific Name-----------Annual Production (Lb/Acre)
GRASS/GRASSLIKE
1 blue grama---------------BOGR2---------*Bouteloua gracilis*------------------158–218
2 hairy grama---------------BOHI2---------*Bouteloua hirsuta*-------------------158–218
3 little bluestem-----------SCSC----------*Schizachyrium scoparium*-----------105–158
3 mountain muhly---------MUMO---------*Muhlenbergia montana*-----------32–53
4 sideoats grama-----------BOCU----------*Bouteloua curtipendula*------------53–105
5 big bluestem--------------ANGE---------*Andropogon gerardii*----------------21–53
6 common wolfstail--------LYPH----------*Lycurus phleoides*--------------------21–53
7 James' galleta-------------PLJA-----------*Pleuraphis jamesii*-------------------21–53
8 *Graminoid (grass or grass-like)*-2GRAM-*Graminoid (grass or grass-like)*---21–53
FORB
9 buckwheat-----------------ERIOG---------Eriogonum-----------------------------21–32
10 *Forb, annual*--------------2FA------------ *Forb, annual*--------------------------53–105
*Forb, perennial* --------------2FP------------- *Forb, perennial*-----------------------53–105

SHRUB/VINE
11 juniper----------------------JUNIP---------Juniperus-----------------------------105–158
12 twoneedle pinyon---------PIED---------*Pinus edulis*--------------------------53–105
13 oak--------------------------QUERC-------Quercus------------------------------105–158
14 hairy mountain mahogany-CEMOP-*Cercocarpus montanus* var. paucidentatus-53–74
15 skunkbush sumac----------RHTR---------*Rhus trilobata*------------------------21–53
16 *Shrub, deciduous*-----------2SD---------- *Shrub, deciduous*---------------------32–53

From the San Miguel County (NM630) manuscript:
The potential natural plant community* of the Penrose soil is mainly true mountain mahogany, blue grama, needlegrass, and little bluestem(…) As the range deteriorates, the proportion of desirable forage plants decreases and the proportion of ring muhly, galleta, pricklypear, and oneseed juniper increases. Grazing management should be designed to increase the production and reproduction of sideoats grama, western wheatgrass, and little bluestem.
*This manuscript plant information appears to fit this ecological site better than the currently correlated site. However, based on our observations, mountain mahogany does not occur on most escarpments.

Adapted from the Rangeland Productivity table in the NM630 Manuscript:
Penrose component of map unit ME (correlated here to the “Shale Breaks” range site) -- The approximate species composition of the potential plant community is as follows:
Blue Grama----------------------------------------------30
Sideoats grama----------------------------------------15
Needlegrass*--------------------------------------------10
Juniper----------------------------------------------------10
Little bluestem-------------------------------------------5
Indian ricegrass-------------------------------------------5
Total production in pounds per acre for unfavorable, normal, and favorable years: 400, 700, 1,000
*“Needlegrass” most likely refers to New Mexico feathergrass here.

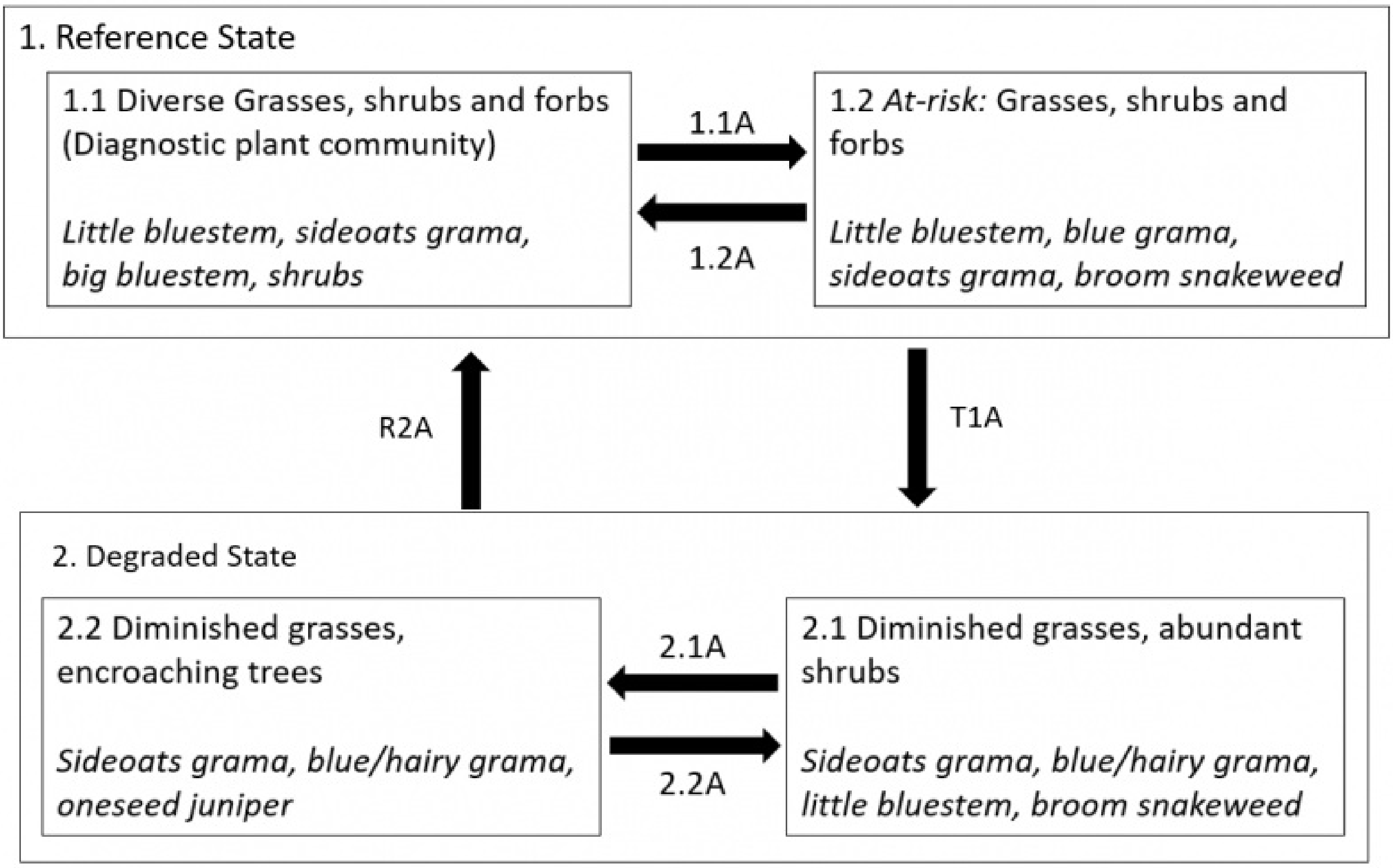
Adapted from the Rangeland Productivity table in the NM630 Manuscript:
Mion component of map unit ME (correlated here to the “Shale Breaks” range site) -- The approximate species composition of the potential plant community is as follows:
Sideoats grama---------------------------------------20
Little bluestem----------------------------------------20

Blue Grama--------------------------------------------20
Needleandthread*-----------------------------------15
New Mexico feathergrass------------------------10
Wolftail----------------------------------------------------5
Red threeawn------------------------------------------5
*Needleandthread has not been observed on the Limy Escarpments site.

From the Mora County (NM638) manuscript:
The potential natural plant community on the Mion soil component is mainly blue grama, sideoats grama, and little bluestem. The potential natural plant community of the Penrose Variant soil is mainly sideoats grama, blue grama, little bluestem, and New Mexico feathergrass. As the potential natural plant community deteriorates, little bluestem, sideoats grama, and New Mexico feathergrass decrease and there is an increase in ring muhly, threeawn, and broom snakeweed, which normally occur in small amounts in the potential natural plant community. Grazing management should be designed to increase the vigor, productivity, and reproduction of New Mexico feathergrass, little bluestem, and sideoats grama.

From the Colfax County (NM007) manuscript description of the Laporte series:
The vegetation is pinyon pine, oneseed juniper, and Gambel oak and an understory of blue grama, sideoats grama, and little bluestem.
From the Colfax County (NM007) manuscript description of the Mion series:
The vegetation is sideoats grama, fringed sagewort, yucca, pinyon pine, and one-seed juniper.

### State and transition model




### State 1
### Reference State

This state exists where the effects of grazing pressure are less pronounced. The two most obvious variables that distinguish States 1 and 2 are the annual production and species composition of grasses. Since topsoils are characteristically thin and soil profiles are generally protected from erosion by surface fragments, thickness of topsoil is not a reliable indicator of state or community phase. While trees can be found on all states and phases of this site, they are generally confined to the uppermost portions of the escarpment in State 1. Significant encroachment of trees onto the lower escarpment (where limestone bedrock does not control soil depth) only occurs in State 2.

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

**Figure 8. Community phase 1.1 on the upper third of an escarpment, Colfax County, September 2018. Soil here is very shallow (< 25 cm to root-restrictive, limestone bedrock). Note the rock outcrop in the foreground.**

**Figure 9. Phase 1.1 on the lower third of an escarpment, Colfax County, September 2018. Soil here is 74 cm deep to root-restrictive, weathered shale. As in Figure 7 above, grasses here are thriving in spite of considerable shrub cover.**

This community is dominated by grasses, but contains a number of forb species, along with a considerable amount of shrubs (generally less than 10 percent cover). Foliar cover ranges from 45 to 80 percent. Total canopy cover of warm season grasses is between 30 and 50 percent, and cool-season grass cover can be as high as 10 percent. Forbs and shrubs can each account for up to 10 percent cover. Annual production averages around 850 pounds per acre, but can range between 600 and 1,100, depending mostly on annual weather patterns. Cool-season grasses, particularly New Mexico feathergrass, are much more abundant on the limestone-dominated soils on the upper slopes. Tallgrasses (big bluestem and yellow Indiangrass) are most abundant on steeper slopes, perhaps because cattle tend to avoid such terrain. This community exists where season-long grazing has not occurred in a number of years, and where tallgrass species have not been extirpated. Little bluestem is typically the dominant grass, but sideoats grama and New Mexico feathergrass are often codominant. While forbs represent a small percentage of foliar cover, their species richness is quite high—leading to colorful displays following major rain events. Shrubs are always present, and are often a considerable component. Broom snakeweed, Bigelow sagebrush, and plains yucca are the most common species. While tree species (particularly oneseed juniper) often inhabit shallow limestone soils on the upper escarpment, they are notable absent from the deeper soils below. It is not clear whether periodic fire, the vigor of grasses, or some combination of these two suppresses tree encroachment. Since considerable understory biomass is needed to produce a stand-killing fire, it stands to reason that grass vigor and fire frequency are covariate. It should be note that this community phase has been observed in large pastures where short-duration grazing has not been actively implemented, but recent stocking rates were low. Herbivory by cattle was quite evident on flatter terrain nearby. Thus, the apparent lack of prolonged grazing in this community phase of Limy Escarpments thought to be, in part, a function of cattle behavior. This plant community optimizes energy flow, hydrologic function, and nutrient cycling. The diverse root systems take advantage of moisture from both close to the surface as well as deeper in the soil profile. High canopy cover, in concert with surface fragments, protects the soil surface from raindrop impact; fibrous roots of grasses and good soil structure also promote infiltration of rainwater and prevent erosion. With periodic herbivory and fire, decomposition is active, creating soil organic matter, which enhances “plant available water” needed for plant vigor.

**Dominant plant species**

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Bigelow sage (*Artemisia bigelovii*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

## Community 1.2
## At-risk: Grasses, shrubs and forbs

This community is dominated by grasses, but contains a number of forb species, along with a considerable amount of shrubs (generally less than 10 percent cover). Foliar cover ranges from 30 to 70 percent. Total canopy cover of warm season grasses is between 30 and 60 percent. Cool-season grass cover is generally under 5 percent. Forbs and shrubs can each account for up to 10 and 15 percent cover, respectively. 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. Cool-season grasses, particularly New Mexico feathergrass, are much more abundant on the limestone-dominated soils on the upper slopes. This community exists where season-long grazing has occurred in recent years. Little bluestem, sideoats grama, and blue grama are the dominant grass species. Big bluestem and yellow Indiangrass are either quite sparse or entirely absent. While forbs represent a small percentage of foliar cover, their species richness is quite high—leading to colorful displays following major rain events. Shrubs are always present, and are often a considerable component. Broom snakeweed, Bigelow sagebrush, and plains yucca are the most common species. Tree species (particularly oneseed juniper) often inhabit shallow limestone soils on the upper escarpment, and younger individuals can often be found encroaching on the deeper soils below, although total tree cover remains below 2%. Relatively high canopy cover (for this site), in concert with surface fragments, protects the soil surface from raindrop impact; fibrous roots of grasses and good soil structure also promote infiltration of rainwater and prevent erosion. With periodic herbivory, decomposition is active, creating soil organic matter, which enhances “plant available water” needed for plant vigor.

**Dominant plant species**

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Bigelow sage (*Artemisia bigelovii*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass

## Pathway P1.1A

## Community 1.1 to 1.2

Diverse grasses, shrubs and forbs (diagnostic plant community)

At-risk: Grasses, shrubs and forbs

This pathway represents a period of heavy grazing, typically season-long, which advantages the growth and reproduction of shrubs and grazing-tolerant grasses, and suppresses herbaceous species that are more palatable and/or less resilient under grazing pressure. Under such a grazing regime, broom snakeweed and blue grama increase in abundance. Conversely, New Mexico feathergrass decreases in abundance, and tallgrasses diminish drastically or disappear altogether. In the absence of fire, tree species often begin to encroach on the lower slopes.

## Pathway P1.2A
## Community 1.2 to 1.1

At-risk: Grasses, shrubs and forbs

Diverse grasses, shrubs and forbs (diagnostic plant community)

This pathway represents a period of rest from season-long grazing—either in the form of a deferred or short-duration regime. During this period, the vigor of the more palatable and grazing-sensitive species increases. New Mexico feathergrass increases in abundance, and tallgrasses recover or are are re-established. If tree encroachment has occurred on lower slopes, either a fire or chemical treatment is likely a necessary component of this pathway.

## State 2
## Degraded State

This state occurs where a prolonged continuous grazing regime, coupled with fire suppression (intentional or incidental) has resulted in diminished diversity and vigor in the grass community, and an attendant increase in the abundance of woody plants. Total annual production is significantly lower than in State 1. Tallgrass species are absent, and early seral grasses such as purple threeawn, galleta, and silvery bluestem are well-represented.

## Community 2.1
## Diminished grasses, abundant shrubs

**Figure 10. Community 2.1 in San Miguel County, November 2017. The younger trees on the lower escarpment represent the beginnings of**

**encroachment.**

This community exists where late-seral grasses have been suppressed by continuous grazing, but tree encroachment is not pronounced on the lower portions of the escarpment. The latter could be so for any of the following reasons: an upslope seed source is lacking, fire has killed encroaching trees, or herbicides have been applied. In this community, grasses either enjoy marginal dominance, or are codominant to shrubs. Trees may be present on all portions of the escarpment, but their cover on the lower slopes is less than 2 percent. Foliar cover ranges from 30 to 55 percent. Total canopy cover of warm season grasses is between 15 and 40 percent. Cool-season grass cover is generally under 5 percent. Forbs account for up to 10 percent cover. Annual production averages around 550 pounds per acre, but can range between 400 and 750 pounds per acre, depending mostly on annual weather patterns. Cool-season grasses, particularly New Mexico feathergrass, are much more abundant on the limestone-dominated soils on the upper slopes. Dominant grass species here are sideoats grama, blue grama, hairy grama, little bluestem, and purple threeawn. Big bluestem and yellow Indiangrass are absent. As in most phases of this site, forbs are relatively diverse, but sulfur flower buckwheat is particularly common on this phase. Broom snakeweed, Bigelow sagebrush, skunkbush sumac, and plains yucca are the most common shrub species. Tree species (particularly oneseed juniper) often inhabit shallow limestone soils on the upper escarpment, and younger individuals can often be found encroaching on the deeper soils below, although total tree cover remains below 2 percent. Reduced total production and root diversity translate to reduced rates of energy flow and soil organic matter accumulation. This, in turn, leads to lower water-holding capacity. Thus, past the State 2 threshold, diminished plant productivity appears to be self-perpetuating. Fortunately, high surface fragment cover translates to lower rates of erosion than would be otherwise expected on such steep and sparsely-vegetated slopes.

### Dominant plant species

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Bigelow sage (*Artemisia bigelovii*), shrub
- skunkbush sumac (*Rhus trilobata*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta var. hirsuta*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- purple threeawn (*Aristida purpurea*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass

## Community 2.2
## Diminished grasses, encroaching trees.

**Figure 11. Community 2.2 in Mora County, October 2018. Herbaceous production is quite low here, even for this community phase.**

This community exists where grasses have been heavily impacted by continuous grazing and further suppressed by competition with encroaching trees. Shrub cover is often conspicuously low, suggesting that trees are out-competing shrubs for resources. The forb community is quite sparse and, in contrast to other phases, is often limited to a few species. In most cases, tree encroachment appears to be the result of reduced fuel loads rather than active fire suppression. In this community, grasses are typically dominant in terms of canopy cover, but their vigor is quite low. Tree cover is greater than 2 percent on all slope positions, and is often much higher. Foliar cover ranges from 25 to 60 percent. Total canopy cover of warm season grasses is between 15 and 40 percent. Cool-season grass cover is generally under 2 percent. Forbs typically account less than 2 percent cover. Shrub cover is typically less than 5 percent, suggesting that trees have a competitive advantage over other woody species. Annual production averages around 400 pounds per acre, but can range between 250 and 700 pounds per acre, depending largely on annual weather patterns. Cool-season grasses, particularly New Mexico feathergrass, are much more abundant on the limestone-dominated soils on the upper slopes. Dominant grass species here are sideoats grama, blue grama, hairy grama, galleta, and purple threeawn. Big bluestem and yellow Indiangrass are absent. Unlike other phases of this site, forbs diversity is generally low, but the dominant forb species vary considerably between locations. Perkysue and low spurge are the most commonly-documented forb species. Broom snakeweed, skunkbush sumac, and plains yucca are the most common shrub species. In contrast to all other phases, Bigelow sagebrush is typically absent on lower slope positions. Trees (particularly oneseed juniper) abound on all slope positions, but older individuals are typically confined to lithic soils near the shoulders of escarpments. Minimal total production and root diversity translate to reduced rates of energy flow and soil organic matter accumulation. This, in turn, leads to lower water-holding capacity. Thus, past the State 2 threshold, diminished plant productivity appears to be self-perpetuating. Fortunately, high surface fragment cover translates to lower rates of erosion than would be otherwise expected on such steep and sparsely-vegetated slopes.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- skunkbush sumac (*Rhus trilobata*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta var. hirsuta*), grass
- James' galleta (*Pleuraphis jamesii*), grass

## Pathway P2.1A
## Community 2.1 to 2.2

**Diminished grasses, abundant shrubs**

**Diminished grasses, encroaching trees.**

This pathway represents a prolonged period without fire. This, coupled with grazing pressure on herbaceous plants, gives a competitive advantage to tree species, particularly oneseed juniper. Increased competition from trees suppresses the growth of all other functional groups. This translates to diminished understory fuel loads and a decreased likelihood of stand-replacing fire.

## Pathway P2.2A
## Community 2.2 to 2.1

**Diminished grasses, encroaching trees.**

**Diminished grasses, abundant shrubs**

This pathway represents tree mortality—resulting from either a stand-replacing fire or from chemical or mechanical treatments. Given that effective fire requires significant understory fuel loads, and the suppression of understory species by trees appears to be self-perpetuating, fire alone may not be a viable management option. Certain producers have resorted to a three-pronged approach: herbicide application and deferred grazing, followed by prescribed fire once adequate fuel loads are attained.

### Transition T1A
### State 1 to 2

This pathway represents season-long grazing providing little rest and recovery for preferred grazed plants during critical growing periods, coupled with high utilization. The absence of fire is also a component of this pathway. Drought is thought to push the plant community over the threshold into the degraded State 2. During this transition, tallgrass species are extirpated. Highly palatable and grazing-sensitive grass species are diminished—both in vigor and abundance. Concurrently, shrub and tree species enjoy a competitive advantage, and increase in abundance.

### Restoration pathway R2A
### State 2 to 1

This process results in the recovery of the vigor and diversity of herbaceous species, as well as a significant increase in total productivity. Since tree encroachment beyond the shallowest soils of the upper escarpment seems to effectively prevent such a process, it is likely that this process will only proceed from community phase 2.1. While the eradication of tree species will do much to promote the vigor of other functional groups, the recovery of vigor among existing palatable species will also require careful grazing management. Since State 2 lacks some of the species present in State 1, restoration will be incomplete without the reintroduction of certain species—particularly big bluestem. Whether or not the establishment of these species requires human intervention will depend on a number of factors, including proximity to a seed source and the activities of migratory animals.

## Additional community tables

## Animal community

Habitat for Wildlife:
From the Hills (R070AY014NM) site:
This site provides habitats which support a resident animal community that is characterized by mule deer, coyote, eastern cottontail, grasshopper mouse, brush mouse, great horned owl, red-tailed hawk, plain titmouse, scrub jay, rufous sided towhee, western diamondback rattlesnake and fence lizard.

## Hydrological functions

Soil Hydrology
The Limy Escarpments ecological site is not associated with a wetland or riparian system; it is an upland ecological site. Because this site occurs on plateau escarpments, it readily sheds water (via run-off and through-flow) to sites lower in the catena. The Limy, Playas, and Ephemeral Drainageways are the sites that most commonly receive additional moisture from this site. Small isolated areas of seeping water may be discharging from the bottoms, or footslope positions, of these slopes.

## Wood products

This site can support stands of oneseed juniper and twoneedle pinyon.

## Other information

Future Work:
Refinement of this ecological site concept through additional observations and data collection, and development of plant tables based on moderate intensity, quantitative analyses.

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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 | 05/13/2025 |
| 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:

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

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

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

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:**

17. **Perennial plant reproductive capability:**