USDA Natural Resources
Conservation Service

Ecological site GX070A01X013
Lithic Sandstone

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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 only applicable to the Canadian Plateaus LRU of MLRA 70A (LRU 70A.1).

LRU notes

This site is only applicable to the Canadian Plateaus LRU of MLRA 70A (LRU 70A.1). Please refer to the following key:

Land Resource Unit (LRU) Key for MLRA 70A
– High Plateaus of the Southwestern Great Plains
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: Lithic Sandstone 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: Lithic Sandstone Sandy Smooth High Plains Subsection Southern High Plains Section Great Plains-Palouse Dry Steppe Province (Cleland, et al., 2007).

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

Ecological site concept

The Lithic Sandstone ecological site occurs on plateau summits in the CP-LRU. The CP 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 CP LRU ranges from 5,000 to 7,500 feet.

Lithic Sandstone sites have soil depths that range from 4 to 20 inches to a bedrock contact with Cretaceous-aged Dakota sandstone that, at a minimum, is strongly cemented. Rock outcrop is visible somewhere on the site, or at least 10 percent surface fragments that are cobble sized (3 inches in diameter) or larger. The presence of bedrock or larger fragments at the surface creates abundant ecological micro-sites that increases the variability of plant and animal habitat. Surface textures are most often loam and fine sandy loam; stony loam occurs in one existing component and very stony sandy loam occurs in two. The soils of this site are distinguished from the soils of the Lithic Limestone ecological site in that they are underlain by sandstone rather than limestone bedrock and therefore some greater proportion of the parent materials are also derived from this bedrock. This results in soils that are sandier, redder in color, and lower total secondary carbonate content in subsurface horizons. Fragments are mostly non-calcareous.

Landscape: Plateaus
Landforms: Plateau Summits
Slope: 0 to 10 percent, but mostly under 5 percent
Aspect: Aspect does not exert much influence on this ecological site.

Associated sites

GX070A01X008	**Ephemeral Drainageways** This site occurs on the channels and floodplains of ephemeral streams. Adjacent Lithic Sandstone sites contribute water to this site via run-on and through-flow.

GX070A01X021	**Sandy** This site occurs where soil depths are > 50 cm to a root restrictive layer and have surface textures of sandy loam or coarser and subsurface horizons of sandy clay loam or sandier.
GX070A01X017	**Playas** This site occurs in playas. Adjacent Lithic Sandstone sites can occur on playa rims and may contribute water to this site via run-on and through-flow.
GX070A01X002	**Clayey Uplands** This site occurs in soils that have high clay in subsurface horizons and exist on more stable landforms that have resisted erosion, or else they have subsurface horizons derived from shale residuum.
GX070A01X005	**Limy** This site occurs where soils surfaces have strong or violent effervescence and ≥ 5% calcareous rock fragments. There are little to no free carbonates at the surface of the Lithic Sandstone site.
GX070A01X003	**Loamy Uplands** These sites are deeper than 50 cm to bedrock contact.
GX070A01X004	**Shallow Loamy** This site occurs where soils have paralithic contact within 50 cm.
GX070A01X006	**Slopes** This site occurs on escarpments with slopes > 10%. These soils have bedrock at a depth ≤ 50cm that may or may not be lithic.
R070AA009NM	**Saline Playas** This site occurs in discharge playas, typically at the lowest positions on plateaus. Adjacent Lithic Sandstone sites contribute water to this site via run-on and through-flow.
GX070A01X014	**Lithic Limestone** This site occurs where soils are = 75 cm to lithic contact with limestone bedrock, and often supports oneseed juniper savannahs. There is no limestone bedrock in the Lithic Sandstone site.

Similar sites

R070AY001NM	**Loamy Upland** The Carnero components of this site are correlated to the Loamy Upland (R070AY001NM) site. This site fits deeper subsets of the Carnero components, but is a poor fit for soils less than 75 cm deep. Refer to the Future Work section below for more information on this issue.
R070AY003NM	**Shallow Upland** The Bernal components of the Lithic Sandstone are currently correlated to the Shallow Upland (R070AY003NM) site. As noted above, the plant community described in this ESD seems to have been developed using data from hotter, drier areas than the CP, such as MLRAs 70B and 70C.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R070AA013NM

Physiographic features

The CP 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 Lithic Sandstone ecological site occurs on plateau summits, often near the margins of the plateau where the Dakota Sandstone is the surface strata. This site is extensive, but other sites also occur on plateau summits in the Canadian Plateaus (CP) LRU including the Clayey Uplands, Loamy, Limy, Lithic Limestone, Sandy, and Shallow Loamy. Shallow Loamy Slopes and Loamy Slopes exist on smaller escarpments within the plateau summit landscape, but where this plateau landscape meets its margin, a major escarpment occurs and the Mesozoic Canyons and Breaks LRU begins.

Associated sites that occur on landforms and landform positions adjacent to the Lithic Sandstone site are the Ephemeral Drainageways, Playas and Saline Playas. For more detail on how the Lithic Sandstone site contrasts with and relates to other sites in the CP, see the Provisional Ecological Site Key and Associated Sites section below.

Geology:
The geology of the CP consists primarily of Cretaceous rocks: shale, limestone, and sandstone of the Dakota, Graneros, Greenhorn, Pierre, and Niobrara Formations. The Lithic Sandstone ecological site occurs directly above the Dakota Formation, which forms the hard sandstone bedrock contact that defines this site. Soils form in thin deposits of loess over sandstone residuum. The loess is often from sandy sources as it blows out of nearby canyons of Mesozoic-aged sandstones and mudstones. Some younger Cretaceous sandstone layers, like those associated with the Pierre or Niobrara Formations, are rarely, if ever, lithic.

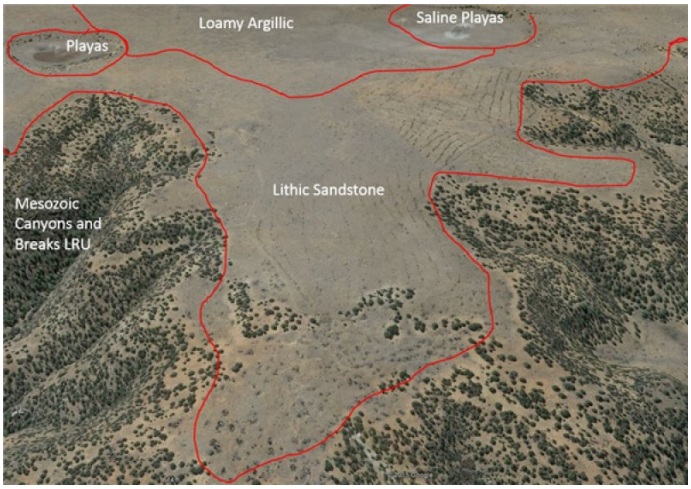


Figure 1. A physiographic diagram showing the Lithic Sandstone ecological site in a typical setting.

Table 2. Representative physiographic features

Landforms	(1) Plateaus or tablelands > Plateau
Flooding frequency	None
Ponding frequency	None
Elevation	5,000–7,500 ft
Slope	0–10%
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 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)	15-18 in
Frost-free period (average)	150 days
Freeze-free period (average)	
Precipitation total (average)	16 in

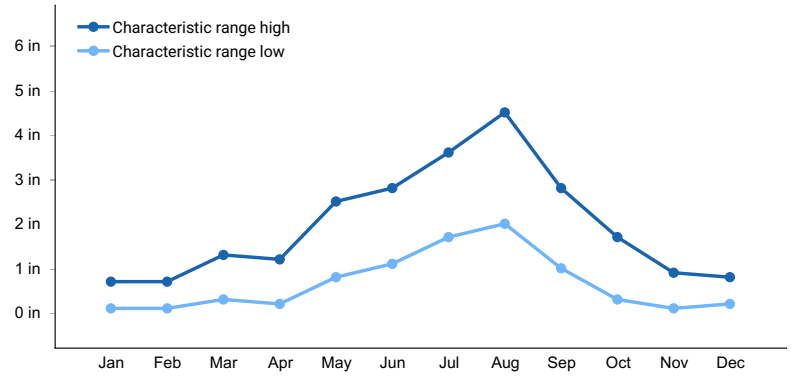


Figure 2. Monthly precipitation range

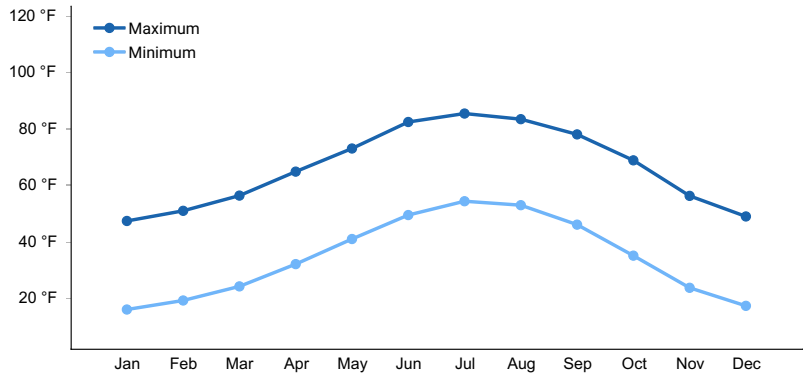


Figure 3. Monthly average minimum and maximum temperature

Climate stations used

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

Influencing water features

The Lithic Sandstone 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. The 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 Lithic Sandstone 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 soils in this ecological site typically form in eolian deposits over residuum weathering from Dakota Sandstone. This eolian cap is usually rich in fine and very fine sand, but also contains significant amounts of silt and clay. In most locations, the Lithic Sandstone ecological site occupies relatively old plateau summits. Thus, in most associated soil profiles, significant amounts of clay have eluviated (migrated) from the surface to subsurface horizons—forming an argillic horizon, or clay increase at depth. These horizons can act to impede the downward movement of water, which can serve to extend the period of accessible moisture to shallower rooting plants such as grasses. In many places, both burrowing animals and frost heave have mixed materials from underlying residual horizons with overlying eolian materials. Thus, fragments far too coarse to have been transported by wind are often found throughout the soil profile.

The Lithic Sandstone ecological site currently correlates to major components of a number of map units in the Canadian Plateaus LRU of 70A. The soil series correlated to these components include Bernal, Carnero, and Sombordoro. These soils form in sandstone residuum that often has an eolian cap.

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 fine sandy loam or loam as a surface texture; very stony sandy loam and stony loam also occur at the surface. Profiles generally exhibit significant clay increases with depth, with clay loam, sandy clay loam, and even clay occurring in subsurface horizons.

TYPICAL PEDON: Bernal loam, Mora County, New Mexico; about 20 miles southeast of Wagon Mound, along New Mexico Highway 271; From the Mora County (NM638) soil survey manuscript. Horizon designations below have been modernized: Possibly close in location to UTM: 13S 551671 3964875; Elevation 5,605 feet.

A—0 to 4 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist, weak very fine granular structure; loose, very friable; slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; moderately alkaline; clear smooth boundary.

Bt1—4 to 9 inches; brown (7.5YR 5/2) heavy loam, dark brown (7.5YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; slightly sticky and slightly plastic; many very fine and fine roots; common fine tubular pores; moderately alkaline; clear smooth boundary.

Bt2—9 to 19 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak very coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; sticky and plastic; common very fine and fine roots; many fine tubular pores; many moderately thick clay films on the faces of peds; moderately alkaline; abrupt wavy boundary.

R—19 inches; hard, red sandstone.

Parent Material Kind: Loess over residuum
Parent Material Origin: Eolian and sandstone
Surface Texture Group: loam, very stony sandy loam, stony loam
Subsurface Texture Group: clay loam, sandy clay loam, clay, extremely stony clay

Table 4. Representative soil features

Parent material	(1) Eolian deposits–sandstone (2) Residuum–sandstone and shale

Surface texture	(1) Clay loam (2) Sandy clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderate
Soil depth	2–20 in
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–15%
Available water capacity (0-20in)	1–4 in
Calcium carbonate equivalent (0-20in)	0–5%
Electrical conductivity (0-20in)	0–2 mmhos/cm
Sodium adsorption ratio (0-20in)	0–2
Soil reaction (1:1 water) (0-20in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

Plant tables have not been developed for this site. In their absence, one can refer to the legacy sites to which Lithic Sandstone loosely correlates. Refer to plant tables from legacy sites below for these correlations, but note that there is no perfect analog to the Lithic Sandstone site.

The Lithic Sandstone ecological site contains a mix of grasses, forbs, shrubs, succulents, and trees. While warm-season plants dominate this site, the relative abundance of cool-season plants increases in response to moisture in the spring and late fall. Fire has likely been an important disturbance agent and ecological driver in this site, but evidence of recent burns has not been found during field work—likely the result of deviation from the historic fire regime.

The Lithic Sandstone site exhibits more diversity in its plant communities than any other upland site in the CP. This is largely due to variability in the depth and fracture interval of sandstone bedrock and the percentage of rock outcrop. Such variability translates to numerous microsites. Deeply-fractured bedrock favors deeply-rooted woody species such as twoneedle pinyon and oneseed juniper, which can access water in fractures. Microsites adjacent to rock outcrop receive extra moisture in the form of run-on. This favors Apache plume, big bluestem, and little bluestem. At the upper elevational extreme, montane species such as ponderosa pine and wax currant can be found beside outcroppings. In contrast, where rock outcrop is lacking, plant communities more closely resemble those of the Loamy Uplands site—but with a greater density of shrubs. Finally, sideoats grama is virtually ubiquitous where surface textures are sandy, but is much less resilient to continuous grazing in heavier loams and clay loams.

There are numerous variables such as elevation, latitude, hydrology, soil depth, fire frequency, grazing dynamics, and anthropogenic effects that influence plant communities. Elevation generally increases as the plateaus gently climb to the west, and proximity to greater warm-season moisture from the Gulf of Mexico increases toward the east. Thus, both of these factors result in an increase in the relative amount of warm-season moisture to the east. As elevation increases toward its upper extreme (about 7,500 feet) near the foot of the Rocky Mountains, cool-season plants become most abundant within this site. Therefore, blue grama and broom snakeweed are more

abundant in the east; while fringed sage and bottlebrush squirreltail increase in abundance as one travels west.

Since the Canadian Plateaus (CP) LRU is bounded by areas with strongly-contrasting geology and geomorphology, the Lithic Sandstone ecological site does not transition smoothly into adjacent ecological sites of other LRUs at its upper and lower elevations. Rather, the landscape transitions at the upper end into the Rocky Mountain Province (MLRAs 49 and 48A) or the Volcanic Plateaus LRU of MLRA 70A, and at the lower end to the Mesozoic Canyons and Breaks LRU (MCB) of 70A. Since the boundary between the CP and MCB most often occurs where Dakota Sandstone bedrock is within 20 inches of the surface and slopes reach 10 percent, the Lithic Sandstone site commonly occurs at the boundary between these LRUs.

Legacy Correlations:
The Bernal components of the Lithic Sandstone are currently correlated to the Shallow Upland (R070AY003NM) site. As noted above, the plant community described in this ESD seems to have been developed using data from hotter, drier areas than the Canadian Plateaus, such as MLRAs 70B and 70C.

Shallow Upland legacy table (R070AY003NM)
Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	312	700	858
Shrub/Vine	32	70	88
Forb	32	70	88
Total	376	840	1034

Community 1.1 plant community composition

Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)
GRASS/GRASSLIKE			
1 sideoats grama	BOCU	*Bouteloua curtipendula*	63–150
2 blue grama	BOGR2	*Bouteloua gracilis*	63–150
3 hairy grama	BOHI2	*Bouteloua hirsuta*	63–150
4 little bluestem	SCSC	*Schizachyrium scoparium*	63–150
5 needle and thread	HECO26	*Hesperostipa comata*	75–113
6 New Mexico feathergrass	HENE5	*Hesperostipa neomexicana*	75–113
7 threeawn	ARIST	Aristida	8–38
8 common wolfstail	LYPH	*Lycurus phleoides*	8–38
9 squirreltail	ELEL5	*Elymus elymoides*	8–38
10 western wheatgrass	PASM	*Pascopyrum smithii*	8–38
11 *Graminoid (grass or grass-like)*	2GRAM	*Graminoid (grass or grass-like)*	8–38
FORB			
12 buckwheat	ERIOG	Eriogonum	8–38
13 globemallow	SPHAE	Sphaeralcea	8–38
14 *Forb, annual*	2FA	*Forb, annual*	15–38
15 *Forb, perennial*	2FP	*Forb, perennial*	15–38
SHRUB/VINE			
16 prairie sagewort	ARFR4	*Artemisia frigida*	8–38
17 Bigelow sage	ARBI3	*Artemisia bigelovii*	15–23
18 winterfat	KRLA2	*Krascheninnikovia lanata*	15–23
19 skunkbush sumac	RHTR	*Rhus trilobata*	15–38
20 *Shrub, deciduous*	2SD	*Shrub, deciduous*	8–38

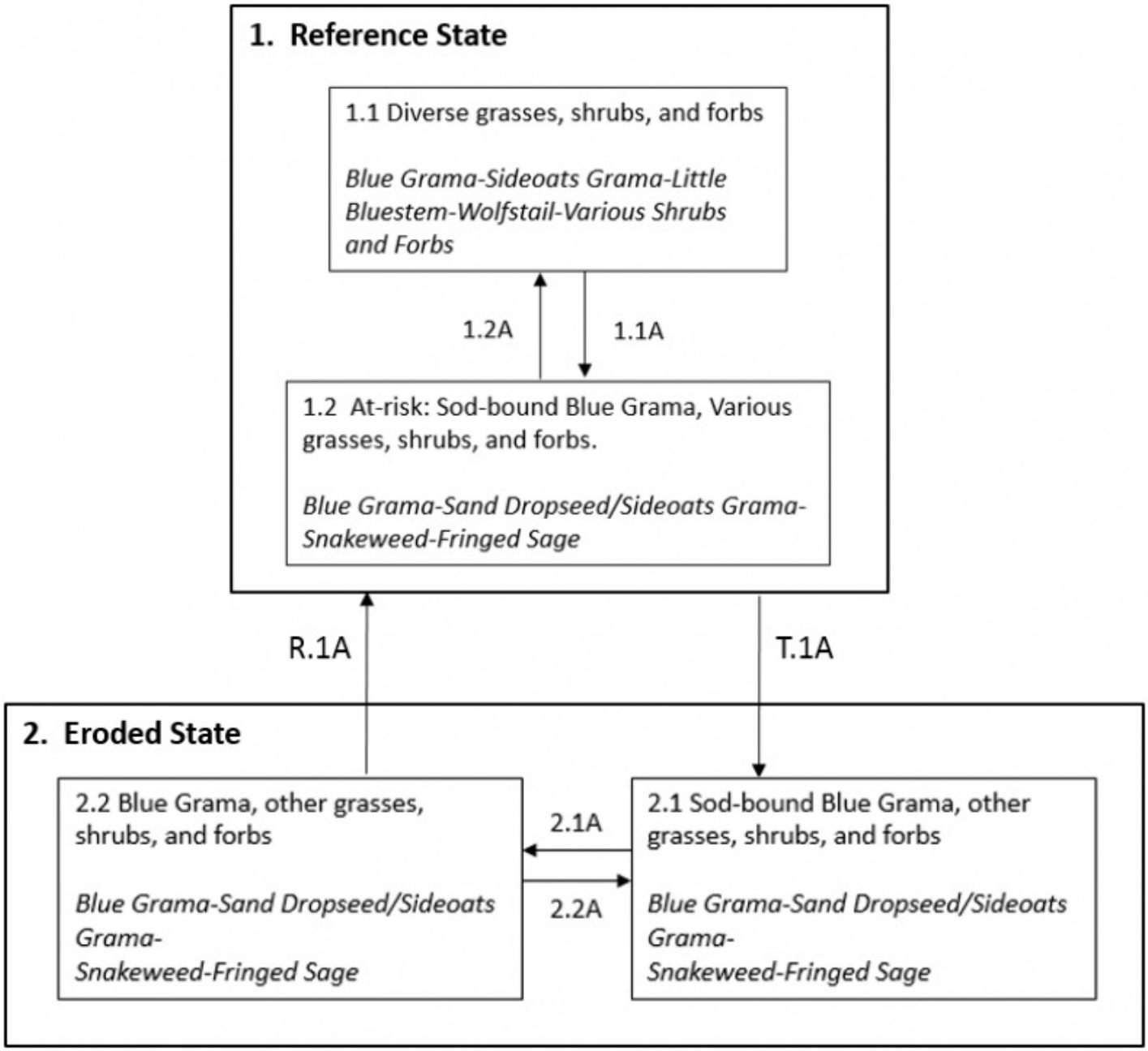
Loamy Upland legacy table (R070AY001NM)
Annual production by plant type

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

State and transition model



State 1
Reference State

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

Community 1.1
Reference State

Figure 4. Plant community 1.1 in Colfax County, September 2017. Note the relatively high species diversity and canopy cover of grasses (in spaces between outcrop and surface fragments).

This community is a mix of grass, forb, and shrub species; and often contains trees. None of these groups exhibits pronounced dominance. Nearly all grass species are warm-season. Decreasers such as sideoats grama, little bluestem, and wolfstail are very well-represented. Topsoil (often a mollic epipedon) remains in-place. Because the abiotic factors (soil depth, amount of rock outcrop) vary so widely across this site, ranges of canopy cover and production are comparably broad. Canopy cover is typically greater than 85 percent in spaces between outcrop and surface fragments, but its total ranges from 60 to 85 percent. Production ranges from 600 to 1200 pounds per acre, depending on rock outcrop percentages and on annual weather patterns. This plant community phase optimizes energy flow, hydrologic function, and nutrient cycling. The variety in species translates to a robust subsoil ecosystem, with diverse root systems taking advantage of moisture both close to the surface as well as deep in the profile. Decomposition is active, creating soil organic matter, which enhances plant available nutrients and water needed for plant vigor.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- common wolfstail (*Lycurus phleoides*), grass

Community 1.2
At risk: Sod-bound blue grama, various grasses, shrubs, and forbs

Figure 5. Plant community 1.2 in Mora County, August 2017. Here, the blue grama has assumed a sod-bound habit, but the topsoil (far right) remains.

Figure 6. Plant community 1.2 in San Miguel County, May 2017. Note the sod-bound habit of the blue grama here. Species richness is actually quite high in this area due to the diversity of microsites and the persistence of topsoil (and the seedbank it holds).

Figure 7. Community 1.2 transitioning to 1.1 (pathway 1.2A). Note that the blue grama is transitioning from a sod-bound habit to a cespitose habit. Sandy textures throughout the soil profile here have selected for Apache plume—the dominant shrub in this image.

The structure and species composition of this community are similar to that of community 1.1. Decreaser grasses (wolfstail, little bluestem, big bluestem, and sideoats grama) are somewhat less abundant, and tree species are somewhat better-represented. The most striking difference from 1.1 is that blue grama has assumed a sod-bound growth habit in response to prolonged grazing (typically multiple season-long events). Topsoil (often a mollic epipedon) remains in-place. Because the abiotic factors (soil depth, amount of rock outcrop) vary so widely across this site, ranges of canopy cover and production are comparably broad. Canopy cover is typically greater than 85 percent in spaces between outcrop and surface fragments, but its total ranges from 50 to 80 percent. Production ranges from 500 to 1100 pounds per acre, depending, in part, on annual weather patterns.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- common wolfstail (*Lycurus phleoides*), grass

Pathway P1.1A
Community 1.1 to 1.2

Reference State

At risk: Sod-bound blue grama, various grasses, shrubs, and forbs

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. Examples of the latter are wolfstail, little bluestem, big bluestem, and sideoats grama. Heavy grazing can also impair the historic fire frequency intervals by reducing the density of ladder fuels and, thereby providing another competitive advantage to woody plants.

Pathway P1.2A
Community 1.2 to 1.1

At risk: Sod-bound blue grama, various grasses, shrubs, and forbs

Reference State

This pathway represents prescribed grazing or rest from grazing. In either case, herbaceous plants that are palatable and/or sensitive to grazing (wolfstail, little bluestem, big bluestem, and sideoats grama) increase in vigor and abundance, and shrubs are at a competitive disadvantage.

State 2
Eroded State

The central feature of this state is that topsoil has been mostly or entirely eroded. While State 1 does not always contain a mollic epipedon, State 2 necessarily lacks one.

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

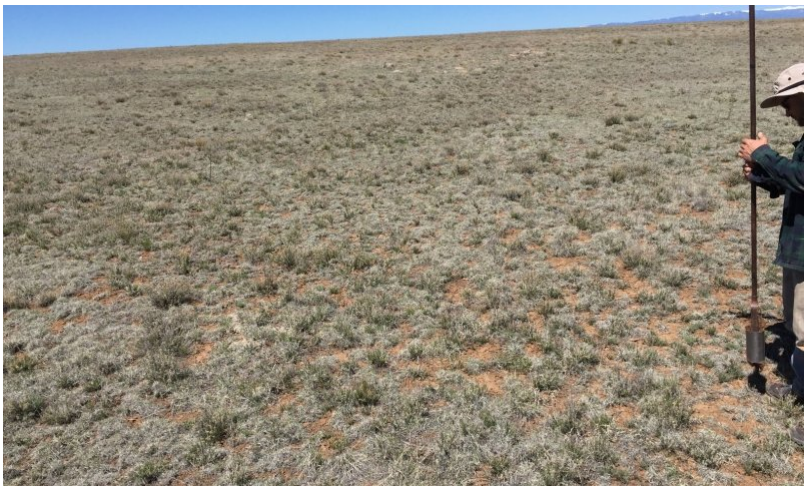


Figure 8. Community 2.1, May 2017. Blue grama here has assumed a sod-bound habit. Wolfstail and sideoats grama are barely present, and the topsoil has been eroded away. This area is less rocky than most that correlate to the Lithic Sandstone site.

Figure 9. Community 2.1 in San Miguel County, June 2015. This is a rockier version of the Lithic Sandstone ecological site. Severe erosion has occurred in the foreground, and decreaser grasses have been extirpated.

This plant community occurs on eroded soils—where productive potential and species diversity have been lost with topsoil and the seedbank it held. Grasses are typically codominant to shrubs, and sod-bound blue grama is the most abundant grass. Decreaser grasses such as little bluestem and sideoats grama are either absent or confined to positions directly adjacent to rock outcrop; wolfstail is either absent or nearly so. While State 1 does not always contain a mollic epipedon, State 2 necessarily lacks one. Because the abiotic factors (soil depth, amount of rock outcrop) vary so widely across this site, ranges of canopy cover and production are comparably broad. Canopy cover ranges from 40 to 70 percent. Production ranges from 300 to 1000 pounds per acre, depending, in part, on annual weather patterns.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass

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

Figure 10. Community 2.2 in Harding County, November 2017. Blue grama has returned to its cespitose habit, but topsoil is almost absent and species richness is low.

Figure 11. Community 2.2 in Harding County, November 2017, at the end of a particularly wet growing season. Favorable weather conditions have translated to unusually high herbaceous production. This site appears to be slowly recovering toward State 1.

This plant community occurs on eroded soils—where productive potential and species diversity have been lost along with topsoil and the seedbank it held. Grasses are typically dominant, but their species richness is lower than in State 1. Blue grama has a cespitose (bunchgrass) rather than a sod-bound habit. Decreaser grass species such as little bluestem, wolfstail, and sideoats grama are poorly-represented—the latter entirely lacking where topsoil is not sandy in texture. While State 1 does not always contain a mollic epipedon, State 2 necessarily lacks one. Because the abiotic factors (soil depth, amount of rock outcrop) vary so widely across this site, ranges of canopy cover and production are comparably broad. Canopy cover ranges from 60 to 75 percent. Production ranges from 600 to 1200 pounds per acre, depending, in part, on annual weather patterns.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass

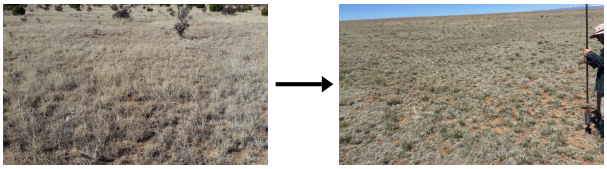
Pathway P2.1A
Community 2.1 to 2.2

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

Blue grama, other grasses, shrubs, and forbs

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 P2.2A
Community 2.2 to 2.1



Blue grama, other grasses, shrubs, and forbs

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

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.

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 with its high organic matter content, and an associated decrease in available water and nutrients. Trigger event: A severe drought kills already-weakened perennial grasses, resulting in a major 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, soil surfaces become more susceptible to wind and water erosion, and rates of evaporation increase.

Restoration pathway R1A
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, or some method of temporary irrigation, may also be necessary to ensure successful seeding.

Additional community tables

Animal community

Habitat for Wildlife:
From the Shallow Upland* (R070AY003NM) site: “Habitat for Wildlife: This site provides habitats which support a resident animal community that is characterized by pronghorn antelope, coyote, gray fox, black-tailed jackrabbit, northern grasshopper mouse, hispid pocket mouse, marsh hawk, horned lark, meadowlark, prairie rattlesnake, six-lined racerunner, and the Great Plains toad.”
*Note that this site was apparently developed based, in part, on data from MLRAs 70B and 70C. Some animals listed here may be restricted to these MLRAs.

Hydrological functions

Soil Hydrology
The Lithic Sandstone 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. The Playas and Ephemeral Drainageways are the sites that most commonly receive additional moisture from this site.

Wood products

This site often supports woodlands of oneseed juniper--many of which contain some piñon pine. At higher elevations, and where rock outcrop is particularly abundant, ponderosa pine is not uncommon.

Other information

Future Work:

This site is associated with large amounts of rock outcrop in certain delineations. Where this occurs, soils receive additional moisture via run-on from adjacent outcrop. This results in a preponderance of species that are typical of significantly wetter climates growing along the interface with outcrop; ponderosa pine is a good indicator of such communities. However, it doesn't appear that there is much acreage of these areas of soil-outcrop interface. Future update work on map units with significant outcrop should assess whether this interface is extensive enough to warrant its own ecological site.

ESD Workgroup:
Logan Peterson, MLRA 70 Soil Scientist, NRCS
Aaron Miller, MLRA 70 Project Leader, NRCS
Robert (Scott) Woodall, Region 8 Ecological Site Specialist, NRCS

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 No. 36

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.

Contributors

Aaron Miller
Logan Peterson

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	05/11/2025
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:**

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

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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:**
