

Ecological site F116AY043MO

Loamy Sinkhole Woodland

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Accessed: 09/16/2026

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): 116A–Ozark Highland

The Ozark Highland constitutes the Salem Plateau of the Ozark Uplift. Elevation ranges from about 300 feet on the southeast edge of the Ozark escarpment, to about 1,600 feet in the west, adjacent to the Burlington Escarpment of the Springfield Plateau. The underlying bedrock is mainly horizontally bedded Ordovician-aged dolomites and sandstones that dip gently away from the uplift apex in southeast Missouri. Cambrian dolomites are exposed on deeply dissected hillslopes. In some places, Pennsylvanian and Mississippian sediments overlie the plateau. Relief varies, from the gently rolling central plateau areas to deeply dissected hillslopes associated with drainageways such as the Buffalo, Current, Eleven Point and White Rivers.

Classification relationships

Terrestrial Natural Community Type in Missouri (Nelson, 2010): The reference state for this ecological site is not correlated to a community. Missouri Department of Conservation Forest and Woodland Communities (MDC, 2006): The reference state for this ecological site is most similar to an Upland Woodland. National Vegetation Classification System Vegetation Association (NatureServe, 2010): The reference state for this ecological site is not correlated to a community. Geographic relationship to the Missouri Ecological Classification System (Nigh & Schroeder, 2002): This ecological site occurs primarily in the Current River Hills Subsection.

Ecological site concept

NOTE: This is a “provisional” Ecological Site Description (ESD) that is under development. It contains basic ecological information that can be used for conservation planning, application and land management. After additional information is collected, analyzed and reviewed, this ESD will be refined and published as “Approved”. Loamy Sinkhole Woodlands occur in small, scattered delineations, primarily in the central Ozark Highland counties of Shannon and Reynolds, in Missouri. Soils are very deep, and are loamy throughout. The reference plant community is woodland with an overstory dominated by white oak and black oak and a ground flora of native grasses and forbs.

Associated sites

F116AY011MO	Chert Upland Woodland Chert Upland Woodlands, and other upland and backslope ecological sites formed over dolomite, are upslope.
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Similar sites

F116AY043MO	Loamy Sinkhole Woodland Loamy Sinkhole Woodlands have no similar sites.
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Table 1. Dominant plant species

Tree	(1) <i>Quercus velutina</i> (2) <i>Quercus alba</i>
Shrub	(1) <i>Vaccinium</i>
Herbaceous	(1) <i>Elymus virginicus</i> (2) <i>Carex pensylvanica</i>

Physiographic features

This site is on sinkholes with slopes of 0 to 8 percent. The site receives runoff from the adjacent uplands, and is subject to rare ponding in the winter months.

The following figure (adapted from Sturdevant et al, 2001) shows the typical landscape position of this ecological site, and landscape relationships with other ecological sites. It is within the area labeled “3” on the figure. Loamy Sinkhole Woodland sites are associated with a variety of other upland ecological sites formed over dolomite bedrock.

Figure 1. Landscape relationships for this ecological site.

Table 2. Representative physiographic features

Landforms	(1) Sinkhole
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to rare
Slope	0 – 10 %
Water table depth	50 – 150 cm
Aspect	Aspect is not a significant factor

Climatic features

The Ozark Highland has a continental type of climate marked by strong seasonality. In winter, dry-cold air masses, unchallenged by any topographic barriers, periodically swing south from the northern plains and Canada. If they invade reasonably humid air, snowfall and rainfall result. In summer, moist, warm air masses, equally unchallenged by topographic barriers, swing north from the Gulf of Mexico and can produce abundant amounts of rain, either by fronts or by convectional processes. In some summers, high pressure stagnates over the region, creating extended droughty periods. Spring and fall are transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses.

The Ozark Highland experiences regional differences in climates, but these differences do not have obvious geographic boundaries. Regional climates grade inconspicuously into each other. The basic gradient for most climatic characteristics is along a line crossing the MLRA from northwest to southeast.

The average annual precipitation in almost all of this area is 38 to 45 inches. Snow falls nearly every winter, but the snow cover lasts for only a few days. The average annual temperature is about 53 to 60 degrees F. The lower temperatures occur at the higher elevations in the western part of the MLRA. Mean January minimum temperature follows a stronger north-to-south gradient. However, mean July maximum temperature shows hardly any geographic variation in the MLRA. Mean July maximum temperatures have a range of only two or three degrees across the area.

Mean annual precipitation varies along a northwest to southeast gradient. Seasonal climatic variations are more complex. Seasonality in precipitation is very pronounced due to strong continental influences. June precipitation, for example, averages three to four times greater than January precipitation. Most of the rainfall occurs as high-intensity, convective thunderstorms in summer.

During years when precipitation comes in a fairly normal manner, moisture is stored in the top layers of the soil during the winter and early spring, when evaporation and transpiration are low. During the summer months the loss of water by evaporation and transpiration is high, and if rainfall fails to occur at frequent intervals, drought will result. Drought directly affects plant and animal life by limiting water supplies, especially at times of high temperatures and high evaporation rates.

Superimposed upon the basic MLRA climatic patterns are local topographic influences that create topoclimatic, or microclimatic variations. In regions of appreciable relief, for example, air drainage at nighttime may produce temperatures several degrees lower in valley bottoms than on side slopes. At critical times during the year, this phenomenon may produce later spring or earlier fall freezes in valley bottoms. Deep sinkholes often have a microclimate significantly cooler, moister, and shadier than surrounding surfaces, a phenomenon that may result in a strikingly different ecology. Higher daytime temperatures of bare rock surfaces and higher reflectivity of these unvegetated surfaces may create distinctive environmental niches such as glades and cliffs.

Slope orientation is an important topographic influence on climate. Summits and south-and-west-facing slopes are regularly warmer and drier than adjacent north- and-east-facing slopes. Finally, the climate within a canopied forest is measurably different from the climate of a more open grassland or savanna areas.

Source: University of Missouri Climate Center - <http://climate.missouri.edu/climate.php>; Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, United States Department of Agriculture Handbook 296 - <http://soils.usda.gov/survey/geography/mlra/>

Table 3 Representative climatic features

Frost-free period (characteristic range)	160-160 days
Freeze-free period (characteristic range)	190-200 days
Precipitation total (characteristic range)	1,170-1,190 mm
Frost-free period (actual range)	160-160 days
Freeze-free period (actual range)	180-210 days
Precipitation total (actual range)	1,140-1,190 mm
Frost-free period (average)	160 days
Freeze-free period (average)	200 days
Precipitation total (average)	1,170 mm

- (1) EMINENCE 1 N [USC00232619], Eminence, MO
- (2) ROUND SPRING 2SW [USC00237309], Eminence, MO
- (3) SALEM [USC00237506], Salem, MO
- (4) WEST PLAINS MUNI AP [USW00053901], Pomona, MO
- (5) CLEARWATER DAM [USC00231674], Ellington, MO

Influencing water features

This ecological site is in the basins of sinkholes. They are influenced by a seasonal high water table, due to high groundwater levels. Ponding is associated with some areas. The water table is typically near or at the surface in late fall through spring, receding in the summer. Ephemeral ponding may occur from seasonal high groundwater tables above the soil surface, and as a result of runoff from surrounding upslope positions. Some permanent open water may also be present.

This site is in the DEPRESSIONAL wetlands class of the Hydrogeomorphic (HGM) classification system (Brinson, 1993), and are Emergent Palustrine wetlands (Cowardin et al., 1979).

Water features associated with this upland ecological site are influenced by karst landscapes throughout the area (see diagram). Rainfall enters the groundwater system through the soil or by flowing into sinkholes and streams. Springs form where land drops low enough to meet underground water tables. Dissolution of carbonate rocks along fractures and faults has produced cave systems, sinkholes (closed and open), springs, and natural tunnels in the region. These sinkholes and losing streams can rapidly transfer water from upland recharge areas to spring outlets. The most common mechanism for groundwater recharge occurs by the relatively slow downward movement of water through soil and carbonate bedrock over a large area known as diffuse recharge, which maintains a high storage volume providing a consistent supply of water to springs. In addition to diffuse recharge, aquifers in karst terrain receive the relatively rapid transfer of water through sinkholes or losing streams connected by subsurface conduits. Surface water entering the aquifer in this fashion has very little contact with soil or rock and consequently the chemical nature of the water changes little in route. Discharge variability does not seem to be controlled by drainage area, but rather the conduit capacity of losing stream sections that can transport the entire volume of base-flow during dry periods in the year. High variability in base flow shows the impact of karst in the form of losing and gaining stream sections (Owen and Pavlowsky 2010).

The accompanying map depicts the distribution of these karst-related features in the state of Missouri. Relative cave density per USGS 7.5" quadrangle is depicted by shades of red, deeper red signifying a larger number of caves in the quadrangle. Stretches of losing streams are shown in yellow. Known springs are shown as blue dots. Image from Wikimedia Commons developed from the Missouri Department of Natural Resources, Division of Geology and Land Survey.

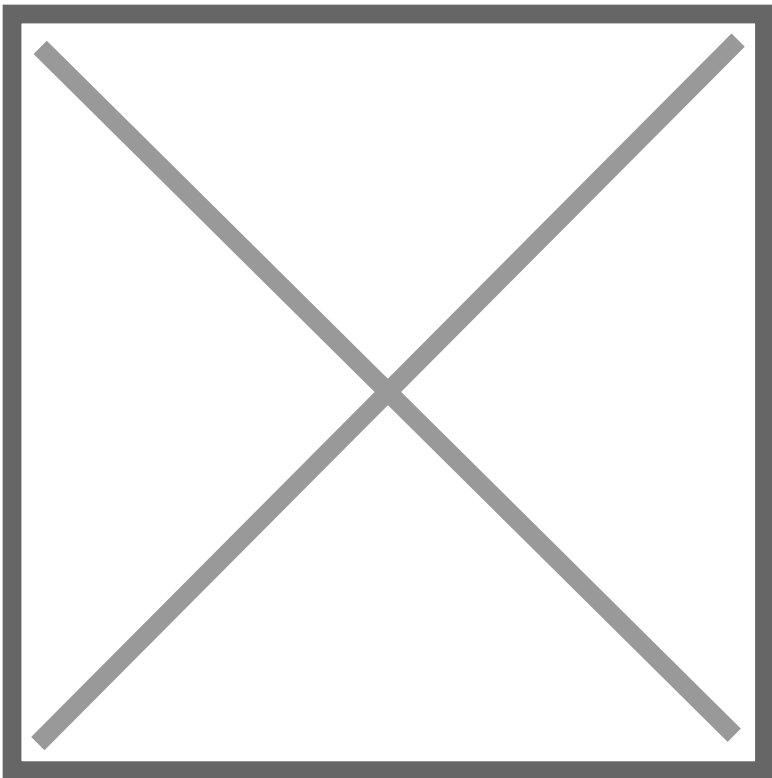


Figure 8. Distribution of karst-related features in Missouri. Image from Wikimedia Commons developed from the Missouri Department of Natural Resources, Division of Geology and Land Survey.

Soil features

These soils have no rooting restriction. The soils were formed under a mixture of herbaceous and woodland vegetation. Organic matter content is variable. Parent material is colluvium. They have silt loam surface horizons, and loamy subsoils. They are not affected by seasonal wetness. Soil series associated with this site include Cornwall, Horneybuck, and Pembroke.

Table 4. Representative soil features

Parent material	(1) Colluvium (2) Residuum – dolomite
Surface texture	(1) Silt loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	180 cm
Surface fragment cover $\leq 3"$	0 – 10 %
Surface fragment cover $> 3"$	Not specified
Available water capacity (0-101.6cm)	17.78 – 20.32 cm
Calcium carbonate equivalent (0-101.6cm)	Not specified
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	4.5 – 7.3
Subsurface fragment volume $\leq 3"$ (Depth not specified)	0 – 30 %

Subsurface fragment volume >3" (Depth not specified)	0 – 10 %
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Ecological dynamics

Information contained in this section was developed using historical data, professional experience, field reviews, and scientific studies. The information presented is representative of very complex vegetation communities. Key indicator plants, animals and ecological processes are described to help inform land management decisions. Plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Loamy Sinkhole Woodlands are variable, but are typically a well-developed woodland dominated by an overstory of black oak and white oak. The canopy is moderately tall (65 to 80 feet) and somewhat open (65 to 85 percent closure). Increased light from the open canopy causes a diversity of woodland ground flora species to flourish. In deeper sinks, more mesic species, such as sugar maple and white ash, are added, and productivity may increase. Woodlands are distinguished from forest, by their relatively open understory, and the presence of sun-loving ground flora species. Characteristic plants in the ground flora can be used to gauge the restoration potential of a stand along with remnant open-grown old-age trees, and tree height growth.

Fire played an important role in the maintenance of these systems. It is likely that these ecological sites burned at least once every 5 to 10 years. These periodic fires kept woodlands open, removed the litter, and stimulated the growth and flowering of the grasses and forbs. During fire free intervals, woody understory species increased and the herbaceous understory diminished. The return of fire would open the woodlands up again and stimulate the abundant ground flora.

Loamy Sinkhole Woodlands were also subjected to occasional disturbances from wind and ice, as well as grazing by native large herbivores, such as bison, elk and white-tailed deer. Wind and ice would have periodically opened the canopy up by knocking over trees or breaking substantial branches off canopy trees. Grazing by native herbivores would have effectively kept understory conditions more open, creating conditions more favorable to oak reproduction and sun-loving ground flora species.

Today, these ecological sites have been cleared and converted to pasture or have undergone repeated timber harvest and domestic grazing. Most existing forested ecological sites have a younger (50 to 80 years) canopy layer whose species composition and quality has been altered by timber harvesting practices. In the long term absence of fire, woody species, especially hickory and hophornbeam, encroach into these woodlands. Once established, these woody plants can quickly fill the existing understory increasing shade levels with a greatly diminished ground flora. Removal of the younger understory and the application of prescribed fire have proven to be effective restoration means.

Uncontrolled domestic grazing has also impacted these communities, further diminishing the diversity of native plants and introducing species that are tolerant of grazing, such as coralberry, gooseberry, and Virginia creeper. Grazed sites also have a more open understory. In addition, soil compaction and soil erosion from grazing can be a problem and lower site productivity.

These ecological sites are moderately productive. Oak regeneration can be problematic. Maintenance of the oak component will require disturbances that will encourage more sun adapted species and reduce shading effects. Single tree selection timber harvests are common in this region and often results in removal of the most productive trees (high grading) in the stand leading to poorer quality timber and a shift in species composition away from more valuable oak species.

Better planned single tree selection or the creation of group openings can help regenerate and maintain more desirable oak species and increase vigor on the residual trees. Clearcutting also occurs and results in dense, even-aged stands dominated by oak. This may be most beneficial for existing stands whose composition has been highly altered by past management practices. However, without some thinning of the dense stands and the application of prescribed fire, the ground flora diversity may be shaded out and diversity of the stand may suffer.

A State and Transition Diagram follows. Detailed descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.

State and transition model

Figure 9. State and transition diagram for this ecological site

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
mockernut hickory	CATO6	<i>Carya tomentosa</i>	Native	–	–	–	–
shagbark hickory	CAOV2	<i>Carya ovata</i>	Native	–	–	–	–
white oak	QUAL	<i>Quercus alba</i>	Native	–	–	–	–
post oak	QUST	<i>Quercus stellata</i>	Native	–	–	–	–
black oak	QUVE	<i>Quercus velutina</i>	Native	–	–	–	–
black hickory	CATE9	<i>Carya texana</i>	Native	–	–	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Virginia wildrye	ELVI3	<i>Elymus virginicus</i>	Native	–	–
big bluestem	ANGE	<i>Andropogon gerardii</i>	Native	–	–
parasol sedge	CAUM4	<i>Carex umbellata</i>	Native	–	–
Pennsylvania sedge	CAPE6	<i>Carex pensylvanica</i>	Native	–	–
hairy woodland brome	BRPU6	<i>Bromus pubescens</i>	Native	–	–
little bluestem	SCSC	<i>Schizachyrium scoparium</i>	Native	–	–
rock muhly	MUSO	<i>Muhlenbergia sobolifera</i>	Native	–	–
eastern bottlebrush grass	ELHY	<i>Elymus hystrix</i>	Native	–	–
broadleaf rosette grass	DILA8	<i>Dichanthelium latifolium</i>	Native	–	–
eastern star sedge	CARA8	<i>Carex radiata</i>	Native	–	–
Forb/Herb					
smooth blue aster	SYLA3	<i>Symphyotrichum laeve</i>	Native	–	–
Canadian blacksnakeroot	SACA15	<i>Sanicula canadensis</i>	Native	–	–
eastern purple coneflower	ECPU	<i>Echinacea purpurea</i>	Native	–	–
elmleaf goldenrod	SOUL2	<i>Solidago ulmifolia</i>	Native	–	–
nakedflower ticktrefoil	DENU4	<i>Desmodium nudiflorum</i>	Native	–	–
fourleaf milkweed	ASQU	<i>Asclepias quadrifolia</i>	Native	–	–
hairy sunflower	HEHI2	<i>Helianthus hirsutus</i>	Native	–	–
Arkansas bedstraw	GAAR4	<i>Galium arkansanum</i>	Native	–	–
slender lespedeza	LEVI7	<i>Lespedeza virginica</i>	Native	–	–
eastern beebalm	MOBR2	<i>Monarda bradburiana</i>	Native	–	–
smooth blue aster	SYLAC	<i>Symphyotrichum laeve var. concinnum</i>	Native	–	–
pointedleaf ticktrefoil	DEGL5	<i>Desmodium glutinosum</i>	Native	–	–
rue anemone	THTH2	<i>Thalictrum thalictroides</i>	Native	–	–
spotted geranium	GEMA	<i>Geranium maculatum</i>	Native	–	–
American hogpeanut	AMBR2	<i>Amphicarpaea bracteata</i>	Native	–	–
Shrub/Subshrub					
fragrant sumac	RHAR4	<i>Rhus aromatica</i>	Native	–	–
lowbush blueberry	VAAN	<i>Vaccinium angustifolium</i>	Native	–	–
farkleberry	VAAR	<i>Vaccinium arboreum</i>	Native	–	–

deerberry	VAST	<i>Vaccinium stamineum</i>	Native	–	–
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Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 11. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 12. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Animal community

Wildlife (MDC 2006): Hard mast from the oaks, soft mast from shrubs, high nutrition seeds and forage is abundant in this ecological site. These food values and the two-tiered structure are attractive to abundant wildlife. Wild turkey, white-tailed deer, and eastern gray squirrel depend on hard and soft mast food sources and are typical upland game species of this type. Bird species associated with this ecological site include Red-headed Woodpecker, Eastern Wood-Pewee, Broad-winged Hawk, Great-Crested Flycatcher, Summer Tanager, Red-eyed Vireo, and Yellow-billed Cuckoo. Amphibians and reptiles associated with ecological site include tiger salamander, small-mouthed salamander, ornate box turtle, northern fence lizard, five-lined skink, broad-headed skink, flat-headed snake, and rough earth snake.

Other information

Forestry (NRCS 2002; 2014): Management: Estimated site index values range from 55 to 65 for oak. Timber management opportunities are good. Create group openings of at least 2 acres. Large clearcuts should be minimized if possible to reduce impacts on wildlife and aesthetics. Uneven-aged management using single tree selection or small group selection cuttings of ½ to 1 acre are other options that can be used if clear cutting is not desired or warranted. Using prescribed fire as a management tool could have a negative impact on timber quality and should be used with caution on a particular site if timber management is the primary objective. Limitations: No major equipment restrictions or limitations exist. Erosion is a hazard when slopes exceed 15 percent. On steep slopes greater than 35 percent, traction problems increase and equipment use is not recommended.

Inventory data references

Potential Reference Sites: Loamy Sinkhole Woodland No quality reference sites are known to exist.

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Contributors

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Approval

Nels Barrett, 9/24/2020

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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	09/16/2026

Approved by	
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:
