Ecological site R067BY056CO
Sandstone Breaks

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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.

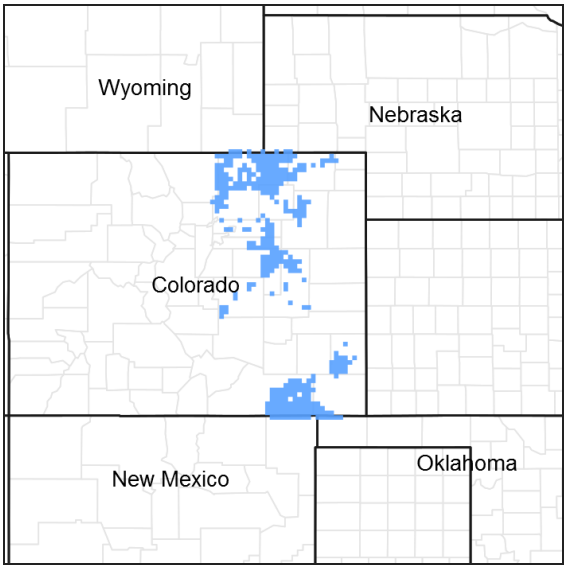


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 067B–Central High Plains, Southern Part

MLRA 67B occurs in eastern Colorado and consists of rolling plains and river valleys. Some canyonlands occur in the southeast portion. The major rivers are the South Platte and Arkansas which flow from the Rocky Mountains to Nebraska and Kansas. Other rivers in the MLRA include the Cache la Poudre and Republican and associated tributaries. This MLRA is traversed by Interstate 25, 70 and 76; and U.S. Highways 50 and 287. Major land uses include 54 percent rangeland, 35 percent cropland, and 2 percent pasture and hayland. Urban, developed open space, and miscellaneous land occupy approximately 9 percent. Major Cities in this area include Fort Collins, Greeley, Sterling, and Denver. Other cities include Limon, Cheyenne Wells, and Springfield. Land ownership is mostly private. Federal lands include Pawnee and Comanche National Grasslands (U.S. Forest Service), Sand Creek Massacre National Historic Site (National Park Service), and Rocky Mountain Arsenal National Wildlife Refuge (U.S. Fish & Wildlife Service). State Parks include Cherry Creek and Chatfield Reservoirs, and Barr and Jackson Lakes.

This region is periodically affected by severe drought, including the historic “Dust Bowl” of the 1930s. Dust storms may form during drought years in windy periods. Elevations range from 3,400 to 6,000 feet. The Average annual precipitation ranges from 14 to17 inches per year and ranges from 13 inches to over 18 inches, depending upon location. Precipitation occurs mostly during the growing season, often during rapidly developing thunderstorms. Mean annual air temperature (MAAT) is 48 to 52 degrees Fahrenheit. Summer temperatures may exceed 100

degrees Fahrenheit. Winter temperatures may be sub-zero, and snowfall varies from 20 to 40 inches per year. Snow cover frequently melts between snow events.

LRU notes

Land Resource Unit (LRU) A is the northeast portion of MLRA 67B, to an extent of approximately 9 million acres. Most of the LRU is rangeland, and includes the Pawnee National Grassland. Dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) are grown in most counties. Irrigated cropland is utilized in the South Platte Valley. Small acreage and urban ownership are more concentrated on the Front Range. This LRU is found in portions of Adams, Arapahoe, Elbert, Kit Carson, Larimer, Lincoln, Logan, Washington, and Weld counties. Other counties include Boulder, Cheyenne, Denver, Jefferson, and Yuma. The soil moisture regime is aridic ustic. The mean annual air temperature (MAAT) is 50 degrees Fahrenheit.

LRU B is in the southeast portion of MLRA 67B (2.6 million acres) and includes portions of Baca, Bent, Cheyenne, Kiowa, Las Animas, and Prowers counties. Most of the LRU remains in rangeland and includes the Comanche National Grassland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. Irrigated cropland is found in the Arkansas Valley. The soil moisture regime is aridic ustic and the MAAT is 52 degrees Fahrenheit.

LRU C occurs in portions of Morgan and Weld counties (approximately 1.2 million acres). Most of LRU C is in rangeland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. The soil moisture regime is ustic aridic and the MAAT is 48 degrees Fahrenheit.

Classification relationships

MLRA 67B is in the Colorado Piedmont and Raton Sections of the Great Plains Province (USDA, 2006). The MLRA is further defined by Land Resource Units (LRUs) A, B, and C. Features such as climate, geology, landforms, and key vegetation further refine these concepts and are described in other sections of the Ecological Site Description (ESD). NOTE: To date, these LRUs are DRAFT.

Relationship to Other Hierarchical Classifications:
NRCS Classification Hierarchy: Physiographic Division, Physiographic Province, Physiographic Section, Land Resource Region, Major Land Resource Area, Land Resource Unit (Fenneman, 1946).
USFS Classification Hierarchy: Domain, Division, Province, Section, Subsection,
Land Type Association: Land Type, Land Type Phase (Cleland et al, 1997).

REVISION NOTES:
The Sandstone Breaks Ecological Site was developed by an earlier version (2004, revised 2007). This earlier version was based on input from Natural Resources Conservation Service (formerly Soil Conservation Service) and historical information obtained from the Sandstone Breaks Range Site descriptions (1975). This ESD meets the Provisional requirements of the National Ecological Site Handbook (NESH). This ESD will continue refinement towards an Approved status according to the NESH.

Ecological site concept

This site is a run-off site on slopes of six percent or greater, and lies over sandstone bedrock that is within 40 inches of the soil surface.

Associated sites

R067BY002CO	**Loamy Plains** This ecological site is commonly adjacent.
R067BY015CO	**Deep Sand** This ecological site is commonly adjacent.
R067BY024CO	**Sandy Plains** This ecological site is commonly adjacent.

R067BY063CO	**Gravel Breaks** This ecological site is commonly adjacent.

Similar sites

R067BY060CO	**Limestone Breaks** The Limestone Breaks Ecological Site lies over limestone bedrock.
R067BY063CO	**Gravel Breaks** The bedrock under the Gravel Breaks Ecological Site is deeper than 40 inches, and is not shale. This site does have greater than 15 percent rock fragments on the surface or in the subsoil.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Prunus virginiana* (2) *Prunus pumila var. besseyi*
Herbaceous	(1) *Calamovilfa longifolia* (2) *Schizachyrium scoparium*

Physiographic features

This site occurs on scarps, escarpments, hillslopes, and ridges on dissected plains or canyonlands.

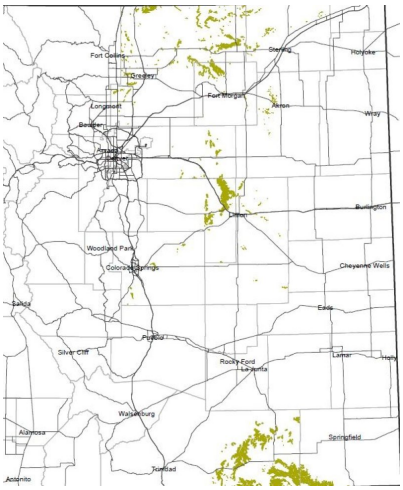


Figure 2. The distribution of the Sandstone Breaks site in MLRA 67B.

Table 2. Representative physiographic features

Landforms	(1) Escarpment (2) Ridge (3) Hillslope (4) Scarp
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	4,400–6,000 ft
Slope	9–30%
Ponding depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation across the MLRA extent is 14 to 17 inches, and ranges from 13 to over 18 inches, depending on location. Precipitation increases from north to south. Mean Annual Air Temperature (MAAT) is 50 degrees Fahrenheit in the northern part and increases to 52 degrees Fahrenheit in the southern part. Portions of Morgan and Weld counties are cooler and drier, the MAAT is 48 degrees Fahrenheit, and average precipitation is 13 to14 inches per year.

Two-thirds of the annual precipitation occurs during the growing season from mid-April to late September. Snowfall averages 30 inches per year, area-wide, but varies by location from 20 to 40 inches per year. Winds are estimated to average 9 miles per hour annually. Daytime winds are generally stronger than at night, and occasional strong storms may bring periods of high winds with gusts to more than 90 mph. High-intensity afternoon thunderstorms may arise. The average length of the freeze-free period (28 degrees Fahrenheit) is 155 days from April 30th to October to 3rd. The average frost-free period (32 degrees Fahrenheit) is 136 days from May 11th to September 24th. July is the hottest month, and December and January are the coldest months. Summer temperatures average 90 degrees Fahrenheit and occasionally exceed 100 degrees Fahrenheit. Summer humidity is low and evaporation is high. Winters are characterized with frequent northerly winds, producing severe cold with temperatures occasionally dropping to -30 degrees Fahrenheit or lower. Blizzard conditions may form quickly. For detailed information, visit the Western Regional Climate Center website:
Western Regional Climate Center Historical Data Western U.S. Climate summaries, NOAA Coop Stations Colorado http://www.wrcc.dri.edu/summary/Climsmco.html.

Table 3. Representative climatic features

Frost-free period (characteristic range)	119-129 days
Freeze-free period (characteristic range)	134-151 days
Precipitation total (characteristic range)	14-17 in
Frost-free period (actual range)	102-132 days
Freeze-free period (actual range)	126-156 days
Precipitation total (actual range)	14-17 in
Frost-free period (average)	121 days
Freeze-free period (average)	142 days
Precipitation total (average)	15 in

Climate stations used

- (1) CHEYENNE WELLS [USC00051564], Cheyenne Wells, CO
- (2) FT MORGAN [USC00053038], Fort Morgan, CO
- (3) SPRINGFIELD 7 WSW [USC00057866], Springfield, CO
- (4) BRIGGSDALE [USC00050945], Briggsdale, CO
- (5) BRIGHTON 3 SE [USC00050950], Brighton, CO
- (6) FLAGLER 1S [USC00052932], Flagler, CO
- (7) KIT CARSON [USC00054603], Kit Carson, CO
- (8) LIMON WSMO [USW00093010], Limon, CO
- (9) BYERS 5 ENE [USC00051179], Byers, CO
- (10) GREELEY UNC [USC00053553], Greeley, CO
- (11) NUNN [USC00056023], Nunn, CO

Influencing water features

There are no water features of the ecological site or adjacent wetland or riparian regimes that influence the vegetation and management of the site.

Soil features

The soils on this site are shallow to moderately deep, well to somewhat excessively drained soils that formed from

residuum weathered from sandstone. They typically have a moderate to moderately slow permeability class, but ranges to moderately rapid in some soils. The soil moisture regime is typically aridic ustic. The soil temperature regime is mesic.

The surface layer of the soils in this site are typically fine sandy loam, sandy loam, or loamy fine sand, but may include loamy sand or loam. The surface layer ranges from a depth of 3 to 9 inches thick. The subsoil is typically fine sandy loam or sandy loam, but may include loam, very fine sandy loam, or loamy fine sand. Soils in this site typically leached of carbonates from 0 to 4 inches, but some soils may have carbonates at the surface. These soils are susceptible to erosion by water and wind. The potential for water erosion accelerates with increasing slope. Exposed areas of sandstone bedrock are inherent to this site.

Major soil series correlated to this ecological site include: Dalerose, Tassel, Terry, and Travessilla.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: Argiustolls, Aridic Lithic Haplustepts, Bernal, Brownson, Canyon, Rizozo, Rough Broken Land, Rough Stony Land, Treon, Tulluck, and Ustic Torriorthents.

Note: Revisions to soil surveys are on-going. For the most recent updates, visit the Web Soil Survey, the official site for soils information: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

The attributes listed below represent 0 to 40 inches in depth or to the first restrictive layer.

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone
Surface texture	(1) Fine sandy loam (2) Sandy loam (3) Loamy fine sand
Drainage class	Somewhat excessively drained to well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	10–40 in
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0–15%
Available water capacity (0-40in)	2–7 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0–25%

Ecological dynamics

The Sandstone Breaks ecological site is characterized by three states: Reference, Warm-Season Shortgrass, and Increased *Bare Ground*. The Reference State is characterized by warm-season mid and tallgrasses with a variety of shrubs. Trees (one-seed juniper) may occur in southeastern Colorado. The Warm-Season Shortgrass State is characterized by a warm-season short bunchgrass (blue grama) and grass-like (threadleaf sedge). The Increased

Bare Ground State is characterized by early successional warm-season bunchgrass (sand dropseed, Fendler threeawn), annual grasses, and annual forbs.

Continuous, heavy grazing without adequate recovery periods following each grazing occurrence will initially cause prairie sandreed, little bluestem, sideoats grama, Indiangrass, sand bluestem, switchgrass, and palatable forbs and shrubs to decrease in frequency and production. Grasses and grass-like plants such as blue grama, hairy grama, and threadleaf sedge increase. If adequate recovery periods between grazing events are not allowed during the growing season, blue grama eventually forms into a patchy sodbound appearance. Mid and tallgrasses can eventually be removed from the plant community. Over the long-term, continuous use without adequate recovery opportunities between grazing events results in large amounts of bare ground. Species such as Fendler threeawn, sand dropseed, small soapweed, broom snakeweed, wormwood, pricklypear cactus, and cheatgrass increase or invade.

The degree of grazing has a significant impact on the ecological dynamics of the site. This region was historically occupied by large grazing animals, such as bison, elk, pronghorn, and mule deer. Grazing by these large herbivores, along with climatic and seasonal weather fluctuations, had a major influence on the ecological dynamics of the site. Deer and pronghorn are widely distributed throughout the MLRA. Secondary influences of herbivory by species such as prairie dogs and other small rodents, insects, and root-feeding organisms continues to impact the vegetation.

Historically, grazing patterns by herds of large ungulates were driven by water distribution, precipitation events, drought events, and fire. It is believed that grazing periods would have been shorter, followed by longer recovery periods. These large migrating herds impacted the ecological processes of nutrient and hydrologic cycles, by urination, trampling (incorporation of litter into the soil surface), and breaking of surface crust, (which increases water infiltration).

Today, livestock grazing, especially beef cattle has been a major influence on the ecological dynamics of the site. Grazing management, coupled with the effects of annual climatic variations, largely dictates the plant communities for the site.

Recurrent drought has historically impacted the vegetation of this region. Changes in species composition vary depending upon the duration and severity of the drought cycle and prior grazing management. Drought events since 2002 have significantly increased mortality of blue grama and buffalograss in some locales.

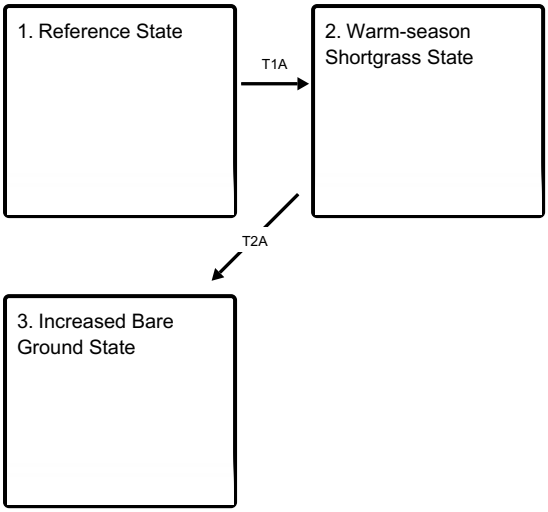
This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely to start fires for various reasons (deliberate or accidental). It is believed that fires were set as a management tool for attracting herds of large migratory herbivores (Stewart, 2002). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

Mechanical treatment consisting of contour pitting, furrowing, terracing, chiseling, and disking has been practiced in the past. It was theorized that the use of this high-input technology would improve production and plant composition on rangeland. These high-cost practices have shown to have no significant long-term benefits on production or plant composition and have only resulted in a permanently rough ground surface. Prescribed grazing that mimics the historic grazing of herds of migratory herbivores, as described earlier, has been shown to result in desired improvements based on management goals for this ecological site.

Eastern Colorado was strongly affected by extended drought conditions in the “Dust Bowl” period of the 1930’s, with recurrent drought cycles in the 1950s and 1970s. Extreme to exceptional drought conditions have re-visited the area from 2002 to 2012, with brief interludes of near normal to normal precipitation years. Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begins about April 1 and continues to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occurs in September in most years, depending on the availability of moisture.

State and transition model

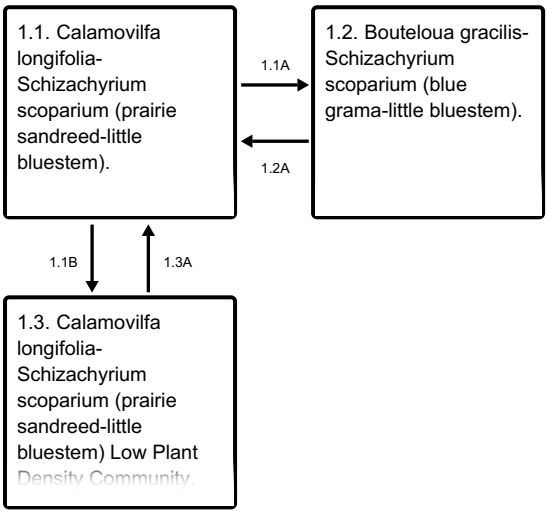
Ecosystem states



T1A - Excessive grazing. Lack of fire.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



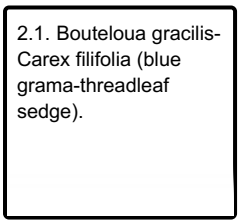
1.1A - Excessive grazing. Lack of fire.

1.1B - Non-use. Lack of fire.

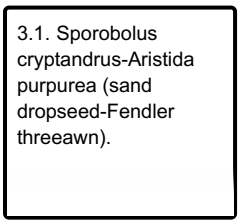
1.2A - Prescribed grazing. Prescribed fire.

1.3A - Prescribed grazing. Prescribed burning.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Reference State

The Reference State is characterized by three distinct plant community phases. The plant communities and various successional stages between them represent the natural range of variability within the Reference State.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- western sandcherry (*Prunus pumila var. besseyi*), shrub
- chokecherry (*Prunus virginiana*), shrub
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
Calamovilfa longifolia-Schizachyrium scoparium (prairie sandreed-little bluestem).

This plant community is the interpretive plant community for this site. This community developed with grazing by large herbivores and is suited to grazing by domestic livestock. Historically, fires likely occurred infrequently. This plant community can be found on areas where grazed plants receive adequate periods of recovery during the growing season. The potential vegetation is about 70 to 90 percent grasses and grass-likes, 5 to 15 percent forbs and 5 to15 percent woody plants. Mid- and tallgrasses dominate this community. The principal grasses are prairie sandreed, little bluestem, and sideoats grama. Secondary grasses are blue grama, switchgrass, and needle and thread. Other important grasses are sand bluestem and big bluestem. Threadleaf and sun sedge are common. Dominant forbs are American vetch, dotted gayfeather, purple prairie clover, and upright prairie coneflower. Key shrubs are chokecherry, skunkbush sumac, western sandcherry, and golden and wax currant. Other shrubs may include hackberry and mountain mahogany. Trees are occasionally present. One-seed juniper occurs in the southeastern counties. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed where vegetative cover is continuous. Some litter movement may occur on steeper, wind-swept slopes. Decadence and natural plant mortality is very low. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. This community is resistant to many disturbances except heavy, continuous grazing, tillage, or development into urban or other uses. Areas having lost all vegetation, such as livestock and vehicle trails are subject to wind and water erosion. Total annual production ranges from 700 to 1600 pounds of air-dry weight with a Represenative Value of 1,100 pounds.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- western sandcherry (*Prunus pumila var. besseyi*), shrub
- chokecherry (*Prunus virginiana*), shrub
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	600	880	1260
Forb	50	110	170
Shrub/Vine	50	110	170
Tree	0	5	10
Total	**700**	**1105**	**1610**

Figure 10. Plant community growth curve (percent production by month). CO6709, Warm-season dominant, cool-season subdominant; MLRA-67B; upland coarse textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	7	25	35	15	10	5	1	0	0

Community 1.2
Bouteloua gracilis-Schizachyrium scoparium (blue grama-little bluestem).

Blue grama has increased. Prairie sandreed, switchgrass, sand bluestem, and Indiangrass have decreased. Little bluestem and sideoats grama are still present as secondary grasses. American vetch, purple prairie clover, leadplant, western sandcherry, chokecherry, and currants are present in reduced amounts. Needle and thread may initially increase or decrease depending on the season of grazing use. White sagebrush (Louisiana sagewort, Cuman ragweed (western ragweed), hairy golden aster, slimflower scurfpea, yucca, and prairie sagewort (fringed sagebrush) have increased. Plant frequency, vigor, and production have decreased. Reduction of warm-season tall and midgrasses, rhizomatous wheatgrass, nitrogen fixing forbs, the shrub component, and increased warm-season shortgrass has begun to alter the biotic integrity of this community. Water and nutrient cycles are at risk of becoming impaired. Litter levels have been reduced. Wind scoured areas and pedestalled plants may be evident. Total annual production ranges from 350 to 950 pounds of air-dry weight and averages 650 pounds during a normal year.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- western sandcherry (*Prunus pumila var. besseyi*), shrub
- chokecherry (*Prunus virginiana*), shrub
- blue grama (*Bouteloua gracilis*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Figure 11. Plant community growth curve (percent production by month). CO6710, Warm-season dominant; MLRA-67B; upland coarse-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	40	20	10	5	0	0	0

Community 1.3
Calamovilfa longifolia-Schizachyrium scoparium (prairie sandreed-little bluestem) Low Plant Density Community.

This plant community developed under many years of non-use and lack of fire. Plant species resemble the Reference Plant Community however, frequency and production is reduced. Eventually, litter levels can become high enough to cause stagnation and mortality of various species such as Indiangrass, sand bluestem, switchgrass, and little bluestem. Bunchgrasses typically develop dead centers and rhizomatous grasses can form small decadent communities due to a lack of impact by grazing animals. Management changes can easily shift this plant community toward the Reference Plant Community. Non-disturbance initially increases litter levels, minimizing soil erosion. In advanced stages of non-use or lack of fire, plants begin to die off and bare areas increase, causing an erosion concern. Total annual production varies from 250 to 900 pounds of air-dry vegetation per acre and averages 600 pounds during a normal year.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- western sandcherry (*Prunus pumila var. besseyi*), shrub
- chokecherry (*Prunus virginiana*), shrub
- prairie sandreed (*Calamovilfa longifolia*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Figure 12. Plant community growth curve (percent production by month). CO6711, Warm-season dominant, cool-season subdominant, excess litter; MLRA-67B; upland coarse texture soil..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	8	20	35	17	10	5	3	0	0

Pathway 1.1A
Community 1.1 to 1.2

Continuous, heavy grazing without adequate recovery periods between grazing events, and lack of fire shift this plant community to the 1.2 Community. Drought accelerates this process. Recurring spring seasonal grazing decreases cool-season plants. Recurring summer grazing decreases warm-season plants.

Pathway 1.1B
Community 1.1 to 1.3

Non-use and lack of fire causes the Reference Plant Community to shift to the 1.3 Community. Plant decadence and standing dead plant material impede energy flow.

Pathway 1.2A
Community 1.2 to 1.1

Grazing that allows for adequate recovery opportunity between grazing events, proper stocking rate, and prescribed fire shift this community back to the Reference Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3A
Community 1.3 to 1.1

The return of grazing with adequate recovery opportunity and normal fire frequency create a community pathway back to the Reference Plant Community. This change can occur in a relatively short time frame with the return of these disturbances.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Warm-season Shortgrass State

Species diversity and production have been significantly decreased due to the major reduction of mid- and tallgrass species and key shrubs. Litter levels are very low and unevenly distributed. Soil erosion may be a concern on steeper slopes and exposed areas. An ecological threshold has been crossed and a significant amount of production and diversity has been lost when compared to the Reference State. Significant biotic and edaphic (soil characteristics) changes have negatively impacted energy flow and nutrient and hydrologic cycles. The loss of functional/structural groups such as warm-season tallgrass reduces the biodiversity and productivity of this site.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- prairie sagewort (*Artemisia frigida*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Community 2.1
Bouteloua gracilis-Carex filifolia (blue grama-threadleaf sedge).

The dominant species are blue grama and threadleaf sedge. These species have developed into a sodbound condition occurring in localized colonies exhibiting a mosaic appearance. Tallgrasses have been removed with the exception of prairie sandreed, which may exist in remnant amounts. Sideoats grama and little bluestem may still be present in small amounts on steeper slopes. Forbs and shrubs that continue to increase are Cuman ragweed (western ragweed), hairy golden aster, prairie sagewort (fringed sagebrush), and yucca. Production ranges from 100 to 500 pounds of air-dry vegetation per acre per year and will average 350 pounds during a normal year.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- prairie sagewort (*Artemisia frigida*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- threadleaf sedge (*Carex filifolia*), grass

Figure 13. Plant community growth curve (percent production by month). CO6712, Warm-season/cool-season codominant; MLRA-67B; upland coarse textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	1	7	48	27	15	2	0	0	0

State 3
Increased Bare Ground State

Soil erosion hazard has increased due to the increase of bare ground and may be severe on steeper slopes. All ecological functions are impaired. An ecological threshold has been crossed. Erosion and loss of organic matter and carbon reserves are concerns. Nutrient and water cycles and energy flow are impaired.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- prairie sagewort (*Artemisia frigida*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- sand dropseed (*Sporobolus cryptandrus*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Sporobolus cryptandrus-Aristida purpurea (sand dropseed-Fendler threeawn).

Bare ground has significantly increased. Remnant amounts of blue grama can still be found in localized areas. The dominant perennial plants are sand dropseed and Fendler threeawn. Annuals such as sixweeks fescue, Russian thistle, burningbush, and cheatgrass have increased or invaded. Total annual production varies from 50 to 150 pounds of air-dry vegetation per acre and averages 100 pounds.

Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- prairie sagewort (*Artemisia frigida*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- sand dropseed (*Sporobolus cryptandrus*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Figure 14. Plant community growth curve (percent production by month). CO6710, Warm-season dominant; MLRA-67B; upland coarse-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	40	20	10	5	0	0	0

Transition T1A
State 1 to 2

Heavy, continuous grazing without adequate recovery opportunity between grazing events nd lack of fire shift this plant community across an ecological threshold to the Warm-season Shortgrass State. Biotic integrity and hydrologic function are impaired as a result of this transition.

Transition T2A
State 2 to 3

Long-term, heavy, continuous grazing without adequate recovery opportunity between grazing events and lack of fire causes a shift across an ecological threshold to the Increased *Bare Ground* State. Erosion, loss of organic matter and carbon reserves, and invasion of annuals are constraints to recovery.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1				770–990	
	sideoats grama	BOCU	*Bouteloua curtipendula*	55–165	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	110–165	–
	little bluestem	SCSC	*Schizachyrium scoparium*	110–165	–
	blue grama	BOGR2	*Bouteloua gracilis*	55–110	–
	sand bluestem	ANHA	*Andropogon hallii*	22–110	–
	big bluestem	ANGE	*Andropogon gerardii*	22–77	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	22–77	–
	switchgrass	PAVI2	*Panicum virgatum*	0–55	–
	Grass, perennial	2GP	*Grass, perennial*	11–55	–
	western wheatgrass	PASM	*Pascopyrum smithii*	11–33	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	11–33	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	11–22	–
	Canada wildrye	ELCA4	*Elymus canadensis*	11–22	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	11–22	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	11–22	–
	threadleaf sedge	CAFI	*Carex filifolia*	11–22	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–11	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–11	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–11	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	0–11	–
	marsh muhly	MURA	*Muhlenbergia racemosa*	0–11	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–11	–

	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–11	–
Forb					
2				55–165	
	Forb, perennial	2FP	*Forb, perennial*	11–55	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	11–22	–
	dotted blazing star	LIPU	*Liatris punctata*	11–22	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	0–11	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	0–11	–
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–11	–
	crownleaf evening primrose	OECO2	*Oenothera coronopifolia*	0–11	–
	New Mexico groundsel	PANEM	*Packera neomexicana var. mutabilis*	0–11	–
	broadbeard beardtongue	PEAN4	*Penstemon angustifolius*	0–11	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–11	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–11	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–11	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–11	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–11	–
	stemless four-nerve daisy	TEAC	*Tetraneuris acaulis*	0–11	–
	stiff greenthread	THFI	*Thelesperma filifolium*	0–11	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–11	–
	American vetch	VIAM	*Vicia americana*	0–11	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	0–11	–
	shaggy dwarf morning-glory	EVNU	*Evolvulus nuttallianus*	0–11	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–11	–
	manystem pea	LAPO2	*Lathyrus polymorphus*	0–11	–
	common starlily	LEMO4	*Leucocrinum montanum*	0–11	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–11	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–11	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–11	–
	woolly locoweed	ASMO7	*Astragalus mollissimus*	0–11	–
	Texas croton	CRTE4	*Croton texensis*	0–11	–
Shrub/Vine					
3				55–165	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	11–33	–
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	11–33	–
	chokecherry	PRVI	*Prunus virginiana*	11–33	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–22	–
	golden currant	RIAU	*Ribes aureum*	11–22	–
	wax currant	RICE	*Ribes cereum*	11–22	–
	spreading buckwheat	EREF	*Eriogonum effusum*	11–22	–

	winterfat	KRLA2	*Krascheninnikovia lanata*	11–22	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	11–22	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–11	–
	common hackberry	CEOC	*Celtis occidentalis*	0–11	–
	leadplant	AMCA6	*Amorpha canescens*	0–11	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–11	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–11	–
	littleleaf mock orange	PHMI4	*Philadelphus microphyllus*	0–11	–
	spinystar	ESVIV	*Escobaria vivipara var. vivipara*	0–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–11	–
	soapweed yucca	YUGL	*Yucca glauca*	0–11	–
Tree					
4	**Tree**			0–10	
	oneseed juniper	JUMO	*Juniperus monosperma*	0–11	–

Animal community

WILDLIFE INTERPRETATIONS:

The combination of grasses, forbs, and shrubs found on the ecological site provide habitat for numerous wildlife species. Historic large grazers that influenced these communities were bison, elk, mule deer, and pronghorn. Bison are no longer widely distributed in their historic range. Pronghorn are the most abundant ungulates using this ecological site, followed by mule deer. Domestic grazers share these habitats with wildlife. The grassland communities of eastern Colorado are home to many bird species. Changes in the composition of the plant community when moving from the Reference Community to other communities on this ecological site may result in species shifts in bird species. The occasional spring found on this site provides essential seasonal water needed for reproductive habitat by some reptiles and amphibians. Because of a lack of permanent water, fish are not common.

Reference Plant Community: Prairie Sandreed, Little Bluestem, Sideoats Grama, and Shrubs:
The grasses, forbs, and shrubs in this plant community provide habitat for reptiles such as prairie rattlesnake and bullsnake. If water is available for breeding, spadefoot toads may be found here. The structural diversity in the plant community on this site provides habitat for Cassin's and Brewer's sparrow, lark bunting, and scaled quail. Ferruginous and Swainson's hawks are commonly seen on this site. The combination of mid-tall grasses and shrubs provides habitat for lesser prairie chicken in the eastern part of this ecological site. Small mammals such as white-tailed jackrabbit, badger, swift fox, and several species of mice are common in this plant community. Pronghorn is a typical ungulate found in this community.

1.2 Community: Increased Blue Grama, Decreased Prairie Sandreed, Decreased Little Bluestem, Decreased Shrubs:
All wildlife species found in the Reference Plant Community are expected in this plant community. However, the loss of some of the vegetative structural diversity in this plant community makes it less attractive to the Reference Plant Community species.

1.3 Community;

The wildlife species found here are similar to those in the Reference Plant Community. However, the lower productivity and vegetative structural diversity makes it less attractive to the Reference Plant Community species.

2.1 Community: Blue Grama, Threadleaf Sedge;
As these communities develop into an open landscape the wildlife species shift away from Reference Plant Community species and toward the species that prefer unvegetated areas and short plants. Texas short- lizard, six-

lined racerunner, and black-tailed jackrabbit would be expected more frequently here.

3.1 Community: Sand Dropseed, Fendler Threeawn, Annuals, *Bare Ground*:

As these communities develop into an open landscape the wildlife species shift away from Reference Plant Community species and toward the species that prefer unvegetated areas and short plants. Texas short- lizard, six-lined racerunner, and black-tailed jackrabbit would be expected more frequently here.

GRAZING INTERPRETATIONS:
The following table lists suggested initial stocking rates for an animal unit (1000-pound beef cow) under continuous grazing (yearlong grazing or growing-season-long grazing) based on normal growing conditions. However, continuous grazing is not recommended. These estimates should only be used as preliminary guidelines in the initial stages of the conservation planning process. Often, the existing plant composition does not entirely match any particular plant community described in this ecological site description. Therefore, field inventories are always recommended to document plant composition, total production, and palatable forage production. Carrying capacity estimates that reflect on-site conditions should be calculated using field inventories.

If the following production estimates are used, they should be adjusted based on animal kind or class and on the specific palatability of the forage plants in the various plant community descriptions. Under a properly stocked, properly applied, prescribed grazing management system that provides adequate recovery periods following each grazing event, improved harvest efficiencies eventually result in increased carrying capacity. See USDA-NRCS Colorado Prescribed Grazing Standard and Specification Guide (528).

The stocking rate calculations are based on the total annual forage production in a normal year multiplied by 25 percent harvest efficiency divided by 912.5 pounds of ingested air-dry vegetation for an animal unit per month (AUM).

Reference PC - (1100) (0.30)

1.2 PC - (650) (0.18)

2.1 PC - (350) (0.10)

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses and other herbivores.

An on-site inventory is required prior to developing a grazing plan.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group A. Infiltration is moderate to high and runoff potential for this site is moderate depending on ground cover. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to NRCS Section 4, National Engineering Handbook (USDA–NRCS, 1972–2012) for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

Site Development and Testing Plan

General Data (MLRA and Revision Notes, Hierarchical Classification, Ecological Site Concept, Physiographic, Climate, and Water Features, and Soils Data):

Updated. All “Required” items complete to Provisional level.

Community Phase Data (Ecological Dynamics, STM, Transition & Recovery Pathways, Reference Plant Community, Species Composition List, Annual Production Table):

Updated. All “Required” items complete to Provisional level.
NOTE: Annual Production Table is from the “Previously Approved” ESD 2004. The Species Composition List is also from the 2004 version, with minor edits. These will need review for future updates at Approved level.

Each Alternative State/Community:

Complete to Provisional level

Supporting Information (Site Interpretations, Assoc. & Similar Sites, Inventory Data References, Agency/State Correlation, References):

Updated. All “Required” items complete to Provisional level.

Livestock Interpretations updated to reflect Total Annual Production revisions in each plant community.

Wildlife interpretations, general narrative, and individual plant communities updated to the Provisional level. Hydrology, Recreational Uses, Wood Products, Other Products, Plant Preferences table, and Rangeland Health Reference Sheet carried over from previously “Approved” ESD 2004.

Reference Sheet

The Reference Sheet was previously approved in 2007.
It will be updated at the next “Approved” level.

“Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.” (NI 430_306 ESI and ESD, April, 2015).

Other information

Relationship to Other Hierarchical Classifications:

NRCS Classification Hierarchy:
Physiographic Divisions of the United States (Fenneman, 1946): Physiographic DivisionPhysiographic ProvincePhysiographic SectionLand Resource RegionMajor Land Resource Area (MLRA)Land Resource Unit (LRU).
USFS Classification Hierarchy:
National Hierarchical Framework of Ecological Units (Cleland et al, 181-200):
DomainDivisionProvinceSectionSubsectionLandtype AssociationLandtypeLandtype Phase.

Inventory data references

NRI: references to Natural Resource Inventory data
Information presented here has been derived from data collection on private and federal lands using:
• Double Sampling (clipped 2 of 5 plots)*
• Rangeland Health (Pellant et al., 2005)

• Soil Stability (Pellant et al., 2005)
• Line Point Intercept : Foliar canopy, basal cover (Forb, Graminoid, Shrub, subshrub, Lichen, Moss, Rock fragments, bare ground, % Litter) (Herrick et al., 2005)
• Soil pedon descriptions collected on site (Schoeneberger et al., 2012)

*NRCS double-sampling method, CO NRCS Similarity Index Worksheet 528(1).
Additional reconnaissance data collection using numerous ocular estimates and other inventory data; NRCS clipping data for USDA program support; Field observations from experienced range trained personnel. Specific data information is contained in individual landowner/user case files and other files located in county NRCS field offices.

Those involved in developing the 2004 site description include: Ben Berlinger, Rangeland Management Specialist, CO-NRCS; Harvey Sprock, Rangeland Management Specialist, CO-NRCS; James Borchert, Soil Scientist, CO-NRCS; Terri Skadeland, Biologist, CO-NRCS.

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Data collection for this ecological site was done in conjunction with the progressive soil surveys within the 67B Central High Plains (Southern Part) of Colorado. It has been mapped and correlated with soils in the following soil surveys: Adams County, Arapahoe County, Baca County, Bent County, Boulder County, Cheyenne County, El Paso County Area, Elbert County, Eastern Part, Kiowa County, Kit Carson County, Larimer County Area, Las Animas County Area, Lincoln County, Logan County, Morgan County, Prowers County, Washington County, Weld County, Northern Part, and Weld County, Southern Part.

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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)	Harvey Sprock, Ben Berlinger, Daniel Nosal
Contact for lead author	Harvey Sprock, Area Rangeland Management Specialist, Greeley, CO
Date	11/19/2004
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None on gentle slopes, slight on steeper slopes.

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2. **Presence of water flow patterns:** None to minimal on gentle slopes (< 15 percent). Flow paths should be broken, irregular in appearance. As slope steepness increases, flow paths become more apparent and may be connected.

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3. **Number and height of erosional pedestals or terracettes:** None to slight on gentle slopes. Expect some evidence of pedestalled plants when slopes exceed 15 percent.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5 percent or less bare ground, with bare patches generally less than 3 inches. Extended drought may increase bare ground 5 to 10 percent.

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5. **Number of gullies and erosion associated with gullies:** None

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None to slight. Minor wind scouring may occur on steep ridges. Wind erosion can occur with disturbances such as wildfire or extended drought.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is associated with water flow patterns and may move as much as 1 to 3 feet or more down slope during severe precipitation events, especially on steeper slopes.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating is anticipated to be 3 to 4 in interspaces at soil surface. These values need verification.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM ranges from 1 to 3 percent. Soils are typically very shallow to shallow, somewhat excessively drained. A-horizon color is light brownish-gray with a weak fine granular structure. Exposed sandstone bedrock is inherent to the site.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Raindrop impact is reduced by the diverse grass, forb, shrub functional/structural groups and root structure. This slows overland flow and provides increased time for infiltration to occur. Extended drought, wildfire or both may reduce basal density, canopy cover, and litter amounts (primarily from tall, warm-season bunch and rhizomatous grasses), resulting in decreased infiltration and increased runoff on steep slopes following intense rainfall events.

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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): None

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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: Warm-season mid bunchgrass = warm-season tall rhizomatous >

    Sub-dominant: Shrubs > warm-season tall bunchgrass > warm-season short bunchgrass > leguminous forbs = other forbs >

    Other: Grasslikes

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None to slight. Decadence may exist on areas inaccessible to grazing animals.

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14. **Average percent litter cover (%) and depth (in):** Litter cover during and following extended drought can range from 20 to 30 percent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 700 lbs./ac. low precip years; 1100 lbs./ac. average precip years; 1600 lbs./ac. high precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 300-500 lbs./ac.

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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:** Invasive plants should not occur in reference plant community. Following fire or extended drought, Russian thistle, burningbush, Rocky Mountain beeplant may invade assuming a seed source is available.

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17. **Perennial plant reproductive capability:** The only limitations are weather-related, fire, natural disease, and insects that may temporarily reduce reproductive capability.
