USDA Natural Resources Conservation Service

Ecological site R067BY045CO
Shaly Plains

Last updated: 12/05/2024
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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.

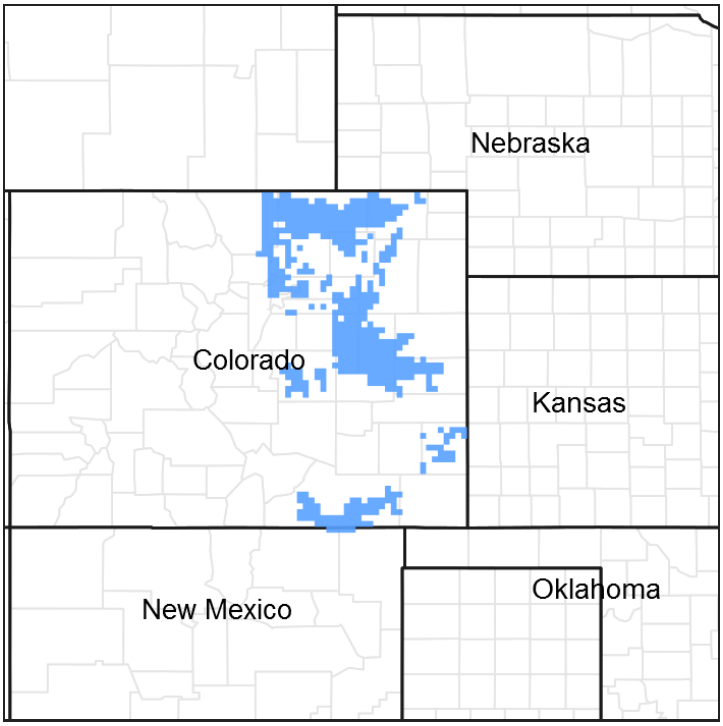


Figure 1. Mapped extent

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).

Ecological site concept

The Shaly Plains Ecological Site is a run-off site that occurs on less than six percent slopes. Shale bedrock lies within 40 inches of the soil surface.

Associated sites

R067BY002CO	**Loamy Plains** This ecological site is commonly adjacent.
R067BY036CO	**Overflow** This ecological site is commonly adjacent.
R067BY042CO	**Clayey Plains** This ecological site is commonly adjacent.
R067BY044CO	**Shale Breaks** This ecological site is commonly adjacent.

Similar sites

R067BY044CO	**Shale Breaks** The Shale Breaks Ecological Site lies on slopes of six percent or greater.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex canescens* (2) *Krascheninnikovia lanata*

Herbaceous	(1) *Sporobolus airoides* (2) *Pascopyrum smithii*

Physiographic features

This site occurs on narrow crests, interfluves, or ridges controlled by shale bedrock.

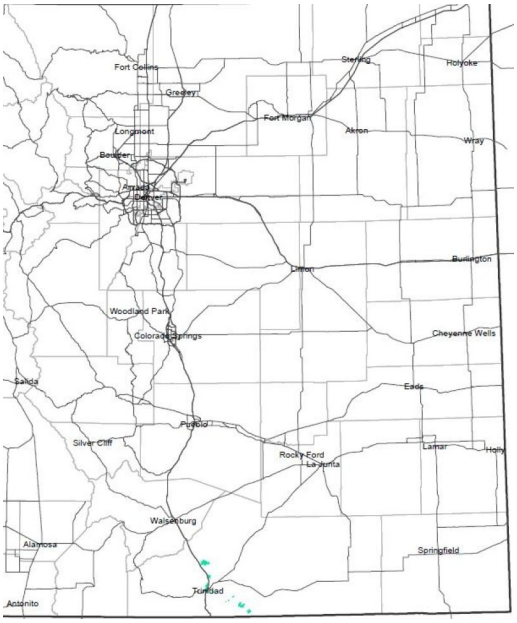


Figure 2. The distribution of the Shaly Plains site in MLRA 69B.

Table 2. Representative physiographic features

Landforms	(1) Interfluve (2) Ridge
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	3,400–6,000 ft
Slope	0–6%
Ponding depth	0 in
Water table depth	80 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) FLAGLER 1S [USC00052932], Flagler, CO
- (3) KIT CARSON [USC00054603], Kit Carson, CO
- (4) BYERS 5 ENE [USC00051179], Byers, CO
- (5) GREELEY UNC [USC00053553], Greeley, CO
- (6) SPRINGFIELD 7 WSW [USC00057866], Springfield, CO
- (7) LIMON WSMO [USW00093010], Limon, CO

- (8) BRIGGSDALE [USC00050945], Briggsdale, CO
- (9) FT MORGAN [USC00053038], Fort Morgan, CO
- (10) NUNN [USC00056023], Nunn, CO
- (11) BRIGHTON 3 SE [USC00050950], Brighton, CO

Influencing water features

There are no water features associated with the ecological site.

Soil features

The soils on this site are shallow to moderately deep, well drained soils that formed from residuum weathered from shale. They typically have a slow permeability class, but range from very slow to moderately slow. 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 clay loam or silty clay loam, but may include clay or silty clay. The surface layer ranges from a depth of 2 to 6 inches thick. The subsoil is typically clay or silty clay, but may include clay loam and silty clay loam. Shale fragments may occur on the surface or in the soil profile. Soils in this site typically are leached of free carbonates at the surface, but some soils may be leached from 10 to 20 inches. These soils are susceptible to erosion by water and wind. The potential for water erosion accelerates with increasing slope.

Parent material is residuum weathered from shale.

Major soil series correlated to this ecological site include: Kutch, Lismas, Litle, Midway, Razor, Renohill, Samsil, Shingle, and Thedalund.

Other soil series that have been correlated to this site: none.

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 0-40 inches in depth or to the first restrictive layer.

Table 4. Representative soil features

Parent material	(1) Residuum–shale
Surface texture	(1) Clay loam (2) Silty clay loam (3) Clay
Family particle size	(1) Clayey

Drainage class	Well drained
Permeability class	Very slow to moderately slow
Soil depth	6–40 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	3–9 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–15
Soil reaction (1:1 water) (0-40in)	6.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Shaly Plains Ecological Site is characterized by four states: Reference, Warm-Season Shortgrass, Increased *Bare Ground*, and Tilled. The Reference State is characterized by warm-season bunchgrass (alkali sacaton, blue grama, sideoats grama), and cool-season midgrass (western wheatgrass, green needlegrass). The Warm-season Shortgrass State is characterized by a warm-season short bunchgrass (blue grama) and stoloniferous grass (buffalograss). The Increased *Bare Ground* State is characterized by early successional warm-season bunchgrass (Fendler threeawn), cool-season short bunchgrass (squirreltail), annual grasses, and annual forbs. The Tilled State has been mechanically disturbed by equipment and includes either a variety of reseeded warm and cool-season grasses or early successional plants as well as annual grasses and forbs.

Heavy grazing by large herbivores without adequate recovery periods causes alkali sacaton and sideoats grama to decrease. Blue grama and buffalograss increase. Blue grama and buffalograss may eventually form a sod-like appearance. Cool-season grasses such as western wheatgrass and green needlegrass decrease in frequency and production. Fourwing saltbush and winterfat decrease in frequency and production. American vetch and other highly palatable forbs also decrease. Fendler threeawn, annuals, and bare ground increases under heavy, continuous grazing or long-term non-use. Some areas of this ecological site have been tilled and used for crop production, or

converted to suburban residence and small acreages, especially near the larger communities.

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.

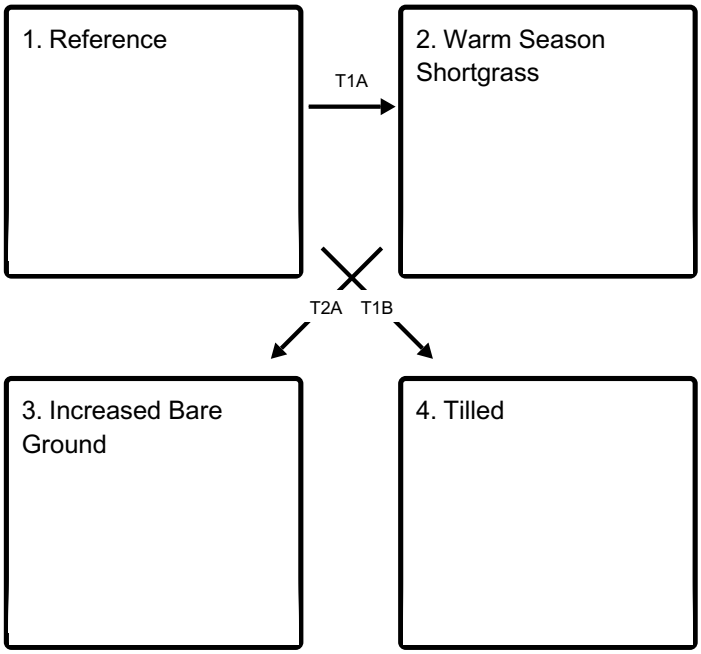
This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely 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

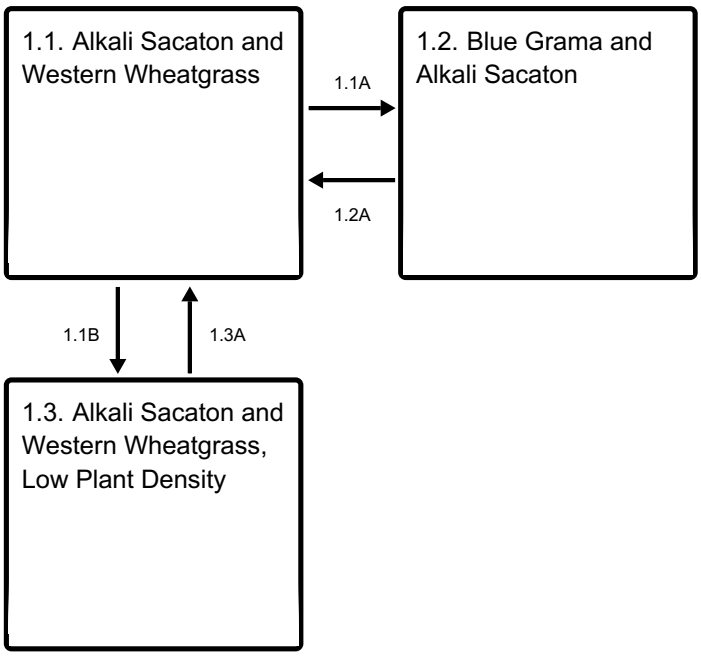


T1A - Excessive grazing. Lack of fire.

T1B - Mechanical tillage.

T2A - Excessive grazing. Lack of fire.

State 1 submodel, plant communities



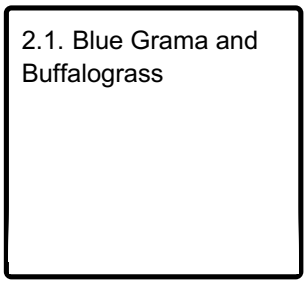
1.1A - Excessive grazing. Lack of fire.

1.1B - Non-use. Lack of fire.

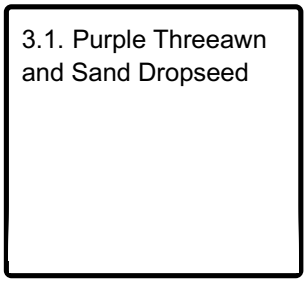
1.2A - Prescribed grazing. Prescribed fire.

1.3A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Cheatgrass, Purple Threeawn, Burningbush, and Russian Thistle, Go-Back Land	4.2. Seeded

State 1
Reference

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

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Community 1.1
Alkali Sacaton and Western Wheatgrass

This is the interpretive plant community. This plant community evolved with grazing by large herbivores, is well suited for grazing by domestic livestock, and can be found on areas that are properly managed with prescribed grazing. The Reference Plant Community consists mainly of warm and cool-season midgrasses. The principal dominant midgrasses are alkali sacaton, western wheatgrass, sideoats grama, and green needlegrass. Blue grama is the dominant shortgrass. Grasses and grass-likes of secondary importance are little bluestem, Indian ricegrass, needle and thread, prairie junegrass, and sun sedge. Forbs and shrubs such as American vetch, leafy false goldenweed, fourwing saltbush, and winterfat are significant. The Reference Plant Community is about 65 to 80 percent grasses and grass-likes, 10 to 15 percent forbs and 10 to 20 percent shrubs by air-dry weight. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed with little movement. Decadence and natural plant mortality is very low. The community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. This community is resistant to many disturbances except heavy, continuous grazing, tillage, and development into urban or other uses. Total annual production, during an average year, ranges from 450 to 1,300 pounds per acre air-dry weight and averages 850 pounds. These production figures are the fluctuations expected during favorable, normal, and unfavorable years due to the timing and amount of precipitation and temperature. Total annual production should not be confused with species productivity, which is the annual

production representing the variability by species throughout the extent of the community phase (i.e. variation of soil characteristics and topography).

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	290	616	995
Shrub/Vine	80	128	175
Forb	80	106	130
Total	**450**	**850**	**1300**

Figure 10. Plant community growth curve (percent production by month). CO6708, Warm-season/cool-season codominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	8	20	35	18	10	5	2	0	0

Community 1.2
Blue Grama and Alkali Sacaton

Blue grama has increased but has not yet developed into a sod bound condition. Sideoats grama is slightly reduced. Key species such as alkali sacaton, western wheatgrass, green needlegrass, American vetch, fourwing saltbush, and winterfat have decreased. Forbs and shrubs such as scarlet globemallow, rubber rabbitbrush, and broom snakeweed have increased. Plant frequency and vigor have decreased. Total aboveground carbon has been reduced due to decreases in forage and litter production. Reduction of rhizomatous wheatgrass, nitrogen fixing forbs, the shrub component, and increased warm-season shortgrass have begun to alter the biotic integrity of this community. Water and nutrient cycles are at risk of becoming impaired. Total annual production, during a normal year, ranges from 300 to 950 pounds per acre air-dry weight and averages 650 pounds.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- blue grama (*Bouteloua gracilis*), grass
- alkali sacaton (*Sporobolus airoides*), grass

Figure 11. Plant community growth curve (percent production by month). CO6702, Warm-season dominant, cool-season subdominant; MLRA-67B, upland fine textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	2	15	45	20	15	3	0	0	0

Community 1.3
Alkali Sacaton and Western Wheatgrass, Low Plant Density

This plant community occurs when grazing is removed for long periods of time in the absence of fire. Plant composition is similar to the Reference Plant Community, however individual species production and frequency will be lower. Much of the nutrients are tied up in standing dead canopy and increased litter. The semiarid environment and the absence of animal traffic to break down litter slow nutrient recycling. Increased standing dead canopy limits sunlight from reaching plant crowns. Many plants, especially bunchgrasses (alkali sacaton, green needlegrass, blue grama, and sideoats grama) exhibit increased mortality. Increased litter and absence of grazing animals (animal impact) reduce seed germination and establishment. In advanced stages, plant mortality can increase and erosion may eventually occur if bare ground increases. Once this happens it will require increased energy input in terms of practice cost and management to bring back. Total annual production, during an average year, ranges from 200 to 800 pounds per acre air-dry weight.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- alkali sacaton (*Sporobolus airoides*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Figure 12. Plant community growth curve (percent production by month). CO6705, Warm-season/cool-season codominant, excess litter; MLRA-67B; upland fine textured soils.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	7	18	35	18	13	5	2	0	0

Pathway 1.1A
Community 1.1 to 1.2

Heavy, continuous grazing without adequate recovery opportunity between grazing events and reduced fire frequency shifts this plant community to the 1.2 Community. Extended drought accelerates this process. Recurring spring seasonal grazing decreases cool-season plants. Recurring summer grazing decreases warm-season plants. Biotic integrity is altered and the water and nutrient cycles become impaired.

Pathway 1.1B
Community 1.1 to 1.3

Non-use and lack of fire moves this plant community to the 1.3 Community. Plant decadence and standing dead plant material impede energy flow. Water and nutrient cycles become impaired.

Pathway 1.2A
Community 1.2 to 1.1

Grazing with adequate recovery periods, proper stocking, and prescribed fire return this plant community to the Reference Community, relative to climatic conditions. Drought followed by a return of normal precipitation may cause western wheatgrass to increase, resembling more closely the Reference Plant Community.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3A
Community 1.3 to 1.1

The return of grazing with adequate recovery periods and normal fire frequency restore this community to the Reference 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

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 characteristic) changes have negatively impacted energy flow and nutrient and hydrologic cycles. This is a very stable state, resistant to change due to the high tolerance of blue grama and buffalograss to grazing, the development of a shallow root system (aka rootpan), and subsequent changes in hydrology and nutrient cycling. The reduction of other functional/structural groups such as cool-season bunchgrasses, warm-season bunchgrasses, forbs, and shrubs, reduces the biodiversity and productivity of this

site.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Community 2.1
Blue Grama and Buffalograss

The key warm and cool-season mid-grasses such as alkali sacaton, western wheatgrass, and green needlegrass have been reduced to remnants while purple threeawn, ring muhly, and sand dropseed have increased. Blue grama and buffalograss dominate the community and have developed into a sod bound condition. Prickly pear and broom snakeweed have also increased. A significant amount of production and diversity has been lost when compared to the Reference Plant Community. The reduction of cool-season grasses, the reference shrub component, and nitrogen fixing forbs have negatively impacted energy flow and nutrient cycling. Soil loss is obvious where flow paths are connected. The plant community lacks diversity and exhibits a greatly impaired water cycle. Total annual production, during a normal year, ranges from 200 to 700 pounds per acre air-dry weight and averages 350 pounds.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass

Figure 13. Plant community growth curve (percent production by month). CO6707, Warm-season dominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	3	20	45	20	10	2	0	0	0

State 3
Increased Bare Ground

This state lacks stability, diversity, and productivity. Bare ground is a major concern, erosion potential is high, and soil loss can be severe. An ecological threshold has been crossed and it is in an extremely degraded condition.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), shrub

- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- burningbush (*Bassia scoparia*), other herbaceous
- Russian thistle (*Salsola*), other herbaceous

Community 3.1
Purple Threeawn and Sand Dropseed

Remnant amounts of blue grama, fourwing saltbush, and winterfat have been replaced by red threeawn, sand dropseed, ring muhly, little barley, plains pricklypear, and broom snakeweed. Annual invaders such as burningbush, Russian thistle, and cheatgrass have increased. Total annual production, during an average year, ranges from 25 to 150 pounds per acre air-dry weight.

Dominant plant species

- plains pricklypear (*Opuntia polyacantha*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- burningbush (*Bassia scoparia*), other herbaceous
- Russian thistle (*Salsola*), other herbaceous

Figure 14. Plant community growth curve (percent production by month). CO6707, Warm-season dominant; MLRA-67B; upland fine-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	3	20	45	20	10	2	0	0	0

State 4
Tilled

The Tilled state is the result of the site being mechanically disturbed to facilitate conversion to production agriculture. An ecological threshold has been crossed due to the complete removal of vegetation and physical, chemical, and biological alterations of the soil.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- burningbush (*Bassia scoparia*), other herbaceous
- Russian thistle (*Salsola*), other herbaceous

Community 4.1
Cheatgrass, Purple Threeawn, Burningbush, and Russian Thistle, Go-Back Land

Go-back land occurs where the soil has been tilled and abandoned. All native plants have been eliminated. Over time, early successional annuals and perennials begin to cover the soil surface. Burningbush, Russian thistle, and cheatgrass are some early annuals which establish. These areas soon become dominated by the perennial grass purple threeawn. Eventually, sand dropseed and ring muhly, begin to establish. Organic matter has left the system through decomposition and erosion. Erosion can be accelerated if ground cover is lacking.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- burningbush (*Bassia scoparia*), other herbaceous
- Russian thistle (*Salsola*), other herbaceous

Community 4.2
Seeded

This community results from any plant community which was tilled and is seeded to adapted native plant species. A seed mixture of grasses, forbs, and shrubs can be used to accomplish various management objectives. Revegetation is extremely difficult and costly due to severe soil limitations.

Transition T1A
State 1 to 2

Continuous, heavy grazing without adequate recovery periods between grazing events and lack of fire shifts this plant community across an ecological threshold to the Warm-season Shortgrass Dominant State.

Transition T1B
State 1 to 4

Tillage of this ecological site will cause an immediate transition across an ecological threshold to the Tilled State. This transition can occur from any plant community and it is irreversible.

Transition T2A
State 2 to 3

Long-term, heavy, continuous grazing without adequate recovery periods and lack of fire

shift this state the Increased *Bare Ground* State. Erosion and loss of organic matter and carbon reserves are concerns.

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				553–680	
	western wheatgrass	PASM	*Pascopyrum smithii*	170–255	–
	alkali sacaton	SPAI	*Sporobolus airoides*	170–255	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	85–170	–
	blue grama	BOGR2	*Bouteloua gracilis*	128–170	–
	green needlegrass	NAVI4	*Nassella viridula*	43–128	–
	little bluestem	SCSC	*Schizachyrium scoparium*	9–43	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	0–26	–
	Grass, perennial	2GP	*Grass, perennial*	9–26	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–17	–
	saltgrass	DISP	*Distichlis spicata*	0–17	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–17	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–17	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–9	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–9	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–9	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–9	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–9	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–9	–
Forb					
2				85–128	
	Forb, perennial	2FP	*Forb, perennial*	9–26	–

	American vetch	VIAM	*Vicia americana*	9–26	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	9–17	–
	leafy false goldenweed	OOFOF	*Oonopsis foliosa var. foliosa*	9–17	–
	creeping nailwort	PASE	*Paronychia sessiliflora*	0–9	–
	beardtongue	PENST	*Penstemon*	0–9	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	0–9	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–9	–
	desert princesplume	STPIP	*Stanleya pinnata var. pinnata*	0–9	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–9	–
	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	0–9	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–9	–
	spiny milkvetch	ASKE	*Astragalus kentrophyta*	0–9	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	0–9	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–9	–
	povertyweed	IVAX	*Iva axillaris*	0–9	–
	dotted blazing star	LIPU	*Liatris punctata*	0–9	–
Shrub/Vine					
3				85–170	
	fourwing saltbush	ATCA2	*Atriplex canescens*	43–85	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	26–68	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	9–26	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–9	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–9	–
	soapweed yucca	YUGL	*Yucca glauca*	0–9	–
	rubber rabbitbrush	ERNAG	*Ericameria nauseosa ssp. nauseosa var. glabrata*	0–9	–

	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–9	–

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. Prairie dogs occupy a small fraction of 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. Because of a lack of permanent water, fish are not common.

1.1 Reference Plant Community
Pronghorn and to a lesser extent, mule deer, use this plant community due to the prevalence of four-wing saltbush and winterfat which provide important browse resources, especially in winter. Black-tailed jackrabbits rely heavily on stands of fourwing saltbush for cover and browse. This site also supports a high diversity of migratory grassland birds including lark bunting, Cassin’s sparrow and loggerheaded shrike among others. Small mammal diversity may be higher on this site compared to others due to the forage and cover resources provided by shrubs. The shallower soils, however may be limiting to burrowing animals.

1.2 Community
This community is very similar to the Reference Community therefore the value for wildlife is not significantly different. Wildlife species using this this plant community would similar to those using the Reference Community.

1.3 Community
This community is very similar to the Reference Community; therefore the value for wildlife is not significantly different. Wildlife species using this this plant community would similar to those using the Reference Community.

2.1 Community
The loss of shrubs and mid-grasses, and reduced forb diversity affects the diversity of wildlife species using this plant community. Pronghorn use this community but it has reduced forage value. Grassland birds preferring shorter structure grasses occur here and these include horned lark, and McCown’s and chestnut collared longspurs, among others.

3.1 Community
The loss of perennial forbs combined with the increase in bare ground results in a change

in wildlife species when compared with the Reference State. Prairie rattlesnake and other reptiles using the Reference state are still be found here. Swainson’s hawks continue to be found here as it is easy to spot prey in this community. This community has low value for pronghorn and mule deer due to the loss of shrubs and more palatable grasses and forbs.

4.1 Community
This community is very similar to the 3.1 Community therefore the value for wildlife is not significantly different and similar species will use both communities.

4.2 Community
Wildlife use of tilled and replanted fields is dependent on the plant species used in the planted seed mix. The purpose of the seeding (i.e. reclamation, soil erosion control, livestock grazing, targeted wildlife species, etc.) affects the usability for wildlife. If wildlife use is a primary concern, then seed mixes must be designed to meet species specific habitat requirements.

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 - (850) (0.23)

1.2 PC - (650) (0.18)

2.1 PC - (350) (0.11)

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 must be conducted prior to development of a grazing plan.

Hydrological functions

Water is the principal factor limiting forage production on this site due to the shallowness of the soil. This site is dominated by soils in hydrologic group D. Infiltration is moderate to low and runoff potential for this site varies from moderate to high depending on ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where short grasses form a strong sod and dominate the site. 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	01/12/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

2. **Presence of water flow patterns:** Typically none, if flow patterns are present, they are short and not connected with debris or obstacle dams.

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3. **Number and height of erosional pedestals or terracettes:** None

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 3 percent or less bare ground, with bare patches generally less than 2 to 3 inches in diameter. Extended drought can cause bare ground to increase upwards to 10 to 20 percent with bare patches reaching upwards to 6 to 12 inches in diameter.

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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

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is minimal and travels a short distance.

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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 4 to 6 in interspaces at soil surface.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** SOM ranges from 1 to 2 percent. Soils formed in clayey material underlain by shale. A-horizon color is light grayish-brown at 0 to 6 inches in depth. Structure is moderate fine to very fin granular and calcareous.

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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 >

    Sub-dominant: Cool-season mid rhizomatous > cool-season mid bunchgrass >/= warm-season short bunchgrass = shrubs >

    Other: forbs > warm-season short rhizomatous

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Typically minimal. Expect slight short and mid bunchgrass and shrub mortality and decadence during and following drought.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover during and following extended drought ranges 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):** 450 lbs./ac. low precip years; 850 lbs./ac. average precip years; 1300 lbs./ac. high precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 250 – 400 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. Russian thistle, burningbush, or other non-native species may invade following extended drought or fire assuming a seed source is available.

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