Natural Resources
Conservation Service

Ecological site R067BY033CO
Salt Flat

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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.

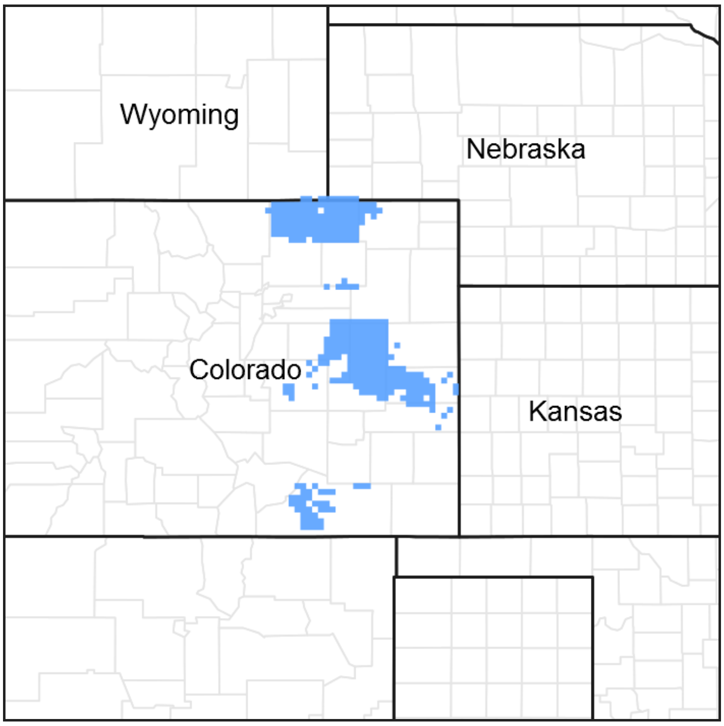


Figure 1. Mapped extent

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 Salt Flat Ecological Site was developed by an earlier version of the Salt Flat Ecological Site 2004, revised 2007. This earlier version was based on input from Natural Resources Conservation services (formerly Soil Conservation Service) and historical information obtained from the Salt Flat 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 ecological site is a run-on site that does not have redoximorphic features, and the water table is deeper than four feet. It is not subject to flooding, and is not a closed depression. The Salt Flat Ecological Site does have slick spots or bare areas of high sodium in the soil, and soil surface textures of loam, clay loam, or clay.

Associated sites

R067BY002CO	**Loamy Plains** This ecological site is commonly adjacent.
R067BY035CO	**Salt Meadow** This ecological site is commonly adjacent.
R067BY036CO	**Overflow** This ecological site is commonly adjacent.
R067BY042CO	**Clayey Plains** This ecological site is commonly adjacent.

Similar sites

R067BY035CO	**Salt Meadow** The Salt Meadow Ecological Site is within four feet of the water table.

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 linear to slightly concave terraces, fans, and drainageways on dissected plains. These areas receive additional runoff from the surrounding areas. Slick spots are inherent to the site. Slick spots are high sodium areas that contain no vegetation and have a puddled or crusted (or salt crusted), very smooth, nearly impervious surface. The underlying material is dense and massive or columnar.

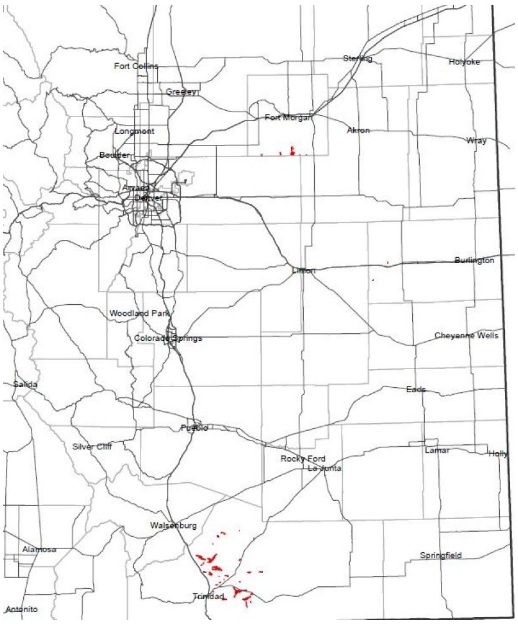


Figure 2. The distribution of the Salt Flat site in MLRA 67B.

Table 2. Representative physiographic features

Landforms	(1) Fan (2) Terrace (3) Drainageway
Runoff class	Medium to high
Flooding frequency	None

Ponding frequency	None
Elevation	1,097–1,829 m
Slope	0–3%
Ponding depth	0 cm
Water table depth	203 cm
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)	356-432 mm
Frost-free period (actual range)	102-132 days
Freeze-free period (actual range)	126-156 days

Precipitation total (actual range)	356-432 mm
Frost-free period (average)	121 days
Freeze-free period (average)	142 days
Precipitation total (average)	381 mm

Climate stations used

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

Influencing water features

There are no water features associated with this ecological site.

Soil features

The soils on this site are very deep, well drained soils that formed from alluvium. They typically have a slow to moderately slow permeability class. The high sodium and clayey subsoil restricts water movement in these soils. The available water capacity is typically very low, but ranges to low. 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 loam or silt loam, but may include clay loam, silty clay loam, or clay. The surface layer ranges from 0 to 10 inches thick. The subsoil is typically clay or silty clay, but may include clay loam and silty clay loam. Soils in this site are typically leached of free carbonates to 10 inches, but some soils may have free carbonates at the surface. These soils are strongly sodic, strongly saline, and very strongly alkaline. The high levels of sodium and salinity adversely affects plant species composition and growth. The subsoil may also contain up to 5 percent gypsum. These soils are susceptible to erosion by water and wind.

Major soil series correlated to this ecological site include: Arvada, Avar, Beckton, Deertrail, and Keyner.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: Firstview and Koen.

In a few areas this ecological site is associated with the Deep Sand, Choppy Sands, and Sandy Plains ecological sites. Wind-caused deposition of coarse-textured material has resulted in surface textures of loamy sand and sandy loam, as compared to the typical loam, silt loam, or clay loam surface textures. This change in surface texture will result in a different plant community (formerly known as Sandy Salt Flat), as mentioned in the Ecological Dynamics of the Site section. The soil series associated with the coarse textured surface horizon(s) are Firstview and Keyner.

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

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) Alluvium
Surface texture	(1) Loam (2) Silt loam (3) Clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	2.54–7.62 cm
Calcium carbonate equivalent (0-101.6cm)	5–15%
Electrical conductivity (0-101.6cm)	4–32 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	13–30
Soil reaction (1:1 water) (0-101.6cm)	7.4–10

Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Salt Flat 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), and cool-season midgrass (western wheatgrass). The Warm- Season Shortgrass State is characterized by a warm-season short bunchgrass (blue grama) and rhizomatous grass (inland saltgrass). The Increased *Bare Ground* State is characterized by early successional warm-season grass (scratchgrass, Fendler threeawn), 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 (seeded community) or early successional plants and annual grasses and forbs (go-back community).

The Salt Flat ecological site, in some landscape positions in MLRA 67B, is associated with the Deep Sand, Choppy Sands, and Sandy Plains ecological sites, and is not common. Wind caused deposition of coarse textured material has resulted in surface textures of loamy sand and sandy loam. The plant community that develops (formerly known as Sandy Salt Flat), reflects the combination of the coarse surface texture in addition to the plant composition described above. Warm-season tallgrasses such as switchgrass, sand bluestem, and composite dropseed (aka tall dropseed), along with cool-season midgrass (needle and thread) will be present. Total annual production increases as a result of this shift in plant composition.

Grazing by large herbivores, without adequate recovery periods causes alkali sacaton to decrease and blue grama and inland saltgrass to increase. Blue grama and inland saltgrass may eventually form a sod-like appearance. Cool-season grasses such as western wheatgrass and green needlegrass decrease in frequency and production. Fourwing saltbush also decreases as does American vetch and other highly palatable forbs. Fendler threeawn, annuals, and bare ground increase under heavy, continuous grazing, excessive defoliation, or long-term non-use. Areas of this ecological site have been tilled and used for crop production, or converted to suburban residence and small acreages.

The information in this ESD, including the state-and-transition model diagram (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a dynamic set of plant communities that represent the complex interaction of several ecological processes. The plant composition has been determined by study of rangeland relic areas, areas protected from excessive disturbance, seasonal use pastures, short duration or time-controlled grazing strategies, and historical accounts.

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.

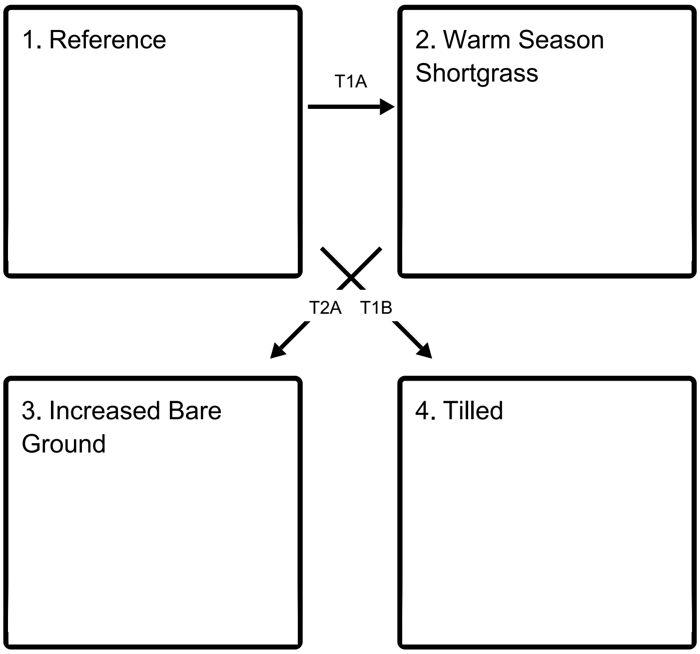
This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely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

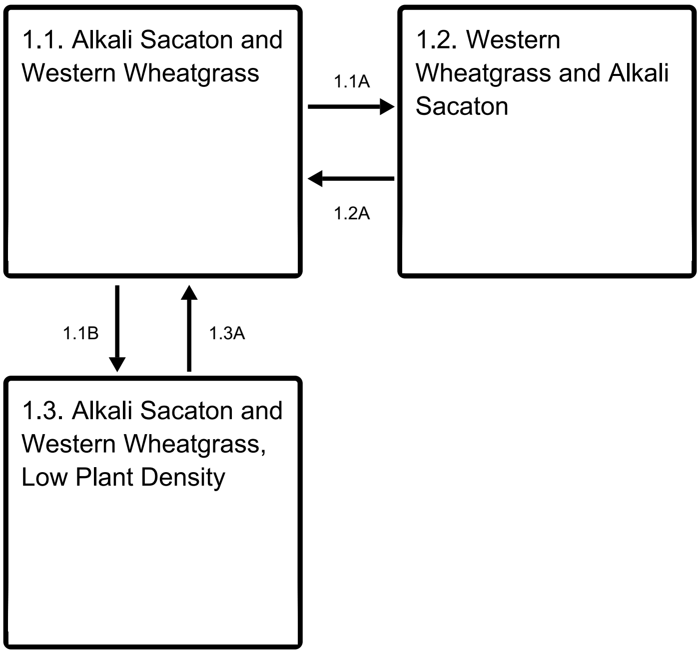


T1A - Excessive grazing. Lack of fire.

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

2.1. Blue Grama and Saltgrass

State 3 submodel, plant communities

3.1. Scratchgrass and Purple Threeawn

State 4 submodel, plant communities

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

4.2. Seeded

State 1
Reference

The Reference state is characterized by three distinct plant communities. These 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 mid warm- and cool-season grasses. The principle dominant plants are alkali sacaton, western wheatgrass, and blue grama. Grasses of secondary importance are green needlegrass and inland saltgrass. Forbs and shrubs such as American vetch, leafy false goldenweed, fourwing saltbush, and winterfat are significant. The Reference Plant Community is about 75 to 90 percent grasses and grass-likes, 5 to10percent forbs and 5 to15 percent shrubs. This plant community is diverse, stable, and productive. Litter is properly distributed with very little movement off-site, and natural plant mortality is very low. Slick spots (bare exposed areas, high in sodium) are an inherent characteristic occupying less than 3 percent of the community. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Total annual production ranges from 500 to 1,800 pounds of air-dry vegetation per acre with a Representative Value of 1,100 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 (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	448	1018	1698
Shrub/Vine	56	123	191
Forb	56	92	129
Total	**560**	**1233**	**2018**

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
Western Wheatgrass and Alkali Sacaton

This community developed with heavy, continuous grazing and lack of adequate recovery periods between grazing events. Blue grama and inland saltgrass have increased but have not yet developed into a sod bound condition. Alkali sacaton has decreased. Cool-season grasses such as western wheatgrass and green needlegrass have been reduced. American vetch has also decreased. Fourwing saltbush and winterfat are reduced in abundance. Forbs and shrubs such as scarlet globemallow, leafy false goldenweed, rubber rabbitbrush, and broom snakeweed have increased. Total above ground carbon has been reduced due to decreases in forage and litter production. Reduction of rhizomatous wheatgrass, nitrogen fixing forbs, shrub component and increased warm-season shortgrasses have begun to alter the biotic integrity of this community. Water and nutrient cycles are impaired. Slick spots (bare high sodium areas) are developing or increasing. Total annual production ranges from 250 to 800 pounds of air-dry vegetation per acre and averages 550 pounds during a normal year.

Dominant plant species

- fourwing saltbush (*Atriplex canescens*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- western wheatgrass (*Pascopyrum smithii*), 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 community 1.1, however individual species production and frequency will be lower. Much of the nutrients are tied up with increased litter amounts. The semiarid environment and the absence of animal traffic to break down litter slow nutrient recycling. Standing dead canopy limits sunlight from reaching plant crowns. Many plants, especially bunchgrasses die off. Increased litter and absence of grazing animals (animal impact) or fire reduce seed germination and establishment. In advanced stages, plant mortality can increase and erosion may occur if bare ground increases. Once this happens, an ecological threshold has been crossed, and it will require increased energy input in terms of practice cost and management to bring back. Total annual production ranges from 350 to 1,200 pounds of air-dry vegetation per acre.

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

Excessive grazing and reduced fire frequency shift this plant community to the 1.2 Community. Recurring spring grazing decreases cool-season plants. Recurring summer grazing decreases warm-season plants and increases cool-season plants over time. The biotic integrity will be altered and water and nutrient cycles become impaired as a result of this community pathway.

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 may become impaired.

Pathway 1.2A
Community 1.2 to 1.1

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

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 will facilitate recovery 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

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 inland saltgrass to grazing, the development of a shallow root system (aka root pan), and subsequent changes in hydrology and nutrient cycling. The loss of functional/structural groups such as warm-season bunchgrasses, cool-season bunchgrass, forbs, and shrubs reduces the biodiversity and productivity of this site.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa ssp. nauseosa var. glabrata*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- saltgrass (*Distichlis spicata*), grass

Community 2.1
Blue Grama and Saltgrass

Inland saltgrass and blue grama are the dominant species and have developed into a sod-bound condition. Alkali sacaton may be present in remnant amounts. Slick spots have increased in size. Green needlegrass, fourwing saltbush, and winterfat have been removed. Rubber rabbitbrush (green plume rabbitbrush), plains pricklypear, broom snakeweed, curlycup gumweed, poison suckleya, purple threeawn, and scratchgrass have increased. Western wheatgrass may be present in remnant amounts where moisture conditions are favorable. A significant amount of production and diversity has been lost when compared to the Reference state. Major reduction or loss of cool-season grasses, the shrub component, and nitrogen fixing forbs have negatively impacted energy flow and nutrient cycling. Slick spots have increased in size, accelerated by blowing salt and soil, and may be interconnected by developing flow paths. The plant community exhibits an impaired water cycle. Total annual production ranges from 100 to 800 pounds of air-dry vegetation per acre and averages 400 pounds during a normal year.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa ssp. nauseosa var. glabrata*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- blue grama (*Bouteloua gracilis*), grass
- saltgrass (*Distichlis spicata*), 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

Litter levels are extremely low and bare ground is a major concern. Increased slick spots, soil crusting, reduced infiltration, and ponding are present. Flow paths are connected and plant pedestalling evident. Organic matter and carbon reserves are greatly reduced. This community is not stable. An ecological threshold has been crossed. It is in an extremely degraded condition.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa ssp. nauseosa var. glabrata*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- scratchgrass (*Muhlenbergia asperifolia*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Scratchgrass and Purple Threeawn

This community is in an extremely degraded condition. Blue grama and western wheatgrass have been removed. Inland saltgrass persists in localized areas. Lower successional perennial species that dominate the community are scratchgrass, purple threeawn, and poison suckleya. Russian thistle, burningbush, and cocklebur are common annuals. Total annual production ranges from 25 to 200 pounds of air-dry vegetation per acre and averages 100 pounds during a normal year.

Dominant plant species

- rubber rabbitbrush (*Ericameria nauseosa ssp. nauseosa var. glabrata*), shrub

- plains pricklypear (*Opuntia polyacantha*), shrub
- scratchgrass (*Muhlenbergia asperifolia*), 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). 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 tilled (farmed). An ecological threshold has been crossed due to complete removal of native vegetation and degredation of the soil structure. Physical, chemical, and biological soil properties have been dramatically altered. Due to the saline nature of Salt Flat sites, the Tilled state is uncommon.

Dominant plant species

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

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

Go-back land is created when the soil is tilled or farmed (sod-busted) and abandoned. All of the native plants are eliminated, soil organic matter is reduced, soil structure is altered, and a plowpan or compacted layer is formed. Residual synthetic chemicals often remain from past farming operations and erosion processes may be active. With minor soil loss, the slow process of developing soil and vegetation will start. This is a very slow process. Re-seeding can expedite this process. Due to accelerated erosion another ecological site may evolve through secondary successional processes. Over time, burningbush, Russian thistle, and cheatgrass begin to establish. The plant community in time will become dominated by purple threeawn. Eventually, other early successional perennials may begin to establish.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass

- Fendler threeawn (*Aristida purpurea var. longiseta*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), 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 however, revegetation is costly. This plant community can vary considerably depending on the amount of soil erosion, the species seeded, and post-seeding management.

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 State.

Transition T1B
State 1 to 4

Mechanical tillage causes 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

Excessive grazing and lack of fire shift this plant community across an ecological threshold to the Increased *Bare Ground* State. Erosion and loss of organic matter and carbon reserves are constraints to recovery.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				925–1110	
	alkali sacaton	SPAI	*Sporobolus airoides*	370–493	–
	western wheatgrass	PASM	*Pascopyrum smithii*	247–432	–

	blue grama	BOGR2	*Bouteloua gracilis*	123–247	–
	switchgrass	PAVI2	*Panicum virgatum*	0–185	–
	sand bluestem	ANHA	*Andropogon hallii*	0–185	–
	green needlegrass	NAVI4	*Nassella viridula*	37–86	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–62	–
	saltgrass	DISP	*Distichlis spicata*	25–62	–
	Grass, perennial	2GP	*Grass, perennial*	12–62	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–37	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	0–37	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–37	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–37	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–25	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–25	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	0–25	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–25	–
	vine mesquite	PAOB	*Panicum obtusum*	0–25	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–12	–
	little barley	HOPU	*Hordeum pusillum*	0–12	–
	scratchgrass	MUAS	*Muhlenbergia asperifolia*	0–12	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–12	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	0–12	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	0–12	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–12	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–12	–
Forb					
2				62–123	
	Forb, perennial	2FP	*Forb, perennial*	12–62	–

	twogrooved milkvetch	ASBI2	*Astragalus bisulcatus*	0–25	–
	leafy false goldenweed	OOFOF	*Oonopsis foliosa var. foliosa*	12–25	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	12–25	–
	American vetch	VIAM	*Vicia americana*	12–25	–
	desert princesplume	STPIP	*Stanleya pinnata var. pinnata*	0–12	–
	poison suckleya	SUSU2	*Suckleya suckleyana*	0–12	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–12	–
	broadleaf milkweed	ASLA4	*Asclepias latifolia*	0–12	–
	scrambled eggs	COAU2	*Corydalis aurea*	0–12	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	0–12	–
	fetid marigold	DYPA	*Dyssodia papposa*	0–12	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–12	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–12	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–12	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	0–12	–
Shrub/Vine					
3				62–185	
	fourwing saltbush	ATCA2	*Atriplex canescens*	62–185	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	37–86	–
	rubber rabbitbrush	ERNAG	*Ericameria nauseosa ssp. nauseosa var. glabrata*	12–37	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	12–37	–
	sand sagebrush	ARFI2	*Artemisia filifolia*	0–37	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–12	–

	plains pricklypear	OPPO	*Opuntia polyacantha*	0–12	–

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.

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 - (550) (0.15)

2.1 PC - (400) (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 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 groups B, C, and D. Infiltration is moderate to slow and runoff potential for this site varies from moderate to high depending on soil hydrologic group and 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 shortgrasses 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).

Note: The Sandy Salt Flat Ecological Site has been combined with the Salt Flat Ecological Site. Since the Sandy Salt Flat is of very minor extent, it will be discontinued.

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	11/17/2004
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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2. **Presence of water flow patterns:** None where vegetation is continuous. Slick spots (high sodium areas) can pond water and concentrate overland flow. Water flow paths are short in length and disconnected.

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground amounts to 5 percent or less. Bare areas can range from 3 to 4 inches in diameter. Extended drought may cause bare ground to increase up to 10 percent. Slick spots occur on the site and support some vegetation.

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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):** None to minimal.

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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 5 to 6 under canopy and 3 to 4 on slick spots. On-site verification is needed.

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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 3 percent. Soils are deep well drained, sodic, saline, and strongly alkaline. Surface texture ranges from loam to clay. A-horizon color is light brownish-gray at 0 to 4 inches in depth. Structure is weak moderate sub-angular blocky to strongly medium columnar.

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 grass > cool-season mid bunchgrass = warm-season mid bunchgrass >

    Other: Shrubs > forbs > warm-season short rhizomatous grass

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None to minimal.

---

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

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 500 lbs./ac. low precip years; 1100 lbs./ac. average precip years; 1800 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. Russian thistle, burningbush, or other non-native alkali tolerant 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.
