USDA Natural Resources Conservation Service

Ecological site R064XY050NE
Thin Breaks

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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

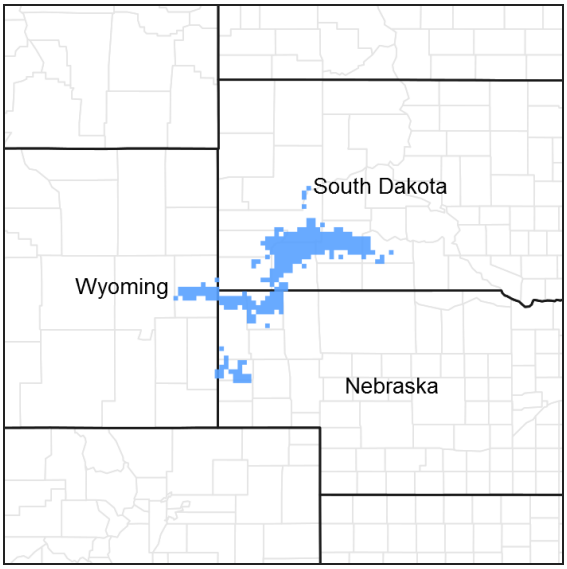

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 064X–Mixed Sandy and Silty Tableland and Badlands

The Mixed Sandy and Silty Tableland and Badlands (MLRA 64) is shared almost equally between South Dakota (42 percent) and Nebraska (41 percent). A small portion is in Wyoming (17 percent). The MLRA consists of 11,895 square miles. The towns of Kadoka and Pine Ridge, South Dakota; Chadron and Alliance, Nebraska; and Lusk, Wyoming, are all within the boundaries of this MLRA.

The following areas of special interest are in this MLRA: Agate Fossil Beds National Monument, Chadron State Park, Fort Robinson State Park, and the Pine Ridge Indian Reservation; parts of the Oglala and Buffalo Gap National Grasslands, which are in the Nebraska National Forest; and nearly all of Badlands National Park. The Badlands are internationally renowned for their Oligocene vertebrate fossils.

The northern section of the MLRA consists of old plateaus and terraces that have been deeply eroded by wind, water, and time. The southern section consists of nearly level to broad intervalley remnants of smooth fluvial plains. These two sections are separated by the Pine Ridge escarpment. Elevations gradually increase from 2,950 to 5,073 feet from east to west. The main drainageway through Badlands National Park is the White River. The headwaters of both the White and Niobrara Rivers are in MLRA 64. The Pine Ridge escarpment is at the northernmost extent of the Ogallala Aquifer.

Tertiary continental sediments consisting of sandstone, siltstone, and claystone underlie most of the area. Many of the bedrock units in the southern third of the MLRA are covered by loess. Soils range from shallow to very deep and from generally well drained to excessively drained. They are loamy or sandy. The Badlands consist of stream-laid layers of silt, clay, and sand mixed with layers of volcanic ash.

Average annual precipitation for the area is 14 to 20 inches. Most of the rainfall occurs as frontal storms in the spring and early summer. This area supports a mixture of short-, mid-, and tall-statured warm- and cool-season grasses. On the Pine Ridge Escarpment, these plants grow in association with ponderosa pine, Rocky Mountain juniper, western snowberry, skunkbush sumac, common chokecherry, and rose. Wyoming big sagebrush grows in minor amounts in the drier, far western portion of the MLRA; however, small remnant stands can be found in the eastern portion of the Oglala National Grassland in Nebraska.

Sixty percent of the MLRA is grassland, 11 percent of which is under Federal management. Twenty-two percent of the area is used as cropland, and 4 percent is forested. Major resource concerns include wind erosion, water erosion, and surface water quality (USDA-NRCS, 2006, Ag Handbook 296).

For development of ecological sites, MLRA 64 is divided into two precipitation zones (PZ): 14 to 17 inches per year and 17 to 20 inches per year. The wetter zone extends from the western end of the Pine Ridge Escarpment near Lusk, Wyoming, eastward along the escarpment through Nebraska and into the Big Badlands area of South Dakota. The drier zone extends from Wyoming eastward to Alliance and Oshkosh, Nebraska, south of the Pine Ridge Escarpment. MLRA 64 stops at the western edge of the Nebraska Sand Hills (MLRA 65).

A unique geologic area known as the Hartville Uplift is in the far southwest corner of the 14 to 17 inch precipitation zone. The Hartville Uplift is an elongated, north-northwest-oriented, broad domal arch of Laramide age (70-50 million years ago). It extends approximately 45 miles between Guernsey and Lusk, Wyoming, and is 15 miles wide at its widest point. Erosion has exposed a core of granite and Precambrian metasedimentary and metavolcanic rocks (Steele et al., 2018). In addition to the ecological sites in the 14 to 17 inch precipitation zone of MLRA 64, three unique ecological site descriptions were developed to describe the soils and plant community dynamics in the Hartville Uplift.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 64—Mixed Sandy and Silty Tableland and Badlands

U.S. Environmental Protection Agency (EPA)
Level IV Ecoregions of the Conterminous United States:
High Plains—25:
Pine Ridge Escarpment—25a.
Flat to Rolling Plains—25d.
Pine Bluffs and Hills—25f.
Sandy and Silty Tablelands—25g.
Northwestern Great Plains—43:
White River Badlands—43h.
Keya Paha Tablelands—43i.

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Great Plains and Palouse Dry Steppe Province—331:
Western Great Plains Section—331F:
Subsections:
Shale Scablands—331Fb.
White River Badlands—331Fh.
Pine Ridge Escarpment—331Fj.
High Plains—331Fk.
Hartville Uplift—331Fm.
Western Nebraska Sandy and Silty Tablelands—331Fn.
Keye Paha Tablelands—331Ft.

Powder River Basin Section—331G:
Subsection: Powder River Basin—331Ge.

Ecological site concept

The Thin Breaks ecological site occurs throughout MLRA 64. It is located on steep slopes, escarpments, river breaks, or slump areas with exposed bedrock at or near the surface. It is a runoff site with north- and east-facing slopes typically ranging from 9 to 45 percent. Soils are typically calcareous and of varying depths (very shallow to deep). The surface layer is typically 2 to 10 inches thick. Surface and subsurface textures range from very fine sandy loam to silt loam. The combination of cooler exposures and additional moisture supplied by water seepage and small springs emanating from rock fissures, and the lateral flow of water along rock exposures, makes the establishment of deciduous trees and shrubs common.

The vegetation in the Reference State consists of a mix of cool- and warm-season grasses and deciduous shrubs and trees. The dominant grasses include big bluestem, marsh muhly, Canada wildrye, and prairie sandreed. Common shrubs and trees include American plum, chokecherry, silver buffaloberry, green ash, and juniper. The steepness of slope, rugged terrain, and dense shrub thickets often makes this site inaccessible to livestock. Common plant communities can provide excellent habitat for wildlife.

Associated sites

R064XY037NE	**Thin Upland** The Thin Upland ecological site can be found adjacent to the Thin Breaks ecological site, or on similar landscape position on drier south- and west-facing slopes.
R064XY040NE	**Shallow** The Shallow ecological site can be found on ridgetops adjacent to the Thin Breaks ecological site.

Similar sites

R064XY037NE	**Thin Upland** The Thin Upland ecological site can be found on similar landscape positions as the Thin Breaks ecological site but on drier south- and west-facing slopes. The Thin Upland ecological site rarely has a significant amount of shrubs and few, if any, trees.
R064XY026NE	**Loamy Overflow** The Loamy Overflow ecological site will occur on floodplains below the Thin Breaks ecological site. The Loamy Overflow will have fewer shrubs and marsh muhly will not be a dominant component.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Shepherdia argentea*
Herbaceous	(1) *Muhlenbergia racemosa* (2) *Andropogon gerardii*

Physiographic features

The Thin Breaks ecological site occurs on steeply sloping uplands

Table 2. Representative physiographic features

Landforms	(1) Upland > Hill (2) Escarpment (3) Ridge
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None

Elevation	884–1,524 m
Slope	30–80%
Aspect	N, NE, E

Climatic features

MLRA 64 has a continental climate consisting of cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature are common in some years. The climate results from MLRA 64 being near the geographic center of North America. There are few natural barriers on the Northern Great Plains. Air masses move freely across the plains and account for rapid changes in temperature.

Average annual precipitation ranges from 14 to 20 inches per year. The normal average annual temperature is about 47 °F. January is the coldest month with average temperatures ranging from about 21 °F (Wood, SD) to about 25 °F (Hemingford, NE). July is the warmest month with average temperatures ranging from about 70 °F (Keeline 3 W, WY: 1953–1986) to about 76 °F (Wood, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 55 °F. This large annual range attests to the continental nature of the climate of this area. Wind speeds average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime winds. Occasionally, strong storms bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and continue to early or mid-September. Cool-season plants may green-up in September and October if adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	92-120 days
Freeze-free period (characteristic range)	119-139 days
Precipitation total (characteristic range)	406-483 mm
Frost-free period (actual range)	87-122 days
Freeze-free period (actual range)	110-149 days
Precipitation total (actual range)	381-508 mm
Frost-free period (average)	107 days
Freeze-free period (average)	130 days
Precipitation total (average)	432 mm

Climate stations used

- (1) HARRISON 20 SSE [USW00094077], Harrison, NE
- (2) ALLIANCE 1WNW [USC00250130], Alliance, NE
- (3) HARRISON [USC00253615], Harrison, NE
- (4) HEMINGFORD [USC00253755], Hemingford, NE
- (5) INTERIOR 3 NE [USC00394184], Interior, SD
- (6) WOOD [USC00399442], Wood, SD
- (7) LUSK 2 SW [USC00485830], Lusk, WY
- (8) TORRINGTON 29N [USC00488997], Jay Em, WY
- (9) CHADRON 3NE [USC00251578], Chadron, NE
- (10) MARTIN [USC00395281], Martin, SD

Influencing water features

No riparian or wetland features are directly associated with this site.

Wetland description

Not Applicable.

Soil features

The feature common to soils in this site is the surface layer, 2 to 10 inches deep, ranging in texture from very fine sandy loam to silt loam. Soils are formed in soft siltstone or sandstone with slopes of 9 to 45 percent. These soils are typically calcareous at or near the surface; however, carbonates are not always distinguishable in the upper layers. The soils in this site are well to somewhat excessively drained and have a moderate infiltration rate. The soil-water-plant relationship is strongly influenced by cooler exposures and typically have additional moisture supplied by water seepage and small springs emanating from rock fissures and the lateral flow of water along rock exposures.

This site can show slight to moderate evidence of rills and pedestalled plants. Water flow paths are broken, irregular in appearance, or discontinuous with few debris dams or vegetative barriers. The soil surface is relatively stable; however, natural erosion is not uncommon on steeper slopes and in areas with sparser vegetation. Subsurface soil layers are variably restrictive to water movement and root penetration.

The soil correlated to the Thin Breaks ecological site: Keota.

The Keota soils without a moist local phase are correlated to the Thin Upland (R064XY037NE) ecological site in MLRA 64. These areas will tend to be located on south- and west-facing slopes.

This soil is mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 15 percent and on areas with sparse vegetation.

More information regarding the soil is available in soil survey reports. Contact the local USDA Service Center for details specific to your area of interest, or go online to access USDA’s Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and siltstone (2) Colluvium–sandstone and siltstone
Surface texture	(1) Loam (2) Silt loam (3) Very fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	25–102 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–20%
Available water capacity (0-101.6cm)	5.08–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–25%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4

Subsurface fragment volume <=3" (Depth not specified)	5–45%
Subsurface fragment volume >3" (Depth not specified)	5–45%

Ecological dynamics

The Thin Breaks ecological site developed under Northern Great Plains climatic conditions; light to severe grazing by bison and other large herbivores; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Although the following plant community descriptions are typical of the transitions between communities, severe disturbances, such as periods of well below average precipitation and the introduction of non-native cool-season grasses, can cause significant shifts in plant communities and species composition.

This site continues to develop largely through natural climatic cycles and as a result of plant species that can benefit from a moister and cooler conditions found on north- and east-facing slopes with additional moisture supplied by water seepage from rock fissures and the lateral flow of water along rock exposures. With time, the woody species begin to dominate. Eventually, conifer species such as eastern redcedar and Rocky Mountain juniper can establish in the deciduous overstory, and eventually dominate this site. This represents a lower condition on this site in regard to biotic integrity, soil stability, and the hydrologic functions of the site. This site tends to be on landscapes where snow drifting and accumulation occurs naturally. The establishment of woody species increases the amount of snow collection and the amount of available moisture to the plant community. Those sites with northern and eastern aspects will tend to have more tree shrub cover and diversity. Those sites with southern and western aspect will tend to have fewer trees more drought-tolerant shrubs and grasses.

This site may have played an important role in the development of associated woody draw plant communities prior to European settlement in the area. During favorable climatic conditions and the lack of fire in a given area, the woody species which dominate this site would tend to expand into the more favorable soils of the associated overflow sites. With extended dry periods or increased fire activity, the woody species would tend to be eliminated or greatly reduced on overflow sites, but the Thin Breaks site often acts as a refugium for many woody species. It is thought that the current extent of woody draws in the associated overflow sites is largely due to fire suppression efforts post-settlement.

Interpretations are primarily based on the Muhly-Bluestem/Shrub/Green Ash Plant Community (1.1). It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Thin Breaks – R064XY050NE 3/25/19

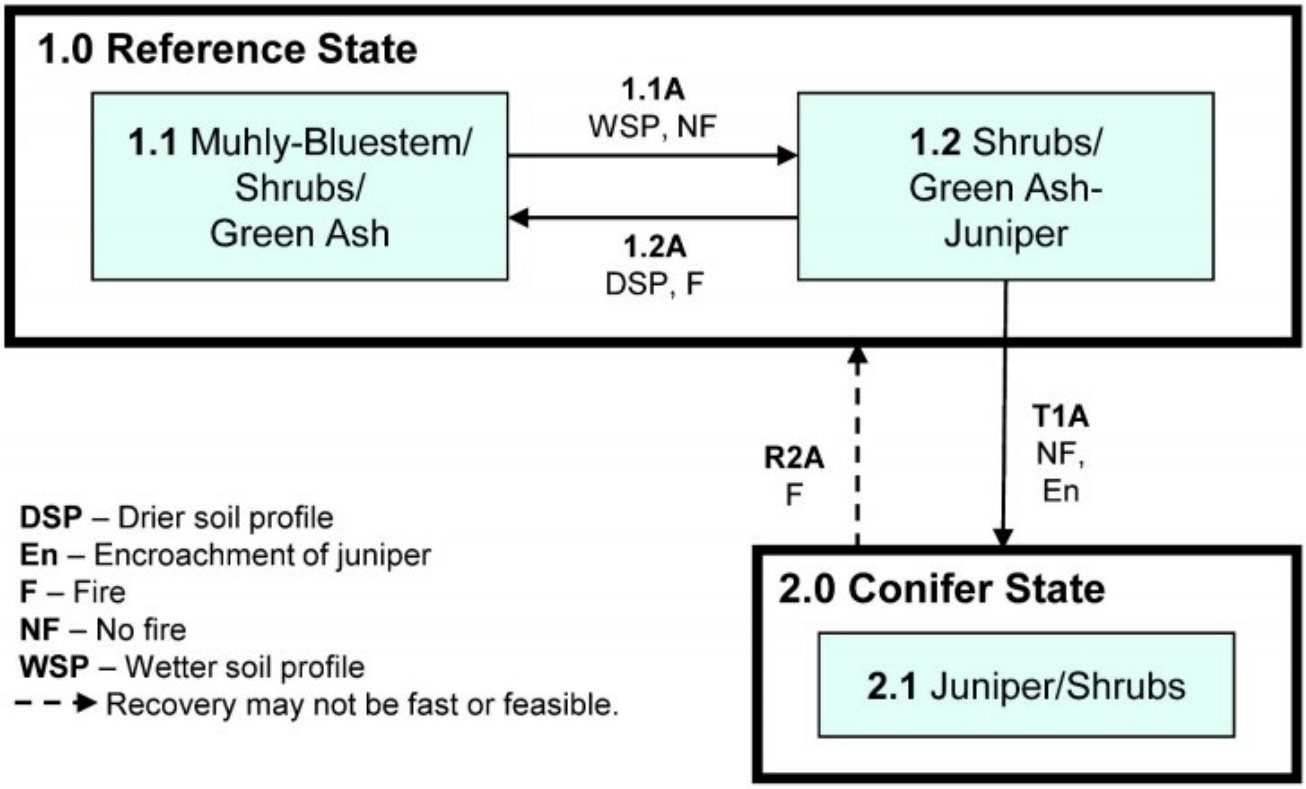

Diagram Legend - Thin Breaks - R064XY050NE

T1A	1.0 to 2.0	No fire over an extended period of time, encroachment or expansion of juniper.
R2A	2.0 to 1.0	Fire, which removes juniper species and restores the native plant community.
CP 1.1A	1.1 to 1.2	Wetter soil profile due to climatic conditions, and no fire.
CP 1.2A	1.2 to 1.1	Drier soil profile due to climatic conditions, or fire.

State 1
Reference State

The Reference State represents the best estimate of the natural range of variability that dominated the dynamics of the Thin Breaks ecological site prior to European settlement. This site, in Reference condition, is a mix of grasses, grass-likes, forbs, shrubs, and tree species. Wet and dry climatic cycles, fire, no fire, and encroachment of junipers are the major drivers between plant communities. In general, grazing pressure is limited because of limited accessibility; however, on flatter slopes, livestock will utilize the site for shade and loafing. Favorable growing conditions occur during the spring and the warm months of June through August. Today a similar state can be found in areas where proper livestock use has occurred.

Community 1.1
Muhly-Bluestem/Shrubs/Green Ash

Interpretations are based primarily on the Green Muhly-Bluestem/Shrubs/Green Ash Plant Community. This is also considered the Reference Plant Community (1.1). The potential vegetation is about 65 percent grasses or grass-like plants, 10 percent forbs, 15 percent shrubs, and 10 percent trees. Warm-season grasses dominate the understory of this site, but cool-season grasses are also significant. Various combinations of shrubs and trees usually dominate the overstory of this site. The major grasses include marsh muhly (green muhly), big bluestem, Canada wildrye, plains muhly, and sideoats grama. Other grasses and grass-likes occurring include green needlegrass, porcupine

grass, western wheatgrass, little bluestem, and sedge. Significant forbs include white sagebrush (cudweed sagewort), heath aster, and purple coneflower. The most significant shrubs occurring in this plant community include silver buffaloberry, snowberry, currant, and sometimes skunkbush sumac. Other shrubs commonly found include rose, yucca, and fringed sagewort. Various species of trees will occasionally dominate the plant community but typically occur in a more scattered fashion. Trees that commonly occur on this plant community include American elm, green ash, Rocky Mountain juniper, bur oak, and boxelder. This plant community is extremely resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought. Community dynamics, nutrient and water cycles, and energy flow are functioning properly. Plant litter is properly distributed with very little movement offsite; however, litter amounts are often quite high. Natural plant mortality is moderate to high, but the plant species dominating this plant community seem to be adapted to these conditions. The diversity in plant species and the aspect of the slopes allow for high tolerance to drought.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1726	1948	2046
Tree	22	294	616
Shrub/Vine	135	350	616
Forb	135	211	308
Total	**2018**	**2803**	**3586**

Figure 9. Plant community growth curve (percent production by month). NE6404, Pine Ridge/Badlands, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	8	15	24	23	15	5	5		

Community 1.2
Shrubs/Green Ash-Juniper

This plant community develops from extended periods of no fire, wetter climatic conditions, and some encroachment of juniper species. The shrub and tree components increase while the grass and grass-like components decrease. The grasses and grass-likes make up between 45 percent of the plant community, 5 percent for forbs, 30 percent for shrubs, and 20 percent for trees. Dominant grasses and grass-likes include green muhly, Canada wildrye, and plains muhly. Common forbs include white sagebrush (cudweed sagewort) and starry false Solomon’s-seal. American plum, silver buffaloberry, and snowberry are dominant shrubs found on this site. Green ash, bur oak, and hackberry are the common trees on this site. This plant community is moderately resistant to change. However, juniper species are beginning to become established in the understory, and without fire, they will eventually dominate the plant community.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	667	924	1216
Shrub/Vine	247	493	673
Tree	174	269	392
Forb	34	108	185
Total	**1122**	**1794**	**2466**

Figure 11. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

Pathway 1.1A
Community 1.1 to 1.2

Wetter soil profiles due to wetter climatic conditions and no fire will convert this plant community to the Shrubs/Green Ash-Juniper Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Drier soil profiles due to drier climatic conditions or fire will move this plant community to the Muhly-Bluestem/Shrubs/Green Ash Plant Community (1.1).

State 2
Conifer State

The Conifer State occurs when eastern redcedar or Rocky Mountain juniper encroach onto the site and become the dominant species. As the juniper becomes established, the herbaceous component declines and more bare ground is exposed. This negative feedback creates the condition for continuing encroachment. As bare ground increases, juniper establishes more readily.

Community 2.1
Juniper/Shrubs

This plant community is a result of the encroachment of eastern redcedar and Rocky Mountain juniper and the lack of fire over an extended time period. This plant community is made up of 15 to 40 percent grass and grass-like species, 1 to 10 percent forbs, 35 to 55 percent shrubs, and 10 to 20 percent trees. Compared to the Reference plant community (1.1), a decrease in diversity is seen as the grasses and forbs decrease, and shrubs and trees increase. The deciduous trees decrease as the conifers increase. Some of the grasses found in lesser amounts on this site include Canada wildrye, bluegrass, and cheatgrass. There is potential for white sagebrush (cudweed sagewort), northern bedstraw, and starry false Solomon’s-seal to be present on-site. Dominant shrubs are American plum, silver buffaloberry, chokecherry, and snowberry. Common trees include eastern redcedar, Rocky Mountain juniper, and remnant green ash. The potential exists for this to be a closed canopy of the juniper species with little herbaceous production and decadence of other trees. This plant community is highly resistant to change. The absence of fine fuels reduces the likelihood of fire, and hot, stand-replacing fire is necessary to eliminate the strongly competitive juniper species. The hydrology as a result of this plant community is highly altered, to the point of reducing flows from intermittent streams. There is also a higher incidence of slumping and water erosion due to a lack of a well-distributed fine root layer.

Figure 12. Plant community growth curve (percent production by month). NE6403, Pine Ridge/Badlands, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		5	10	20	25	20	10	5	5		

Transition T1A
State 1 to 2

Over time with no fire and encroachment of juniper, the Reference State will transition to the Conifer State (2.0). Junipers and shrubs will eventually replace the grasses, forbs, and shrubs found in the Reference State. This transition is most likely to occur through the Shrubs/Green Ash-Juniper Plant Community (1.2).

Restoration pathway R2A

State 2 to 1

If the site is not too degraded, and many of the native grasses, forbs, and shrubs are still present in the plant community, a stand removing fire will eliminate the juniper cover and allow for a transition back to the Reference State (1.0). Depending on the remnant native herbaceous and shrub community this may be a relatively fast transition or a slow successional process where non-native forbs and grasses could potentially invade.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			280–841	
	big bluestem	ANGE	*Andropogon gerardii*	140–701	–
	spiked muhly	MUGL3	*Muhlenbergia glomerata*	28–224	–
2	**Mid- Warm-Season Grasses**			280–560	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	140–280	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	140–280	–
	little bluestem	SCSC	*Schizachyrium scoparium*	28–140	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–140	–
3	**Cool-Season Bunchgrasses**			280–560	
	Canada wildrye	ELCA4	*Elymus canadensis*	140–420	–
	green needlegrass	NAVI4	*Nassella viridula*	56–280	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–280	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–140	–
4	**Other Native Grasses & Grass-Likes**			140–420	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–140	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–140	–
	sedge	CAREX	*Carex*	56–140	–
	Grass, perennial	2GP	*Grass, perennial*	0–140	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–84	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	28–84	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–84	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–56	–
5	**Non-Native Cool-Season Grasses**			–	
	Kentucky bluegrass	POPR	*Poa pratensis*	–	–
	cheatgrass	BRTE	*Bromus tectorum*	–	–
	field brome	BRAR5	*Bromus arvensis*	–	–
Forb					
6	**Forbs**			140–280	
	goldenrod	SOLID	*Solidago*	0–84	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	28–84	–
	Forb, perennial	2FP	*Forb, perennial*	0–84	–
	white heath aster	SYER	*Symphyotrichum ericoides*	28–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	–

	white sagebrush	ARLU	*Artemisia ludoviciana*	28–84	
	beardtongue	PENST	*Penstemon*	0–56	–
	milkvetch	ASTRA	*Astragalus*	28–56	–
	cutleaf anemone	PUPAM	*Pulsatilla patens ssp. multifida*	0–56	–
	dotted blazing star	LIPU	*Liatris punctata*	0–56	–
	anemone	ANEMO	*Anemone*	0–28	–
	cinquefoil	POTEN	*Potentilla*	0–28	–
	northern bedstraw	GABO2	*Galium boreale*	0–28	–
	old man's whiskers	GETR	*Geum triflorum*	0–28	–
	pussytoes	ANTEN	*Antennaria*	0–28	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–28	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–28	–
	common starlily	LEMO4	*Leucocrinum montanum*	0–28	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–28	–
	Forb, annual	2FA	*Forb, annual*	–	–
Shrub/Vine					
7	**Shrubs**			140–560	
	silver buffaloberry	SHAR	*Shepherdia argentea*	28–420	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–280	–
	American plum	PRAM	*Prunus americana*	0–224	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–140	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–140	–
	currant	RIBES	*Ribes*	0–140	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–140	–
	rose	ROSA5	*Rosa*	28–84	–
	prairie sagewort	ARFR4	*Artemisia frigida*	28–56	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–56	–
	soapweed yucca	YUGL	*Yucca glauca*	0–56	–
	chokecherry	PRVI	*Prunus virginiana*	0–28	–
Tree					
8	**Trees**			28–560	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–420	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–280	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–280	–
	common hackberry	CEOC	*Celtis occidentalis*	0–140	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–140	–
	Tree	2TREE	*Tree*	0–140	–
	American elm	ULAM	*Ulmus americana*	0–140	–
	eastern redcedar	JUVI	*Juniperus virginiana*	0–28	–

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm Season Grasses**			0–672	

1	**Tall Warm-Season Grasses**			0–179	
	spiked muhly	MUGL3	*Muhlenbergia glomerata*	18–179	–
	big bluestem	ANGE	*Andropogon gerardii*	0–90	–
2	**Mid- Warm-Season Grasses**			36–143	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	18–90	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–72	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–72	–
	little bluestem	SCSC	*Schizachyrium scoparium*	18–54	–
3	**Cool-Season Bunchgrasses**			90–359	
	Canada wildrye	ELCA4	*Elymus canadensis*	90–269	–
	green needlegrass	NAVI4	*Nassella viridula*	0–90	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–90	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–54	–
4	**Other Native Grasses & Grass-Likes**			18–179	
	sedge	CAREX	*Carex*	0–90	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–54	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–54	–
	Grass, perennial	2GP	*Grass, perennial*	0–36	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–36	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–18	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	0–18	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–18	–
5	**Non-Native Cool-Season Grasses**			18–143	
	Kentucky bluegrass	POPR	*Poa pratensis*	18–90	–
	cheatgrass	BRTE	*Bromus tectorum*	18–90	–
	field brome	BRAR5	*Bromus arvensis*	0–90	–
Forb					
6	**Forbs**			36–179	
	Forb, annual	2FA	*Forb, annual*	0–90	–
	Forb, perennial	2FP	*Forb, perennial*	18–72	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	18–54	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	18–36	–
	goldenrod	SOLID	*Solidago*	0–36	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–36	–
	northern bedstraw	GABO2	*Galium boreale*	0–36	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–36	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	0–18	–
	beardtongue	PENST	*Penstemon*	0–18	–
	old man's whiskers	GETR	*Geum triflorum*	0–18	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–18	–
	pussytoes	ANTEN	*Antennaria*	0–18	–
	milkvetch	ASTRA	*Astragalus*	0–18	–
	dotted blazing star	LIPU	*Liatris punctata*	0–18	–

	cutleaf anemone	PUPAM	*Pulsatilla patens ssp. multifida*	0–18	–
	anemone	ANEMO	*Anemone*	0–18	–
	cinquefoil	POTEN	*Potentilla*	0–18	–
	common starlily	LEMO4	*Leucocrinum montanum*	0–18	–
Shrub/Vine					
7	**Shrubs**			359–628	
	silver buffaloberry	SHAR	*Shepherdia argentea*	18–269	–
	American plum	PRAM	*Prunus americana*	18–269	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–179	–
	skunkbush sumac	RHTR	*Rhus trilobata*	18–179	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	18–143	–
	chokecherry	PRVI	*Prunus virginiana*	18–143	–
	currant	RIBES	*Ribes*	0–143	–
	prairie sagewort	ARFR4	*Artemisia frigida*	18–90	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	18–90	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–54	–
	rose	ROSA5	*Rosa*	18–54	–
	soapweed yucca	YUGL	*Yucca glauca*	0–18	–
Tree					
8	**Trees**			179–359	
	green ash	FRPE	*Fraxinus pennsylvanica*	72–269	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–269	–
	American elm	ULAM	*Ulmus americana*	0–143	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–126	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	18–126	–
	eastern redcedar	JUVI	*Juniperus virginiana*	0–126	–
	common hackberry	CEOC	*Celtis occidentalis*	0–90	–
	Tree	2TREE	*Tree*	0–90	–

Animal community

Wildlife Interpretations:
MLRA 64 is in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, this MLRA consisted of diverse grassland and shrubland habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, and amphibians and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors. The prairie dog was once abundant and remains a keystone species within its range. The black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, and swift fox are associated with prairie dog complexes.

Historically, the northern mixed-grass prairie was a disturbance-driven ecosystem in which fire, herbivory, and climate functioned as the primary disturbance factors, either singly or in combination. Following European settlement, livestock grazing, cropland conversion, elimination of fire, energy development, and other anthropogenic factors influenced species composition and abundance. Introduced and invasive species further

affected plant and animal communities. The bison was a historical keystone species but has been extirpated in this area as a free-ranging herbivore. The loss of the bison and the reduction of prairie dog populations and fire as ecological drivers greatly influenced the character of the remaining native plant communities and altered wildlife habitats. Human development reduced habitat quality for area-sensitive species.

Within MLRA 64, the Thin Breaks ecological site provides upland grassland cover with associated forb, shrub, and tree components. It was typically part of an expansive grassland landscape that included combinations of Clayey, Claypan, Dense Clay, Loamy, Saline, Sandy, Shallow, Overflow, and Terrace ecological sites.

Although the Thin Breaks ecological site is primarily dominated by green muhly and big bluestem, it can support a plant community composed of various age classes of American elm, green ash, bur oak, hackberry, boxelder, Eastern red cedar, Rocky Mountain juniper, and ponderosa pine; with a shrub component of American plum, rose, chokecherry, western snowberry, currant, silver buffaloberry, and skunkbush sumac. The presence or absence of this tree and shrub component is an important factor influencing wildlife species composition.

This site provides habitat for grassland- and shrub thicket-nesting birds, small rodents, bats, mammalian predators, and a variety of reptiles, amphibians, and insects. Within the MLRA, this site provides the suitable habitat for numerous shrub thicket-associated species. This site provides foraging and brood-rearing habitat for upland game birds such as the sharp-tailed grouse. However, due to the presence of woody species, reproduction for ground-nesting birds is reduced.

Reference State (1.0): Multiple successional changes can occur when trees establish on the site. During favorable climatic conditions and the lack of fire in a given area, the shrub and tree species abundance and diversity will be greatly increased. Grass species may decline dramatically, and species composition can shift due to woody competition and disturbances. Seeps and springs provide vital water supply and localized wildlife habitat especially for reptiles and amphibians, bats, and game species (both predators and prey).

Woody vegetation provides excellent nesting cover, escape cover, and den sites for a variety of species. The presence of bur oak, Rocky Mountain juniper, Eastern red cedar, and ponderosa pine provides a significant food source for species such as fox squirrel, turkey, elk, and deer. Species such as white-footed mice, bushy-tailed woodrat, porcupine, sharp-tailed grouse, black-billed magpie, Townsend’s solitaire, dark-eyed junco, brown thrasher, lark sparrow, and white-crowned sparrow will also increase. Species such as meadow voles, spotted ground squirrel, northern grasshopper mice, and western harvest mice will not utilize this site. Grassland-nesting songbirds will be significantly reduced. Raptors such as the long-eared owl will increase.

The diversity and abundance of fruiting shrubs such as plum, chokecherry, currant, rose, buffaloberry, and sumac provide a significant food source for a variety of animals including songbirds, turkey, sharp-tailed grouse, deer, and small mammals. This site provides habitat for other songbirds such as yellow warbler, orange-crowned warbler, yellow-rumped warbler, Wilson’s warbler, gray catbird, Say’s phoebe, loggerhead shrike, Lazuli bunting, yellow-breasted chat, and wrens and chickadees. Other raptors such as red-tailed hawk, Swainson’s hawk, American kestrel, and great-horned owl may continue to use this site. The diverse and abundant forb (flowering plants) community provides significant forage base for pollinating animals such as bees, flies, beetles, butterflies, and moths. Insects continue to provide a significant forage base for birds and various bats, especially species such as the western small-footed Myotis, the fringe-tailed Myotis, and the Townsend’s big-eared bat. Diverse prey populations are available for grassland raptors and mammalian predators, especially bobcat and mountain lion. Other mammalian predators utilizing this plant community include the coyote, mink, long-tailed and least weasels, red fox, and spotted and striped skunks.

Grazing Interpretations:
The following list suggests annual, initial stocking rates for average growing conditions. These estimates are conservative and should be used only as guidelines in the initial stages of conservation planning. Commonly, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate estimates of carrying capacity should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. In consultation with the land manager, a more intensive grazing management program that results in improved harvest efficiencies and increased carrying capacity may be developed.

The following suggested initial stocking rates are based on 912 lb/acre (air-dry weight) per animal-unit-month (AUM) with a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA-NRCS, National Range and Pasture Handbook). An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow, with or without calf, for one month.

Plant Community: Muhly-Bluestem/Shrubs/Green Ash (1.1)
Average Production (lb/acre, air-dry): 2,500
Stocking Rate (AUM/acre): 0.48 (based on 1,738 lbs. of grasses and grass-likes)

Plant Community: Shrubs/Green Ash/Juniper (1.2)
Average Production (lb/acre, air-dry): 1,600
Stocking Rate (AUM/acre): 0.23 (based on 824 lbs. of grasses and grass-likes)

*Plant Community: Juniper/Shrubs (2.1)
Average Production (lb/acre, air-dry): Variable
Stocking Rate (AUM/acre): Variable

Plant Community: All other plant communities identified in this document have variable annual production values and require onsite sampling to determine initial stocking rates.

* Total annual production and stocking rates are highly variable and require onsite sampling.

** Total onsite annual production may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for livestock. During the dormant period, the forage for livestock likely have insufficient protein to meet livestock requirements. Added protein allows ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group D. Infiltration varies from moderately to high and runoff varies from low to medium depending upon slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff. Refer to the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

Local or individual firewood can be utilized from this site. This site has low potential for timber harvest due to steep slopes and variability in site production.

Other products

Harvesting the seeds of native plants can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
This Provisional ecological site description (ESD) has passed Quality Control (QC) and Quality Assurance (QA) to

ensure the it meets the 2014 NESH standards for a Provisional ecological site description.

This ESD is an updated “Previously Approved” ESD that represented a first-generation tier of documentation that, prior to the release of the 2014 National Ecological Site Handbook (NESH), met all requirements as an “Approved” ESD as laid out in the 1997 National Range and Pasture Handbook (NRPH). The document fully described the Reference State and Community Phase in the State-and-Transition model. All other alternative states are at least described in narrative form. The “Previously Approved” ESD has been field-tested for a minimum of five years and is a proven functional document for conservation planning. The “Previously Approved” ESD may not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that it will continue refinement toward an “Approved” status.

Site Development and Testing Plan
Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are required to produce the final document.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, range management specialist (RMS), NRCS; Jill Epley, RMS, NRCS; Rick Peterson, RMS, NRCS; David Steffen, RMS, NRCS; Jeff Vander Wilt, RMS, NRCS; and Phil Young, soil scientist, NRCS.

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Contributors

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Approval

Suzanne Mayne-Kinney, 12/16/2024

Acknowledgments

This ecological site was reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS on 1/10/2019.

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)	Stan Boltz, Mitch Faulkner, Emily Helms, John Hartung, Ryan Murray, George Gamblin, Rick Peterson, Nadine Bishop, Jeff Nichols
Contact for lead author	jeffrey.nichols@usda.gov
Date	12/12/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are expected on slopes steeper than 15 percent becoming more evident as slopes increase. Rills will be 5 feet long or shorter and will be at least 6 feet apart.

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2. **Presence of water flow patterns:** Typically, none. When present, water flow patterns will be barely visible and discontinuous with numerous debris dams.

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3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants and terracettes are not expected on gentle slopes but will occur on slopes steeper than 15 percent becoming more evident as slopes increase.

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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 is typically 15 percent or less and bare ground patches will be 2 to 3 inches (5 to 7.5 cm) in diameter.

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5. **Number of gullies and erosion associated with gullies:** Gullies may be present, typically in association with drainageways and on steeper slopes. Gullies may develop after intense rainfall events and will re-vegetate rapidl

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured and/or depositional areas should not be present.

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7. **Amount of litter movement (describe size and distance expected to travel):** Small size litter classes will generally move short distances (less than 6 inches or 12.5 cm), some medium size class litter will move very short distances (less than 3 inches or 6.25 cm). On the steepest slopes (greater than 30 percent) litter will travel greater distances.

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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):** Soil aggregate stability ratings should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 2 to 10 inches (5.1 to 25.4 cm) thick. Soil colors are light brownish gray (value of 6) when dry and dark grayish brown (value of 4) when moist. Structure should typically be fine granular as least in the upper A-horizon. Some soils have subangular blocky structure parting to weak fine granular. Layers of exposed bedrock occur at or near the surface.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid and tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration. Invasion of introduced cool-season grasses such as Kentucky bluegrass, annual brome, smooth brome, and crested wheatgrass may have an adverse impact infiltration and runoff.

    Relative composition is approximately 65 percent grasses or grass-like plants, 10 percent forbs, 15 percent shrubs, and 10 percent trees. The grass component is composed of C4, tallgrasses (10-30%), C3 bunchgrasses (10-20%), C4, midgrasses (10-20%), C3, rhizomatous grasses (0-5%), C4, shortgrasses (0-5%) and grass-likes (2-5%).

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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. When dry, subsoil can be hard and appear to be compacted, but no platy structure will be present.

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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: Phase 1.1
    1. Native, perennial, C4 tallgrass, 250-750 #/ac, 10-30% (2 species minimum): big bluestem, spiked muhly.
    2. Native, perennial, C3 bunchgrass, 250-500 #/ac, 10-20%, (3 species minimum): Canada wildrye, green needlegrass, prairie Junegrass, needle and thread, porcupine grass.
    3. Native, perennial, C4 midgrass, 250-500 #/ac, 10-20% (3 species minimum): little bluestem, plains muhly, prairie dropseed, sideoats grama, sand dropseed.

    Phase 1.2
    1. Shrubs, 320-560 #/ac, 20-35% (7 species minimum): silver buffaloberry, American plum, skunkbush sumac, chokecherry, prairie sagewort, western snowberry, rose and other shrubs that vary from location to location.
    2. Native, perennial, C3 grass, 80-400 #/ac, 5-25% (1 species minimum): Canada wildrye, green needlegrass, needle and thread, porcupinegrass, prairie Junegrass, western wheatgrass, thickspike wheatgrass.

    Sub-dominant: Phase 1.1
    1. Shrubs, 125-500 #/ac, 5-20% (2 species minimum): prairie sagewort, rose and other shrubs which vary from location to location.
    2. Native trees, 25-500 #/ac, 1-20% (2 species minimum): green ash, Rocky Mountain juniper and other species vary from location to location.

    Phase 1.2
    1. Native trees, 160-320 #/ac, 10-20% (2 species minimum): green ash, Rocky Mountain juniper, and other species that

vary from location to location.

Other: Minor - Phase 1.1
1. Native forbs, 125-250 #/ac, 5-10%: forbs present vary from location to location.
2. Grass-likes, 50-125 #/ac, 2-5%: sedges.
3. Native, perennial, C3 rhizomatous grass, 0-125 #/ac, 0-5%: western wheatgrass, thickspike wheatgrass.
4. 0-125 #/ac (0-5%): blue grama, hairy grama.

Minor - Phase 1.2
1. Native forbs, 32-160 #/ac, 2-10 %: forbs present vary from location to location.
2. Native, perennial, C4 tallgrass, 0-160 #/ac, 0-10%: spiked muhly, big bluestem.
3. Native, perennial, C4 midgrass, 32-128 #/ac, 2-8%: plains muhly, sideoats grama, prairie dropseed, little bluestem, sand dropseed.
4. Non-native C3 grass, 16-128 #/ac, 1-8%: Kentucky bluegrass, field brome, cheatgrass.
5. Grass-likes, 0-80 #/ac, 0-5%: sedges.

Trace - Phase 2.2
1. Native, perennial, C4, shortgrass, 0-32 #/ac, 0-2%: blue grama, hairy grama.

Additional: The Muhly-Bluestem/Shrubs/Green Ash Community or Reference Community (1.1) is composed of nine F/S groups. These groups, in order of relative abundance, are native, perennial, C4, tallgrass; native, perennial, C3, bunchgrass; native, perennial, C4 midgrass; shrubs; native trees; native forbs; grass-likes; native, perennial C3, rhizomatous grass; and native, perennial, C4, shortgrass.

The Shrubs/ Green Ash-Juniper Community (1.2) includes nine F/S groups. These groups include, in order of abundance, shrubs; native, perennial, C3 grass; native trees; native forbs; native, perennial, C4 tallgrass; native, perennial, C4 midgrass; non-native C3 grass; grass-likes; and native, perennial, C4 shortgrass.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 50 to 80 percent and at a depth of 0.25 to 0.50 inch (0.65 to 1.3 cm). Kentucky bluegrass excessive litter can negatively impact the functionality of this site.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 2,500 pounds per acre on an air dry basis. Low and high production years should yield 1,800 and 3,200 pounds per acre respectively.

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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:** No non-native invasive species are present. Annual bromes, Kentucky bluegrass, and eastern red cedar are known invasives that have the potential to become dominant or co-dominant on this site. Consult the state

noxious weed and state watch lists for potential invasive species. Note: species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
