Ecological site R061XW166WY
Shallow Sandy-West (16-20" PZ)

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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): 061X–Black Hills Foot Slopes

The Black Hills Foot Slopes (MLRA 61) is shared between Wyoming (WY) (58 percent) and South Dakota (SD) (42 percent). The MLRA is approximately 1,865 square miles. The towns of Spearfish, Sturgis, and Hot Springs, South Dakota, and Newcastle and Sundance, Wyoming, are all in this MLRA. Rapid City, South Dakota, is on the eastern edge of the MLRA. Wind Cave National Park, Devils Tower National Monument, and parts of Thunder Basin National Grassland and the Black Hills National Forest are also in MLRA 61. Devils Tower was the nation’s first National Monument, designated by President Theodore Roosevelt in 1906.

The Black Hills Foot Slopes consists of steeply dipping rocks circling the domed mountains of the Black Hills. As the mountains were uplifted, older sediments were tipped up and dipped away from the core of the mountains. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones, which are on the outside edge of the area, are referred to as the Dakota Hogback. The next geologic formation is the Triassic-aged red beds of the Spearfish shale. It forms a low valley. This “red valley” surrounds the Black Hills between the two ridges formed by the Inyan Kara (hogback) and Minnekahta Formations associated with the Black Hills (MLRA 62). The Lakota referred to the red valley as the “Big Racecourse or the Red Racetrack.” The red beds have gypsum and anhydrous layers. Ground water seepage can dissolve these layers, creating sinkholes on the surface.

The average elevation of MLRA 61 ranges from 2,950 to 3,940 feet with extremes to 5,580 feet. Slopes are generally hilly; however, the interior red beds are nearly level to moderately sloping. The exterior hogback is steep, erosion-resistant rock. The Belle Fourche River is the only river flowing through MLRA 61. It passes through Hulett, Wyoming.

The dominant soil orders in this MLRA are Alfisols, Entisols, and Mollisols. The soils in the area predominantly have frigid or mesic soil temperature regimes and aridic or ustic soil moisture regimes. The soils are shallow to very deep, generally well drained, and loamy.

Average annual precipitation is 16 to 22 inches. The majority of rainfall occurs early in the growing season. Some high-intensity thunderstorms occur in mid-late summer. This MLRA supports open grassland, open ponderosa forest, and savanna-like vegetation. The grassland is characterized by native grasses, such as big bluestem, little bluestem, western wheatgrass, needle and thread, prairie dropseed, and green needlegrass. Bur oak grows throughout the northern area and can develop into nearly pure stands.

The major resource concerns are water quality, wind erosion, water erosion, and urban expansion.

MLRA 61 is 54 percent privately owned rangeland and 19 percent forest land. Federal lands make up 7 percent of the rangeland and 5 percent of the forest land. The remaining 15 percent of the MLRA is privately owned cropland and urban development (USDA-NRCS, 2006: Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 61 is divided into three precipitation zones (PZ).

The northern area (18–22” PZ) extends from just south of Rapid City, South Dakota, north to the Wyoming border.

The southern area (16–18” PZ) extends from Newcastle, Wyoming, south to Hot Springs, South Dakota, then north to just south of Rapid City.

The western area (16–20” PZ) is primarily located in Wyoming, extending from Newcastle in the south, to north of the Bear Lodge Mountains, then south through the gap between the Bear Lodge Mountains and the Black Hills.

One additional grouping of ecological sites represents sites that are common for the entire MLRA and do not have a precipitation zone designation.

The forest lands in MLRA 61 are represented by three forest ecological sites, which are currently correlated to MLRA 62 Black Hills.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 61—Black Hills Foot Slopes

US Environmental Protection Agency (EPA)
Level IV Ecoregions of the Conterminous United States:
Black Hills Foothills—17a

USDA Forest Service
Ecological Subregions: Sections and Subsections of Conterminous United States:
Black Hills Coniferous Forest Province—M334:
Black Hills Foothills Subsection—M334Aa

Ecological site concept

The Shallow Sandy 16-20" PZ ecological site occurs throughout the western portion of MLRA 61. It is located on hills, ridges and escarpments and does not receive additional moisture from runoff or overflow. The typical slopes range from 0 to 45 percent. Soils are shallow, (between 10 and 20 inches in depth) with a 3 to 6-inch-thick surface layer. Surface and subsurface soil textures are typically fine sandy loam.

The vegetation in the Reference State (1.0) is a mix of cool- and warm-season grasses. Needle and thread, prairies sandreed, and bluebunch wheatgrass are the major grass species. Forbs are common and diverse. Shrubs, such as yucca, leadplant, and rose are almost always present. The Shallow Sandy 16-20” PZ site is susceptible to invasion of non-native cool-season grasses and possibly the encroachment of conifers from adjacent sites.

Associated sites

R061XW162WY	**Shallow Loamy-West (16-20" PZ)** The Shallow Loamy 16-20” PZ ecological site is found on similar landscapes as the Shallow Sandy 16-20” PZ ecological site.
R061XY009SD	**Sandy** The Sandy ecological site is found on near level to gently slopes landscapes adjacent to the Shallow Sandy 16-20” PZ ecological site.

Similar sites

R061XY009SD	**Sandy** The Sandy ecological site will be have more big bluestem, little bluestem, and prairie sandreed; and higher vegetative production than the Shallow Sandy 16-20” PZ ecological site.
R061XW162WY	**Shallow Loamy-West (16-20" PZ)** The Shallow Loamy 16-20” PZ will have less needle and thread and prairie sandreed and slightly higher vegetative production than the Shallow Sandy 16-20” PZ ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Hesperostipa comata ssp. comata* (2) *Calamovilfa longifolia*

Physiographic features

The Shallow Sandy 16-20” PZ ecological site occurs on gently to steeply sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hill (2) Upland > Ridge (3) Upland > Hogback
Runoff class	Medium to high
Flooding frequency	None
Ponding frequency	None
Elevation	3,500–5,000 ft
Slope	0–45%
Ponding depth	0 in
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation in the western precipitation zone of MLRA 61 ranges from 16 to 20 inches. Wide fluctuations may occur in yearly precipitation and result in more years that are dry than years that have above normal precipitation. Temperatures show a wide range between summer and winter and between daily maximums and minimums. This range is predominantly due to the high elevation and dry air, which permit rapidly incoming and outgoing radiation. In winter, cold air outbreaks move rapidly from northwest to southeast and account for extreme minimum temperatures. Extreme storms may occur during the winter. They most severely affect ranch operations during late winter and spring.

The average annual temperature is about 46 °F. January is the coldest month with average temperatures ranging from about 20 °F (Devils Tower, WY) to about 24 °F (Newcastle, WY). July is the warmest month with average temperatures ranging about 74 °F (Newcastle, WY) to about 70 °F (Devils Tower, WY). The range of average monthly temperatures between the coldest and warmest months is about 50 °F. Wind speeds are estimated to average about 12 miles per hour annually, ranging from about 14 miles per hour during the spring to about 10 miles per hour during the summer. Winds are generally stronger during the day than at night. Occasionally, 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)	81-101 days
Freeze-free period (characteristic range)	115-123 days
Precipitation total (characteristic range)	17-19 in
Frost-free period (actual range)	73-108 days
Freeze-free period (actual range)	115-127 days
Precipitation total (actual range)	17-20 in
Frost-free period (average)	91 days
Freeze-free period (average)	119 days
Precipitation total (average)	18 in

Climate stations used

- (1) DEVILS TWR #2 [USC00482466], Devils Tower, WY
- (2) HULETT [USC00484760], Hulett, WY
- (3) UPTON 14ENE [USC00489208], Newcastle, WY
- (4) NEWCASTLE [USC00486660], Newcastle, WY
- (5) SUNDANCE [USC00488705], Sundance, WY

Influencing water features

No riparian areas or wetland features are directly associated with the Shallow Sandy 16-20” PZ ecological site.

Wetland description

Not Applicable.

Soil features

Soils common to the Shallow Sandy 16-20” PZ ecological site are shallow (10 to 20 inches deep), well drained and formed in residuum or colluvium from sandstone or interbedded sandstone and shale. The surface layer is fine sandy loam textured 3 to 6 inches thick. Subsurface textures are fine sandy loam. Slopes typically range from about 0 to 45 percent. The soils have rapid to very rapid infiltration rates. There is a restrictive layer of bedrock (typically sandstone) at about 10 to 20 inches in depth which impedes water movement and root penetration.

This site typically should show slight to no evidence of rills, wind-scoured areas or pedestalled plants. If present, water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact.

Major soils correlated to the Shallow Sandy 16-20” PZ ecological site include, Blacksheep and Mittenbutte.

In the South Dakota portion of MLRA 61, Mittenbutte, which has a fine sandy loam texture, is correlated to the Shallow Loamy ecological site.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than about 10 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

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 shale

Surface texture	(1) Fine sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Rapid to very rapid
Depth to restrictive layer	10–20 in
Soil depth	10–20 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	0.6–1.4 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Shallow Sandy 16-20” PZ 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.

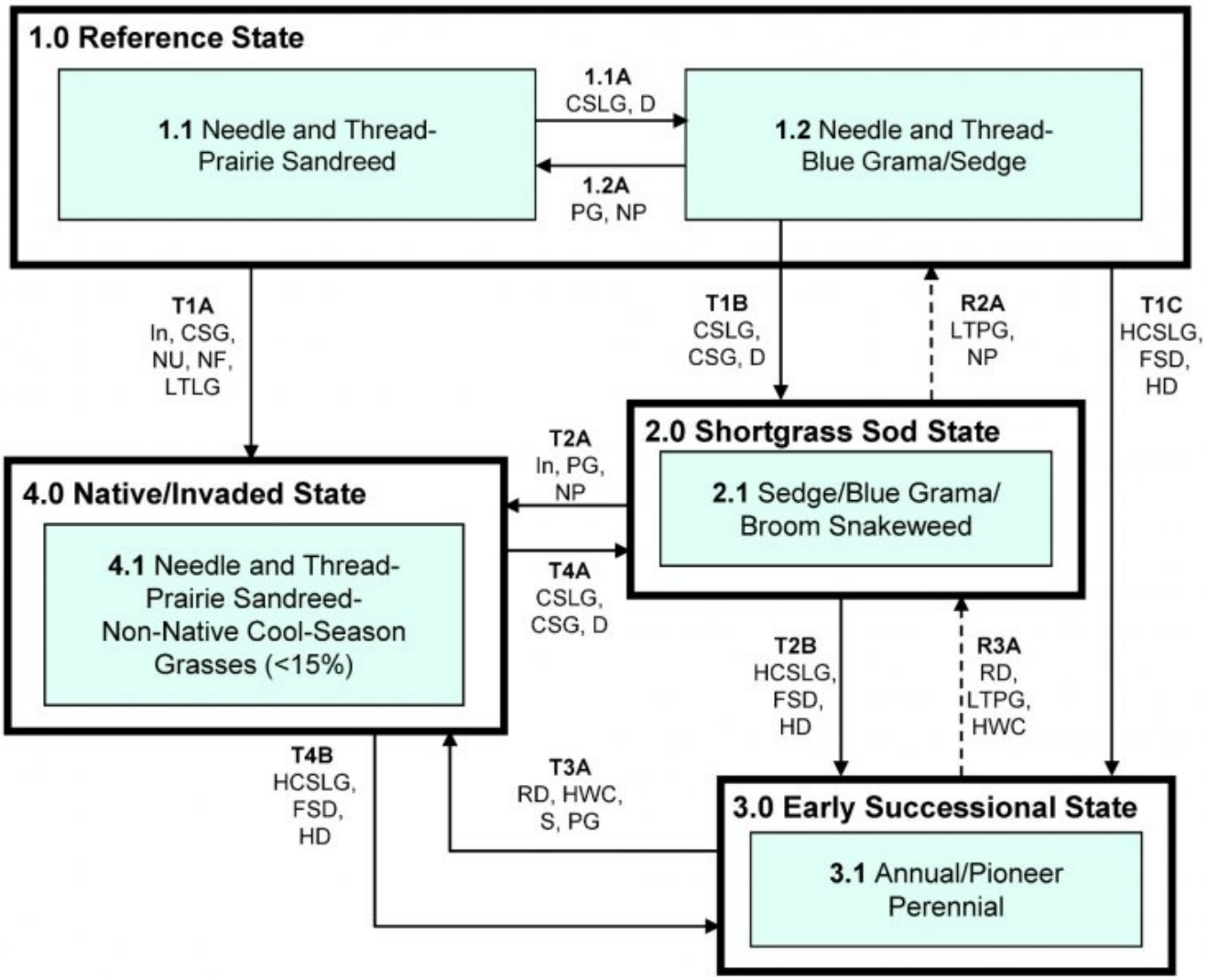
Continuous season-long grazing (e.g., every spring and/or every summer at moderate to heavy stocking levels) without adequate recovery periods following grazing events causes departure from the Needle and Thread-Prairie Sandreed Plant Community (1.1). Blue grama and sedges will increase and eventually develop into a sod. Excessive defoliation can cause threeawn and annuals to increase and dominate the site. A few mature trees comprised of ponderosa pine and Rocky Mountain juniper will occupy this site. With extended periods with no fire, trees will begin to encroach into the herbaceous community but typically will not dominate the site. The Shallow Sandy 16-20” PZ ecological site is susceptible to invasion of non-native cool-season grasses.

Interpretations are primarily based on the Needle and Thread-Prairie Sandreed 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 community phases, 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

Shallow Sandy 16-20” PZ – R061XY166WY 9/17/19



CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
D – Drought
FSD – Frequent and severe defoliation
HD – Heavy disturbance
HCSLG – Heavy, continuous season-long grazing
HWC – Herbaceous weed control
In – Invasion of non-native cool-season grasses

LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NP – Normal precipitation
NF – No fire
NU – No use
PG – Prescribed grazing
RD – Removal of disturbance
- - - → Transition may not be rapid or feasible

Diagram Legend: Shallow Sandy 16-20" PZ - R061XY166WY

T1A	1.0 to 4.0	Invasion of non-native cool-season grasses; continuous seasonal grazing (summer); long-term light grazing; or non-use and no fire.
T1B	1.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T1C	1.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2A	2.0 to 4.0	Invasion of non-native cool-season grasses; prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery; a return to normal precipitation patterns following drought.
T2B	2.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T3A	3.0 to 4.0	Removal of management induced disturbance; herbaceous weed control; seeding; prescribed grazing with proper stocking rates, change in season of use, adequate time for plant recovery following grazing event.
T4A	4.0 to 2.0	Continuous season-long grazing; continuous seasonal grazing; or heavy grazing in combination with drought.
T4B	4.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.

R2A	2.0 to 1.0	Long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for plant recovery; a return to normal precipitation patterns following drought. This transition may not be fast or feasible.
R3A	3.0 to 2.0	Removal of management induced disturbance followed by long-term prescribed grazing with proper stocking rates, change in season of use, adequate time for plant recovery following grazing event. Herbaceous weed control may be required. This transition may not be fast or feasible.

1.1A	1.1 to 1.2	Continuous season-long grazing; or heavy grazing in combination with drought.
1.2A	1.2 to 1.1	Prescribed grazing with proper stocking rates, change in season of use, adequate time for plant recovery; a return to normal precipitation patterns following drought.

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. This site in the Reference State (1.0) is dominated by warm-season grasses, with cool-season grasses being subdominant. In pre-European times, the primary disturbance mechanisms included frequent fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Taller cool- and warm-season grasses would have declined and a corresponding increase in short statured grass and grass-like species would have occurred. Today, a similar state can be found on areas that are properly managed with grazing and prescribed burning and sometimes on areas receiving occasional short periods of rest. The Reference State is susceptible to invasion of non-native cool-season grasses and the encroachment of conifers from adjacent sites.

Community 1.1
Needle and Thread-Prairie Sandreed

Interpretations are based primarily on the Needle and Thread-Prairie Sandreed Plant Community. It is also considered to be Reference Plant Community (1.1). The potential vegetation is about 70 percent grasses or grass-like plants, 15 percent forbs, and 15 percent shrubs and trees. The community is dominated by cool-season and warm-season grasses. The major grasses include needle, prairie sandreed, and bluebunch wheatgrass. Other grasses include plains muhly, little bluestem, porcupine grass, western wheatgrass, blue grama, and grass-like species. Forbs are common and diverse, yucca, leadplant, and rose are common shrubs. Scattered ponderosa pine and Rocky Mountain juniper will typically be present. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allowed for high drought tolerance. This was a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	700	1071	1340
Forb	135	175	215
Shrub/Vine	65	140	215
Tree	0	14	30
Total	**900**	**1400**	**1800**

Figure 9. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	10	20	28	21	10	5	3		

Community 1.2
Needle and Thread-Blue Grama/Sedge

This plant community developed under continuous season-long grazing or from over utilization during extended drought periods. This community can also develop where this site occurs near water sources. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 10 percent forbs, 15 percent shrubs and trees. Dominant grasses include needle and thread, blue grama, and threadleaf sedge. Grasses of secondary importance include sideoats grama, bluebunch wheatgrass, prairie sandreed, hairy grama, and western wheatgrass. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, white prairie aster, scurfpea and Cuman ragweed. When compared to the Needle and Thread-Prairie Sandreed Plant Community Phase (1.1), needle and thread, blue grama, and sedge have increased. Tall and mid-warm-season grasses have decreased, and production has also been reduced. This plant community is moderately resistant to change. This is due in part to the shallow rooted nature of the shortgrass species which decreases infiltration especially to the deeper rooted tall and mid-grass species. The herbaceous species present are well adapted to grazing; however, species composition can be altered through continued overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. This plant community is reaching a critical point where continued overgrazing will likely shift this community over a threshold leading to a short grass and grass-like dominated state. The shorter, more grazing tolerant species tend to self-perpetuate as the shallow, dense rooting structure takes advantage of rainfall and reduces deeper infiltration to the taller species.

Figure 10. Plant community growth curve (percent production by month). SD6103, Black Hills Foot Slopes, cool-season/warm-season co-dominant. Cool-season, warm-season co-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	10	20	28	21	10	5	3		

Pathway 1.1A
Community 1.1 to 1.2

Continuous season-long grazing (stocking levels above carrying capacity for extended portions of the growing season); or heavy grazing in combination with drought will shift the Reference Plant Community (1.1) to the Needle and Thread-Blue Grama/Sedge Plant Community (1.2).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing (proper stocking, alternating season of use, and providing adequate recovery periods); periodic light to moderate grazing possibly including periodic rest; a return to normal precipitation patterns following drought will convert the Needle and Thread-Blue Grama/Sedge Plant Community (1.2) to the Needle and Thread-Prairie Sandreed Plant Community (1.1).

Conservation practices

Prescribed Grazing

State 2
Shortgrass Sod State

This state is a result of continuous season-long grazing, or continuous seasonal grazing, or heavy grazing during extended periods of drought. This type of grazing causes reduced vigor of the selected species (i.e., typically the most desired by grazing ungulates). As the photosynthetic area of these species is repeatedly removed, carbohydrate production needed for root respiration is inadequate and the root systems of these species begin to falter. The shorter, more grazing tolerant species are given the advantage and will dominate the site. In the early stages of this state, mid- and tall grass remnants may be present in sufficient quantities to allow for recovery to the Reference State (1.0). Over time, this recovery will become less likely due to higher runoff and reduced infiltration.

Community 2.1
Sedge/Blue Grama/Broom Snakeweed

This plant community evolved under continuous seasonal grazing; continuous season-long grazing; or from over utilization during extended drought periods. The potential plant community is made up of approximately 65 percent grasses and grass-like species, 10 percent forbs, 15 percent shrubs, and up to about 10 percent trees. Dominant grass and grass-like species include threadleaf sedge, blue grama, and threeawn. Grasses of secondary importance include western wheatgrass, needle and thread, little bluestem, sideoats grama, hairy grama, and prairie Junegrass. Cheatgrass may also invade and become quite prevalent. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, spiny phlox, and Cuman ragweed. Broom snakeweed and small soapweed will typically increase in this plant community. When compared to the Needle and Thread-Prairie Sandreed Plant Community (1.1), short statured species are dominant on this plant community. Tall and mid-grasses have decreased significantly. This vegetation state is very resistant to change due to the increase in the root mat near the surface of the soil which further reduces infiltration. The herbaceous species present are well adapted to grazing. This plant community is less productive than other plant community phases. The thick sod prevents other species from getting established. Lack of litter and reduced plant vigor causes higher soil temperatures, poor water infiltration rates, and high evapotranspiration which give the short statured species a competitive advantage. Soil erosion will be minimal due to the sod forming habit of dominant species in this phase.

Figure 11. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, 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
		3	7	17	25	25	15	7	1		

State 3
Early Successional State

The Early Successional State is the result of very heavy, concentrated disturbance such as intense rodent activity, or livestock concentration areas. This State can also develop as a result of invasion by highly competitive or noxious weed species. Extended periods of drought accompanied by heavy grazing can also push an at-risk plant community phase to this state. In most cases, this phase is dominated by pioneer perennial and annual grass and forb species. Bare ground is also much higher than on any other plant community phase.

Community 3.1
Annual/Pioneer Perennial

This plant community developed under heavy, continuous season-long grazing; frequent and severe defoliation; or other heavy disturbances (e.g., heavy use areas). The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and 0 to 5 percent shrubs and trees. The species present in this phase are highly variable, but often include non-native invasive and early successional

species. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase, and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank) within the existing plant community, and the plant communities on adjacent sites.

State 4
Native/Invaded State

The Native/Invaded State is dominated by native cool- and warm-season grasses, and sub-dominant non-native cool-season grasses. It can be found on areas that would appear to be properly managed with grazing and possibly prescribed burning. Extended periods of non-use and no fire, or long-term light grazing can result in the invasion and establishment of non-native cool-season grasses onto this site. If the native cool-season grasses decline a corresponding increase of non-native cool-season grasses can occur. The non-native cool-season grasses will include, cheatgrass, field brome, Kentucky bluegrass, and smooth brome.

Community 4.1
Needle and Thread-Prairie Sandreed-Non-Native Cool-Season Grasses (<15%)

This plant community develops when non-native cool-season grasses, such as cheatgrass, field brome, smooth brome, or Kentucky bluegrass invade and become established on the site. This may occur due to the sites close proximity to seed sources, expansion from road ditches, improved pastures, other invaded sites, or from contaminated hay. These non-native grasses typically will not exceed 15 percent of total annual production on this site. Repeated seasonal grazing (typically during the summer), or long-term light grazing, or extended periods of non-use and no fire, will allow these non-native cool-season grasses to increase in the plant community. Plant litter accumulates in large amounts when this community first develops. Litter buildup reduces mature native plant vigor and density, and seedling recruitment declines. Eventually litter levels become high enough that plant density decreases. Typically, rhizomatous grasses form small colonies because of a lack of tiller stimulation. The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs and trees. The community is dominated by cool-season grasses. The major grasses include needle and thread, porcupine grass, western wheatgrass, and non-native cool-season grasses. Other grass and grass-like species include prairie sandreed, little bluestem, blue grama, sideoats grama, and threadleaf sedge. This is a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity. However, the presence of annual brome grasses, smooth brome, and Kentucky bluegrass, and other invasive species will begin to alter the soil biotic community and potentially lead to further invasion of non-native species.

Figure 12. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		3	10	23	34	15	6	5	4		

Transition T1B
State 1 to 2

Continuous grazing (stocking levels above carrying capacity for extended portions of the growing season); continuous seasonal grazing (spring or fall); or heavy grazing in combination with drought will result in a transition from the Reference State (1.0) to the Shortgrass Sod State (2.0). This transition will most likely occur from the Needle and Thread-Blue Grama/Sedge Plant Community (1.2).

Transition T1C
State 1 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the

Reference State (1.0) to the Early Successional State (3.0).

Transition T1A
State 1 to 4

Continuous seasonal grazing (summer); long-term light grazing; or no use and no fire; and the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (4.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing including proper stocking rates, change in season of use, adequate time for plant recovery; and a return to normal precipitation patterns following drought will transition the Shortgrass Sod State (2.0) to the Reference State (1.0). This transition may not be fast or feasible.

Conservation practices

Prescribed Grazing

Transition T2B
State 2 to 3

Heavy, continuous season-long grazing; or frequent and severe defoliation; or heavy disturbance will transition the Shortgrass Sod State (2.0) to the Early Successional State (3.0).

Transition T2A
State 2 to 4

Invasion of non-native cool-season grasses combination with a grazing system that allows these non-native grass species to continue to invade and persist on the site will result in a transition from the Shortgrass Sod State (2.0) to the Native/Invaded State (4.0). Normal to above normal precipitation patterns may aid in this transition, especially if it is early spring or late fall precipitation.

Restoration pathway R3A
State 3 to 2

Removal of disturbances coupled with long-term prescribed grazing with change in season of use, and adequate recovery time following grazing may return the Early Successional State (3.0) to the Shortgrass Sod State (2.0). Herbaceous weed control may also be needed. This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T3A
State 3 to 4

Removal of disturbances; herbaceous weed control; possibly seeding to native species; followed by prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery may transition the Early Successional State (3.0) to the Native/Invaded State (4.0). This transition may not be fast or meet management objectives.

Conservation practices

Prescribed Grazing

Herbaceous Weed Control

Transition T4A
State 4 to 2

Continuous grazing (stocking levels above carrying capacity for extended portions of the growing season); continuous seasonal grazing (spring or fall); or heavy grazing in combination with drought will result in a transition the Native/Invaded State (4.0) to the Shortgrass Sod State (2.0).

Transition T4B
State 4 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Native/Invaded State (4.0) to the Early Successional State (3.0).

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Bunchgrass**			280–490	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	210–350	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	70–210	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–70	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–70	–
2	**Mid- Warm-Season Grasses**			70–210	
	little bluestem	SCSC	*Schizachyrium scoparium*	70–140	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	28–70	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	14–70	–
3	**Tall Warm-Season Grasses**			140–280	
	prairie sandreed	CALO	*Calamovilfa longifolia*	140–280	–
	sand bluestem	ANHA	*Andropogon hallii*	0–70	–
	big bluestem	ANGE	*Andropogon gerardii*	0–28	–
4	**Rhizomatous Wheatgrass**			70–140	
	western wheatgrass	PASM	*Pascopyrum smithii*	70–140	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–70	–
5	**Short Warm-Season Grasses**			28–70	
	blue grama	BOGR2	*Bouteloua gracilis*	28–70	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–28	–
6	**Other Native Grasses**			14–70	
	prairie Junegrass	KOMA	*Koeleria macrantha*	14–42	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	14–42	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–42	–
	Sandberg bluegrass	POSE	*Poa secunda*	14–42	–
	timber oatgrass	DAIN	*Danthonia intermedia*	0–28	–
	onespike danthonia	DAUN	*Danthonia unispicata*	0–28	–
	Grass, perennial	2GP	*Grass, perennial*	0–28	–

	threeawn	ARIST	*Aristida*	0–14	–
7	**Grass-Likes**			28–70	
	needleleaf sedge	CADU6	*Carex duriuscula*	28–70	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	0–42	–
8	**Non-Native Cool-Season Grasses**			0	
Forb					
9	**Forbs**			140–210	
	Forb, perennial	2FP	*Forb, perennial*	14–56	–
	fleabane	ERIGE2	*Erigeron*	14–28	–
	American vetch	VIAM	*Vicia americana*	14–28	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	14–28	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	14–28	–
	dotted blazing star	LIPU	*Liatris punctata*	14–28	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	14–28	–
	Indian breadroot	PEDIO2	*Pediomelum*	0–28	–
	beardtongue	PENST	*Penstemon*	14–28	–
	purple prairie clover	DAPU5	*Dalea purpurea*	14–28	–
	scurfpea	PSORA2	*Psoralidium*	14–28	–
	spiny phlox	PHHO	*Phlox hoodii*	14–28	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	14–28	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	14–28	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–14	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–14	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–14	–
	western marbleseed	ONBEO	*Onosmodium bejariense var. occidentale*	0–14	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	0–14	–
	bluebells	MERTE	*Mertensia*	0–14	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–14	–
	cinquefoil	POTEN	*Potentilla*	0–14	–
	goldenrod	SOLID	*Solidago*	0–14	–
Shrub/Vine					
10	**Shrubs**			70–210	
	soapweed yucca	YUGL	*Yucca glauca*	14–70	–
	silver sagebrush	ARCA13	*Artemisia cana*	28–70	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–42	–
	rose	ROSA5	*Rosa*	14–42	–
	field sagewort	ARCA12	*Artemisia campestris*	0–28	–
	leadplant	AMCA6	*Amorpha canescens*	0–28	–
	prairie sagewort	ARFR4	*Artemisia frigida*	14–28	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–14	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–14	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	0–14	–

Tree					
11	**Trees**			0–28	
	ponderosa pine	PIPO	*Pinus ponderosa*	0–28	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–28	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–14	–

Animal community

MLRA 61 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 gray 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 61, the Shallow Sandy 16-20” PZ ecological site provides upland grassland cover with an associated forb component. It was typically part of an expansive grassland landscape that included combinations of Clayey, Loamy, Shallow Loamy, Overflow, Subirrigated, and Terrace ecological sites.

This site provided habitat for species requiring unfragmented grassland. Important habitat features, and components found commonly or exclusively on this site may include sharp-tailed grouse leks; upland nesting habitat for grassland birds, forbs and insects for brood habitat; and a forage source for small and large herbivores. Many grassland and shrub steppe nesting bird populations are declining. Extirpated species include free-ranging American bison, grizzly bear, gray wolf, black-footed ferret, mountain plover, Rocky Mountain locust, and swift fox.

The majority of the Shallow Sandy 16-20” PZ ecological site has remained relatively intact and provides increasingly important habitat for grassland and shrub steppe nesting birds, small rodents, coyote, and a variety of reptiles, amphibians, and insects. Invasive species such as Kentucky bluegrass, and annual brome grasses have impacted the biological integrity of the site for some grassland birds. Changes in historic fire regime and domestic grazing have impacted the forb/shrub/grass percentages.

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: Needle and Thread-Prairie Sandreed (1.1)
Average Production (lb/acre, air-dry): 1,400
Stocking Rate (AUM/acre): 0.38

Plant Community: Needle and Thread-Blue Grama/Sedge (1.2)
Average Production (lb/acre, air-dry): 900*
Stocking Rate (AUM/acre): 0.25*

Plant Community: Sedge/Blue Grama/Broom Snakeweed (2.1)
Average Production (lb/acre, air-dry): Variable*
Stocking Rate (AUM/acre): Variable*

Plant Community: Needle and Thread-Prairie Sandreed-Non-Native Cool-Season Grasses (<15%) (4.1)
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 need to be 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 has 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 forage production on this site. This site is dominated by soils in hydrologic groups B and C. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, 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. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, buffalograss, bluegrass, or smooth brome will result in reduced infiltration and increased 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, hiking, photography, bird watching, and other opportunities. The wide variety of plants that bloom from spring until fall have aesthetic value that appeals to visitors.

Wood products

HNo appreciable wood products are typically present on this site.

Other products

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

Other information

This provisional ecological site concept has passed quality control (QC) and quality assurance (QA) to ensure that the site meets the 2014 NESH standards for a “Provisional” ecological site description (ESD). This is an updated “Previously Approved” ESD that represented a first-generation tier of documentation that met all requirements as an “Approved” ESD as laid out in the 1997 (rev.1, 2003) National Range and Pasture Handbook (NRPH). The requirements for approved status changed with the release of the 2014 National Ecological Site Handbook (NESH). The “Previously Approved” ESD does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that this ESD 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, NRCS; Cynthia Englebert, Range Management Specialist, Forest Service; George Gamblin, Range Management Specialist, NRCS; Ryan Murray, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

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Approval

Suzanne Mayne-Kinney, 7/17/2024

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All ecological sites were written to the Provisional Level by Rick L. Peterson, ESS, Rapid City, SSO in FY20.

The ESDs were reviewed for quality control by Emily Helms, John Hartung, Mitch Faulkner, and Ryan Murray.

All ecological sites were then reviewed and approved at the Provisional Level by David Kraft, Regional ESS, Salina, KS in September 2020.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	04/01/2005
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be present

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2. **Presence of water flow patterns:** Barely observable

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3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent

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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 35-55% occurring in small areas throughout site

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5. **Number of gullies and erosion associated with gullies:** Active gullies should be restricted to areas of concentrated water flow patterns on steeper slopes

6. **Extent of wind scoured, blowouts and/or depositional areas:** Small scoured sites may be observed

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is little to none based on topography and water flow patterns

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 55% or greater of soil surface and maintains soil surface integrity. Soil Stability class is anticipated to be 3 or greater

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Use Soil Series description for depth and color of A-horizon

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Grass canopy and basal cover should reduce raindrop impact and slow overland flow providing increased time for infiltration to occur. Infiltration is rapid to very rapid

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer or soil surface crusting should be present

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional: Mid stature Cool Season Grasses = Mid Stature Warm Season Grasses > Forbs > Short Grasses/Grasslikes = Shrubs

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very Low

14. **Average percent litter cover (%) and depth (in):** Average litter cover is 20-30% with depths of 0.25 to 0.5 inches

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1400 lbs/ac

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:** Threadleaf sedge, Fringed sagewort, Broom Snakeweed, Yucca, and Species found on Noxious Weed List

17. **Perennial plant reproductive capability:** All species are capable of reproducing