USDA Natural Resources Conservation Service

Ecological site R063BY019SD
Closed Depression

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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.

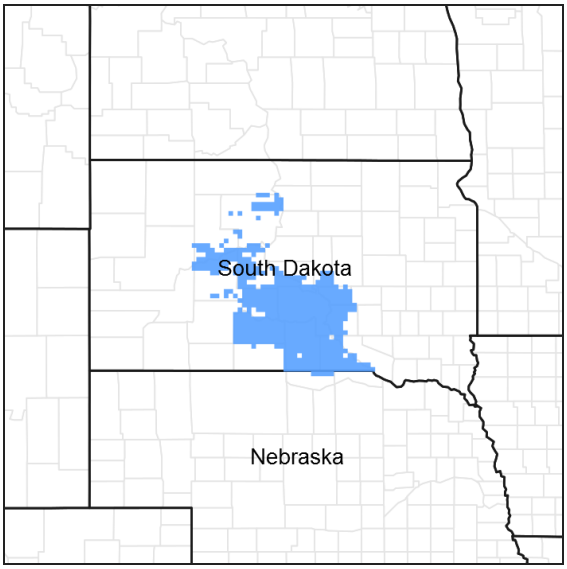


Figure 1. Mapped extent

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): 063B–Southern Rolling Pierre Shale Plains

MLRA Notes:
The Southern Rolling Pierre Shale Plains (MLRA 63B) is approximately 4,460 square miles in size. The majority of the MLRA is located in South Dakota (82 percent), and the remaining 18 percent is located in Nebraska. Interstate 90 crosses the northern portion through Chamberlin, SD. There are several Indian Reservations, including the Lower Brule, Crow Creek, Santee, and Yankton Reservations.
This MLRA is an area of old plateaus and terraces that have been deeply eroded, with nearly level to rolling long slopes and well-defined dendritic drainage systems. The rivers and creek valleys have smooth floors and steep walls. The majority of the MLRA is located in the unglaciated section of the Missouri Plateau, Great Plains Province. The northeast corner of the MLRA, east of the Missouri River, is located in the glaciated section with higher areas having deposits of glacial drift. The southwestern tip is located in the High Plains Section.
Elevations range from 1,310 feet to 1,640 feet on the bottom lands along the Missouri River, and from 1,310 feet to 1,970 feet on the shale plains uplands.
The Missouri and Niobrara Rivers, and the confluence of the White and Missouri Rivers, occur within this MLRA. Lake Francis Case, Fort Randall Dam, and Lewis and Clark Lake are also within the borders of MLRA 63B.
Cretaceous Pierre Shale underlies most of the area. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clays. These clays shrink as they dry and swell as they become wet, causing significant problems for road and structural foundations.

Younger Niobrara chalk occurs in the southern part of the MLRA. Alluvial sand and gravel underlie the valley floors along major streams.

Soils are shallow to very deep, generally well drained, and with loamy or clayey textures. Annual precipitation is 19 to 26 inches, mostly falling during the growing season, as frontal storms during the spring and convective thunderstorms in summer. The average annual temperature is 45°-50°F. The freeze-free period averages 165 days, and ranges from 145 to 185 days.

Vegetation is a transition between tall prairie grasses and mixed prairie grasses. Western wheatgrass, green needlegrass, porcupinegrass, and big bluestem are the major species. Little bluestem, buffalograss, sideoats grama, and sedges are dominant on the shallow soils. Buffaloberry, skunkbush sumac, and prairie rose are common on steep slopes along the major streams. Prairie cottonwood and a variety of willow species are common on flood plains along the major streams. Green ash, boxelder, chokecherry, bur oak, and buffaloberry occur in draws and narrow valleys. Encroachment of Rocky Mountain juniper and eastern redcedar on to the river breaks is becoming a concern.
The majority of the land is utilized for ranching (60 percent) and farming (27 percent). Major resource concerns for the area are wind erosion, water erosion, maintenance of the content of organic matter and soil productivity, and management of soil moisture.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 63B – Southern Rolling Pierre Shale Plains (USDA-NRCS, Ag Handbook 296).

EPA - Level IV Ecoregions of the Conterminous United States:

Northwestern Glaciated Plains - 42f – Southern Missouri Coteau Slopes, 42g – Ponca Plains, 42h – Southern River Breaks, 42p – Holt Tablelands

North Western Great Plains - 43C – River Breaks, 43f – Subhumid Pierre Shale Plains, 43r – Niobrara River Breaks.

Ecological site concept

The Closed Depression ecological site occurs throughout MLRA 63B. It is located on level or nearly level upland landscapes with slopes ranging from 0 to 1 percent. The site is a poorly drained upland depression that will pond water from 15 to 60 days in the spring and after heavy rain events. Soils are formed from clayey alluvium. The texture of the surface layer is silty loam to clay. The high clay content of the subsurface soil layers are restrictive to water movement and root penetration. Depending on climatic cycles, the vegetation can range from nearly pure stands of rhizomatous wheatgrass in dry years to rushes, sedges, and smartweed during wet years.

Some, but not all, Hoven soils will have a Btn horizon that is high in sodium. This soil may have plant communities where inland saltgrass makes up a significant portion of the total annual production.

Associated sites

R063BY010SD	**Loamy** The Loamy site can be found on the higher landscape positions adjacent to or surrounding the Closed Depression site.
R063BY011SD	**Clayey** The Clayey site can be found on the higher landscape positions adjacent to or surrounding the Closed Depression site.

Similar sites

R063BY021SD	**Clayey Overflow** The Clayey Overflow site will have more plant diversity, tall warm-season grasses like big bluestem, more green needlegrass, and shrub species.
R063BY013SD	**Claypan** The Claypan site will typically not occur in a concave depression, will not pond water for any length of time, will have more shortgrass species, and lower forage production than the Closed Depression site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Hordeum jubatum*

Physiographic features

This site occurs on concave to nearly level depressions on uplands.

Table 2. Representative physiographic features

Landforms	(1) Depression
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	Occasional to frequent
Elevation	1,300–2,000 ft
Slope	0–1%
Ponding depth	0–12 in
Water table depth	0–80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 63B is considered to have a continental climate: cold winters and hot summers, low humidity, light rainfall, and ample sunshine. Extremes in temperature may also abound. The climate is the result of the location of MLRA 63B near the geographic center of North America. There are few natural barriers on the Northern Great Plains, and air masses move freely across the plains and account for rapid changes in temperature. Annual precipitation typically ranges from 18 to 25 inches per year. The average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, SD), to about 22°F (Winner, SD). July is the warmest month with temperatures averaging from about 73°F (Stephan, SD), to about 76°F (Winner, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 56°F. This large annual range attests to the continental nature of the climate of this area. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph during the summer. Daytime winds are generally stronger than nighttime, and occasional strong storms may bring brief periods of high winds with gusts to more than 50 mph. 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. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	113-122 days
Freeze-free period (characteristic range)	130-154 days
Precipitation total (characteristic range)	21-24 in

Frost-free period (actual range)	110-126 days
Freeze-free period (actual range)	127-155 days
Precipitation total (actual range)	20-25 in
Frost-free period (average)	118 days
Freeze-free period (average)	141 days
Precipitation total (average)	23 in

Climate stations used

- (1) PICKSTOWN [USC00396574], Lake Andes, SD
- (2) LYNCH [USC00255040], Lynch, NE
- (3) WINNER [USC00399367], Winner, SD
- (4) NIOBRARA [USC00255960], Niobrara, NE
- (5) GANN VALLEY 4NW [USC00393217], Gann Valley, SD
- (6) STEPHAN 2 NW [USC00397992], Highmore, SD
- (7) WOOD [USC00399442], Wood, SD

Influencing water features

This site is occasionally to frequently flooded, in the spring to the late summer months. Annual ponding lasts between 15 and 60 days.

Wetland description

Palustrine System; Emergent Wetland Class (Cowardin System).

Soil features

The common features of soils in this site are the silty loam to clay-textured surface layer, and slopes ranging from 0 to 1 percent. The soils in this site are poorly drained and formed in alluvium. The surface layer is 2 to 9 inches thick. Subsoil textures consist of clay and clay loam. The subsurface soil layers are restrictive to water movement and root penetration and have a very slow infiltration rate. Available water capacity is 4 to 6 inches. Soils will tend to crack when dry, and when they are wet, heavy traffic can cause surface compaction.

Major soils correlated to the Closed Depression site include Hoven, Kolls, Plankinton, and Scott.

The Hoven soil will exhibit an extremely hard clayey Btn horizon that has a round-topped columnar structure. The Btn horizon is high in sodium.

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

Access Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) for specific local soils information.

Table 4. Representative soil features

Parent material	(1) Alluvium–clayey shale (2) Residuum–clayey shale
Surface texture	(1) Silt loam (2) Clay (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Poorly drained

Permeability class	Very slow
Soil depth	80 in
Available water capacity (0-40in)	1–6 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–20
Soil reaction (1:1 water) (0-40in)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0–5%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, natural influences of large herbivores, occasional fire, and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, 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/or species composition.

This site is very sensitive to precipitation fluctuations from year to year. With above average precipitation, the site becomes very wet, leading to a much different plant community than what would be present with average to below average precipitation. In dry years, plant density becomes very low. The two plant communities phases are influenced strongly by precipitation alone (Western Wheatgrass and Grass-likes, Forbs) make up the natural fluctuation of what could be considered the Reference Plant Community (1.1).

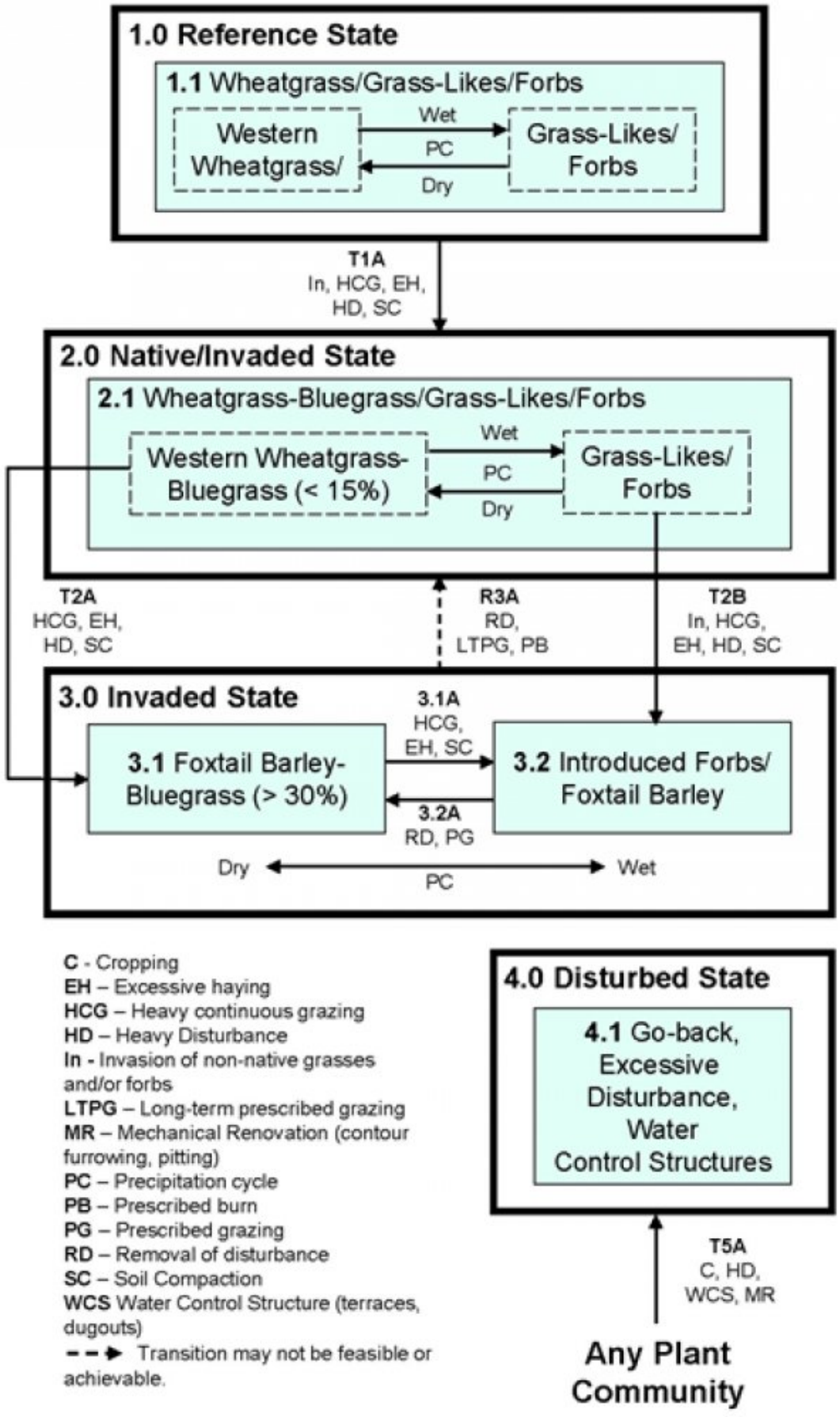
Interpretations are primarily based on the Western Wheatgrass/Grass-Likes/Forbs Plant Community (1.1). These have been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging 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 Reference State may be difficult to locate in this MLRA with the introduction of non-native cool-season grasses. Plant Community Phase
2.1 is most similar to the Reference Plant Community, but a restoration pathway to the Reference State is not believed to be achievable because of the persistence of non-native cool-season grasses.

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition pathways between communities. These are the most common plant community phases based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model

Closed Depression - R063BY019SD 11/17/17



C - Cropping
EH – Excessive haying
HCG – Heavy continuous grazing
HD – Heavy Disturbance
In - Invasion of non-native grasses and/or forbs
LTPG – Long-term prescribed grazing
MR – Mechanical Renovation (contour furrowing, pitting)
PC – Precipitation cycle
PB – Prescribed burn
PG – Prescribed grazing
RD – Removal of disturbance
SC – Soil Compaction
WCS Water Control Structure (terraces, dugouts)
- - → Transition may not be feasible or achievable.

Diagram Legend - Closed Depression - R063BY019SD

T1A	Invasion of non-native cool-season grasses; heavy, continuous grazing without change in season of use or adequate recovery time; and/or excessive haying, heavy disturbance, and soil compaction.
T2A	Heavy, continuous grazing without change in season of use or adequate recovery time, and/or excessive haying, heavy disturbance, and soil compaction.
T2B	Invasion of non-native forbs; heavy, continuous grazing without change in season of use or adequate recovery time; and/or excessive haying, heavy disturbance, and soil compaction.
T5A	Abandoned cropland, heavy disturbance, installation of water control structures, or mechanical range renovation.

R3A	Removal of management-induced disturbance followed by long-term prescribed grazing, including change in season of use and adequate recovery, long- or short-term rest (non-use), and/or prescribed burning. Recovery may not be fast and/or meet management goals.

CP 3.1A	3.1 - 3.2	Heavy, continuous grazing without adequate recovery, and/or excessive haying, and/or soil compaction.
CP 3.2A	3.2 - 3.1	Removal of disturbance followed by prescribed grazing including change in season of use, proper stocking and adequate time for rest and recovery, possibly long- or short-term rest (non-use).

State 1
Reference State

This State represents the natural range of variability that dominates the dynamics of this ecological site. This State is dominated by cool- season grasses, grass-likes and forbs. In pre-European times, the primary disturbance mechanisms for this site in the Reference condition included periods of below-average and above-average precipitation (resulting in alternating periods of ponding and drying), and grazing by large herding ungulates. Timing of grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Today, this State can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Wheatgrass species can decline and a corresponding increase in foxtail barley, warm-season shortgrasses, and forbs will occur. Under extended periods of disturbance, the main change is a reduction in vigor and production and an increase in bare ground and forb composition. The Reference State (1.0) has one plant community (1.1) with two distinct sub-phases as a result of the alternating periods of ponding and drying.

Community 1.1
Wheatgrass/Grass-Likes/Forbs

Figure 8. Closed Depression - PCP 1.1 Wet Phase.

Interpretations are based primarily on the Western Wheatgrass/Grass-likes/Forbs Plant Community, which are also considered to be Reference Plant Community. This plant community evolved with grazing by large herbivores and occasional fire, as well as periodic ponding and drying, and can be maintained with prescribed grazing, prescribed burning, or receiving occasional short periods of rest or deferment. This plant community phase has two sub-phases, referred to as phases in this ecological site description. These sub-phases are mainly driven by precipitation and ponding/drying sequences. Western Wheatgrass Phase (shorter ponding interval): Following several years of above-average precipitation, the plant community stabilizes and becomes dominated with perennial grasses such as western wheatgrass. Other grasses and grass-likes present can include Nuttall's alkaligrass, sedge, rush, and slender wheatgrass. The occurrence of forbs will be considerably lower including some species such as American licorice, curlytop knotweed, Pennsylvania smartweed, Pursh seepweed, and western dock. The plant community is made up of about 80 to 90 percent grasses and grass-likes and about 10 to 20 percent forbs. The total annual production (air-dry weight) of this plant community is typically about 3,500 pounds per acre. Grass-Likes/Forbs Phase (longer ponding interval): This plant community often occurs after a period of higher precipitation that follows an extended dry cycle. Grasses and grass-likes that commonly occur include sedge, spikerush, rush, foxtail barley, western wheatgrass, and bluegrasses. The forbs commonly found include western dock, mint, Pursh seepweed, lambsquarters, knotweed, evening-primrose, golden tickseed (plains coreopsis), and New England aster. The plant community is made up of about 5 to 10 percent grasses, 30 to 40 percent grass-likes, and about 50 to 60 percent forbs. The total annual production (air-dry weight) is about 2,200 pounds per acre.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1845	2363	3050
Forb	155	1137	1450
Total	**2000**	**3500**	**4500**

Figure 10. Plant community growth curve (percent production by month). SD6301, Pierre Shale Plains, cool-season dominant.. Cool-season dominant on uplands..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

State 2
Native/Invaded State

This State is dominated by native and non-native cool-season grasses. The non-native cool-season grasses, primarily Kentucky bluegrass, make up less than 15 percent of the total annual production. This State is the result of heavy, continuous grazing and/or excessive haying, or heavy disturbance which can create soil compaction. The Native/Invaded State is very resilient and resistant to change. This State, like the Reference State (1.0), will have one plant community (2.1) with two distinct sub-phases as a result of the alternating periods of ponding and drying.

Community 2.1
Western Wheatgrass-Bluegrass (< 15%)/Grass-Likes/Forbs

This plant community is the result of invasion of non-native cool-season grasses, heavy, continuous grazing and/or excessive haying. Repeated removal of the leaf area, without adequate time for recovery, will adversely affect the health and vigor of the plant community. Other grass and grass-like species will increase including; Nuttall's alkaligrass, plains bluegrass, common spikerush, needle Spikerush, and other sedges and rushes. Early cool-season grasses, including foxtail barley, fowl bluegrass, and Kentucky bluegrass will invade. Inland saltgrass will increase on sites where salts accumulate in the soil. Forbs that will invade are curly dock and cocklebur. Common forbs to the site include lambsquarters, Pennsylvania smartweed, curlytop knotweed, plantain, and Pursh povertyweed. This plant community is relatively stable, but at-risk if Kentucky bluegrass becomes a dominant component. Plant vigor, frequency, and production have decreased. The biological integrity, water, and nutrient cycles of this plant community are becoming impaired. This plant community is less productive than the Reference Plant Community (1.1).

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1400	1760	1875
Forb	100	440	925
Total	**1500**	**2200**	**2800**

Figure 12. Plant community growth curve (percent production by month). SD6303, Pierre Shale Plains, cool/warm-season codominant.. Cool-season, warm-season codominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

State 3
Invaded State

This State is the result of heavy, continuous grazing and/or excessive haying, or heavy disturbance that creates soil compaction. It is dominated by native and non-native cool-season grasses. The non-native cool-season grasses make up more than 30 percent of the total annual production. Preliminary studies tend to indicate a threshold may be crossed when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community. Plant communities dominated by Kentucky bluegrass will have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014). This State is very resilient and resistant to change.

Community 3.1
Foxtail Barley-Bluegrass (> 30%)

This plant community developed with heavy, continuous grazing where adequate recovery periods between grazing events were not allowed, and/or with excessive haying, or by heavy disturbance and soil compaction. Foxtail barley, Kentucky bluegrass, and fowl bluegrass are well distributed throughout the community. Nuttall's alkaligrass and western wheatgrass have been greatly reduced in production and vigor, and may only persist in remnant amounts. This plant community is resistant to change due to the grazing tolerance of bluegrass. Kentucky bluegrass makes up 30 percent or more of the total annual production. A significant amount of production and diversity has been lost when compared to the Reference Plant Community (1.1). Loss of key cool-season grasses and increased bare ground have negatively impacted energy flow and nutrient cycling. Water infiltration is reduced significantly due to the massive shallow root system, called a "root pan," characteristic of Kentucky bluegrass.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	745	1020	1455
Forb	55	180	345
Total	**800**	**1200**	**1800**

Figure 14. Plant community growth curve (percent production by month). SD6303, Pierre Shale Plains, cool/warm-season codominant.. Cool-season, warm-season codominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	20	28	21	10	5	3	0	0

Community 3.2
Introduced Forbs/Foxtail Barley

This plant community can be reached with heavy, continuous grazing coupled with compaction due to grazing when the soil is saturated. This plant community can also result from long-term ponding and occasional subsequent drying as when this site is developed for a water source. The dominant vegetation includes pioneer annual grasses, forbs, invaders, and early successional biennial and perennial species. Grasses may include foxtail barley, which may become dominant along with fowl bluegrass, Nuttall's alkaligrass, and western wheatgrass. The dominant forbs include curly dock, curlycup gumweed, kochia, cocklebur, and other early successional species. The community is susceptible to invasion of non-native species due to severe soil disturbances and relatively high percent of bare ground. This plant community is resistant to change, as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing plant community and neighboring plant communities.

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods) in conjunction with compaction resulting from grazing that occurs when the soil is saturated will cause this site to shift to the Introduced Forbs/Foxtail Barley Plant Community Phase (3.2). PCP 3.2 tends to develop during wetter precipitation cycles when ponding intervals are longer in duration.

Pathway 3.2A
Community 3.2 to 3.1

Removal of management-induced disturbances coupled with prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will potentially convert this plant community to the Foxtail Barley-Bluegrass (> 30%) Plant Community Phase (3.1). This pathway also requires the return of more normal ponding and drying cycles.

Conservation practices

Prescribed Grazing

State 4
Disturbed State

This State developed through mechanical manipulation of the watershed causing the loss of hydrologic function, biotic integrity, and soil site stability. On existing rangeland, hydrologic function is disrupted through terracing, contour furrowing, or pitting in the area surrounding the closed depression. Other causes include installation of dugouts, severe mechanical disturbance through tillage and conversion to cropland or pastureland.

Community 4.1
Go-back, Excessive Disturbance, Water Control Structures

During the early successional stages, on Go-back lands (abandoned cropland), the species that dominate are annual grasses and forbs, later replaced by both native and introduced perennials. The vegetation on this site varies greatly, sometimes dominated by bluegrass, smooth bromegrass, annual brome, crested wheatgrass, broom snakeweed, sweetclover, and non-native thistles. Other plants that commonly occur on the site include western wheatgrass, deathcamas, prickly lettuce, horseweed, kochia, and foxtail barley. Bare ground is prevalent due to the loss of organic matter and lower overall soil health. Excessive disturbance can be reached when long duration ponding events and/or excessive defoliation occurs. This can result from heavy livestock concentration during wet precipitation cycles, and cropping abandonment (Go-back land). This plant community is resistant to change, as long as soil disturbance or severe vegetation defoliation persists, thus holding back secondary plant succession. Secondary succession is highly variable, depending upon availability and diversity of a viable seed bank of higher successional species within the existing and neighboring plant communities. When runoff flowing into this site is eliminated though construction of water control structures such as terraces or dugouts, or through mechanical range renovation practices such as contour furrowing or pitting, this site is likely to resemble the Claypan ecological site and have similar ecological dynamics.

Transition T1A
State 1 to 2

Invasion of non-native herbaceous species; heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods); and/or excessive haying or heavy disturbance may cause a shift to the Native/Invaded State (2.0). During the wet cycles prior to soils drying, the Reference Plant Community (1.1) is highly susceptible to compaction if heavy grazing occurs when the soil is saturated. This type of disturbance can cause a rapid decline in the native vegetation and a subsequent influx of non-native forb species to occur.

Transition T5A
State 1 to 4

Heavy disturbance, installation of water control structures, mechanical renovation practices, or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Transition T2A & T2B
State 2 to 3

T2A: Heavy, continuous grazing (grazing at full to heavy levels for extended portions of the growing season without adequate recovery periods) and/or excessive haying, or heavy disturbance causing soil compaction will likely lead to the Foxtail Barley-Bluegrass (> 30%) Plant Community Phase (PCP) (3.1) within the Invaded State. This transition is most likely to originate from the drier sub-phase of PCP 2.1 to the drier 3.1 PCP. T2B: Soil compaction due to heavy disturbance when the soils are saturated coupled with heavy continuous grazing and/or excessive haying, and invasion of non-native species may cause a shift to the Introduced Forbs/Foxtail Barley Plant Community (3.2). This combination of disturbances can cause a rapid decline in the native vegetation and a subsequent influx of non-native grasses and forb species to occur. This transition is most likely to originate from the wetter sub-phase of PCP 2.1 to the wetter 3.2 PCP.

Transition T5A
State 2 to 4

Heavy disturbance, installation of water control structures, mechanical renovation practices, or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Restoration pathway R3A
State 3 to 2

Removal of heavy disturbance combined with long-term prescribed grazing that includes alternating season of use

and allowing adequate recovery periods between grazing events, and possibly the use of prescribed burning, may eventually lead this plant community back to the Native/Invaded State (2.0). Due to soil compaction and the high percentage of non-native cool-season grasses, this transition my not be feasible or meet management goals.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T5A
State 3 to 4

Heavy disturbance, installation of water control structures, mechanical renovation practices, or land use conversion to crop or pasture will transition any plant community in this ecological site to the Degraded State (4.0).

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrasses**			700–2975	
	western wheatgrass	PASM	*Pascopyrum smithii*	700–2975	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–175	–
2	**Cool-Season Bunchgrasses**			175–1400	
	foxtail barley	HOJU	*Hordeum jubatum*	70–1225	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	70–525	–
3	**Short Warm-Season Grasses**			1–350	
	saltgrass	DISP	*Distichlis spicata*	0–350	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–175	–
4	**Other Native Grasses**			70–350	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–350	–
	plains bluegrass	POAR3	*Poa arida*	35–175	–
	fowl bluegrass	POPA2	*Poa palustris*	35–175	–
5	**Grass-likes**			350–1575	
	common spikerush	ELPA3	*Eleocharis palustris*	175–1400	–
	needle spikerush	ELAC	*Eleocharis acicularis*	35–525	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–350	–
	sedge	CAREX	*Carex*	70–350	–
	rush	JUNCU	*Juncus*	0–175	–
Forb					
6	**Forbs**			175–2100	
	Forb, native	2FN	*Forb, native*	0–700	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–525	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–525	–
	pale dock	RUAL4	*Rumex altissimus*	0–525	–
	western dock	RUAQ	*Rumex aquaticus*	0–350	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–350	–

	Parish seepweed	SUCA2	*Suaeda calceoliformis*	0–350	
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–350	–
	lambsquarters	CHAL7	*Chenopodium album*	0–350	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–175	–
	golden tickseed	COTI3	*Coreopsis tinctoria*	0–175	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–175	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–175	–
	povertyweed	IVAX	*Iva axillaris*	0–175	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–175	–
	cinquefoil	POTEN	*Potentilla*	0–175	–
	plantain	PLANT	*Plantago*	0–175	–
	mint	MENTH	*Mentha*	0–175	–
	evening primrose	OENOT	*Oenothera*	0–175	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–105	–
	tall fringed bluebells	MECI3	*Mertensia ciliata*	0–105	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–105	–

Table 9. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrasses**			330–1320	
	western wheatgrass	PASM	*Pascopyrum smithii*	330–1320	–
2	**Cool-Season Bunchgrasses**			110–440	
	foxtail barley	HOJU	*Hordeum jubatum*	66–330	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	22–220	–
3	**Short Warm-Season Grasses**			0–440	
	saltgrass	DISP	*Distichlis spicata*	0–440	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–66	–
4	**Other Native Grasses**			0–110	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–110	–
	plains bluegrass	POAR3	*Poa arida*	0–66	–
	fowl bluegrass	POPA2	*Poa palustris*	0–66	–
5	**Grass-likes**			110–550	
	common spikerush	ELPA3	*Eleocharis palustris*	44–330	–
	sedge	CAREX	*Carex*	0–176	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–110	–
	rush	JUNCU	*Juncus*	0–110	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–110	–
6	**Non-Native Grasses**			110–330	
	bluegrass	POA	*Poa*	110–330	–
	cheatgrass	BRTE	*Bromus tectorum*	22–110	–
Forb					
7	**Forbs**			110–770	

	lambsquarters	CHAL7	*Chenopodium album*	0–220	–
	Forb, introduced	2FI	*Forb, introduced*	0–220	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–220	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–220	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–110	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–110	–
	plantain	PLANT	*Plantago*	0–110	–
	Forb, native	2FN	*Forb, native*	0–110	–
	povertyweed	IVAX	*Iva axillaris*	0–110	–
	cocklebur	XANTH2	*Xanthium*	0–110	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–110	–
	New England aster	SYNO2	*Symphyotrichum novae-angliae*	0–66	–
	evening primrose	OENOT	*Oenothera*	0–66	–
	Indianhemp	APCA	*Apocynum cannabinum*	0–66	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–66	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–66	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–66	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–66	–
	pale dock	RUAL4	*Rumex altissimus*	0–66	–
	western dock	RUAQ	*Rumex aquaticus*	0–66	–
	curly dock	RUCR	*Rumex crispus*	0–66	–
	cinquefoil	POTEN	*Potentilla*	0–22	–

Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrasses**			0–60	
	western wheatgrass	PASM	*Pascopyrum smithii*	0–60	–
2	**Cool-Season Bunchgrasses**			240–600	
	foxtail barley	HOJU	*Hordeum jubatum*	240–600	–
	Nuttall's alkaligrass	PUNU2	*Puccinellia nuttalliana*	0–36	–
3	**Short Warm-Season Grasses**			60–300	
	saltgrass	DISP	*Distichlis spicata*	60–300	–
4	**Other Native Grasses**			0–60	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–60	–
5	**Grass-likes**			60–240	
	common spikerush	ELPA3	*Eleocharis palustris*	24–180	–
	sedge	CAREX	*Carex*	0–60	–
	needle spikerush	ELAC	*Eleocharis acicularis*	0–60	–
	rush	JUNCU	*Juncus*	0–36	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–36	–
6	**Non-Native Grasses**			180–480	
	bluegrass	POA	*Poa*	180–480	–
	cheatgrass	BRTE	*Bromus tectorum*	24–120	–
Forb					
7	**Forbs**			60–300	
	lambsquarters	CHAL7	*Chenopodium album*	0–180	–
	Forb, introduced	2FI	*Forb, introduced*	0–120	–
	curly dock	RUCR	*Rumex crispus*	0–120	–
	cocklebur	XANTH2	*Xanthium*	0–60	–
	Forb, native	2FN	*Forb, native*	0–60	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–60	–
	povertyweed	IVAX	*Iva axillaris*	0–36	–
	creeping woodsorrel	OXCO	*Oxalis corniculata*	0–36	–
	plantain	PLANT	*Plantago*	0–36	–
	curlytop knotweed	POLA4	*Polygonum lapathifolium*	0–36	–
	Pennsylvania smartweed	POPE2	*Polygonum pensylvanicum*	0–36	–
	bushy knotweed	PORA3	*Polygonum ramosissimum*	0–36	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–36	–
	mealy goosefoot	CHIN2	*Chenopodium incanum*	0–24	–
	Pursh seepweed	SUCA2	*Suaeda calceoliformis*	0–12	–

Animal community

Grazing Interpretations:
The following table lists annual suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, 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 carrying capacity estimates 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. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.
The following suggested initial stocking rates are based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA NRCS, National Range and Pasture Handbook).

Plant Community: Wheatgrass/Grass-Likes/Forbs (1.1)
Average Annual Production (lbs./acre, air-dry): 3500
Stocking Rate (AUM/acre): 0.96

Plant Community: Western Wheatgrass-Bluegrass/Grass-Likes/Forbs (2.1)
Average Annual Production (lbs./acre, air-dry): 2200
Stocking Rate (AUM/acre): 0.60

Plant Community: Foxtail Barley-Bluegrass (> 30%) (3.1)
Average Annual Production (lbs./acre, air-dry): 1200
Stocking Rate (AUM/acre): 0.33

Total annual production on-site 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. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements and added protein will allow 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 group D. Infiltration is slow and runoff potential for this site is high. In many cases, areas with greater than 75 percent ground cover have the greatest potential for higher infiltration and lower runoff. An example of an exception would be an area where shortgrasses form a strong sod and dominate the site.
Dominance by inland saltgrass 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 Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

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

Wood products

No appreciable wood products are typically present on this site.

Other products

Seed harvest of native plant species can provide additional income on this site.

Other information

Revision Notes: “Previously Approved” Provisional
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. This is an updated “Previously Approved”

ESD which represents 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, rev.1, 2003 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 does not contain all tabular and narrative entries as required in the current “Approved” level of documentation, but it is expected that the “Previously Approved” ESD will continue refinement toward an “Approved” status.

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to validate the information in this Provisional Ecological Site Description. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. The final field review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final document.

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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: April Boltjes, Range Management Specialist, (RMS), NRCS; Stan Boltz, RMS, NRCS; and Dana Larsen, RMS, NRCS.

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Approval

David Kraft, 9/10/2018

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ESD updated by Rick L. Peterson on 11/17/17.
Editorial Review by Carla Green Adams.

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
Contact for lead author	Stan Boltz, stanley.boltz@sd.usda.gov, 605-352-1236
Date	02/20/2009
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

2. **Presence of water flow patterns:** None.

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 0 to 10 percent is typical during normal precipitation cycles. Considerably higher amounts can occasionally occur after flooding/drying cycles, up to 50%.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter falls in place. Little movement occurs.

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 can range widely. Readings of 2-3 are not uncommon, but can range up to 5-6. Surface organic matter adheres to the soil surface, but due to the inherent content of soluble salts in these soils, flocculation can readily occur. Soil surface fragments can dissolve quickly when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 4 to 16 inches thick with dark gray colors when moist. Structure typically is thin platy to subangular blocky in the A-horizon.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Infiltration is greatly reduced on this site due to the nature of the soils. Plant composition changes have little effect. Default rating of none to slight is acceptable.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A-horizon naturally has some platy structure. Compaction layers, if formed by management, do not typically persist. Compaction will be difficult to determine. Evidence of compaction can be confirmed by signs of recent concentration of livestock.

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: Wheatgrasses (mid, cool-season) > mid, cool-season bunchgrasses > grass-like species >

Sub-dominant: Forbs >

Other: Short, warm-season grasses > short, cool-season bunchgrasses

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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14. **Average percent litter cover (%) and depth (in):** Litter cover can range widely, from 20 to 70 percent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total annual production ranges from 2,000 to 4,500 pounds/acre, with the reference value being 3,500 pounds/acre (air-dry basis).

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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:** State and local noxious weeds.

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17. **Perennial plant reproductive capability:** Perennial grasses should have vigorous rhizomes or tillers.
