USDA Natural Resources
Conservation Service

Ecological site R060AY040SD
Clayey 16-18" P.Z.

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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.

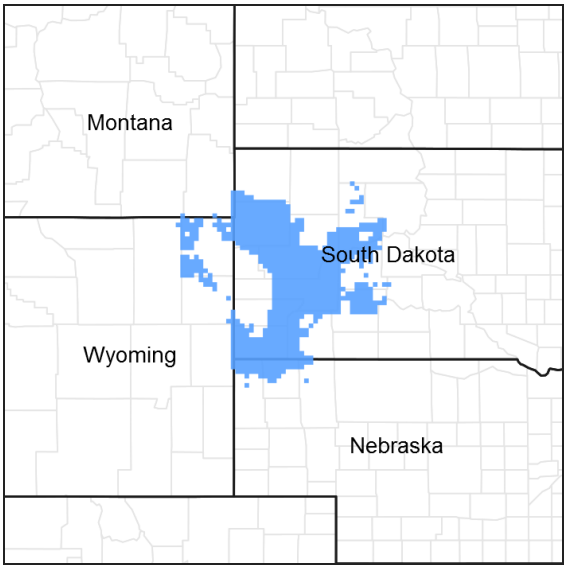

Figure 1. Mapped extent

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): 060A–Pierre Shale Plains

MLRA Notes:
The Pierre Shale Plains (MLRA 60A) consists of approximately 10,150 square miles, the majority of which is located in South Dakota (70 percent) and small portions are in Montana (2 percent), Nebraska (8 percent), and Wyoming (20 percent). It encircles the Black Hills (MLRA 62) and the Dakota Hogback (MLRA 61). MLRA 60A includes portions of the Oglala, Buffalo Gap, and Thunder Basin National Grasslands. It also includes small sections of the Pine Ridge Indian Reservation, Badlands National Park, and Black Hills National Forest. The Cheyenne and Belle Fourche Rivers flow through the MLRA.

MLRA 60A is in the unglaciated section of the Missouri Plateau, of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Cretaceous Pierre Shale underlies almost all of this MLRA. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clay. These clays shrink as they dry and swell as they receive moisture. Soils are shallow to very deep and generally are well drained and clayey.
Elevations generally range from 2,620 to 3,610 feet throughout the MLRA, but can range up to 4,260 feet. The average annual precipitation for the western side of the MLRA is 13 to 16 inches, whereas the eastern side receives 16 to 18 inches. A suite of ecological sites have been written specifically for these two precipitation zones. The Locator Map shows the break between the two precipitation zones.

This area supports a mixed natural prairie vegetation consisting of both cool- and warm-season grasses and forbs. Wyoming big sagebrush occurs primarily in the drier western portion of the MLRA; however, small remnant stands can be found in the eastern portion. Dominant land uses of the area are primarily ranching and, to a lesser extent, farming. Major resource concerns to this MLRA are wind erosion and surface water quality.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 60A – Pierre Shale Plains.

EPA - Level IV Ecoregions of the Continental United States: 43e – Sagebrush Steppe, 43g Semiarid Pierre Shale Plains, and 43k – Dense Clay Prairie.

Ecological site concept

The Clayey 16-18” PZ ecological site occurs on the eastern side of the MLRA. Clayey is the most common ecological site in MLRA 60A. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. Typical slopes range from 0 to 30 percent. Soils are deep with silty clay loam to clay surface textures 3 to 11 inches thick. The vegetation in the Reference State consists of a mix of cool- and warm-season grasses; however, mid-statured cool-season grasses will be the dominant group. Western wheatgrass and needle grasses are the dominant cool-season grasses, while sideoats grama, little bluestem, blue grama, and buffalograss are the dominant warm-season grasses. Forbs are common and diverse, and shrubs are present but are in minor amounts.

Associated sites

R060AY012SD	**Thin Upland** The Thin Upland site can be located in steeper slopes adjacent to the Clayey 16-18” PZ site.
R060AY017SD	**Shallow Clay** The Shallow Clay site can be located on steep slopes above the Clayey 16- 18” PZ site.
R060AY018SD	**Dense Clay** The Dense Clay site can be located adjacent to or mixed with the Clayey 16-19” PZ site.
R060AY021SD	**Clayey Overflow** The Clayey Overflow site can be located on drainageways adjacent to the Clayey 16-18” PZ site.
R060AY041SD	**Loamy 16-18" P.Z.** The Loamy 16-18” PZ site can be located adjacent to the Clayey 16-18” PZ site.

Similar sites

R060AY041SD	**Loamy 16-18" P.Z.** The Loamy 16-18” PZ site will have less green needlegrass and more needle and thread than the Clayey 16-18” PZ site.
R060AY018SD	**Dense Clay** The Dense Clay site will have less green needlegrass, more western wheatgrass, and less shortgrasses than the Clayey 16-18” PZ site.
R060AY021SD	**Clayey Overflow** The Clayey Overflow site will have more big bluestem and higher production than the Clayey 16-18” PZ site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This site occurs on gently undulating to rolling uplands.

Table 2. Representative physiographic features

Landforms	(1) Fan (2) Plain (3) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	762–1,311 m
Slope	0–30%
Ponding depth	0 cm
Water table depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate in this MLRA is typically the drier portion of the Northern Great Plains, where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation in the wetter portion of the MLRA ranges from 16 to 18 inches per year, with most occurring during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permit rapid incoming and outgoing radiation. Cold air masses from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but the more severe storms occur during late fall and late winter, and spring. The normal average annual temperature is about 47°F. January is the coldest month, with average temperatures ranging from about 18°F (Newell, SD) to about 23°F (Oelrichs, SD). July is the warmest month, with average temperatures ranging from about 72°F (Newell, SD) to about 74°F (Oelrichs, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 53°F. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime, and occasional strong storms may 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 can 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 (average)	119 days
Freeze-free period (average)	148 days
Precipitation total (average)	457 mm

Climate stations used

- (1) SAINT ONGE 2 S [USC00397418], Belle Fourche, SD
- (2) WASTA [USC00398911], Owanka, SD
- (3) RAPID CITY RGNL AP [USW00024090], Rapid City, SD
- (4) ARDMORE 1 NW [USC00390236], Edgemont, SD
- (5) OELRICHS [USC00396212], Oelrichs, SD

Influencing water features

No significant water features influence this site.

Soil features

The soils in this site are well drained and formed in shale, residuum from shale or alluvium. The surface layer is 3 to 11 inches thick. The texture of the profile ranges from silty clay loam to clay. The soils have a low to moderate infiltration rate. 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 with numerous debris dams or vegetative barriers. The soil surface is stable and intact. Subsurface soil layers are generally not restrictive to water movement and root penetration. These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about 6 percent.

Major soils correlated to the Clayey 16-18” PZ ecological site include: Bufton, Kyle, Norrest, and Pierre.

More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location.

Table 4. Representative soil features

Surface texture	(1) Silt loam (2) Silty clay loam (3) Silty clay
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	51–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–17.78 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–8 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–13
Soil reaction (1:1 water) (0-101.6cm)	6.1–9
Subsurface fragment volume <=3" (Depth not specified)	0–13%
Subsurface fragment volume >3" (Depth not specified)	0–6%

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, can cause significant shifts in plant communities and/or species composition.

Continuous season-long grazing (during the typical growing season of May through October) and/or repeated seasonal grazing (e.g., every spring, every summer) without adequate recovery periods following each grazing occurrence, causes this site to depart from the Western Wheatgrass-Green Needlegrass Plant Community (1.1). Blue grama and buffalograss will increase and eventually develop into a sod.
Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needle and thread, sideoats grama, and little bluestem will decrease in frequency and production. Excessive defoliation can cause threeawns and annuals to increase and dominate the site.

Extended periods of non-use and/or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as western wheatgrass, and non-native cool-season grasses. Invasion of non-native cool-season grasses, primarily smooth brome and Kentucky bluegrass can alter the dynamics of this site. Once these species establish it is unlikely the plant community will return to the Reference State (1.0).

Encroachment of ponderosa pine, Rocky Mountain juniper, and eastern redcedar may occur from associated sites, and can shift site characteristics. These shifts can alter the site dynamics and potential. Ponderosa pine and Rocky Mountain juniper may occur in small amounts on several Plant Community Phases (PCPs) without adversely affecting the site dynamics.
The plant community upon which interpretations are primarily based is the Reference Plant Community (1.1). The Reference Plant Community has been determined by studying rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following is a diagram that illustrates the common plant communities that can occur on the site and the transitions between communities. The ecological processes are discussed in more detail in the plant community narratives following the diagram.

State and transition model

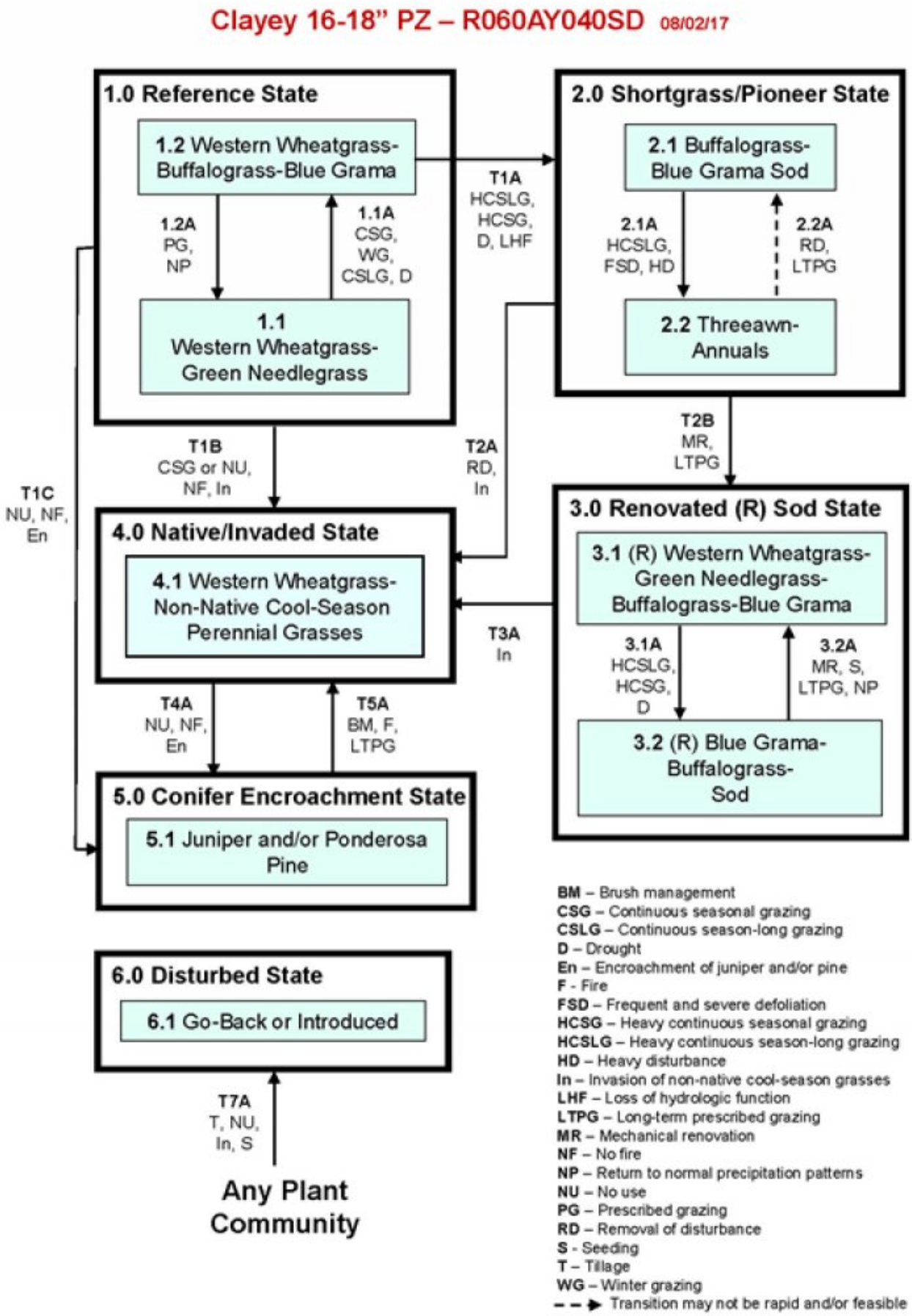

Figure 6. Clayey 16-18" PZ - R060AY040SD

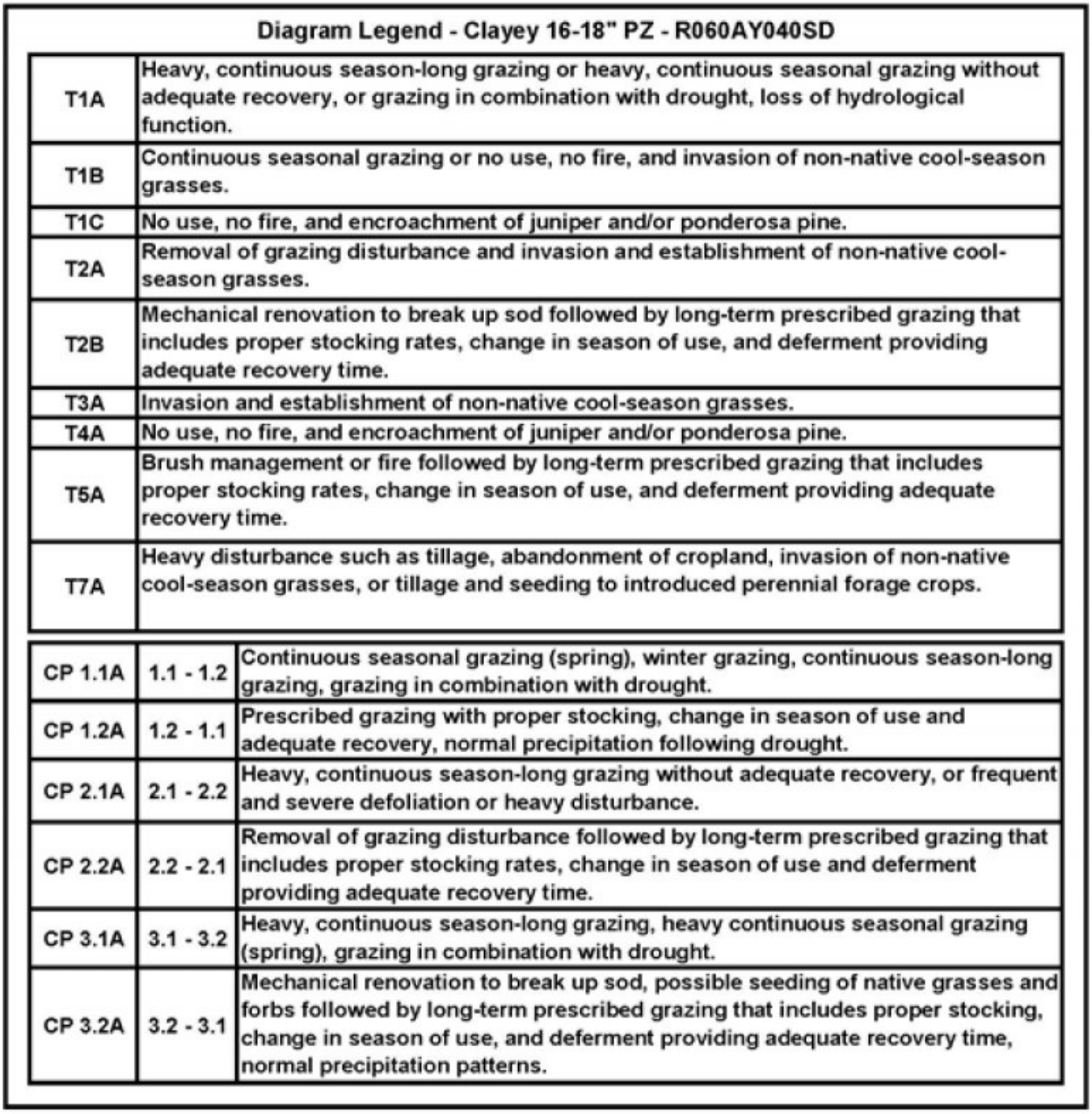

Figure 7. Clayey 16-18" PZ - R060AY040SD

State 1
Reference State

This 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 cool-season grasses and subdominant warm-season grass. Grazing and the lack of grazing, fire, and drought are the major drivers between plant communities. Continuous season-long grazing can push this State to a warm-season shortgrass-dominated State. Non-use, no fire, and invasion of non-native cool-season grasses will result in a transition to a Native/Invaded State (4.0).

Community 1.1
Western Wheatgrass-Green Needlegrass

Figure 8. Clayey 16-18" PZ - PCP 1.1

The plant community upon which interpretations are primarily based is the Western Wheatgrass-Green Needlegrass Plant Community (1.1). This is also considered the Reference Plant Community. The potential vegetation is about 85 to 95 percent grasses or grass-like plants, 5 to 10 percent forbs, and 2 to 5 percent shrubs. Cool-season grasses dominate this plant community. Major grasses include western wheatgrass and green needlegrass. Other grasses occurring on the site include sideoats grama, blue grama, buffalograss, prairie Junegrass, and sedge. Significant forbs include scarlet globemallow, wild parsley, biscuitroot, deer vetch, American vetch, and milkvetch. The significant shrubs that occur include cactus and rose. This plant community is well adapted to the Northern Great Plains climatic conditions. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation and temperature). The diversity in plant species allows for high drought tolerance. Moderate or high available water capacity provides a favorable soil-water-plant relationship. Overall the interpretive plant community has the appearance of being extremely stable, diverse, and productive. Litter normally falls in place, and does not occur in excess amounts. Most plant species have a wide range of age classes represented and reproduction is not limited. Plant roots occupy most of the soil profile, which provides for soil stability and promotes infiltration.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1199	1995	2791
Forb	106	168	230
Shrub/Vine	39	78	118
Total	**1344**	**2241**	**3139**

Figure 10. Plant community growth curve (percent production by month). SD6001, Pierre Shale Plains, cool-season dominant. Cool-season dominant..

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

Community 1.2
Western Wheatgrass-Buffalograss-Blue Grama

This plant community develops under continuous seasonal grazing (i.e., grazing an area during the same season every year) or from over utilization during extended drought periods. The potential vegetation is made up of approximately 80 to 90 percent grasses and grass-like species, 5 to 10 percent forbs and 5 to 10 percent shrubs. The dominant grasses include buffalograss, blue grama, and western and/or thickspike wheatgrass. Other grasses may include green needlegrass, prairie Junegrass and a small amount of Kentucky bluegrass. Significant forbs include scarlet globemallow, wild parsley, biscuitroot, phlox, golden pea, deer vetch, asters, and milkvetch. The significant shrubs that occur include cactus, broom snakeweed, and rose. Compared to the Reference Plant Community (1.1), the shortgrass species including blue grama and buffalograss have increased. The cool- season

species, including western wheatgrass and green needlegrass, have decreased in composition. Annual bromes, curlycup gumweed, sweetclover, and other annual grasses and forbs can invade the site. While plant diversity is relatively high, the structure of the community is dominated by shortgrasses. This plant community is resistant to change. The dominant herbaceous species are very adapted to grazing; however, the midgrass species and the more palatable forbs will decrease in the community through continuous seasonal grazing. If the herbaceous component is intact, it tends to be resilient if disturbance is not long-term. Because of the sod-forming habit of the dominant shortgrass species, water infiltration is low, and runoff is moderate to high. Typically the runoff is very clean because of the low potential for on-site soil erosion; however, off-site areas may be affected by increased runoff.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	706	1715	2275
Shrub/Vine	95	151	207
Forb	95	151	207
Total	**896**	**2017**	**2689**

Figure 12. Plant community growth curve (percent production by month). SD6003, Pierre Shale Plains, cool-season/warm-season co-dominant.. Cool-season, warm-season co-dominant.

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

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing or winter grazing that extends into the active growing period of cool- season plants, and continuous season-long grazing will lead to the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2). Extended periods of drought will expedite this transition.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, which allows for adequate plant recovery periods, and/or a return to normal precipitation patterns will move this plant community to the Western Wheatgrass-Green Needlegrass Plant Community (1.2). Periods of non-use or deferment may be a management option to reach the Reference Plant Community.

State 2
Shortgrass/Pioneer State

The Shortgrass/Pioneer State is dominated by shortgrass species and upland sedges. This State is the result of grazing patterns that did not provide adequate recovery time for cool-season wheatgrasses and needlegrasses. If heavy disturbances such as frequent and severe defoliation and livestock concentration continues, pioneer perennials and annual grass and forb species may become dominant. The hydrologic function of this state is dramatically altered. Runoff is high and infiltration is low. This State is very resistant to change through grazing management alone.

Community 2.1
Buffalograss-Blue Grama Sod

This plant community develops under heavy, continuous season-long grazing, and with continuous seasonal grazing with concentrated use in the early part of the growing season (as in calving/lambing pastures). It is made up of approximately 80 to 90 percent grasses (primarily short-, warm-season grasses), 5 to 10 percent forbs, and 5 to 10 percent shrubs. The dominant grasses include blue grama and buffalograss. Other grasses may include western

wheatgrass, prairie Junegrass, threeawn, and annual brome. The dominant forbs include slimflower scurfpea, pussytoes, curlycup gumweed, and scarlet globemallow. The dominant shrub is plains pricklypear. Compared to the Reference Plant Community (1.1), shortgrasses have increased, and the cool-season midgrasses have diminished greatly. Some forbs and cacti have either increased and/or invaded the site. Plant diversity is low. This plant community is very stable. Generally, this plant community will require significant management inputs (i.e., high animal impact, long term prescribed grazing, favorable climatic conditions, etc.) and time to move it toward the Western Wheatgrass-Buffalograss-Blue Grama Plant Community (1.2). On-site soil erosion is low. Infiltration is low and runoff is high. Typically the runoff is very clean because of the low potential for on-site soil erosion. However, off-site areas can be significantly impacted due to the increased runoff.

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	381	666	841
Shrub/Vine	34	59	84
Forb	34	59	84
Total	**449**	**784**	**1009**

Figure 14. Plant community growth curve (percent production by month). SD6005, Pierre Shale Plains, warm-season dominant. Warm-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	5	15	25	30	15	7	1	0	0

Community 2.2
Threeawn-Annuals

This plant community develops under heavy, continuous season-long grazing and/or frequent and severe defoliation, and/or heavy disturbance such as livestock feeding areas. The potential plant community is made up of approximately 50 to 85 percent grasses and grass- like species, 10 to 25 percent forbs, and 5 to 25 percent shrubs. The dominant grasses include threeawn and annual brome grasses. Other grasses may include blue grama, buffalograss, sedges, western wheatgrass, and sixweeks fescue. The dominant forbs include fringed sagewort, fetid marigold, western ragweed, pussytoes, prostrate verbena, and other annual invader-like species. Other plant species from adjacent ecological sites can become minor components of this plant community. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percentage of bare ground. Compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), red threeawn, annual brome grasses, and percentage of bare ground has increased. Western wheatgrass, needlegrasses and other cool-season grasses and grass-like species have decreased, as have the warm-season species including sideoats grama, blue grama, and buffalograss. Many annual and perennial forbs, including native and non-native species, have invaded the site. This plant community is resistant to change back to a higher successional plant community because of the loss of plant diversity and overall soil disturbance. It is very susceptible to invasion of non-native plant species. The potential for soil erosion is 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 toward another plant community. This movement is highly variable in its succession.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	342	529	717
Shrub/Vine	34	118	202
Forb	73	138	202
Total	**449**	**785**	**1121**

Figure 16. Plant community growth curve (percent production by month). SD6003, Pierre Shale Plains, cool-season/warm-season co-dominant.. Cool-season, warm-season co-dominant.

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

Pathway 2.1A
Community 2.1 to 2.2

Heavy, continuous season-long grazing or frequent and severe defoliation will move this plant community to the Threeawn-Annuals Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

After removal of the heavy disturbance causing the severe defoliation followed by long-term prescribed grazing, including adequate recovery periods, this plant community will likely move to the Buffalograss-Blue Grama Sod Plant Community (2.1).

State 3
Renovated (R) Sod State

The forage production potential of a shortgrass plant community can be quickly improved through mechanical renovation. Mechanical renovation creates microrelief that can restore hydrologic function by increasing infiltration and decreasing runoff. These factors favor cool- season species such as western wheatgrass, green needlegrass, and a variety of forbs. Mechanical renovation may not be economically feasible, and the renovation will not be successful if the management activities that created the plant community are not changed.

Community 3.1
(R) Western Wheatgrass-Green Needlegrass-Buffalograss

With proper management after renovation (R), this plant community will have similar plant composition and growth curve characteristics as the Reference PCP (1.1); however, the production will likely be slightly higher, depending on the degree of alteration. Proper grazing management must be implemented to maintain this plant community.

Community 3.2
(R) Blue Grama-Buffalograss Sod

This plant community will be similar to the Blue Grama-Buffalograss Sod Plant Community (2.1) in most respects. The main difference is the microrelief created by the renovation. Depending on the renovation technique, the microrelief can remain on the landscape for many decades, making vehicular travel across the landscape uncomfortable if not extremely difficult.

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous season-long grazing or heavy, continuous seasonal grazing and drought will shift this plant community to the renovated (R) Blue Grama-Buffalograss Sod Plant Community (3.2). Proper grazing management must be included in order to derive the benefits of renovation.

Pathway 3.2A
Community 3.2 to 3.1

This plant community can be returned to (R) Western Wheatgrass-Green Needlegrass-Buffalograss-Blue Grama Plant Community Phase (3.1) through another mechanical renovation treatment, and possibly seeding, followed by long-term prescribed grazing and normal precipitation patterns. The 2nd mechanical treatment may make travel

across the landscape difficult for vehicles and livestock.

State 4
Native/Invaded State

This State has been invaded by smooth brome and/or Kentucky bluegrass, but not at the levels where the plant communities are dominated by these species. Long-term non-use, in combination with above average precipitation, may transition a native/non-native cool-season grass plant community phase (PCP) to a predominantly non-native PCP. This scenario has been observed on this ecological site in small acreage field but not on larger tracts of land. This transition can be observed in the adjacent MLRAs: MLRA 63A – Northern Rolling Pierre Shale Plains, MLRA 61 – Black Hills Foot Slopes, and MLRA 62 – Black Hills. Once these species are established, it is unlikely that an invaded plant community can be returned to the Reference State (1.0).

Community 4.1
Western Wheatgrass-Non-Native Cool-Season Grasses

This plant community developed under continuous seasonal grazing, or under extended periods of non-use and no fire where a heavy litter layer builds up that can favor cool-season species and invasion of smooth brome, Kentucky bluegrass, annual brome, and other invaders. Initially, the dominant grasses include bluegrass, western wheatgrass, needle and thread, and green needlegrass. Other grasses may include blue grama, buffalograss, threeawn, and prairie Junegrass. Sedges will flourish in the understory. The dominant forbs include western ragweed, scurfpeas, cudweed sagewort, and verbenas. Dominant shrubs in this community include snowberry, rose, and plains pricklypear. This plant community is resistant to change, and if disturbed, it is resilient. Bluegrass and smooth brome will increase under grazing pressure. Cool, moist climatic conditions will also tend to increase the non-native cool-season grass production. Soil erosion is low. Compared to the Reference PCP (1.1), infiltration is reduced, and runoff increases. Once this plant community is reached, time and external resources will be needed to see any immediate recovery in the diversity of the site.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	796	1533	2034
Forb	84	179	280
Shrub/Vine	17	54	95
Tree	–	27	56
Total	**897**	**1793**	**2465**

Figure 18. Plant community growth curve (percent production by month). SD6001, Pierre Shale Plains, cool-season dominant. Cool-season dominant..

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 5
Conifer Encroachments State

This state is greatly influenced by conifers, primarily ponderosa pine in the northern portion of the MLRA and pine and or Rocky Mountain juniper in the southern portion. Ponderosa pine canopy was found to significantly reduce precipitation reaching the soil surface (average of 30 percent) due to interception in area of intermediate and dense canopy (Wrage, 1994). This state will develop when conifers encroach onto the site from adjacent forest sites or ecological sites that have been invaded. Encroachment and the establishment of conifers on this site is primarily the result of no fire and grazing management that reduced the competitive nature of the native herbaceous plant community. Once conifers become established on this site, non-native cool-season grasses will increase especially in the shaded areas. The site in general will become more droughty, but the shallow-rooted cool-season species will be able to outcompete the deeper rooted native species for available moisture.

Community 5.1
Juniper and/or Ponderosa Pine

Historically, conifers (eastern redcedar, Rocky Mountain juniper, and ponderosa pine) were confined to ridges and steep, shallow slopes located adjacent to this ecological site. Currently, conifers are expanding onto this site due to the suppression of fire. The conifer canopy is greater than 30 percent of mature trees. The understory production is made up of about 50 to 70 percent grasses and grass-like species, 5 to 10 percent forbs, and 10 to 40 percent shrubs or trees. Dominant grasses include bluegrass, annual brome, and threeawn. Other grasses that occur include western wheatgrass, green needlegrass, and prairie Junegrass. Forbs commonly found in this community include western ragweed, verbena, cudweed sagewort, and pussytoes. When compared to the Reference Plant Community (1.1), conifers have increased significantly. The grass component decreases dramatically. Total annual production of the understory also decreases significantly. While the conifer canopy provides excellent protection from the weather for both livestock and wildlife, it is not capable of supporting large numbers of wildlife and livestock due to decreased forage production. This vegetation state is resistant to change. A significant reduction of conifers can only be accomplished through brush management or fire. The vegetation in the understory is capable of enduring fire; however, very hot fires will have a detrimental effect to the plant community. Reclamation of conifer-dominated areas can be costly and prove to be temporary without proper management (i.e., prescribed burning, and prescribed grazing). If the conifer canopy becomes high enough, bare ground and soil erosion will likely increase.

Table 10. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	549	1134	1334
Tree	78	294	560
Forb	78	127	174
Shrub/Vine	78	127	174
Total	**783**	**1682**	**2242**

Figure 20. Plant community growth curve (percent production by month). SD6011, Pierre Shale Plains, heavy conifer canopy. Mature ponderosa pine/juniper overstory. .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3	7	11	24	27	12	5	4	3	2	1

State 6
Disturbed State

This State can be transition to from any Plant Community. The two separate vegetative Plant Communities are highly variable in nature. They are derived through different management scenarios, and are not related successionally. Infiltration, runoff, and soil erosion varies depending on the vegetation present on the site.

Community 6.1
Go-Back or Introduced

The Go-Back Plant Community can be reached whenever severe mechanical disturbance occurs (e.g., tilled and abandoned land, either past or present). During the early successional stages, the species that mainly dominate are annual grasses and forbs, later replaced by both native and introduced perennials. The species vary greatly, sometimes dominated by threeawn, annual brome, crested wheatgrass, buffalograss, dropseeds, broom snakeweed, verbena, sweet clover, mullein, and non-native thistles. Other plants that commonly occur on the site include western wheatgrass, deathcamas, prickly lettuce, mare’s tail, kochia, foxtail, and sunflowers. Bare ground is prevalent due to the loss of organic matter and lower overall soil health. The Introduced Plant Community normally consists of those areas seeded to pubescent or intermediate wheatgrass, alfalfa, crested wheatgrass, or other introduced species. Refer to the associated Forage Suitability Group description in the FOTG for adapted species.

Transition T1A
State 1 to 2

With heavy, continuous seasonal grazing this site will move toward the Shortgrass/Pioneer State (2.0). This would be typical of calving/lambing pastures where the unit is continuously utilized during the late winter through spring. This transition will result in decreases in both forage production and plant species diversity. Heavy, continuous season-long grazing will also move this plant community toward State 2.0. During this transition, the plant community can have the appearance of a mosaic, with sod and mixed grass communities intermingled. As the plant community becomes dominated by shortgrasses, runoff will increase, and infiltration will decrease. This change in hydrologic function can make any restoration very difficult.

Transition T1B
State 1 to 4

Continuous seasonal grazing, or non-use and no fire and invasion of non-native cool-season grasses, including smooth brome and Kentucky bluegrass, will lead to the Native/Invaded State (4.0).

Transition T1C
State 1 to 5

No fire, non-use, and encroachment from adjacent plant sites containing juniper and/or ponderosa pine will move this State toward the Conifer Encroachment State (5.0).

Transition T7A
State 1 to 6

Heavy disturbances including tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0). This transition can happen from any plant community on this site.

Transition T2B
State 2 to 3

Mechanical renovation such as pitting, light disking, chiseling and possible inter-seeding in combination with long-term prescribed grazing may help improve the productivity of the site. This pathway will convert the plant community to the Renovated Sod State (3.0).

Transition T2A
State 2 to 4

If theses plant communities are invaded by non-native cool-season grasses and the heavy disturbance causing the frequent defoliation is removed, these plant communities are likely to transition to the Native/Invaded State (4.0).

Transition T7A
State 2 to 6

Heavy disturbance including tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0). This transition can happen from any plant community on this site.

Transition T3A
State 3 to 4

If this State is invaded by non-native cool-season grasses, this plant community is likely to transition to the Native/Invaded State (4.0).

Transition T7A
State 3 to 6

Heavy disturbance including tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0). This transition can happen from any plant community on this site.

Transition T4A
State 4 to 5

Non-use and encroachment (or escaped) of conifers from adjacent sites will lead to the Conifer Encroachment State (5.0). This occurs when this plant community is protected from natural fires or controlled burning.

Transition T7A
State 4 to 6

Heavy disturbance including tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0). This transition can happen from any plant community on this site.

Transition T5A
State 5 to 4

Wildfire or prescribed burning, or mechanical brush management in combination with long-term prescribed grazing will move this plant community to the Native/Invaded State (4.0).

Transition T7A
State 5 to 6

Heavy disturbance including tillage, abandoned cropland, or seeding to improved pasture species result in a transition to the Disturbed State (6.0). This transition can happen from any plant community on this site.

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Mid Grasses**			1569–1905	
	western wheatgrass	PASM	*Pascopyrum smithii*	785–1233	–
	green needlegrass	NAVI4	*Nassella viridula*	560–785	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–112	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–112	–
2	**Short Grasses & Grass-Likes**			112–336	
	blue grama	BOGR2	*Bouteloua gracilis*	45–224	–
	sedge	CAREX	*Carex*	22–112	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	22–112	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–112	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–112	–
3	**Warm-Season Tall & Mid**			45–336	
	sideoats grama	BOCU	*Bouteloua curtipendula*	45–224	–
	big bluestem	ANGE	*Andropogon gerardii*	0–224	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–112	–
4	**Other Native Grasses**			0–112	
	Grass, annual	2GA	*Grass, annual*	0–112	–

	Grass, perennial	2GP	*Grass, perennial*	0–112	–
Forb					
6	**Forbs/Cryptogams**			112–224	
	Forb, perennial	2FP	*Forb, perennial*	0–45	–
	yarrow	ACHIL	*Achillea*	0–45	–
	onion	ALLIU	*Allium*	0–45	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–45	–
	pussytoes	ANTEN	*Antennaria*	0–45	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–45	–
	aster	ASTER	*Aster*	0–45	–
	milkvetch	ASTRA	*Astragalus*	0–45	–
	false boneset	BREU	*Brickellia eupatorioides*	0–45	–
	thistle	CIRSI	*Cirsium*	0–45	–
	dotted blazing star	LIPU	*Liatris punctata*	0–45	–
	desertparsley	LOMAT	*Lomatium*	0–45	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–45	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–45	–
	bluebells	MERTE	*Mertensia*	0–45	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–45	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–45	–
	beardtongue	PENST	*Penstemon*	0–45	–
	spiny phlox	PHHO	*Phlox hoodii*	0–45	–
	scurfpea	PSORA2	*Psoralidium*	0–45	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–45	–
	goldenrod	SOLID	*Solidago*	0–45	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–45	–
	American vetch	VIAM	*Vicia americana*	0–45	–
	deathcamas	ZIGAD	*Zigadenus*	0–45	–
Shrub/Vine					
7	**Shrubs**			45–112	
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–45	–
	rose	ROSA5	*Rosa*	0–45	–
	snowberry	SYMPH	*Symphoricarpos*	0–45	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–22	–
	pricklypear	OPUNT	*Opuntia*	0–22	–

Table 12. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Mid Grasses**			404–807	
	western wheatgrass	PASM	*Pascopyrum smithii*	404–706	–
	green needlegrass	NAVI4	*Nassella viridula*	101–202	–

	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–101	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–101	–
2	**Shot Grasses & Grass Likes**			303–807	
	blue grama	BOGR2	*Bouteloua gracilis*	202–504	–
	buffalograss	BODA2	*Bouteloua dactyloides*	101–404	–
	sedge	CAREX	*Carex*	101–202	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	20–101	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–101	–
3	**Warm-Season Tall & Mid**			101–202	
	sideoats grama	BOCU	*Bouteloua curtipendula*	101–202	–
	big bluestem	ANGE	*Andropogon gerardii*	0–101	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–61	–
4	**Other Native Grasses**			0–101	
	Grass, annual	2GA	*Grass, annual*	0–101	–
	Grass, perennial	2GP	*Grass, perennial*	0–101	–
	threeawn	ARIST	*Aristida*	0–101	–
5	**Non-Native Grasses**			0–141	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–141	–
	cheatgrass	BRTE	*Bromus tectorum*	0–101	–
Forb					
6	**Forbs/Cryptogams**			101–202	
	sweetclover	MELIL	*Melilotus*	0–101	–
	desertparsley	LOMAT	*Lomatium*	0–61	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–61	–
	aster	ASTER	*Aster*	0–61	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–61	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–61	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–40	–
	American vetch	VIAM	*Vicia americana*	0–40	–
	deathcamas	ZIGAD	*Zigadenus*	0–40	–
	goldenrod	SOLID	*Solidago*	0–40	–
	milkvetch	ASTRA	*Astragalus*	0–40	–
	thistle	CIRSI	*Cirsium*	0–40	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–40	–
	dotted blazing star	LIPU	*Liatris punctata*	0–40	–
	Forb, perennial	2FP	*Forb, perennial*	0–40	–
	yarrow	ACHIL	*Achillea*	0–40	–
	onion	ALLIU	*Allium*	0–40	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–40	–
	pussytoes	ANTEN	*Antennaria*	0–40	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–40	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–40	–
	beardtongue	PENST	*Penstemon*	0–40	–

	spiny phlox	PHHO	*Phlox hoodii*	0–40	–
	scurfpea	PSORA2	*Psoralidium*	0–40	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–40	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–20	–
	bluebells	MERTE	*Mertensia*	0–20	–
	false boneset	BREU	*Brickellia eupatorioides*	0–20	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–20	–
	vervain	VERBE	*Verbena*	0–20	–
Shrub/Vine					
7	**Shrubs**			101–202	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–101	–
	pricklypear	OPUNT	*Opuntia*	0–101	–
	rose	ROSA5	*Rosa*	0–61	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–61	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–40	–
	snowberry	SYMPH	*Symphoricarpos*	0–40	–

Table 13. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Mid Grasses**			78–196	
	western wheatgrass	PASM	*Pascopyrum smithii*	78–118	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	39–78	–
	green needlegrass	NAVI4	*Nassella viridula*	0–39	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–16	–
2	**Short Grasses & Grass-Likes**			314–471	
	buffalograss	BODA2	*Bouteloua dactyloides*	157–275	–
	blue grama	BOGR2	*Bouteloua gracilis*	157–235	–
	sedge	CAREX	*Carex*	39–118	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	8–39	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–39	–
3	**Warm-Season Tall & Mid**			0–39	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–39	–
4	**Other Native Grasses**			0–63	
	Grass, annual	2GA	*Grass, annual*	0–39	–
	Grass, perennial	2GP	*Grass, perennial*	0–39	–
	threeawn	ARIST	*Aristida*	0–39	–
5	**Non-Native Grasses**			0–39	
	cheatgrass	BRTE	*Bromus tectorum*	0–39	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–39	–
Forb					
6	**Forbs/Cryptogams**			39–78	

	sweetclover	MELIL	*Melilotus*	0–78	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–31	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–24	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–24	–
	desertparsley	LOMAT	*Lomatium*	0–24	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–24	–
	aster	ASTER	*Aster*	0–24	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–20	–
	beardtongue	PENST	*Penstemon*	0–16	–
	spiny phlox	PHHO	*Phlox hoodii*	0–16	–
	scurfpea	PSORA2	*Psoralidium*	0–16	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–16	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–16	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–16	–
	dotted blazing star	LIPU	*Liatris punctata*	0–16	–
	milkvetch	ASTRA	*Astragalus*	0–16	–
	thistle	CIRSI	*Cirsium*	0–16	–
	Forb, perennial	2FP	*Forb, perennial*	0–16	–
	yarrow	ACHIL	*Achillea*	0–16	–
	onion	ALLIU	*Allium*	0–16	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–16	–
	pussytoes	ANTEN	*Antennaria*	0–16	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–16	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–16	–
	vervain	VERBE	*Verbena*	0–16	–
	American vetch	VIAM	*Vicia americana*	0–16	–
	deathcamas	ZIGAD	*Zigadenus*	0–16	–
	goldenrod	SOLID	*Solidago*	0–16	–
	fetid marigold	DYPA	*Dyssodia papposa*	0–8	–
Shrub/Vine					
7	**Shrubs**			39–78	
	pricklypear	OPUNT	*Opuntia*	16–63	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–39	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–39	–
	rose	ROSA5	*Rosa*	0–16	–
	snowberry	SYMPH	*Symphoricarpos*	0–16	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–16	–

Table 14. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Mid Grasses**			8–78	

	western wheatgrass	PASM	*Pascopyrum smithii*	8–78	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–16	–
	green needlegrass	NAVI4	*Nassella viridula*	0–8	–
2	**Short Grasses & Grass-Likes**			39–275	
	buffalograss	BODA2	*Bouteloua dactyloides*	8–118	–
	blue grama	BOGR2	*Bouteloua gracilis*	8–118	–
	sedge	CAREX	*Carex*	8–39	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–24	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–8	–
3	**Warm-Season Tall & Mid**			0–24	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–16	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–8	–
4	**Other Native Grasses**			78–275	
	threeawn	ARIST	*Aristida*	78–275	–
	Grass, annual	2GA	*Grass, annual*	0–39	–
	Grass, perennial	2GP	*Grass, perennial*	0–16	–
5	**Non-Native Grasses**			8–78	
	cheatgrass	BRTE	*Bromus tectorum*	8–78	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–16	–
Forb					
6	**Forbs/Cryptogams**			78–196	
	sweetclover	MELIL	*Melilotus*	0–78	–
	fetid marigold	DYPA	*Dyssodia papposa*	16–78	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–39	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	8–39	–
	pussytoes	ANTEN	*Antennaria*	0–39	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	16–39	–
	vervain	VERBE	*Verbena*	8–39	–
	aster	ASTER	*Aster*	0–16	–
	Forb, perennial	2FP	*Forb, perennial*	0–16	–
	yarrow	ACHIL	*Achillea*	0–16	–
	spiny phlox	PHHO	*Phlox hoodii*	0–8	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–8	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–8	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–8	–
	dotted blazing star	LIPU	*Liatris punctata*	0–8	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–8	–
Shrub/Vine					
7	**Shrubs**			39–196	
	prairie sagewort	ARFR4	*Artemisia frigida*	16–118	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	8–78	–
	pricklypear	OPUNT	*Opuntia*	8–78	–

	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–8	–

Table 15. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			359–897	
	western wheatgrass	PASM	*Pascopyrum smithii*	269–717	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	90–269	–
2	**Needlegrass**			90–359	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	36–179	–
	green needlegrass	NAVI4	*Nassella viridula*	36–179	–
3	**Warm Season Short Grasses**			18–143	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–90	–
	blue grama	BOGR2	*Bouteloua gracilis*	18–90	–
4	**Native Grasses and Grass-likes**			90–359	
	sideoats grama	BOCU	*Bouteloua curtipendula*	18–90	–
	sedge	CAREX	*Carex*	36–90	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	36–90	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	18–90	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–54	–
	Grass, perennial	2GP	*Grass, perennial*	0–54	–
	big bluestem	ANGE	*Andropogon gerardii*	0–54	–
	dropseed	SPORO	*Sporobolus*	0–36	–
	sixweeks fescue	VUOC	*Vulpia octoflora*	0–36	–
	threeawn	ARIST	*Aristida*	0–18	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–18	–
5	**Non-native Grasses**			269–717	
	Kentucky bluegrass	POPR	*Poa pratensis*	269–717	–
	cheatgrass	BRTE	*Bromus tectorum*	18–179	–
	smooth brome	BRIN2	*Bromus inermis*	0–90	–
Forb					
6	**Forbs**			90–269	
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	18–143	–
	scurfpea	PSORA2	*Psoralidium*	18–90	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	36–90	–
	vervain	VERBE	*Verbena*	36–72	–
	American vetch	VIAM	*Vicia americana*	18–54	–
	white heath aster	SYER	*Symphyotrichum ericoides*	18–54	–
	goldenrod	SOLID	*Solidago*	18–54	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–36	–
	pussytoes	ANTEN	*Antennaria*	0–36	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–36	–
	Forb, perennial	2FP	*Forb, perennial*	0–36	–

	textile onion	ALTE	*Allium textile*	18–36	–
	spiderwort	TRADE	*Tradescantia*	0–36	–
	goatsbeard	TRAGO	*Tragopogon*	18–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–18	–
	milkvetch	ASTRA	*Astragalus*	0–18	–
	false boneset	BREU	*Brickellia eupatorioides*	0–18	–
	corn gromwell	BUAR3	*Buglossoides arvensis*	0–18	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–18	–
	dotted blazing star	LIPU	*Liatris punctata*	0–18	–
	western marbleseed	ONBEO	*Onosmodium bejariense var. occidentale*	0–18	–
	beardtongue	PENST	*Penstemon*	0–18	–
Shrub/Vine					
7	**Shrubs**			18–90	
	snowberry	SYMPH	*Symphoricarpos*	18–90	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–36	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–36	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–36	–
	pricklypear	OPUNT	*Opuntia*	0–36	–
	rose	ROSA5	*Rosa*	0–36	–
Tree					
8	**Trees**			0–54	
	juniper	JUNIP	*Juniperus*	0–54	–
	ponderosa pine	PIPO	*Pinus ponderosa*	0–54	–

Table 16. Community 5.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Cool-Season Mid Grasses**			504–841	
	green needlegrass	NAVI4	*Nassella viridula*	336–673	–
	western wheatgrass	PASM	*Pascopyrum smithii*	336–673	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	84–252	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–168	–
2	**Short Grasses & Grass-Likes**			84–252	
	blue grama	BOGR2	*Bouteloua gracilis*	34–168	–
	sedge	CAREX	*Carex*	34–135	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	17–84	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–84	–
	buffalograss	BODA2	*Bouteloua dactyloides*	0–84	–
3	**Warm-Season Tall & Mid**			84–252	
	sideoats grama	BOCU	*Bouteloua curtipendula*	84–168	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–84	–

	big bluestem	ANGE	*Andropogon gerardii*	0–84	–
4	**Other Native Grasses**			0–84	
	Grass, annual	2GA	*Grass, annual*	0–84	–
	Grass, perennial	2GP	*Grass, perennial*	0–84	–
	threeawn	ARIST	*Aristida*	0–50	–
5	**Non-Native Grasses**			84–168	
	cheatgrass	BRTE	*Bromus tectorum*	34–135	–
	Kentucky bluegrass	POPR	*Poa pratensis*	0–118	–
Forb					
6	**Forbs/Cryptogams**			84–168	
	sweetclover	MELIL	*Melilotus*	0–84	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–67	–
	aster	ASTER	*Aster*	0–50	–
	Forb, perennial	2FP	*Forb, perennial*	0–50	–
	yarrow	ACHIL	*Achillea*	0–50	–
	dotted blazing star	LIPU	*Liatris punctata*	0–50	–
	scurfpea	PSORA2	*Psoralidium*	0–50	–
	goldenrod	SOLID	*Solidago*	0–50	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–34	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–34	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–34	–
	desertparsley	LOMAT	*Lomatium*	0–34	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–34	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–34	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–34	–
	beardtongue	PENST	*Penstemon*	0–34	–
	spiny phlox	PHHO	*Phlox hoodii*	0–34	–
	onion	ALLIU	*Allium*	0–34	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–34	–
	pussytoes	ANTEN	*Antennaria*	0–34	–
	milkvetch	ASTRA	*Astragalus*	0–34	–
	thistle	CIRSI	*Cirsium*	0–34	–
	deathcamas	ZIGAD	*Zigadenus*	0–34	–
	vervain	VERBE	*Verbena*	0–17	–
Shrub/Vine					
7	**Shrubs**			84–168	
	snowberry	SYMPH	*Symphoricarpos*	0–84	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–84	–
	rose	ROSA5	*Rosa*	0–67	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–67	–
	pricklypear	OPUNT	*Opuntia*	0–34	–
Tree					

8	**Trees**			84–504	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	84–504	–
	eastern redcedar	JUVI	*Juniperus virginiana*	84–504	–

Animal community

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.

Plant Community = Western Wheatgrass-Green Needlegrass 1.1
Average Annual Production (lbs./ac, air-dry) = 2000
Stocking Rate (AUM/ac) = 0.55

Plant Community = Western Wheatgrass-Buffalograss-Blue Grama 1.2
Average Annual Production (lbs./ac, air-dry) = 1800
Stocking Rate (AUM/ac) = 0.49

Plant Community = Buffalograss-Blue Grama Sod 2.1
Average Annual Production (lbs./ac, air-dry) = 700
Stocking Rate (AUM/ac) = 0.19

Plant Community = Threeawn-Annuals 2.2
Average Annual Production (lbs./ac, air-dry) = 700
Stocking Rate (AUM/ac) = 0.19**

Plant Community = Renovated (R) Western Wheatgrass-Green Needlegrass-Buffalograss-Blue Grama 3.1
Average Annual Production (lbs./ac, air-dry) = 2500
Stocking Rate (AUM/ac) = 0.68**

Plant Community = Renovated (R) Blue Grama-Buffalograss Sod 3.2
Average Annual Production (lbs./ac, air-dry) = 900
Stocking Rate (AUM/ac) = 0.25**

Plant Community = Western Wheatgrass-Non-Native Cool-Season Perennial Grasses 4.1
Average Annual Production (lbs./ac, air-dry) = 1600
Stocking Rate (AUM/ac) = 0.44**

Plant Community = Juniper and/or Ponderosa Pine 5.1
Average Annual Production (lbs./ac, air-dry) = 500
Stocking Rate (AUM/ac) = 0.14**

Stocking rates are based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and on 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA NRCS, National Range and Pasture Handbook).

** Stocking rates are highly variable and onsite evaluation is required.

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 groups C and D. Infiltration varies from very low to moderate, and runoff potential varies from moderate to very 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 high runoff when shortgrasses form a strong sod and dominate the site. Normally, 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 opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an aesthetic value that appeals to visitors.

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 description include: Stan Boltz, Range Management Specialist, NRCS; Darrel DuVall, Range Management Specialist, NRCS; Jill Epley, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; Rick Peterson, Range Management Specialist, NRCS; Maxine Rasmussen, Range Management Specialist, NRCS; and Mike Stirling, Range Management Specialist, NRCS.

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Approval

David Kraft, 5/28/2019

Acknowledgments

ESD updated by Rick L. Peterson on 8/3/17

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, Ryan Beer, Mitch Iverson, Thad Berrett, Cheryl Nielsen, Emily Helms, Mitch Faulkner, Rick Peterson
Contact for lead author	emily.helms@usda.gov; 605-352-1241
Date	05/09/2019
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, or barely visible and discontinuous.

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.

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

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

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 3 to 6 inches thick with mollic (dark) colors when moist. Structure typically is medium to fine granular at least in the upper A-horizon.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool-season grasses) with fine and coarse roots positively influences infiltration.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None – when dry, B horizons can be hard and appear to be compacted, but no platy structure will be present.

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

    Dominant: Cool-season tall-mid rhizomatous grasses = cool-season tall-mid bunchgrasses >>

    Sub-dominant: Warm-season short grasses = warm-season tall-mid rhizomatous >

    Other: Cool-season short bunchgrasses = forbs > warm-season tall-mid bunchgrasses = grass-likes = sprouting shrubs

    Additional: 12a: Warm-season tall-mid rhizomatous functional/structural (f/s) group may or may not occur in the reference state for this site.

    12b: Non-native invasive plants such as Kentucky bluegrass, smooth brome, crested wheatgrass, and sweetclover do not count towards any f/s groups.

    12c: Number of f/s groups - Nine groups are typically present in reference state.

    12d: Number of species in dominant and subdominant f/s groups - Minimum of two grass species should be present on the site.

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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 does not typically accumulate in inter-spaces.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-**

production): Production ranges from 1,200-2,800 lbs./acre (air-dry weight). Reference value production is 2,000 lbs./acre (air-dry weight).

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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, Kentucky bluegrass, smooth brome, annual bromes, crested wheatgrass, sweetclover

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.
