USDA Natural Resources Conservation Service

Ecological site R062XA042SD
Lowland 22-30 PZ

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Accessed: 05/10/2025

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.

MLRA notes

Major Land Resource Area (MLRA): 062X–Black Hills

The Black Hills (MLRA 62) is a unique, low lying mountain range situated in the midst of a mixed short and mid-grass prairie. It is a true Island in the Plains, as it has geophysical and biological attributes that are unlike the surrounding area. The Black Hills have strong floristic ties to four of the North American biomes: Cordilleran (Rocky Mountain) Forest, Northern Coniferous Forest, Eastern Deciduous Forest, and Grasslands.

MLRA 62 is approximately 3,040 square miles in size; 74 percent is located in South Dakota, and 26 percent is in Wyoming. The towns of Lead, Deadwood, Hill City, and Custer, South Dakota, are in this area. U.S. Highways 16 and 385 cross the MLRA. The Black Hills National Forest, Custer State Park, Mt. Rushmore National Monument, Jewel Cave National Monument, and Wind Cave National Park are located in this MLRA.

This area forms the core of the Black Hills and the Bear Lodge Mountains where the elevation ranges between 3,600 to 6,565 feet, however, Black Elk Peak (Harney Peak) rises to 7,242 feet. Slopes range from moderately sloping on some of the high plateaus to very steeply sloping along drainageways and on peaks and ridges. Narrow valleys generally are gently sloping to strongly sloping.

The Black Hills uplift is the product of the Laramide mountain-building episodes that produced most of the ranges in the Rocky Mountains. Uplift began near the end of the Cretaceous period, 65 million years ago and ended by 35 million years ago (Froiland 1999). The core of the Black Hills is a plutonic mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, which directly surrounds the granite core. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock core. The Madison limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Madison limestone.

The dominant soil orders in this MLRA are Alfisols (forest soils) and Mollisols (grassland soils). The soils in the area have a frigid or cryic soil temperature regime, a udic or ustic soil moisture regime, and mixed, micaceous, or smectitic mineralogy. They are shallow to very deep, generally well drained, and loamy in texture.

The Black Hills MLRA supports open to dense forest vegetation. Ponderosa pine is the dominant species across the Black Hills. White spruce grows at the higher elevations and along the major drainageways. Bur oak is found intermixed with pine in the northern and eastern fringes of the Black Hills, and Rocky Mountain Juniper is most common in the southern portion of the Black Hills. Aspen is of minor extent throughout the Black Hills area. Roughleaf ricegrass, slender wheatgrass, bearded wheatgrass, poverty oatgrass, Richardson’s needlegrass, and mountain ricegrass are the most common native grasses under open forest stands. The most common native shrubs are common snowberry, bearberry, common juniper, Oregon grape, and Saskatoon serviceberry.

MLRA 62 land ownership is approximately 47 percent private and 53 percent federal. Rangeland and forestland are split almost equally between private and federal ownership (47 percent each). Minor areas of land are privately

owned cropland and urban development. The forestland in this area is used mainly for timber production, recreation, and grazing.

The major resource concerns are soil erosion and surface compaction caused by logging, mining, wildfires, grazing, and urban expansion. The quality of ground and surface water is another concern, especially in the northern part of the Black Hills. The primary cause is contamination from mine waste and septic systems in areas of rural development and urban expansion (USDA-NRCS Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 62 is divided into three Land Resource Units (LRU's) or physiographic zones (A, B, C, and Y). Each LRU has a set of ecological sites that represents these zones.

The LRU is identified in the Ecological Site ID: R062XY000SD; "062X" identifies the MLRA, the next letter "Y" identifies the LRU. Note: The organization of Ecological Site ID's will likely change in the future.

LRU-A includes the northern Black Hills and Bear Lodge Mountains (22-30" PZ); LRU-B includes the high elevation central core of the Black Hills (25-35" PZ); and LRU-C includes the southern portion of the Black Hills (17-21" PZ).

The Forest ecological sites are representative of sites in the Black Hills, Bear Lodge Mountains (MLRA-62), and the surrounding Dakota Hogback (MLRA-61). These sites are separated by elevation, soil temperature regimes, and slope.

The Low Mountain area includes all of the Black Hills, Bear Lodge Mountains, and Dakota Hogback below 6,200 feet in elevation (LRU's A and C). The soils in this area have a frigid soil temperature regime.

The High Mountain area includes all of the Black Hills above 6,200 feet elevation (LRU-B). The soils in this area have a cryic soil temperature regime.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region

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

USDA Forest Service Ecological Subregions- Sections and Subsections of the Conterminous United States:
Black Hills Coniferous Forest Province—M334:
Black Hills Section—334A
Black Hills Foothills Subsection—M334Aa
Black Hills Limestone Plateau-Core Highlands Subsection—M334Ab

Ecological site concept

The Lowland-North ecological site is found throughout MLRA 62.This site is a run-in site and receive additional moisture through occasional overflow during flooding and high-water events, and to a minor extent, runoff from adjacent sites. The slopes range is from 0 to 3 percent. The soil surface layer is 4 to 20 inches in depth with a texture range of silt loam to fine sandy loam. The soils in this site are formed in stratified alluvium. This site occurs on low stream terraces and most vegetation has access to the water table.

Associated sites

R062XA020SD	**Loamy Overflow - North** Loamy Overflow sites may be found upslope or adjacent to the Lowland ecological sites.

Similar sites

R062XC042SD	**Lowland 17-22 PZ** Similar sites with differing precipitation levels found in different LRU's.

Table 1. Dominant plant species

Tree	(1) *Fraxinus pennsylvanica* (2) *Acer negundo*
Shrub	(1) *Symphoricarpos occidentalis* (2) *Prunus virginiana*
Herbaceous	(1) *Andropogon gerardii* (2) *Panicum virgatum*

Physiographic features

The Lowland-North ecological site occurs on nearly level drainageways, low stream terraces, and floodplains.

Table 2. Representative physiographic features

Landforms	(1) Alluvial plain (2) Flood plain (3) Drainageway (4) Stream terrace
Runoff class	Negligible to medium
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	2,900–5,000 ft
Slope	0–3%
Ponding depth	80 in
Water table depth	80 in
Aspect	Aspect is not a significant factor

Climatic features

MLRA 62 is in a microclimate caused by the influence of increased elevation which leads to increased precipitation, moderate air temperature, and lower wind velocities compared to the surrounding Great Plains. In general, the Black Hills climate is a continental type, cold in the winter and hot in the summer.

Growth of cool-season plants begins in April, slowing or ceasing growth by mid-August. Warm-season plants begin growth in May and continue to mid-September. Regrowth of cool-season plants may occur in September and October, depending upon soil moisture availability.

Table 3. Representative climatic features

Frost-free period (characteristic range)	83-104 days
Freeze-free period (characteristic range)	115-130 days
Precipitation total (characteristic range)	19-30 in
Frost-free period (actual range)	70-115 days
Freeze-free period (actual range)	111-135 days
Precipitation total (actual range)	19-30 in

Frost-free period (average)	93 days
Freeze-free period (average)	123 days
Precipitation total (average)	24 in

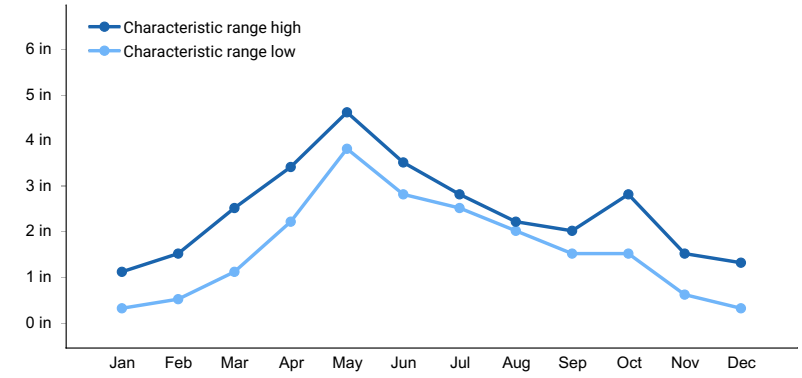


Figure 1. Monthly precipitation range

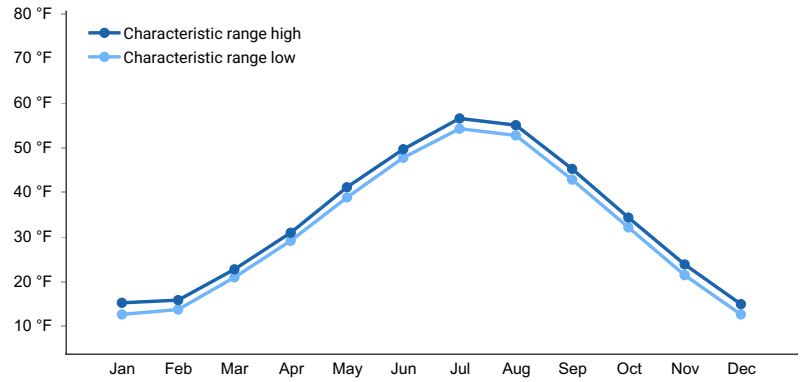


Figure 2. Monthly minimum temperature range

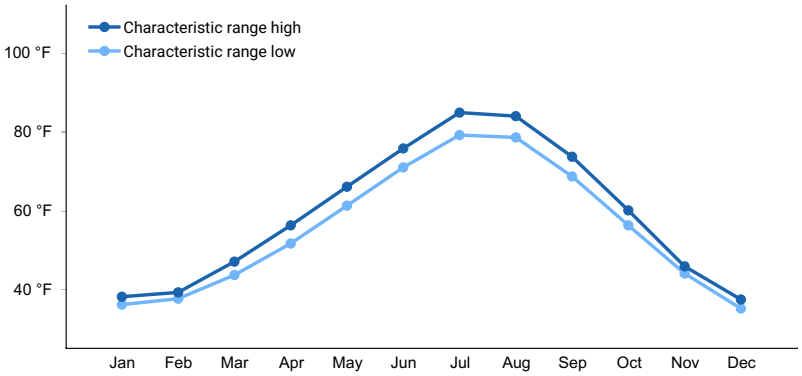


Figure 3. Monthly maximum temperature range

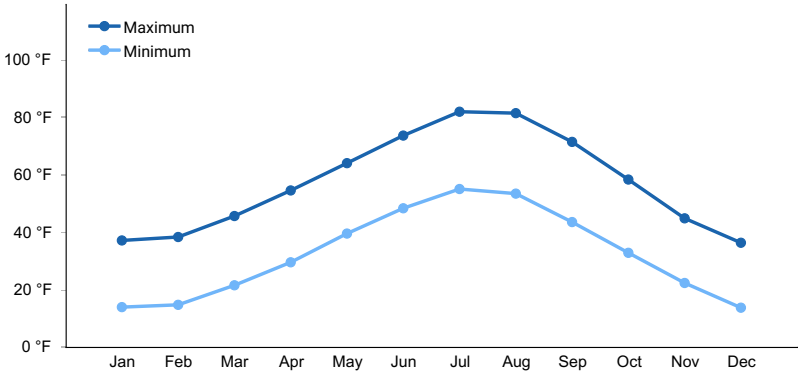


Figure 4. Monthly average minimum and maximum temperature

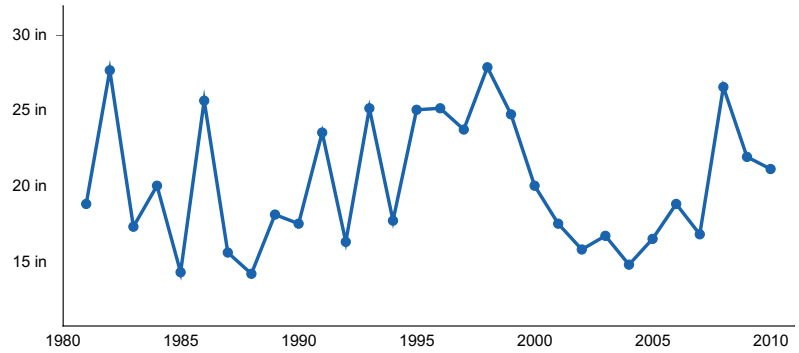


Figure 5. Annual precipitation pattern

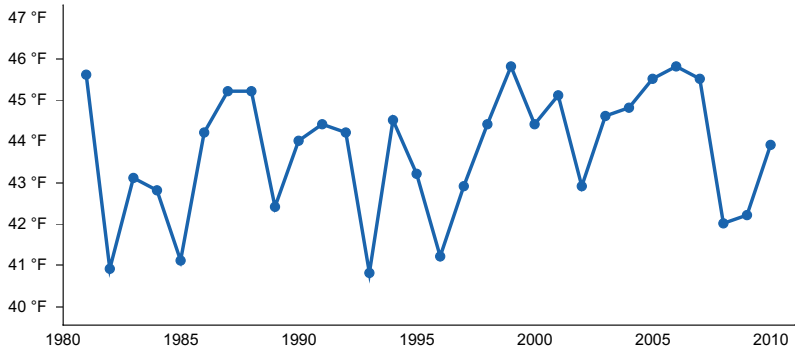


Figure 6. Annual average temperature pattern

Climate stations used

- (1) LEAD [USC00394834], Lead, SD
- (2) SUNDANCE [USC00488705], Sundance, WY
- (3) DEADWOOD 2NE [USC00392209], Whitewood, SD
- (4) PACTOLA DAM [USC00396427], Rapid City, SD
- (5) RAPID CITY 4NW [USC00396947], Rapid City, SD

Influencing water features

The Lowland-North ecological site will be associated with riparian areas and possible wetland features.

Wetland description

While not a true wetland, this site is susceptible to flooding and areas of increased moisture, and may show signs of wetland plants or high water tables.

Soil features

Soils common to the Lowland-North ecological site has a 4 to 20 inches thick silt loam to fine sandy loam surface layer. Sub-surface textures are fine sandy loam to loam. Slopes ranging from about 0 to 3 percent. The soils in this site are well drained and formed in stratified alluvium. They have a moderate to moderately slow infiltration rate. This site is on a low stream terrace and is occasionally flooded. Most vegetation has access to the water table.

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

Major Soils correlated to the Lowland-North ecological site: Coaliams, Rockypoint, and Sodawells. These soils will typically have an occasionally to rarely flooded Local Phase, and a Flooding rating of occasional to rare.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases on slopes greater than

about 10 percent. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and production.

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

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Fine sandy loam (3) Loam
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	80 in
Soil depth	80 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–2%
Available water capacity (0-40in)	5–8 in
Calcium carbonate equivalent (0-40in)	0–20%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0–4
Soil reaction (1:1 water) (0-40in)	5.1–9

Ecological dynamics

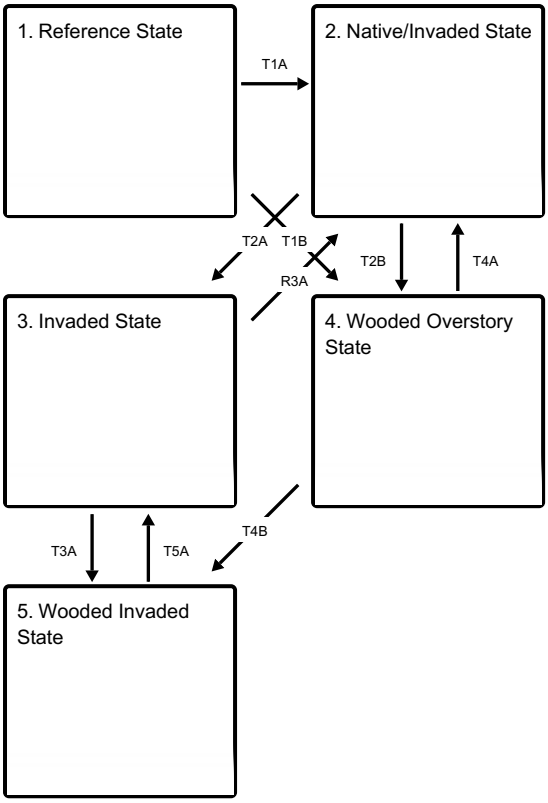
The vegetation in the Reference State (1.0) is a mix of grasses and grass-likes, forbs, shrubs, and tree. Vegetation in reference consists primarily of warm- and cool-season tall and mid grasses. Major grasses included big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Forbs are common and very diverse. Patches of western snowberry, American plum, chokecherry, silver sage, and willow are almost always present. Green ash, boxelder, cottonwood, and in some locations bur oak, will occurred as scattered individuals to larger patches.

This site is susceptible to encroachment of ponderosa pine form the surrounding uplands and breaks and from the invasion of Russian olive. When disturbed, this site is very susceptible to invasion of non-native cool-season grasses, Canada thistle, hound's tongue, and other weedy forbs.

Annual production numbers from this site need to be verified as they are borrowed from MLRA 61. Expect more production than LRU C. Only use what is contained in this guide as a rough estimate of potential.

State and transition model

Ecosystem states



T1A - Continuous season-long grazing; excessive haying; long-term light grazing; or no use and no fire; and the invasion of non-native cool-season grasses.

T1B - Flooding.

T2A - Continuous heavy grazing; excessive haying; or long-term light grazing will result in an increase in non-native cool-season grasses.

T2B - Flooding.

R3A - Long term prescribed grazing, prescribed burns.

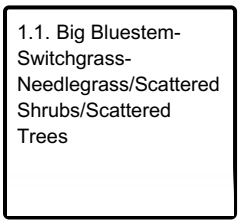
T3A - Tree encroachment.

T4A - Fire; invasion of non-native, cool-season grasses; excessive haying; continuous season-long grazing.

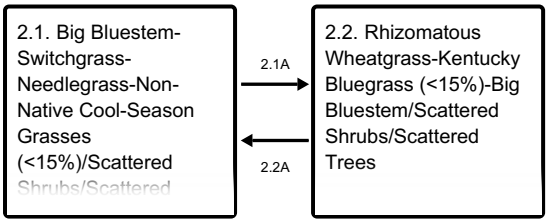
T4B - Tree encroachment.

T5A - Fire, brush management.

State 1 submodel, plant communities



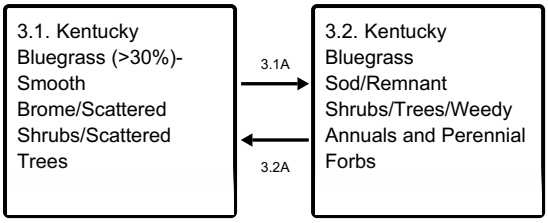
State 2 submodel, plant communities



2.1A - Continuous seasonal grazing.

2.2A - Prescribed grazing.

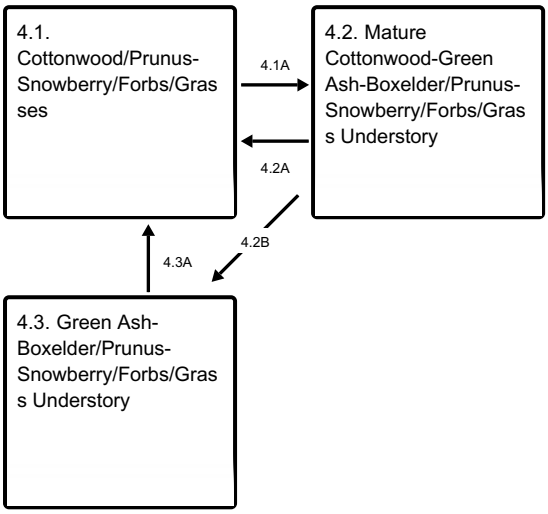
State 3 submodel, plant communities



3.1A - Heavy, continuous seasonal grazing.

3.2A - Prescribed burning followed by prescribed grazing.

State 4 submodel, plant communities



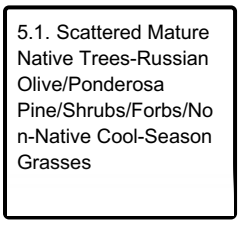
4.1A - No flooding and long-term prescribed grazing .

4.2A - Flooding, and possibly fire.

4.2B - No flooding, no fire, and long-term prescribed grazing.

4.3A - Flooding, and possibly fire.

State 5 submodel, plant communities



State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. Historically, this state ranged from a tall, warm-season grass dominated site to one dominated by deciduous shrubs, saplings, and trees depending upon disturbance regime. The primary disturbance mechanisms for this site in the reference condition included periodic fire and grazing by large herding ungulates. Timing of fires and grazing coupled with weather events dictated the dynamics that occurred within the natural range of variability. Dominance during the herbaceous phases of this state shifted between warm-season and cool-season grasses. Although slight shifts may have occurred in timing of energy capture, hydrologic function, and nutrient cycling between plant community phases within the Reference State (1.0), overall the ecological processes were functioning at near optimum levels. High basal density and deep root systems resulted in low runoff rates and high infiltration rates. Areas of trees and shrubs existed within this state due to irregularity of burn patterns. Areas which escaped fire may have permitted trees and shrubs to become established. These areas may have served as a seed source for further expansion of the woody dominated plant

communities as the fire frequency was altered after settlement.

Dominant plant species

- green ash (*Fraxinus pennsylvanica*), tree
- American elm (*Ulmus americana*), tree
- western snowberry (*Symphoricarpos occidentalis*), shrub
- big bluestem (*Andropogon gerardii*), grass
- switchgrass (*Panicum virgatum*), grass
- American licorice (*Glycyrrhiza lepidota*), other herbaceous
- sunflower (*Helianthus*), other herbaceous

Community 1.1
Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees

Interpretations are based primarily on the Big Bluestem-Switchgrass-Needlegrass/Scattered Shrubs/Scattered Trees Plant Community. This is also considered to be the Reference Plant Community (1.1). This community evolved with grazing by large herbivores and occasional prairie fire. The vegetation was about 70 percent grasses and grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent trees. Major grasses included big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Other grasses that occurred within this community included slender wheatgrass, thickspike wheatgrass, Canada wildrye, little bluestem, sideoats grama, and blue grama. Major forbs and shrubs included American licorice, sunflower, goldenrod, and western snowberry. Green ash, American elm, bur oak, and other native tree species occurred as scattered individuals to larger patches. This plant community was well adapted to the Northern Great Plains climatic conditions. Individual species varied greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle, and energy flow were properly functioning. Due to the diversity of warm- and cool-season species within this plant community phase, energy capture was spread more evenly throughout the growing season compared to other plant community phases within this state. Plant litter was properly distributed in contact with the soil surface and with very little movement offsite. Natural plant mortality was very low. The diversity in plant species allowed for high drought tolerance. Runoff from adjacent sites and moderate or high available water capacity provided a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1935	2480	2950
Shrub/Vine	155	240	350
Tree	155	240	350
Forb	155	240	350
Total	**2400**	**3200**	**4000**

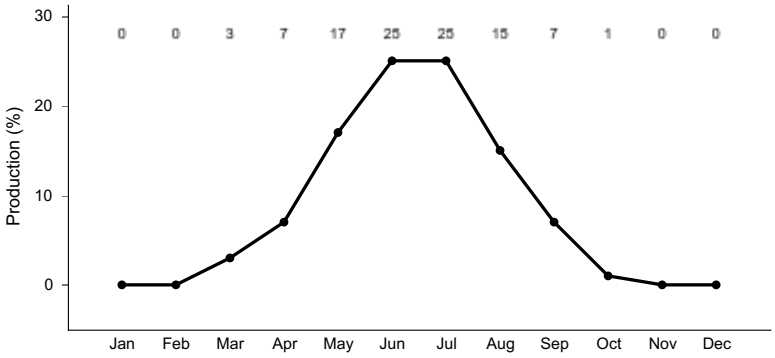


Figure 8. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

State 2

Native/Invaded State

The Native/Invaded State (2.0) represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. The invasion of non-native cool-season grasses has also altered the natural range of variability for this ecological site. Currently this state is dominated by tall native warm-season grasses, but invasive introduced cool-season grasses are now present in all community phases of this state. It 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. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing. Native cool- and warm-season species can decline and a corresponding increase in non-native cool-season grasses will occur. Non-native cool-season grasses will typically make up less than 15 percent of total annual production. Preliminary studies tend to indicate that when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition a threshold has been crossed to an Invaded State (5.0). These invaded plant communities that are dominated by Kentucky bluegrass will have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014).

Dominant plant species

- green ash (*Fraxinus pennsylvanica*), tree
- American elm (*Ulmus americana*), tree
- western snowberry (*Symphoricarpos occidentalis*), shrub
- chokecherry (*Prunus virginiana*), shrub
- big bluestem (*Andropogon gerardii*), grass
- switchgrass (*Panicum virgatum*), grass
- goldenrod (*Solidago*), other herbaceous
- American licorice (*Glycyrrhiza lepidota*), other herbaceous

Community 2.1
Big Bluestem-Switchgrass-Needlegrass-Non-Native Cool-Season Grasses (<15%)/Scattered Shrubs/Scattered Trees

This plant community phase is similar to the Big Bluestem-Switchgrass-Needlegrass/Scattered Shrub /Scattered Trees Plant Community (1.1) but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass. smooth brome, and possibly timothy (up to about 15 percent by air-dry weight). The potential vegetation is about 70 percent grasses or grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent mature trees. The community is dominated by warm-season grasses. Major grasses include big bluestem, switchgrass, green needlegrass, Indiangrass, and western wheatgrass. Other grasses that occur within this community include slender wheatgrass, thickspike wheatgrass, Canada wildrye, little bluestem, sideoats grama, and blue grama. Major forbs and shrubs include American licorice, sunflower, goldenrod, chokecherry, and western snowberry. Green ash, American elm, bur oak, and other native tree species occur as scattered individuals to larger patches. Ecological processes are functioning at levels near what would be expected for the Reference State (1.0) although nutrient cycling may be somewhat altered due to changes in disturbance regimes (lack of fire, frequency and intensity of grazing events) and energy capture may be shifted slightly to more late spring, early summer. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regard to soil and site stability, watershed function, and biologic integrity.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1765	2325	2825
Forb	145	225	325
Shrub/Vine	145	225	325
Tree	145	225	325
Total	**2200**	**3000**	**3800**

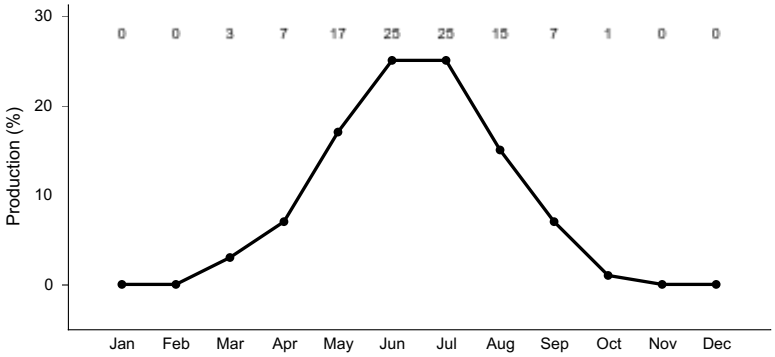


Figure 10. Plant community growth curve (percent production by month). SD6104, Black Hills Foot Slopes, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

Community 2.2
Rhizomatous Wheatgrass-Kentucky Bluegrass (<15%)-Big Bluestem/Scattered Shrubs/Scattered Trees

This plant community is characterized by a shift to mid-cool-season rhizomatous grasses with minor amounts of tall warm-season and mid-cool-season bunchgrasses. The vegetation is about 70 percent grasses and grass-like plants, 10 percent forbs, 10 percent shrubs, and 10 percent trees. Dominant grasses would include western wheatgrass and Kentucky bluegrass with minor amounts of needlegrasses, big bluestem, and switchgrass. Major forbs would include Cumin ragweed (western ragweed), goldenrods, and western yarrow. Chokecherry and snowberry would be the dominate shrubs. Green ash, plains cottonwood, and possibly bur oak will be present in most areas. Energy capture by this plant community phase has shifted from late spring and summer to early spring through early summer.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1370	1783	2150
Shrub/Vine	110	172	250
Tree	110	172	250
Forb	110	173	250
Total	**1700**	**2300**	**2900**

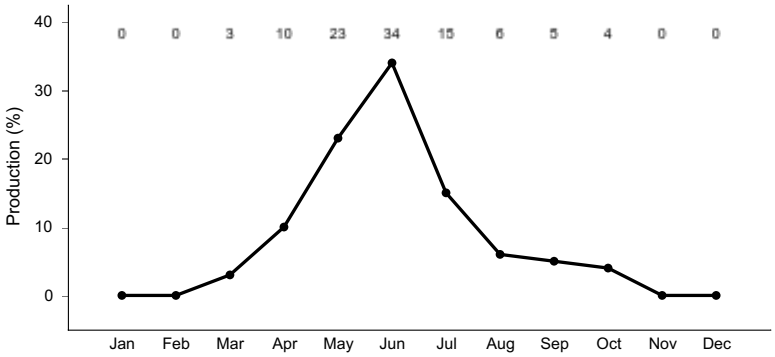


Figure 12. Plant community growth curve (percent production by month). SD6102, Black Hills Foot Slopes, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

Pathway 2.1A
Community 2.1 to 2.2

Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year; or continuous season-long grazing; will shift this community (2.1) to the Rhizomatous Wheatgrass-

Kentucky Bluegrass (<15%)/Shrubs/Scattered Trees Plant Community (2.2).

Pathway 2.2A
Community 2.2 to 2.1

Prescribed grazing (proper stocking levels, alternating season of use, and providing adequate recovery periods); possibly prescribed burning in combination with prescribed grazing; will convert this plant community (2.2) to the Big Bluestem-Switchgrass-Needlegrass-Rhizomatous-Non-Native Cool-Season Grass (<15%)/Shrubs/Scattered Trees Plant Community (2.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Invaded State

This Invaded State (3.0) is the result of invasion and dominance of introduced species. The Invaded State is characterized by the dominance of Kentucky bluegrass and smooth brome, and an increasing thatch layer that effectively blocks introduction of other plants into the system. Plant litter accumulation tends to favor the more shade-tolerant, introduced grass species. The nutrient cycle is also impaired, and the result is typically a higher level of nitrogen, which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns, thereby shifting competitive advantage to shade-tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo, D., et al., 2014). Once this state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch may not result in more than a very short-term reduction of Kentucky bluegrass. These events can reduce the dominance of Kentucky bluegrass, but due to the large amount of rhizomes in the soil, there is little opportunity for the native species to establish and dominate before Kentucky bluegrass rebounds and again dominates the system.

Dominant plant species

- western snowberry (*Symphoricarpos occidentalis*), shrub
- chokecherry (*Prunus virginiana*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

Community 3.1
Kentucky Bluegrass (>30%)-Smooth Brome/Scattered Shrubs/Scattered Trees

This plant community phase is a result of heavy, continuous grazing, excessive haying, or extended periods of non-use and no fire. It is characterized by a dominance of Kentucky bluegrass and smooth brome. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface through non-use. Vegetative production can be variable in this plant community. The period that forage palatability is high is relatively short, as these cool-season species mature rapidly. Grasses constitute about 70 percent of the production with forbs contributing 10 percent, shrubs 10 percent, and trees 10 percent. Dominant forbs include white sagebrush (cudweed sagewort), goldenrod, and American licorice. Shrubs would include snowberry, plum, chokecherry, and prairie rose. Grazing pressure alone cannot induce a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease, and runoff increases. Energy capture into the system is restricted to early season low producing species. The opportunity for high intensity spring burns is reduced by early green-up and increased moisture and humidity at the soil surface. Nutrient cycling

is greatly reduced, and native plants have great difficulty becoming established.

Table 8. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1780	2175	2500
Shrub/Vine	140	290	450
Tree	140	218	325
Forb	140	217	325
Total	**2200**	**2900**	**3600**

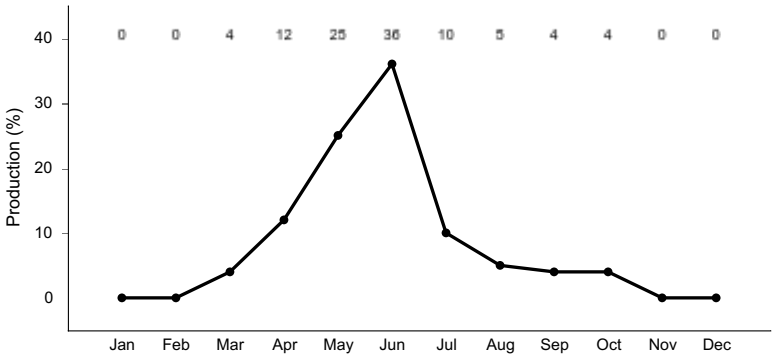


Figure 14. Plant community growth curve (percent production by month). SD6101, Black Hills Foot Slopes, cool-season dominant. Cool-season dominant.

Community 3.2
Kentucky Bluegrass Sod/Remnant Shrubs/Trees/Weedy Annuals and Perennial Forbs

This plant community is characterized by a dense Kentucky bluegrass sod. Kentucky bluegrass is the dominant grass species with minor amounts of other grasses such as western wheatgrass and needlegrass, as well as, grass-likes still represented. Forb species would include curly-cup gumweed, western yarrow, and stiff goldenrod. Shrubs are very limited but may include snowberry. This plant community is resistant to change, and if disturbed, it is resilient. Bluegrass will increase under grazing pressure. Cool, moist climatic conditions will also tend to increase bluegrass production. The opportunity for spring burns can be limited due to lack of fine fuel and early green up. Production is reduced due to lack of plant vigor. Infiltration is greatly reduced due to the dense sod while energy capture is shifted to early spring through early summer.

Table 9. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	875	1120	1335
Forb	75	200	350
Shrub/Vine	75	160	250
Tree	75	120	165
Total	**1100**	**1600**	**2100**

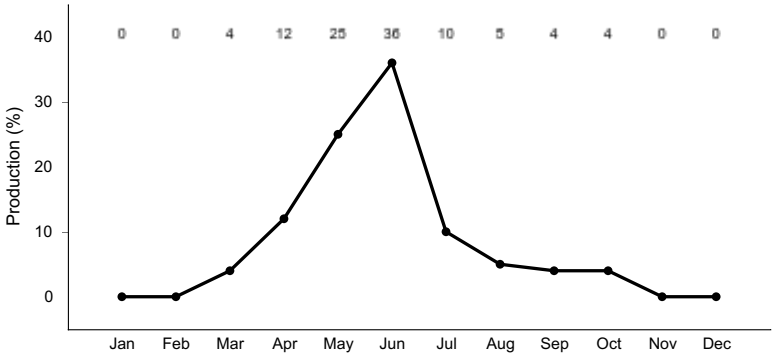


Figure 16. Plant community growth curve (percent production by month). SD6101, Black Hills Foot Slopes, cool-season dominant. Cool-season dominant.

Pathway 3.1A
Community 3.1 to 3.2

Heavy, continuous seasonal grazing (stocking levels well above carrying capacity for extended portions of the growing season, and at the same time of year each year) or heavy, continuous season-long grazing will convert this plant community (3.1) to the Kentucky Bluegrass Sod/Remnant Shrubs/Trees/Weedy Annual and Perennial Forbs Plant Community (3.2).

Pathway 3.2A
Community 3.2 to 3.1

Prescribed burning followed by prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing, possibly including periodic rest, may convert this plant community (3.2) to the Kentucky Bluegrass-Smooth Brome/Scattered Shrubs/Trees Plant Community (3.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 4
Wooded Overstory State

Historically, this state existed as small patches of trees and shrubs scattered across the site. Repeated intense disturbances (e.g., fire coupled with grazing) would have reverted these smaller patches of trees to the herbaceous dominated Reference State (1.0). In pre-European times, periodic low intensity fires typically would have maintained these small, wooded patches in a tree dominated state. Alterations to the historic fire and grazing disturbance regimes have resulted in these scattered tree/shrub patches forming almost continuous woody dominated plant communities across the site. This state is characterized by an overstory of tall trees, an understory of shrubs, and depending upon the amount of canopy cover, an herbaceous understory of grasses, sedges, and forbs. The dynamics of the Wooded Overstory State (4.0) are largely due to flooding and the natural successional changes, starting with cottonwood and shrub establishment, and eventually the development of a green ash and boxelder plant community. The successional process can restart following another flooding event. Water control structures which limit flooding, livestock grazing, heavy wildlife browse, fire, the introduction of non-native, cool-season grasses, and encroachment of juniper can alter the dynamics of this site, resulting in old remnant stands of trees with little, if any regeneration.

Dominant plant species

- eastern cottonwood (*Populus deltoides*), tree
- American plum (*Prunus americana*), shrub
- chokecherry (*Prunus virginiana*), shrub

Community 4.1
Cottonwood/Prunus-Snowberry/Forbs/Grasses

This plant community typically develops after a flooding event. Flooding reduces herbaceous competition through scouring and silt deposition at the soil surface, which provides a site for regeneration and establishment of cottonwood and shrubs. Long-term rest periods during the growing season will be required to allow cottonwood seedlings to reach a height which is out of reach of livestock. Late winter and early spring grazing will also need to be closely monitored to prevent grazing of cottonwood seedlings during early spring leaf development. Restricted grazing during late-summer and fall grazing when browsing is common is also necessary for this plant community to establish. Plains cottonwood develop quickly into a robust tree so grazing deferment may only be required for 3 to 4 years. Trees will range from seedlings to saplings, and the herbaceous understory will still be productive as a result of the filtered canopy of the deciduous trees. Understory shrubs, primarily plum, chokecherry, and snowberry will likely establish. However, other species, including silver buffaloberry, silver sagebrush, big sagebrush, and currants can occur and make up a significance percentage of the shrub layer.

Community 4.2
Mature Cottonwood-Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory

This plant community develops over time with prescribed grazing and no flooding or fire. Mature cottonwood trees and woody shrubs provide a suitable microclimate for establishment of other deciduous trees. Green ash and boxelder are typically the first trees to establish, but other species such as hackberry and possibly bur oak will establish as well. Regeneration of woody species will normally be evident (i.e., seedlings and saplings should be present). The herbaceous plant community will remain relatively productive but will be reduced somewhat from the Reference Plant Community (1.1). This is due mainly to the competition from the woody shrub understory.

Community 4.3
Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory

This plant community develops over time, with prescribed grazing and no flooding. Mature cottonwood trees will likely remain in lesser numbers, but the dominant trees will normally consist of green ash and boxelder. At times there will be a mix of all three species; however, some areas will be dominated by one or two of these species. Woody shrubs will remain in the understory, but typically in lesser amounts than in the previous two plant communities. While somewhat reduced, the herbaceous understory will remain relatively productive. The trees will mostly be in the mature stage, but regeneration will normally be evident (i.e., seedlings and saplings should be present).

Pathway 4.1A
Community 4.1 to 4.2

No flooding and long-term prescribed grazing that manages the herbaceous understory, but is not detrimental to woody regeneration, will allow this plant community (4.1) to develop into the Mature Cottonwood-Immature Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory Plant Community (4.2). Existing saplings must be large enough to avoid damage by livestock and wildlife for this pathway to occur.

Conservation practices

Prescribed Grazing

Pathway 4.2A
Community 4.2 to 4.1

Flooding, and possibly fire, which opens-up the herbaceous understory and allows for woody regeneration, followed by long-term prescribed grazing that manages for woody regeneration and establishment will shift this plant community (4.2) back to the Cottonwood/Prunus-Snowberry/Forbs/Grasses Plant Community (4.1).

Conservation practices

Prescribed Grazing

Pathway 4.2B
Community 4.2 to 4.3

No flooding, no fire, and long-term prescribed grazing that manages the herbaceous understory but is not detrimental to woody regeneration, and time will transition this plant community (4.2) to the Green Ash-Boxelder/Prunus-Snowberry/Forbs/Grass Understory Plant Community (4.3).

Conservation practices

Prescribed Grazing

Pathway 4.3A
Community 4.3 to 4.1

Flooding, and possibly fire, which opens up the herbaceous understory and allows for woody regeneration, followed by long-term prescribed grazing that manages for woody regeneration and establishment will shift this plant community (4.3) back to the Cottonwood/Prunus-Snowberry/Forbs/Grasses Plant Community (4.1).

Conservation practices

Prescribed Grazing

State 5
Wooded Invaded State

The Woody Invaded State develops as a result of continuous season-long grazing, or continuous seasonal grazing and no fire combined with the invasion and establishment of Russian olive, saltcedar, or conifer trees. With time, the cottonwood, boxelder, and ash trees that survive become mature, with little or no regeneration. This is due mainly to grazing of seedlings and saplings. Wildlife browse can also contribute to the loss of native tree and shrub regeneration. Grazing that limits regeneration also results in a reduction of the desirable native herbaceous species, often resulting in a dominance of species such as bluegrass and smooth brome, and forbs such as western ragweed, Canada thistle, burdock, and hound’s tongue.

Dominant plant species

- Russian olive (*Elaeagnus angustifolia*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- cottonwood (*Populus*), tree
- boxelder (*Acer negundo*), tree
- green ash (*Fraxinus pennsylvanica*), tree
- tamarisk (*Tamarix*), shrub

Community 5.1
Scattered Mature Native Trees-Russian Olive/Ponderosa Pine/Shrubs/Forbs/Non-Native Cool-Season Grasses

This plant community developed due to the lack of natural occurring flooding events, native woody regeneration, and continuous season-long grazing without adequate recovery periods. Older mature trees remain, including cottonwood, boxelder, and green ash. The trees are scattered, and the site may have a “park-like” appearance with few trees and reduced understory. If grazed during the winter, the increased durations of livestock loitering can result in manure accumulations and soil compaction which will reduce the vigor of the native understory plant community. Kentucky bluegrass and smooth brome continue to persist as dominant grass species at reduced production rates. The presence of non-desirable forb species such as Canada thistle, burdock, and hound’s tongue can be prolific and difficult to control. When invaded by Russian olive and/or saltcedar these species will increase dramatically over time and will eventually dominate the site.

Transition T1A
State 1 to 2

Continuous season-long grazing; excessive haying; long-term light grazing; or no use and no fire; and the invasion of non-native cool-season grasses will transition the Reference State (1.0) to the Native/Invaded State (2.0).

Transition T1B
State 1 to 4

Flooding, which opens the herbaceous understory and allows for woody establishment; no fire; long-term prescribed grazing to promote tree survival; and an extended period of time will transition the Reference State (1.0) to the Wooded Overstory State (4.0).

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 3

Continuous heavy grazing; excessive haying; or long-term light grazing will result in an increase in non-native cool-season grasses and cause a transition from the Native/Invaded State (2.0) to the Invaded State (3.0). Extended periods of non-use and no fire, and heavy litter build-up will favor non-natives cool-season grasses transition this state to the Invaded State (3.0).

Transition T2B
State 2 to 4

Flooding, which opens the herbaceous understory and allows for woody establishment; no fire; long-term prescribed grazing to promote tree survival; and an extended period of time will transition the Native/Invaded State (2.0) to the Wooded Overstory State (4.0).

Conservation practices

Prescribed Grazing

Restoration pathway R3A
State 3 to 2

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems intended to treat specific species dominance, or periodic light to moderate stocking levels, possibly including periodic rest) may lead the Invaded State (3.0) over a threshold to the Native/Invaded State (2.0). Prescribed burning may also be needed to suppress cool-season invasive grasses. This will likely take a long period of time, possibly up to ten years or more, and recovery may not be attainable. Success depends upon whether native reproductive propagules remain intact on the site.

Conservation practices

Prescribed Burning
Prescribed Grazing

Transition T3A
State 3 to 5

Encroachment of juniper trees from upland sites, or invasion of non-native deciduous trees; no fire for extended periods of time; continuous season-long grazing, or continuous seasonal grazing, and time; will cause a transition from the Invaded State (3.0) to the Wooded Invaded State (5.0). Canopy cover increases as trees increase in size,

which alters microclimate and reduces fine fuel amounts, resulting in reduced fire intensity and frequency.

Transition T4A
State 4 to 2

Fire; invasion of non-native, cool-season grasses; excessive haying; continuous season-long grazing or continuous seasonal grazing resulting in little woody regeneration; and time; will transition the Wooded Overstory State (4.0) to the Native/Invaded State (2.0).

Transition T4B
State 4 to 5

Encroachment of juniper from upland sites, and/or invasion of non-native deciduous trees, coupled with no fire and continuous season-long grazing or continuous seasonal grazing will transition the Wooded Overstory State (4.0) to the Wooded Invaded State (5.0).

Transition T5A
State 5 to 3

Fire, brush management to remove Russian olive; continuous season-long grazing; or continuous seasonal grazing will transition the Wooded Invaded State (5.0) to the Invaded State (3.0).

Conservation practices

Brush Management

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			800–1600	
	big bluestem	ANGE	*Andropogon gerardii*	640–1280	–
	switchgrass	PAVI2	*Panicum virgatum*	160–800	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–320	–
2	**Cool-Season Bunchgrass**			160–640	
	green needlegrass	NAVI4	*Nassella viridula*	160–640	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–160	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–160	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–160	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–160	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–160	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–64	–
3	**Rhizomatous Wheatgrass**			160–320	
	western wheatgrass	PASM	*Pascopyrum smithii*	160–320	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–160	–
4	**Mid- Warm-Season Grasses**			64–160	
	little bluestem	SCSC	*Schizachyrium scoparium*	32–160	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	32–160	–
5	**Short Warm-Season Grasses**			32–160	

5	**Short Warm-Season Grasses**			32–160	
	blue grama	BOGR2	*Bouteloua gracilis*	32–160	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–96	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–64	–
6	**Other Native Grasses**			32–160	
	Grass, perennial	2GP	*Grass, perennial*	0–160	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	32–96	–
	fowl bluegrass	POPA2	*Poa palustris*	0–96	–
7	**Grass-likes**			32–160	
	Sprengel's sedge	CASP7	*Carex sprengelii*	32–160	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–96	–
	clustered field sedge	CAPR5	*Carex praegracilis*	32–96	–
8	**Non-Native Cool-Season Grasses**			0	
Forb					
9	**Forbs**			160–320	
	Forb, native	2FN	*Forb, native*	32–160	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	32–96	–
	goldenrod	SOLID	*Solidago*	32–96	–
	scurfpea	PSORA2	*Psoralidium*	32–96	–
	vervain	VERBE	*Verbena*	32–64	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–64	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	32–64	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	32–64	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	32–64	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–64	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–64	–
	dotted blazing star	LIPU	*Liatris punctata*	0–64	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	32–64	–
	American vetch	VIAM	*Vicia americana*	32–64	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	32–64	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–64	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–32	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–32	–
	northern bedstraw	GABO2	*Galium boreale*	0–32	–
	beardtongue	PENST	*Penstemon*	0–32	–
Shrub/Vine					
10	**Shrubs**			160–320	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	32–160	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–160	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–96	–
	American plum	PRAM	*Prunus americana*	32–96	–
	chokecherry	PRVI	*Prunus virginiana*	32–96	–

	leadplant	AMCA6	*Amorpha canescens*	0–96	–
	rose	ROSA5	*Rosa*	32–64	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–64	–
	hawthorn	CRATA	*Crataegus*	0–32	–
Tree					
11	**Trees**			160–320	
	American elm	ULAM	*Ulmus americana*	0–256	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–256	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–160	–
	Tree	2TREE	*Tree*	0–160	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–160	–
	boxelder	ACNE2	*Acer negundo*	0–115	–

Table 11. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			600–1200	
	big bluestem	ANGE	*Andropogon gerardii*	450–1200	–
	switchgrass	PAVI2	*Panicum virgatum*	0–450	–
2	**Cool-Season Bunchgrass**			150–600	
	green needlegrass	NAVI4	*Nassella viridula*	150–600	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–150	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–150	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–150	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–150	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–150	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–60	–
3	**Rhizomatous Wheatgrass**			150–300	
	western wheatgrass	PASM	*Pascopyrum smithii*	150–300	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–150	–
4	**Mid- Warm-Season Grasses**			60–150	
	little bluestem	SCSC	*Schizachyrium scoparium*	30–150	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	30–150	–
5	**Short Warm-Season Grasses**			30–150	
	blue grama	BOGR2	*Bouteloua gracilis*	30–150	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–90	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–60	–
6	**Other Native Grasses**			30–150	
	Grass, perennial	2GP	*Grass, perennial*	0–150	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	30–90	–
	fowl bluegrass	POPA2	*Poa palustris*	0–90	–
7	**Grass-Likes**			30–150	
	Sprengel's sedge	CASP7	*Carex sprengelii*	30–150	–

	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–90	–
	clustered field sedge	CAPR5	*Carex praegracilis*	30–90	–
8	**Non-Native Cool-Season Grasses**			150–450	
	Kentucky bluegrass	POPR	*Poa pratensis*	60–300	–
	smooth brome	BRIN2	*Bromus inermis*	0–300	–
	timothy	PHPR3	*Phleum pratense*	0–150	–
	cheatgrass	BRTE	*Bromus tectorum*	0–60	–
	field brome	BRAR5	*Bromus arvensis*	0–60	–
Forb					
9	**Forbs**			150–300	
	Forb, native	2FN	*Forb, native*	30–150	–
	Forb, introduced	2FI	*Forb, introduced*	30–150	–
	scurfpea	PSORA2	*Psoralidium*	30–90	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	30–90	–
	goldenrod	SOLID	*Solidago*	30–90	–
	dotted blazing star	LIPU	*Liatris punctata*	0–60	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	30–60	–
	American vetch	VIAM	*Vicia americana*	30–60	–
	vervain	VERBE	*Verbena*	30–60	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–60	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	30–60	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	30–60	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	30–60	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–60	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–60	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	30–60	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–60	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0–30	–
	northern bedstraw	GABO2	*Galium boreale*	0–30	–
	beardtongue	PENST	*Penstemon*	0–30	–
	starry false lily of the valley	MAST4	*Maianthemum stellatum*	0–30	–
Shrub/Vine					
10	**Shrubs**			150–300	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–150	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	30–150	–
	American plum	PRAM	*Prunus americana*	30–90	–
	chokecherry	PRVI	*Prunus virginiana*	30–90	–
	leadplant	AMCA6	*Amorpha canescens*	0–90	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–90	–
	rose	ROSA5	*Rosa*	30–60	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–60	–
	hawthorn	CRATA	*Crataegus*	0–30	–

	hawthorn	CRATA	*Crataegus*	0–30	
Tree					
11	**Trees**			150–300	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–240	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–150	–
	Tree	2TREE	*Tree*	0–150	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–150	–
	boxelder	ACNE2	*Acer negundo*	0–115	–
	American elm	ULAM	*Ulmus americana*	0–46	–

Table 12. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			115–345	
	big bluestem	ANGE	*Andropogon gerardii*	46–345	–
	switchgrass	PAVI2	*Panicum virgatum*	0–69	–
2	**Cool-Season Bunchgrass**			46–230	
	green needlegrass	NAVI4	*Nassella viridula*	46–230	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–115	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–46	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–46	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–46	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	0–46	–
3	**Rhizomatous Wheatgrass**			230–575	
	western wheatgrass	PASM	*Pascopyrum smithii*	230–575	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	0–46	–
4	**Mid- Warm-Season Grasses**			0–115	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–115	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–69	–
5	**Short Warm-Season Grasses**			46–230	
	blue grama	BOGR2	*Bouteloua gracilis*	46–230	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–115	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–69	–
6	**Other Native Grasses**			23–115	
	Grass, perennial	2GP	*Grass, perennial*	0–115	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	23–69	–
	fowl bluegrass	POPA2	*Poa palustris*	0–46	–
7	**Grass-likes**			46–230	
	clustered field sedge	CAPR5	*Carex praegracilis*	46–230	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	23–230	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–115	–
8	**Non-Native Cool-Season Grasses**			230–575	
	smooth brome	BRIN2	*Bromus inermis*	46–345	–

	timothy	PHPR3	*Phleum pratense*	0–230	–
	Kentucky bluegrass	POPR	*Poa pratensis*	115–230	–
	cheatgrass	BRTE	*Bromus tectorum*	0–115	–
	field brome	BRAR5	*Bromus arvensis*	0–115	–
Forb					
9	**Forbs**			115–230	
	Forb, native	2FN	*Forb, native*	0–92	–
	Forb, introduced	2FI	*Forb, introduced*	23–92	–
	vervain	VERBE	*Verbena*	23–69	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	23–69	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	23–69	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	23–69	–
	goldenrod	SOLID	*Solidago*	23–69	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	23–46	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–46	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–46	–
	scurfpea	PSORA2	*Psoralidium*	23–46	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–46	–
	purple prairie clover	DAPU5	*Dalea purpurea*	0–23	–
	American vetch	VIAM	*Vicia americana*	0–23	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	0–23	–
	dotted blazing star	LIPU	*Liatris punctata*	0–23	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–23	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	0	–
Shrub/Vine					
10	**Shrubs**			115–230	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	23–161	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–115	–
	silver sagebrush	ARCA13	*Artemisia cana*	23–69	–
	rose	ROSA5	*Rosa*	23–46	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–46	–
	American plum	PRAM	*Prunus americana*	23–46	–
	chokecherry	PRVI	*Prunus virginiana*	23–46	–
	leadplant	AMCA6	*Amorpha canescens*	0–23	–
	hawthorn	CRATA	*Crataegus*	0–23	–
Tree					
11	**Trees**			115–230	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–184	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–115	–
	Tree	2TREE	*Tree*	0–115	–
	boxelder	ACNE2	*Acer negundo*	0–115	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–115	–
	American elm	ULAM	*Ulmus americana*	0–46	–

Table 13. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			29–145	
	big bluestem	ANGE	*Andropogon gerardii*	29–145	–
2	**Cool-Season Bunchgrass**			29–145	
	green needlegrass	NAVI4	*Nassella viridula*	29–145	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	29–58	–
3	**Rhizomatous Wheatgrass**			29–290	
	western wheatgrass	PASM	*Pascopyrum smithii*	29–290	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	29–290	–
4	**Mid- Warm-Season Grasses**			29–145	
	little bluestem	SCSC	*Schizachyrium scoparium*	29–145	–
5	**Short Warm-Season Grasses**			0–145	
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–406	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–116	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–29	–
6	**Other Native Grasses**			0–145	
	Grass, perennial	2GP	*Grass, perennial*	0–145	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–58	–
	fowl bluegrass	POPA2	*Poa palustris*	0–58	–
7	**Grass-Likes**			29–290	
	clustered field sedge	CAPR5	*Carex praegracilis*	29–290	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	0–232	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–145	–
8	**Non-Native Cool-Season Grasses**			870–1885	
	smooth brome	BRIN2	*Bromus inermis*	435–1740	–
	Kentucky bluegrass	POPR	*Poa pratensis*	290–1160	–
	timothy	PHPR3	*Phleum pratense*	145–725	–
	cheatgrass	BRTE	*Bromus tectorum*	29–290	–
	field brome	BRAR5	*Bromus arvensis*	0–145	–
Forb					
9	**Forbs**			145–290	
	Forb, introduced	2FI	*Forb, introduced*	29–232	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	29–116	–
	vervain	VERBE	*Verbena*	29–87	–
	goldenrod	SOLID	*Solidago*	29–87	–
	Forb, native	2FN	*Forb, native*	0–87	–
	scurfpea	PSORA2	*Psoralidium*	29–58	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	29–58	–
	western yarrow	ACMIO	*Achillea millefolium var.*	29–58	–

			occidentalis		
	white sagebrush	ARLU	*Artemisia ludoviciana*	29–58	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–29	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–29	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–29	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–29	–
Shrub/Vine					
10	**Shrubs**			145–435	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	29–435	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–87	–
	silver sagebrush	ARCA13	*Artemisia cana*	29–87	–
	American plum	PRAM	*Prunus americana*	0–58	–
	chokecherry	PRVI	*Prunus virginiana*	0–58	–
	rose	ROSA5	*Rosa*	0–58	–
	silver buffaloberry	SHAR	*Shepherdia argentea*	0–29	–
Tree					
11	**Trees**			145–290	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–232	–
	boxelder	ACNE2	*Acer negundo*	0–145	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–145	–
	Tree	2TREE	*Tree*	0–145	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–145	–
	American elm	ULAM	*Ulmus americana*	0–58	–

Table 14. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			0–80	
	big bluestem	ANGE	*Andropogon gerardii*	0–80	–
2	**Cool-Season Bunchgrass**			16–35	
	green needlegrass	NAVI4	*Nassella viridula*	1–32	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	1–32	–
3	**Rhizomatous Wheatgrass**			16–80	
	western wheatgrass	PASM	*Pascopyrum smithii*	1–80	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	1–80	–
4	**Mid- Warm-Season Grasses**			0–80	
	little bluestem	SCSC	*Schizachyrium scoparium*	0–80	–
5	**Short Warm-season Grasses**			32–240	
	blue grama	BOGR2	*Bouteloua gracilis*	2–192	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	0–80	–
	mat muhly	MURI	*Muhlenbergia richardsonis*	0–80	–
6	**Other Native Grasses**			0–80	
	Grass, perennial	2GP	*Grass, perennial*	0–64	–

	prairie Junegrass	KOMA	*Koeleria macrantha*	0–32	–
	fowl bluegrass	POPA2	*Poa palustris*	0–16	–
7	**Grass-Likes**			80–320	
	clustered field sedge	CAPR5	*Carex praegracilis*	5–288	–
	Sprengel's sedge	CASP7	*Carex sprengelii*	0–128	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–80	–
8	**Non-Native Cool-Season Grasses**			400–1040	
	Kentucky bluegrass	POPR	*Poa pratensis*	20–640	–
	smooth brome	BRIN2	*Bromus inermis*	1–240	–
	timothy	PHPR3	*Phleum pratense*	5–160	–
	cheatgrass	BRTE	*Bromus tectorum*	0–80	–
	field brome	BRAR5	*Bromus arvensis*	0–80	–
Forb					
9	**Forbs**			80–320	
	Forb, introduced	2FI	*Forb, introduced*	1–240	–
	vervain	VERBE	*Verbena*	1–80	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	1–80	–
	goldenrod	SOLID	*Solidago*	1–80	–
	scurfpea	PSORA2	*Psoralidium*	1–64	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	1–64	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	1–64	–
	Forb, native	2FN	*Forb, native*	0–48	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	0–32	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–16	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	0–16	–
	wild bergamot	MOFI	*Monarda fistulosa*	0–16	–
Shrub/Vine					
10	**Shrubs**			80–240	
	western snowberry	SYOC	*Symphoricarpos occidentalis*	2–240	–
	silver sagebrush	ARCA13	*Artemisia cana*	1–80	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–48	–
	rose	ROSA5	*Rosa*	0–32	–
Tree					
11	**Trees**			80–160	
	green ash	FRPE	*Fraxinus pennsylvanica*	0–128	–
	boxelder	ACNE2	*Acer negundo*	0–80	–
	plains cottonwood	PODEM	*Populus deltoides ssp. monilifera*	0–80	–
	Tree	2TREE	*Tree*	0–80	–
	bur oak	QUMA2	*Quercus macrocarpa*	0–80	–
	American elm	ULAM	*Ulmus americana*	0–32	–

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; Cynthia Englebert, Range Management Specialist, Forest Service; George Gamblin, Range Management Specialist, NRCS; Ryan Murray, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; L. Michael Stirling, Range Management Specialist, NRCS; Jim Westerman, Soil Scientist, NRCS.

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Approval

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Acknowledgments

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem

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

Author(s)/participant(s)	
Contact for lead author	
Date	05/10/2025
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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:

    Sub-dominant:

    Other:

    Additional:

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

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14. **Average percent litter cover (%) and depth (in):**

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

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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:**

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17. **Perennial plant reproductive capability:**
