USDA Natural Resources Conservation Service

Ecological site F062XA054SD
Low Elevation Northern Hills Pine Forest(15+% Slope)

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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.

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

Major Land Resource Area (MLRA) 62—Black Hills

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 Low Elevation Northern Hills(15+% slope) ecological site is a large extent forest site found in the Black Hills, Bear Lodge Mountains, and the surrounding Dakota Hogback. This site is found below 6,200 feet in elevation. The slopes range above 15 percent. There will typically be a light-colored leached "E" horizon positioned above an argillic horizon of translocated clay. The surface and subsurface soil textures range from loamy sand to clayey.

Vegetation in the Reference State (1.0) consists of a ponderosa pine overstory with a mixed shrub and herbaceous understory. The herbaceous component may be relatively sparse as slope increases, especially on the warmer south- and west-facing slopes.

Associated sites

F062XY057SD	**Cool Fringe Mixed Hardwood Forest** This site occurs adjacent and is often found on the fringes of meadows, valleys, or areas of increased soil moisture.

Similar sites

F062XB052SD	**Highland Hills Pine Forest(0-15% Slope)** This site occurs in the higher elevations, so cooler temperatures allow for a larger shrub component understory.
F062XC053SD	**Low Elevation Dry Southern Hills Pine Forest** This site is warmer and occurs in the southern reach of the Black Hills, often with a larger grass component.

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa* (2) *Populus tremuloides*
Shrub	(1) *Mahonia repens* (2) *Juniperus communis*
Herbaceous	(1) *Oryzopsis asperifolia* (2) *Carex*

Physiographic features

The Low Elevation Northern Hills Ecological Site (15+% Slope) occurs most often between 3,200 feet of elevation but up to 6,200 feet.. This site is characterized by rolling hills as well as steeper side slopes and canyon topography encompassing areas in the northern portion of MLRA 62 deemed LRU A.

Table 2. Representative physiographic features

Landforms	(1) Hills > Hillslope (2) Ridge (3) Hill
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	3,200–6,200 ft
Slope	15–90%
Ponding depth	0 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)	94-95 days
Freeze-free period (characteristic range)	120-125 days
Precipitation total (characteristic range)	23-30 in
Frost-free period (actual range)	94-95 days
Freeze-free period (actual range)	119-126 days
Precipitation total (actual range)	20-30 in
Frost-free period (average)	95 days
Freeze-free period (average)	123 days
Precipitation total (average)	26 in

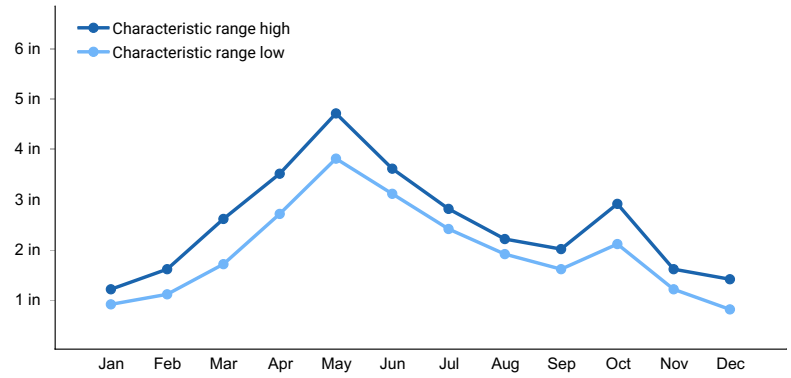


Figure 1. Monthly precipitation range

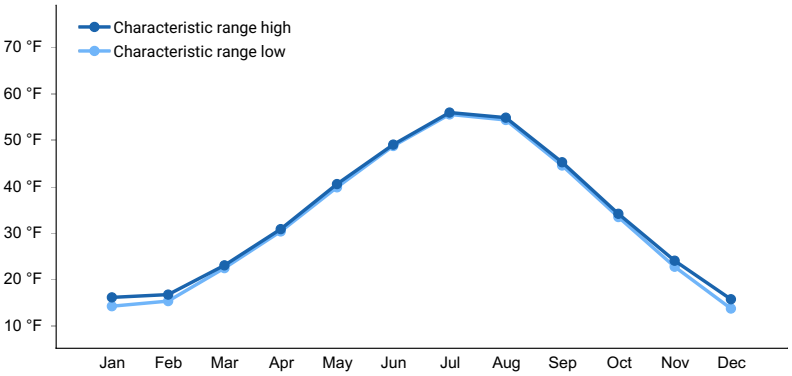


Figure 2. Monthly minimum temperature range

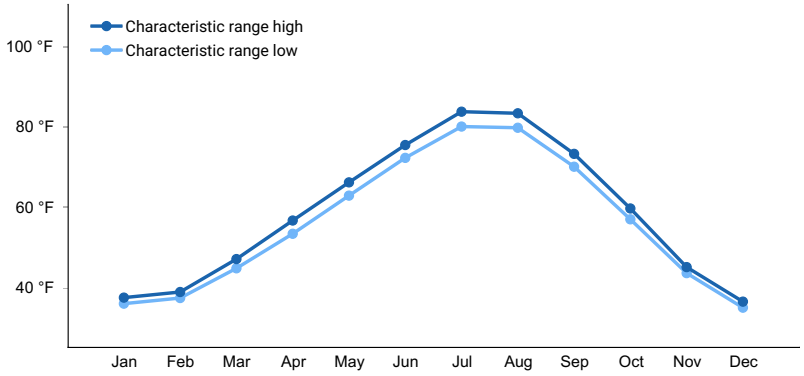


Figure 3. Monthly maximum temperature range

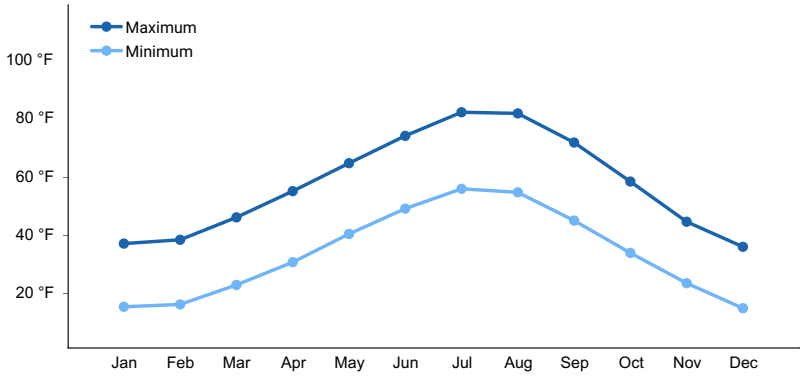


Figure 4. Monthly average minimum and maximum temperature

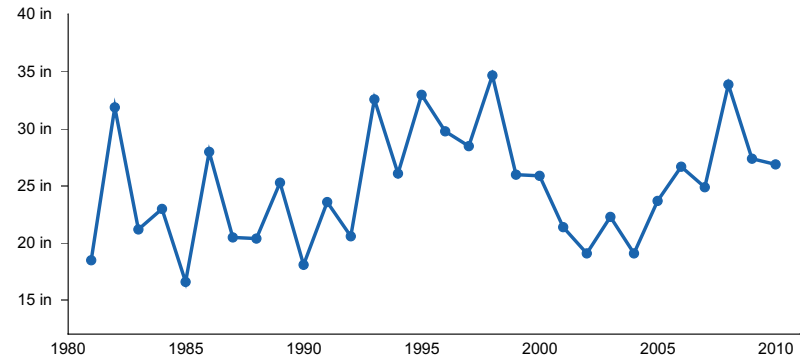


Figure 5. Annual precipitation pattern

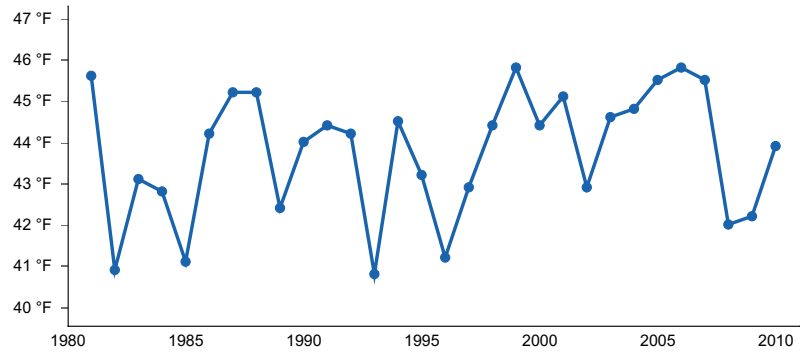


Figure 6. Annual average temperature pattern

Climate stations used

- (1) DEADWOOD 2NE [USC00392209], Whitewood, SD
- (2) SUNDANCE [USC00488705], Sundance, WY
- (3) LEAD [USC00394834], Lead, SD

Influencing water features

Riparian areas and wetland features are not associated with this site.

Wetland description

Not Applicable.

Soil features

Soils correlated to this site are Alfisols which developed under a forest canopy and are typically found in long-term forested environments.

Soils correlated to this site will have a frigid soil temperature regime. Typically in the Black Hills, the mean annual soil temperatures below 6,200 feet, is greater than 32 °F but less than 46 °F and the difference between mean summer (June, July, and August) and mean winter (December, January, and February) soil temperatures is 43 °F or more at a depth of 20 inches below the soil surface, and summer air temperatures are warm.

This site is represented by the Citivar, Grizzly, Hickock, Virkula, Vanocker, Sawdust(moist), MCcooley, Tollflat, Mineshaft, Roubaix, Buska, Pactola, and Citadel soils.

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

Table 4. Representative soil features

Parent material	(1) Residuum–igneous and sedimentary rock (2) Colluvium–igneous and sedimentary rock (3) Alluvium–igneous and sedimentary rock
Surface texture	(1) Silt loam (2) Loam (3) Fine sandy loam
Family particle size	(1) Loamy-skeletal (2) Sandy-skeletal
Drainage class	Well drained
Permeability class	Very slow to rapid
Soil depth	20–80 in
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (40in)	1–6.5 in
Calcium carbonate equivalent (40in)	0–40%
Electrical conductivity (40in)	0–2 mmhos/cm
Sodium adsorption ratio (40in)	0–2
Soil reaction (1:1 water) (40in)	5.1–8.4
Subsurface fragment volume <=3" (40in)	5–65%
Subsurface fragment volume >3" (40in)	5–65%

Ecological dynamics

Dominated by ponderosa pine, the Low Elevation Northern Hills Pine Forest (15+% Slope) ecological site occupies much of the territory of LRU A. There exists a historic reference state, and a managed/invaded state. Given the history of intensive use of the Black Hills and its forestry resources, much of the area today would be found in a managed /invaded state with few areas remaining in the reference state.

The ecological site is characterized by a highly variable uneven age structure canopy of ponderosa pine. Due to an increase in elevation and moisture this ecological site will maintain a hardwood component such as quaking aspen, paper birch or bur oak. Understory species such as Woods rose, Oregon grape, common juniper, bearberry (kinnikinnick), ironwood (hop-hornbeam), are common. The herbaceous layer may consist of ricegrasses, oatgrasses, yarrow, pasqueflower, a variety of asters and sedges. On this site, productivity varies due to slope percentage, where lower slopes are higher producing than steeper slopes. Sub-shrubs will increase in composition

as slopes increase along with bare ground and needle cast.

Ponderosa pine is the dominant tree species in the Black Hills and tends to have dark colored bark (blackjacks) until it reaches 75 to 100 years of age, after which the bark progressively changes to a buff or orange color. Morphologically older trees are marked by the presence of thinning foliar and flat-topped crowns. Additional morphology includes larger lower branching with higher crown- based heights and furrowed or very smooth bark.

Historically spatial heterogeneity was present not only across the Black Hills but also within the smaller dense pine patches (Brown, 2006). This variation of structure consisted of a diverse landscape mosaic that varied from grasslands and stands of ponderosa pine forest with variation in forest structure due to topographically driven microclimates resulting in variation of total tree density, tree group size, proportion of trees in groups versus single random trees, and openness.

Ponderosa pine is a fire-adapted species that is, mostly driven by frequent, low-intensity surface fires that consume small seedlings, prunes lower branches from larger trees, and reduces overall surface fuel loads. With prolific spring rains and higher elevation, the historical fire regime in this ecological site is characterized as one of low-severity with a combination small patch (1-20 acre) of group torching fires and the occasional (>100 years) large patches (20- 200 Ac) group torching fires. Overall, it is estimated that only 3.3 percent of the Black Hills landscape burned as crown fire during 22 landscape fire years between 1529 and 1893 (Brown, 2008). It is estimated that only 3.3 percent of the Black Hills landscape burned as crown fire during 22 landscape fire years between 1529 and 1893 (Brown, 2008). In the central core, low- severity surface fires occurred between 16 and 20 years (Brown, 2008). Frequent surface fires maintained the ecotone between forest and grasslands by killing ponderosa pine seedlings and saplings before they could become established.

In addition to variable fire, pests, and disease- other natural disturbances played a role in the overall maintenance of diversity, structure, and density the Black Hills. The mountain pine beetle (Dendroctonus ponderosae) is an important driver of forest structure. The mountain pine beetle was first described in the Black Hills in 1901 by Andrew D. Hopkins and the first documented epidemic of bark beetles in the Black Hills occurred in 1895 (Graham et al. 2016). These beetles are native in the Black Hills and have cyclical life cycle and emergence, with a continuous endemic and less frequent epidemics in the Black Hills over the last 129 years (Graham et al. 2016). "Mountain pine beetle outbreaks in the Black Hills from 1894 through 2014 had a mean return interval of 20 years and a mean duration of 13 years (Graham et al. 2016)".

At a variable and localized scale additional disturbances include pine engraver beetles and armillaria root rot. Pine engraver beetles are non-aggressive and breed in windthrown ponderosa pine trees, trees damaged by wind, ice storms, or other non-standing trees. Armillaria (Armillaria ostoyae) has been noted across soil types and locations within the Black Hills (Boldt and Van Deusen 1974; Holah1993; Lundquist 1991; Shepperd, Wayne D.; Battaglia, Michael A. 2002).

Studies have shown the current forest contains about the same basal area (ft2/ac) on average as the historic forest. The difference, however, is that the historic forest was dominated by fewer, but much larger trees, than those present today. This suggests that there has been a simplification in structure at stand to landscape scales, with increased tree density leading to fewer gaps and more even spacing and size distributions within groups (Brown, 2008).

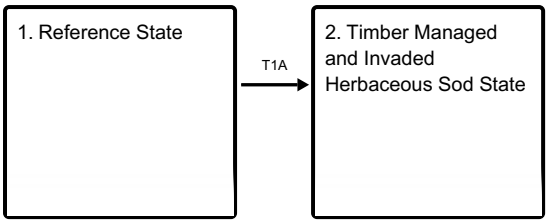
Relative increases in tree density and simplification of structure have contributed to greater vertical and horizontal fuel continuity, and thus increased likelihood for incidence and extent of crown fires. More pole-sized trees (5-to-9-inch DBH) within stands also increases the likelihood of bark beetle (Dendroctonus ponderosae) outbreaks. This is a concern in the Black Hills where pine beetle outbreaks have been a major disturbance agent during the 20th and early 21st centuries.

It is also important to note the change in composition in recent decades of ponderosa pine stands, whereby mainly through the mechanism of fire suppression, the dominance of white spruce has grown by an estimated 5% or more from the original 1.5% composition covered historically (Tatina R.E., Hanberry B.B., 2022).

Due to the spread and establishment of non-native cool-season grasses and other anthropogenic disturbances in MLRA 62, the Reference Plant Community (1.1) is nearly non-existent.

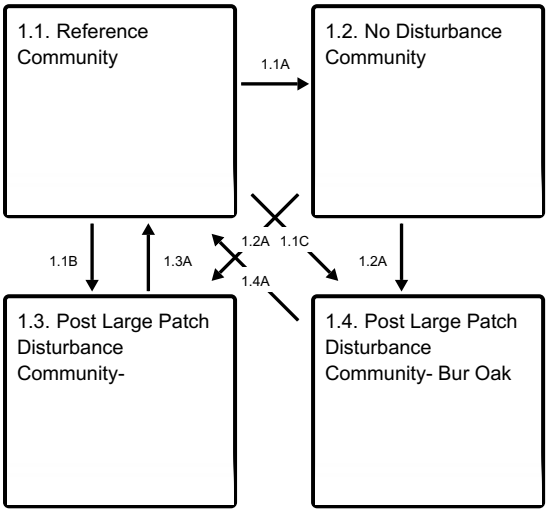
State and transition model

Ecosystem states



T1A - timber harvest designed to achieve forest management objectives

State 1 submodel, plant communities



1.1A - 30+ years no disturbance.

1.1B - Infrequent mixed severity large patch disturbance.

1.1C - Infrequent mixed severity large patch disturbance.

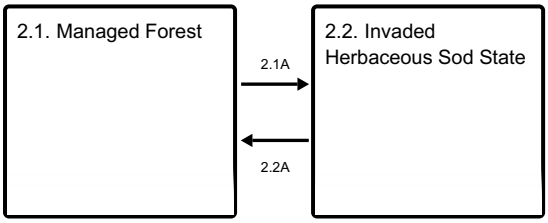
1.2A - Infrequent mixed severity large patch disturbance.

1.2A - Infrequent mixed severity large patch disturbance.

1.3A - 30+ years no disturbance.

1.4A - Frequent low severity disturbance.

State 2 submodel, plant communities



2.1A - Cleared, grazed and invaded or seeded to introduced grass species.

2.2A - Tree Planting

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the Low Elevation Northern Hills Forest ecological site prior to European settlement. The Reference State (1.0) is dominated by ponderosa pine with quaking aspen, paper birch and bur oak. Sites will generally contain either quaking aspen/ paper birch or bur oak as the dominant hardwood component. At higher elevations and in the Bearlodge Mountains the bur oak is frequently in shrub form. Predominant shrubs will include juniper,

Oregon grape, bearberry (kinnikinnick), ironwood (hop-hornbeam).. Dominant cool-season bunchgrasses will include roughleaf ricegrass, slender wheatgrass, poverty oatgrass, and Rocky Mountain fescue. Sedges will include Hood's sedge, dryspike sedge, and Richardson's sedge. Overall herbaceous understory decreases, while needle cast and bare ground increase. Structural variation within this reference state is driven by local hydrology and plant available precipitation. The primary elements of structure that are affected include: 1) variably sized perennial openings and transitional grass, forb, shrub interspaces, where natural regeneration occurs. 2) variably sized, mostly even-aged tree groups and single random trees with a balance of age classes of ponderosa pine (by trees/acre). 3) Amount and location of hardwood tree species. Heterogeneity at the landscape level (100-1000 acres) of stands or patches of the above patterns is largely dictated by a combination of local hydrology and plant available precipitation that represent productivity gradients and resulting disturbance regimes (namely frequent fire or mixed severity over time) that yield variation in stand/patch size. Site gradients from less to more productive demonstrate the following variation: 1) less productive sites typically comprised of shallow soils, ridgetops, sun exposed slopes, head slopes having lower overall tree densities, higher proportion of single random trees, and fewer trees per group. With the caveat that when surface fuels are unable to carry frequent fire. 2) more productive sites comprised of deeper soils, gullies, swales, sheltered slopes, and toe slopes having higher overall tree densities with a higher proportion of trees in groups that tend to be larger, and include a more dominant hardwood component. The caveat to this latter point being that when surface vegetation is productive so too becomes fire severity to regeneration. Variation of type, size, and frequency disturbances result contribute to dynamic stand maintenance or transitions. This dynamic is a result of a continuous layer of extensive low severity disturbance with a component of localized mixed severity disturbances that either occur simultaneously or as a separate disturbance. Most notable of this layered dynamic are the mixed severity disturbances where more frequent small patch (1-20) vs less frequent large patch (20-200 acres) disturbances (fire, insects, wind, ice storms) occur. This short-term maintenance and longer-term mixed severity disturbance supports historical ponderosa pine stands that are arranged such that there were diverse groups of openings, clumps, and individual trees with variable diameters at breast height (DBH) and variable amounts of trees per acre (TPA). The quantity and distribution of hardwood species is also tied to this dynamic. Where there is a higher canopy cover of ponderosa pine both spatially and temporally there will be a decrease in hardwood species as these species are shade intolerant and require full sun to flourish.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- quaking aspen (*Populus tremuloides*), shrub
- paper birch (*Betula papyrifera*), shrub
- bur oak (*Quercus macrocarpa*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- creeping barberry (*Mahonia repens*), shrub
- common juniper (*Juniperus communis*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- roughleaf ricegrass (*Oryzopsis asperifolia*), grass
- sedge (*Carex*), grass
- slender wheatgrass (*Elymus trachycaulus*), grass
- Hood's sedge (*Carex hoodii*), grass
- Richardson's sedge (*Carex richardsonii*), grass
- common yarrow (*Achillea millefolium*), other herbaceous
- pasqueflower (*Pulsatilla*), other herbaceous
- aster (*Aster*), other herbaceous

Community 1.1
Reference Community

Highly variable uneven age/structure, moderately dense, ponderosa pine forest with scattered hardwoods. This community evolved with periodic severe drought, episodic insect and disease outbreaks, low-intensity surface and mixed severity small patch (1-20 acres) fires with a return interval of 10 to 20 years, rare mixed severity large patch (20-200 acre) fires that occurred on a greater than 100-year interval. Severe weather events that include hailstorms, tornados, and microbursts would also contribute to forest structure. Light to moderate levels of wildlife browsing and grazing also occurred on this site prior to European-American settlement. The expected forest canopy cover ranges

from 30-60% with approximately 100 TPA around 13 inches DBH. The spatial arrangement of ponderosa pine consists of 44% groupings, 4% individual trees, and 51% openings. In the lower elevations, a community may form consisting of a scattered bur oak understory, while in the higher elevations, quaking aspen, paper birch, or ironwood can be present throughout the site. The dominant grasses and grass-like species include rough-leaf ricegrass, oatgrasses, slender wheatgrass, Hood's sedge, and Richardson's sedge. The dominant shrubs include common juniper, Oregon grape, bearberry (kinnikinnick), and chokecherry. Herbaceous understory in this community is limited averaging between 15%-50% cover and dominated by a ground cover of needle cast, coarse woody debris, and few shrubs or sub-shrubs. This plant community is diverse, stable, productive, and is well adapted to the Black Hills, Bear Lodge Mountains, and Dakota Hogback. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement offsite, and natural plant mortality is very low. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity. This community self-sustained though moderate frequency low severity disturbances and mixed severity small patch disturbances (1-20 acres).

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- quaking aspen (*Populus tremuloides*), tree
- bur oak (*Quercus macrocarpa*), shrub
- common juniper (*Juniperus communis*), shrub
- creeping barberry (*Mahonia repens*), shrub
- roughleaf ricegrass (*Oryzopsis asperifolia*), grass
- sedge (*Carex*), grass

Community 1.2
No Disturbance Community

Dense highly variable uneven age/structure ponderosa pine forest. This community evolved with a prolonged absence of 20- 100 years of insect and disease outbreaks, low-intensity surface fires and severe weather events that include hailstorms, heavy snow fall, tornados, and microbursts. Light to moderate levels of wildlife browsing and grazing also occurred on this site prior to European- American settlement. The expected forest canopy cover is greater than 60% with approximately 148 TPA around 12 inches DBH. The spatial arrangement of ponderosa pine consists of 66% groupings, 2% individual trees, and 33% openings. Herbaceous understory in this community is limited averaging 5-10% and dominated by a ground cover of needle cast, coarse woody debris, and few shrubs or sub-shrubs. Due to the increase canopy cover the herbaceous understory will decrease in production and species diversity. Shrubs percentage will be decreased with the higher canopy cover. The dominant tree species on this site is ponderosa pine with a diameter at breast height (DBH) ranging from 9 to 14 inches. Quaking aspen and paper birch will be less frequent but still scattered throughout the site.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- common juniper (*Juniperus communis*), shrub
- creeping barberry (*Mahonia repens*), shrub
- sedge (*Carex*), grass

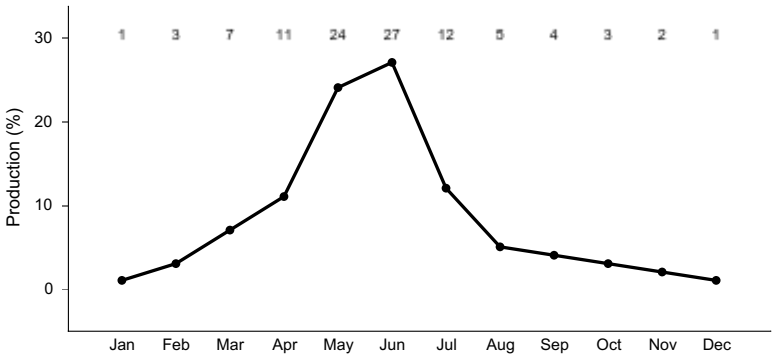


Figure 7. Plant community growth curve (percent production by month). SD6211, Black Hills, heavy conifer canopy. Mature ponderosa pine overstory.

Community 1.3
Post Large Patch Disturbance Community-

This plant community is a successional phase of a post-fire ponderosa pine forest. It consists of open, scattered large ponderosa pine trees and seedlings with a large component of Quaking Aspen or Paper Birch. It evolved with natural disturbances including episodic insect and disease outbreaks in ponderosa pine, high-intensity stand-replacing fire, or severe weather events. This plant community is of small extent and may not develop into a mature aspen stand on all locations where this ecological site occurs. It is most likely to be found on cool moist slopes and toe slopes with northern exposures (Severson, 1976). Insects and disease in mature aspen will play a part in the decline of mature aspen stands and the lack of regeneration (Blodgett, 2017). Cool season bunchgrasses, pioneer forbs and shrubs are common.

Dominant plant species

- quaking aspen (*Populus tremuloides*), tree
- paper birch (*Betula papyrifera*), tree
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- chokecherry (*Prunus virginiana*), shrub
- sedge (*Carex*), grass
- roughleaf ricegrass (*Oryzopsis asperifolia*), grass

Community 1.4
Post Large Patch Disturbance Community- Bur Oak

This community is dominated by large, scattered ponderosa pine and brush/shrub like bur oak and ironwood(hop-hornbeam). Forest canopy cover is less than 30%, with 36 TPA, and 11-inch average DBH. This community is similar to community 1.3 with the exception of the shrub like bur oak resulting from a large patch mixed severity disturbance after being in community 1.2. Also, like 1.3, this community being more open, contains higher amounts of cool season bunchgrasses, pioneer forbs, and shrubs. Once this community is present, it takes a very long time to transition to a different community compared to 1.3 which may transition very quickly.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- common juniper (*Juniperus communis*), shrub
- bur oak (*Quercus macrocarpa*), shrub
- chokecherry (*Prunus virginiana*), shrub
- sedge (*Carex*), grass
- needlegrass (*Nassella*), grass

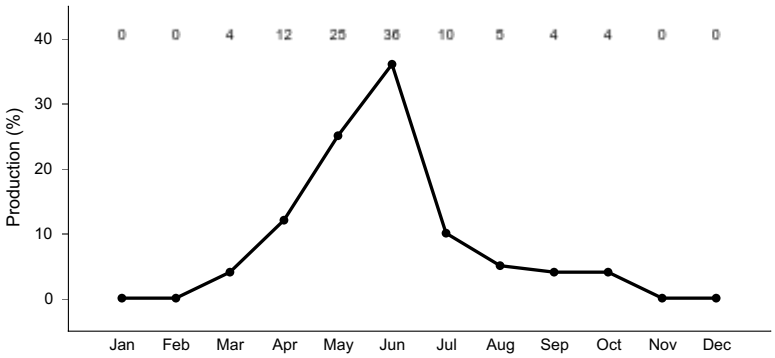


Figure 8. Plant community growth curve (percent production by month). SD6201, Black Hills, cool-season dominant. Cool-season dominant.

Pathway 1.1A
Community 1.1 to 1.2

This transition between communities is a result of the passing of time (30+ years) with no disturbance allowing for tree growth and density to increase.

Pathway 1.1B
Community 1.1 to 1.3

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.1C
Community 1.1 to 1.4

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres of group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.2A
Community 1.2 to 1.3

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres of group torching or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.2A
Community 1.2 to 1.4

This transition between communities is a result of infrequent (>100 years) mixed severity large patch (20-200 acres) disturbance. This disturbance is often in the form of mixed severity fire with acres of group torching fire or epidemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause large scale tree mortality leading to this transition.

Pathway 1.3A
Community 1.3 to 1.1

This transition between communities is a result of the passing of time (30+ years) and frequent low severity disturbance such as fire and endemic Mountain Pine Beetle outbreaks.

Pathway 1.4A
Community 1.4 to 1.1

This transition between communities is a result of Frequent low severity disturbance such as fire and endemic Mountain Pine Beetle outbreaks. Severe weather events hailstorms, heavy snow fall, ice storms, tornados, and microbursts can also cause tree mortality leading to this transition.

State 2
Timber Managed and Invaded Herbaceous Sod State

The Timber managed and Invaded Herbaceous Sod State is largely the result of historic early European-American settlement of the Black Hills region. Large tracts which were logged free of regulatory restraints-prior to establishment of the Forest Reserve in 1897- were commercially clearcut and practically stripped of all trees large enough to yield a mine timber a railroad tie. (Boldt and Van Deusen 1974). Between the mid-1870s to 1890s, the Homestake Mining Company (and their half dozen subsidiary companies) alone cut something upwards of 6 million board feet of timber in the Black Hills. In some areas, this ecological site, was clear-cut for timber, then converted for use as ranch and farmsteads. In other cases, the pine overstory was lost to high- intensity fire events followed by settlement. The cleared areas were often heavily grazed to supply beef and mutton for mining and logging

communities. In later years these sites were often seeded to introduced grasses and clover to increase forage quality or farmed for grain crop production. In many cases the shift in land use from forest to livestock, forage, and crop production remains. Those areas that are not under intensive management resist transitioning back to a forest plant community, even though the soils still exhibit forest attributes. The dominant plants associated with this state are introduced sod-forming grasses, introduced legumes, and weedy forbs. This state is very resistant to change through management alone. As stated earlier in the ecological dynamics, it is also important to note the change in composition in recent decades of ponderosa pine stands, whereby mainly through the mechanism of fire suppression, the dominance of white spruce has grown by an estimated 5% or more from the original 1.5% composition covered historically and may be present throughout the range of the site(Tatina R.E., Hanberry B.B., 2022). Future considerations may need to account for the possibility that portions of the site could be managed for spruce, in which case the Highland Hills Pine Forest ESD for LRU B would be best utilized.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- timothy (*Phleum pratense*), grass
- redtop (*Agrostis gigantea*), grass
- red clover (*Trifolium pratense*), other herbaceous
- white clover (*Trifolium repens*), other herbaceous
- oxeye daisy (*Leucanthemum vulgare*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- cinquefoil (*Potentilla*), other herbaceous
- Canada thistle (*Cirsium arvense*), other herbaceous

Community 2.1
Managed Forest

This plant community is a result of forest activities focused on timber management. Virtually all of the Black Hills unreserved and operable forest acres have been cut over at least once; many acres have received multiple partial cuts. (Boldt and Van Deusen 1974). Current structure is based on the management or silvicultural system that was implemented by forestry professionals. There are a variety of forest harvest systems that have been utilized. These dictate the resulting and future forests structure of the site. One of the primary forest structures resulting from forest management is a single story of evenly spaced trees. The resulting tree size might very from saplings to larger diameter trees. Although the spacing within the site will be fairly uniform different sites will have different spacings ranging from 10ft to 150ft between trees. Generally, the larger the tree the greater the spacing will be between trees. Another common resulting structure of forest management is a site with two separate canopy layers of trees. One layer is commonly made up of lager diameter trees that have a spacing often wider then 30ft. The other layer is seedling and sapling sized trees, these trees may be at an even spacing between 10 and 16 feet apart or they may not be evenly spaced. There are other management objectives and silvicultural systems that result in different forest structures other than then ones previously listed. These structures usually include leaving trees of all sizes from seedling to large dimeter trees in varying amounts. The resulting spatial distribution is generally also uneven with areas of different forest densities. Natural regeneration is the most common following timber management changing the forest structure and need for future management throughout time. Planting of trees maybe done in large fire burn areas,

Community 2.2
Invaded Herbaceous Sod State

This plant community is a result of the loss of the overstory ponderosa pine, either from high-intensity fire or timber harvest, followed by heavy continuous grazing, invasion of non-native cool- season grasses, and in some cases seeding to forage or crop species. It is characterized by a dominance of non-native cool- season grasses including timothy, smooth brome, Kentucky bluegrass, and redtop. Forbs will include red and white clover, ox- eye daisy, western yarrow, cinquefoil, and Canada thistle. Native plants, including ponderosa pine, have great difficulty becoming established in this plant community. This site can be renovated through tillage and seeding of introduced forage species. The renovated plant community can remain productive through prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery following grazing event.

Pathway 2.1A
Community 2.1 to 2.2

During early European-American settlement of the Black Hills this ecological site, in some areas, was clear-cut for timber and then used for ranch and farmsteads. In other cases, the pine overstory was lost to high-intensity fire events followed by settlement. The cleared areas were often heavily grazed to supply beef and mutton for mining and logging communities. In later years these sites were either invaded by or seeded to introduced grasses and clover to increase forage quality or farmed for grain crops.

Pathway 2.2A
Community 2.2 to 2.1

Tree Planting

Transition T1A
State 1 to 2

The transition to this community from the reference community is a result of timber harvest designed to achieve forest management objectives. These treatments will follow one of the silvicultural treatments below. Which will dictate the resulting structure and composition of the site. • Thinning: a treatment made to reduce stand density of trees primarily to improve growth, enhance forest health. o Thinning from above: removal of trees from dominant or codominant crown classes or canopy layers in order to favor those in lower crown classes or layers. o Thinning from below: removal of trees from lower crown classes or canopy layers in order to favor those in upper crown classes or layers. o Thin throughout the dimeters: the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position. o Variable density: the removal of trees that deliberately creates non-uniform conditions through a stand. • Even Age: regenerate and maintain a stand with a single age class. o Overstory Removal: The cutting of trees comprising an upper canopy layer in order to release advance regeneration in an understory. o Patch Cutting: removing all of the live trees from areas that are 2 acres in size or smaller. o Seed Tree: cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class. o Shelterwood: The cutting of most trees, leaving those needed to produce sufficient shade to establish a new age class. • Uneven Age: methods regenerate and maintain a multiage structure by removing some trees in all size classes either singly, or in small groups. o Group Selection: a group of trees are removed, and new age classes are established in openings created. o Single Tree Selection: Individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration

Additional community tables

Animal community

Wildlife Interpretations:

The Black Hills and Bear Lodge Mountains of South Dakota and Wyoming are truly a forested island in a grassland sea. To regional Native Americans, they are ‘Paha Sapa” or “hills that are black”, and from a distance, the ponderosa pine-covered slopes do appear like black hills (Larson, 1999).

The Black Hills and Bear Lodge Mountains are located in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, MLRA 62 consisted of diverse grassland, shrubland, and forest habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles and amphibians, and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the gray wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors.

Ponderosa pine stands provide cavity nesting sites, nesting cover, escape cover, and den sites for a variety of

species. Species that increase include elk, white-footed mice, bushy-tailed woodrat, black-billed magpie, Townsend’s solitaire, western meadowlark, Bohemian waxwing, dark-eyed junco, nuthatch, black-capped chickadees, brown thrasher, lark sparrow, crows, and white-crowned sparrow. Species such as meadow voles, spotted ground squirrel, thirteen-lined ground squirrel, northern grasshopper mice, and western harvest mice do not use this site. Grassland nesting songbirds will decline as pine cover increases. Raptors, such as the long-eared owl, increase.

Beaver inhabited surface waters associated with instream wetlands and woody riparian corridors occur along streams and drainages. Beaver occupation served as a mechanism to maintain water tables along flood plains and valley floors. During pre-European times, the extent of the wet land sites was likely much more wide-spread and persistent during dry periods, however excessive trapping and removal since that time have changed the hydrology and limited the extent of these sites while drying former mesic areas throughout the MLRA.

Grazing Interpretations:

The forage production of plant communities can be highly variable due to many slopes being largely inaccessible to cattle. Domestic sheep and goats would likely utilize this ecological site through the growing season and into fall, but are not commonly produced in the Black Hills area. Those areas that are accessible to livestock use require a complete resource inventory to document plant composition and production. Accurate estimates of carrying capacity should be calculated using vegetative clipping data, animal preference data, and actual historic stocking records.

Hydrological functions

This site is dominated by soils in hydrologic group C. Infiltration and runoff potential for this site varies from moderate to low, depending on soil hydrologic group, slope and ground cover. Refer to the USDA-NRCS National Engineering Handbook, Part 630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

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

Wood products

The ponderosa pine and white spruce produced in the Black Hills area are marketable for saw logs and heating fuel pellets. The steeper slopes found on this ecological site may make this resource less accessible to modern timber harvesting equipment. Management of this forest resource for watershed protection, grazing, wildlife, recreation, and timber harvest may be the most critical issues land managers and owners currently face.

Land management specialists stress the need to create and manage fire-tolerant forests on a landscape basis. They recommend fuel-mitigation treatments through grazing management, forest thinning, prescribed burning, and timber harvest management. Fire is especially damaging in the forest/urban interface and requires the expansion of defensible space around homes and buildings, and education on “Fire Wise” practices.

Other products

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

Other information

Site Development and Testing Plan:

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

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. All inventory information and data records are compiled within the Rapid City, SD USDA-NRCS Shared “S” network drive.

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Approval

Suzanne Mayne-Kinney, 2/06/2025

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	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):**

---

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:

---

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

---

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

---

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

---

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:**

---

17. **Perennial plant reproductive capability:**
