Ecological site F062XY057SD
Cool Fringe Mixed Hardwood Forest

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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, 2006: Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 62 is divided into three Land Resource Units (LRUs) 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, and the next letter “Y” identifies the LRU. Note: The organization of Ecological Site IDs will likely change in the future. The North, LRU-A includes the northern Black Hills and Bear Lodge Mountains. It receives between 22 and 30 inches of annual precipitation and has a frigid soil temperature regime. The High Central, LRU-B includes the high elevation central core of the Black Hills, which receives between 25 to 35 inches of annual precipitation and has a cryic soil temperature regime. The South, LRU-C includes the southern portion of the Black Hills and receives between 17 to 21 inches of annual precipitation and has a frigid soil temperature regime. One additional grouping of ecological sites that are common to the entire MLRA are designated with a “Y” in the ecological site ID.

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 Cool Fringe Mixed Hardwood Forest ecological site consists of a run-in landscape position where excess water occurs and occupies drainages, gulley's, ravines and occasional flats or shallow depressions on areas of the Black Hills and Bear-lodge mountains of MLRA 62. This habitat type often consists of denser woodland type habitat with mixed species composition of hardwood trees ranging in tree size classes up to 20 inches diameter. The primary species consist of aspen and paper birch along with varying proportions of possible ironwood, green ash, and American elm. Often found along fringes of the High Elevation Cool Slopes and Valleys ecological sites transitioning to Valley Loam ecological sites- the mixed hardwood ecological site occupies a small niche in the Black Hills where Ponderosa Pine or White Spruce are not the dominant or expected climax community.

Associated sites

F062XB056SD	**Highland Cool Valley Slopes and Depressions** This site is often found upslope of the mixed hardwood site, often occurring on rockier soils with steeper slopes.

Table 1. Dominant plant species

Tree	(1) *Populus tremuloides* (2) *Betula papyrifera*
Shrub	(1) *Corylus cornuta* (2) *Amelanchier alnifolia*
Herbaceous	(1) *Carex* (2) *Oryzopsis asperifolia*

Physiographic features

The Cool Fringe Mixed Hardwood Forest ecological site occupies drainages, gulley's, ravines and gently sloping toe-slopes/flats or shallow depressions. This site often occupies a run-in type landscape with excess water moving into the system from adjacent uplands. Slopes may be flat/gently sloping and can occur at nearly any elevation throughout the MLRA, though more common in higher elevation areas above 5,200 feet and on the fringes of spruce or pine dominated forests along valley bottoms.

Table 2. Representative physiographic features

Hillslope profile	(1) Toeslope
Landforms	(1) Hills > Depression (2) Hillslope
Runoff class	Low to medium
Flooding duration	Extremely brief (0.1 to 4 hours) to very brief (4 to 48 hours)

Flooding frequency	None to rare
Elevation	1,590 – 2,200 m
Slope	0 – 30 %
Ponding depth	0 cm
Water table depth	50 – 200 cm
Aspect	NW, N, NE

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)	50-90 days
Freeze-free period (characteristic range)	90-120 days
Precipitation total (characteristic range)	530-760 mm
Frost-free period (actual range)	30-90 days
Freeze-free period (actual range)	60-120 days
Precipitation total (actual range)	510-760 mm
Frost-free period (average)	70 days
Freeze-free period (average)	100 days
Precipitation total (average)	610 mm

- (1) DEERFIELD 3 SE [USC00392231], Hill City, SD
- (2) LEAD [USC00394834], Lead, SD
- (3) DEADWOOD [USC00392207], Deadwood, SD
- (4) CUSTER [USC00392087], Custer, SD
- (5) HILL CITY [USC00393868], Hill City, SD

Influencing water features

Water is received primarily through precipitation, seasonal streams/drainages, and runoff from adjacent uplands. Water leaves the site primarily through evapotranspiration, runoff, and groundwater recharge. In sites that contain ephemeral streams, depending on water availability and drought years, vegetation may be very dense and represent more of a riparian ecological site.

Wetland description

Not Applicable.

Soil features

This site is represented by the Goldmine soil series in LRU A, and the moist phase of any soil in LRU B (which do not officially exist yet). The Cool Fringe Mixed Hardwood Forest ecological site occupies run in landscapes and a small niche on the fringes of sloped coarse and skeletal soils dominated by spruce or pine. forests that meet the finer minerology of prairie/grassland soils. Organic matter on similar sites documented range from 2.2 to 8.7 percent (Battaglia, 2002).

Table 4. Representative soil features

Parent material	(1) Colluvium (2) Alluvium
Surface texture	(1) Loamy fine sand (2) Loamy coarse sand
Drainage class	Well drained
Permeability class	Slow to moderate
Depth to restrictive layer	150 – 200 cm
Soil depth	150 – 200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-152.4cm)	7.62 – 15.24 cm

Soil reaction (1:1 water) (0-152.4cm)	4.2 – 7.3
Subsurface fragment volume <=3" (0-101.6cm)	20 – 30 %
Subsurface fragment volume >3" (0-101.6cm)	30 – 40 %

Ecological dynamics

The Cool Fringe Mixed Hardwood Forest ecological site occupies a small niche separate of the pine or spruce systems of the Black Hills although there are hardwood states or inclusions within the other systems. The Cool Fridge Mixed Hardwood Forest differs from these other systems because it is not replaced with conifers in the later states. Although they are often found in proximity, the mixed hardwood site occupies a unique position on the landscape consisting of run-in landscape positions often in ravines, gentle slopes/ flats or shallow depressions within higher elevations of the Black Hills and Bearlodge mountains, often occurring just below the Cool Highland Slopes and Valleys ecological site and on the fringes of the Valley Loam ecological site or other coves and areas of increased moisture.

The reference state for this site consists of a mix of hardwood species including an overstory of aspen and paper birch with possible associates of spruce, pine, ironwood, boxelder, green ash, hawthorn, and American elm. This habitat type occurs at elevations from 4,000 to 6,240 feet (1,219 to 1902 m) (Hoffman and Alexander, 1987). Stands in the central Black Hills will frequently have bur oak in the understory as well. A wide variety of shrubs and forbs with few grasses dominate the understory.

Structural variation within this reference state is the result of environmental factors and a set of characteristics that influence a site's resilience to disturbance. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, insects, disease wind, ice storms) (Caudle et al. 2013).

Hardwood stands evolve from an open canopy, seedling, sapling, pole, immature forest, and eventually to a mature forest. Natural fluctuations in weather patterns allow for a self-sustaining mix of an aspen, birch, shrubs and native grass and grass-like community.

The primary disturbance mechanisms in hardwood/aspen stands include fire, insect and disease outbreaks, and windstorms. The reference state is self-sustaining and resistant to change beyond it's normal seral community types due to a good adaptation to natural disturbances and a high resilience following those disturbances. When natural disturbances such as fire do occur, the rate of recovery can be quite variable. Intense fires that kill the aspen overstory usually stimulate abundant suckering (DeByle and Winokur, 1985).

Although aspen stands rely on fire for successful regeneration, aspen stands don't readily carry fire (Fechner and Barrows 1976, Debyle and Winokur 1985, Debyle et al. 1987). The tree itself is extremely fire sensitive (Baker 1925); with its thin bark most aspens are top-killed by fire, and those left with scarring are usually killed within the next growing season from rot and disease (Bradley et al. 1992,Davidson et al. 1959, Meinecke 1929). Periodic wildfires prevent over-mature aspen stands and maintain a naturally stratified mosaic of even-aged aspen communities in various stages of successional development. Uneven-aged stands form under stable conditions where the overstory gradually disintegrates with disease or age and is replaced by aspen suckers.

Aspen sustainability is threatened by limited regeneration due to the lack of disturbance, shading by conifer trees and/or herbivory. Conifers such as ponderosa pine and white spruce, are shade tolerant and can eventually increase and overtop the aspen trees. The increase in conifers can be attributed to both fire suppression and grazing pressure by livestock and wildlife (Potter 2005, Strand et al. 2009, Bartos and Campbell 1998). Aspen and their root systems persist through conifer infill but diminish as conifers predominate. Continuous browsing by livestock or wildlife may also limit aspen regeneration. Herbivory can reduce community resilience and alter future aspen cover (Rogers et al 2013).

Paper Birch is generally classified as a shallow rooting species, with no tap root, and is considered shade intolerant. Paper birch is short-lived and rarely lives more than 140 years. In addition, although not considered a valuable timber species here, Paper Birch can be tapped in the spring to obtain sap from which syrup, wine, beer, or medicinal tonics can be made(Zasada, Bjorkbom, and Safford 1990).

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Inventory data references

Information presented here has been derived from NRCS field observations, literature 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

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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	08/26/2026
Approved by	
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:**

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

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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:**
