Ecological site F062XB056SD
Highland Cool Valley Slopes and Depressions

Last updated: 2/06/2025
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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 (LRU’s) or physiographic zones (A, B, C). 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 identifies the LRU, with "Y" being a default as it applies across the entire MLRA. 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

Classification System: International Vegetation Classification - Natural Classification Level: Association International Vegetation Classification Hierarchy Class: 1. Forest & Woodland Subclass: 1.B. Temperate & Boreal Forest & Woodland Formation: 1.B.2. Cool Temperate Forest & Woodland Division: 1.B.2.Nb. Rocky Mountain Forest & Woodland Macrogroup: M501. Central Rocky Mountain Montane Forest & Woodland Group: G345. Central Rocky Mountain Montane White Spruce Forest Alliance: A3623. Picea glauca Black Hills Forest Alliance 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 Highland Cool Valley Slopes and Depressions ecological site is mostly found in higher elevations in the central core (LRU-A) and on the Limestone plateau(LRU-B) of the Black Hills. It occurs upslope of the mixed hardwood ecological site on the fringes of Valley Loam ecological sites as well as drainages and areas of run-in water holding capacity. These forest types often result in a dense closed canopy of white spruce. The understory is highly variable but may include paper birch, aspen or pine. At wetter sites, the understory may consist of species typical of riparian or wet meadow types, including Salix bebbiana, Betula occidentalis, Cornus sericea, Calamagrostis canadensis, and Carex nebrascensis (Marriott and Faber-Langendoen 2000). In less wet sites: kinnikinnick, common juniper, twinflower and vaccinium scoparium along with grasses such rough-leaf ricegrass and pussytoes are common. In addition to downed woody debris, often times more than 25% of the ground cover is mosses and lichens.

Associated sites

F062XY057SD	**Cool Fringe Mixed Hardwood Forest** This site is often found downslope of the spruce dominated forest in areas where more soil is found, often on the fringes of valley meadows.

Table 1. Dominant plant species

Tree	(1) *Picea glauca* (2) *Populus tremuloides*
Shrub	(1) *Vaccinium scoparium* (2) *Linnaea borealis*
Herbaceous	(1) *Oryzopsis asperifolia* (2) *Carex*

Physiographic features

This ecological site occurs in the transition between the valley loam ecological site and the mixed hardwood ecological sites of higher elevations (over 6200 feet) -as well as in drainage bottoms/depressions at lower elevations of 5,000-6,300 feet (Steinauer 1981, Girard c. 1991). Sites are often gently sloping to moderately steep with northerly aspects. Ephemeral streams or standing water may be present in run-in type landscapes at certain times of the year or years with especially high snowpack. White spruce forest ecological sites have been documented in the Black Hills from the Central Core and Limestone Plateau in areas most underlain by granite and limestone. (Marriott and Faber-Langendoen 2000).

Table 2. Representative physiographic features

Slope shape across	(1) Linear
Slope shape up-down	(1) Concave

Landforms	(1) Hills > Hillslope (2) Valley side
Runoff class	Low to high
Ponding duration	Very brief (4 to 48 hours)
Ponding frequency	None to rare
Elevation	1,520 – 2,130 m
Slope	0 – 90 %
Ponding depth	0 – 10 cm
Water table depth	0 – 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)	50-80 days
Freeze-free period (characteristic range)	90-110 days
Precipitation total (characteristic range)	510-580 mm
Frost-free period (actual range)	30-80 days
Freeze-free period (actual range)	60-120 days
Precipitation total (actual range)	480-710 mm

Frost-free period (average)	60 days
Freeze-free period (average)	100 days
Precipitation total (average)	560 mm

- (1) DEERFIELD 3 SE [USC00392231], Hill City, SD
- (2) HILL CITY [USC00393868], Hill City, SD
- (3) PACTOLA DAM [USC00396427], Rapid City, SD
- (4) CUSTER CO AP [USW00094032], Custer, SD
- (5) DEADWOOD [USC00392207], Deadwood, SD

Influencing water features

Water is received primarily through precipitation, seasonal streams/drainages, and runoff from adjacent uplands. Water levels are greatly influenced by rates of precipitation and runoff from upland sites. Water leaves the site primarily through evapotranspiration, runoff, and groundwater recharge.

Wetland description

Not Applicable..

Soil features

This site is represented by the Trebor soil series in LRU B and the Buska soil series in LRU A on north facing slopes or landscapes with increased soil moisture (note: the dry phase of the Buska series represents a Pine dominated ecological site in LRU C). The highland spruce ecological site will thrive in both igneous(granitic) and limestone derived soils. North facing, or moist and cool locations with increased soil moisture and reduced sunlight hours are crucial in most sites such as steep valley sides. Surface textures range from loamy to loamy skeletal to sandy skeletal. All soils are classified as alfisols and contain an “E” horizon indicating leached minerals in the upper portion of the profile usually due to forest litter decay and precipitation. Rock fragments are commonly found on these sites in enough quantity to make the soils skeletal- meaning 30% or more of the profile is rock fragments and are often found on steep slopes exceeding 30% or in depressions on valley floors. Soils in this ecological site are of a Udic moisture regime and a Cryic temperature regime.

Table 4. Representative soil features

Parent material	(1) Residuum – granite (2) Colluvium – limestone
Surface texture	(1) Very channery loam (2) Loamy fine sand
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Very slow to very rapid

Depth to restrictive layer	80 – 200 cm
Soil depth	100 – 200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	10.16 cm
Sodium adsorption ratio (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	4.2 – 8.4
Subsurface fragment volume <=3" (0-101.6cm)	0 – 40 %
Subsurface fragment volume >3" (0-101.6cm)	0 – 40 %

Ecological dynamics

The Highland Cool Valley Slopes and Depressions ecological site occupies a small portion of the overall forest (approximately 5%) within the Black Hills yet represents nearly exclusively the high elevation coniferous portion that would be deemed sub-alpine (Hoffman and Alexander, 1987). There exists a reference state in addition to a managed state. The reference community is usually a mix of dense uneven aged white spruce (Black Hills Spruce), with the occasional aspen, paper birch, or pine with lots of downed woody debris on the forest floor.

White spruce is the most dominant species in this ecological site. White spruce is characterized by a conic to spire-like shape, slightly drooping branches, and thin scaly gray-brown bark. These physiological features make white spruce highly succeptible to mortality from fire. Seedling growth is greatest at full light intensity following individual tree, small patch (0-20 acres) or large patch (20-200 acre) mortality where a large number of seedlings may become established. Due to its shade tolerant nature, spruce is able to germination under established or mature stands. Germination occurs on a variety of seedbeds such as rotted logs and moss beds, but exposed mineral soil after windthrow and other disturbances is best. White spruce seeds are light and wind distributed. The seeds may travel a a quarter of a mile but the number of seeds reaching the ground decrease with distance from the seed source. (Abrahamson, 2015).

This ecological site can exist on runoff landscapes with slopes up to 80% as well as landscape positions with run-in water such as gulley’s, ravines, or shallow depressions. Often, in the southern portions of its range this site exists exclusively on north facing slopes with additional moisture and cooler temperatures, while in the northern portion of its range on steep side-slopes it can occupy all aspects often forming stands along minor waterway immediately after the riparian zone. On these sites white spruce is capable of maintaining site dominance even in the presence of a ponderosa pine seed source. Not only is spruce more shade tolerant than pine, but it is also capable of faster height growth (Bolt 1970).

Understory vegetation ranges with a mix of shrubs such as a twinflower dominated community on run in landforms and a grouse whortleberry dominated community on run-off landforms along with grasses and forbs such as rough-leaf ricegrass, pussytoes, raspberry and monkshood.

White spruce tends to be limited to areas that burn infrequently and have less frequent fire intervals than their neighboring pine communities. True fire regime history for the region historically, is relatively varied (Brown, 1999), but it is estimated that large, high severity, stand replacement fires which occur every 150-300 years. The longest fire-rotation intervals in the run-in landscapes, where they may be about 300 years. Nearly all fires in white spruce communities are stand-replacement because fire of any severity generally kills white spruce. Across a landscape, white spruce communities often display a mosaic of unburned patches and burned patches with stand replacement. Most fires in white spruce stands are small, but large wildfires occurring in extreme fire years account for most acreage burned. (Abrahamson, 2015) These fires would result in an early seral hardwood community of aspen and paper birch (not to be mistaken for a mixed hardwood ecological site) that persist until the spruce can re-populate and out compete the others resulting in plant community 1.2

Severe weather and insects/disease are the major drivers of structure during the long periods with the absence of fire due to spruce longer fire return interval.

The most frequent damaging agents to spruce are bark beetles and root diseases. Bark beetles, either spruce beetle (Dendroctonus rufipennis) or spruce engraver beetles (Ips spp.), can killed individual trees or a large number of trees. Root diseases, such as Armillaria(Armillaria ostoyae), are commonly found in spruce and can lead to tree decline and death (Allen et al, 2019). White spruce are known for having shallow rooting depths and therefor are very susceptible to windthrow during storm events. Severe weather events in the Black Hills include hailstorms, heavy snow fall, tornados, and microbursts. Spruce regeneration is able to establish in the openings created by these events developing the uneven-aged structure of the reference state.

Lack of demand for white spruce wood has largely precluded commercial cultural treatment in stands of this species in the Black Hills. Consequently, most stands are natural in origin and remain essentially natural in condition (Boldt, Van Deusen, 1974).

The following state-and-transition diagram illustrates the common plant communities on the site and the transition pathways between communities. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

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 1.4 plant community composition

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

Table 9. Community 2.1 plant community composition

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

Inventory data references

This site has been developed with a local working group comprised of employee's from NRCS, USFS, online resources and literature reviews, as well as local partners. All data will be stored on One-Drive system at Rapid City Soil Survey MLRA office.

Other references

Hoffman, George R.; Alexander, Robert R. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: A habitat type classification. Res. Pap. RM-RP-276. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 48 p. https://doi.org/10.2737/RM-RP-276.

Boldt, Charles E, VanDeusen, James, L, Silviculture of Ponderosa Pine in the Black Hill's: The Status of Our Knowledge, June 1974,

USDA Forest Service Research Paper RM-124

Brown, Peter M., and Carolyn H. SIEG. “Historical Variability in Fire at the Ponderosa Pine - Northern Great Plains Prairie Ecotone, Southeastern Black Hills, South Dakota.” Écoscience, vol. 6, no. 4, 1999, pp. 539–47. JSTOR, http://www.jstor.org/stable/42901151. Accessed 21 July 2023.

Marriott, H. J., and D. Faber-Langendoen. 2000. The Black Hills community inventory. Volume 2: Plant community descriptions. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 326 pp.

Girard, M. [1991]. ECODATA survey of riparian communities of Black Hills National Forest, 1986-1990. Unpublished files, field forms, notes, data analyses and type descriptions. Supervisor's Office, Black Hills National Forest, Custer, SD.

Steinauer, G. A. 1981. A classification of the Cercocarpus montanus, Quercus macrocarpa, Populus tremuloides, and Picea glauca habitat types of the Black Hills National Forest. Unpublished thesis, University of South Dakota, Brookings. 95 pp.

Shepperd, Wayne D.; Battaglia, Michael A. 2002. Ecology, siliviculture, and management of Black Hills ponderosa pine. Gen. Tech. Rep. RMRS-GTR-97. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 112 p.

Abrahamson, Ilana. 2015. Picea glauca, white spruce. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.usda.gov /database/feis/plants/tree/picgla/all.html [2024, May 1].

United States Department of Agriculture, Natural Resources Conservation Service. 2022. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture, Agriculture Handbook 296.
JSTOR, http://www.jstor.org/stable/42901151. Accessed 21 July 2023.

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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	07/20/2026
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:**

    _____

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:

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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:**
