Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region / Black Hills National Forest June 2022

Black Hills National Forest

Draft Forest Assessments:

Ecological Integrity of Non-Forested Ecosystems: Status and Trend

A dirt road traversing typical grasslands and shrublands in the Black Hills National Forest.

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Chapter 1. Introduction

This assessment addresses the ecosystem integrity of two significant terrestrial ecosystems in the Black Hills National Forest: grasslands and shrublands. A discussion of the drivers, stressors, and threats to the ecosystem integrity in the national forest is included. A separate assessment report addresses the ecosystem integrity of forested ecosystems, and aquatic, riparian, and wetland ecosystems, in the Black Hills National Forest. Understory vegetation associated with forested ecosystems is discussed briefly in this document; these vegetation types often serve as transitional or secondary grazing range for permitted livestock and provide habitat and forage for big game animals.

An ecosystem consists of living organisms (plants, animals, and microbes) and their nonliving environment (climate and soil for terrestrial ecosystems; aqueous environment and substrate for aquatic ecosystems). These components interact so that the system captures and stores energy as biomass, has a trophic structure, circulates nutrients, and changes over time.

Assessing ecosystem integrity is required by the Forest Service Planning Rule. Ecological integrity is the quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition, structure, function, and connectivity) act to maintain that quality or condition and maximize its ability to withstand or recover from perturbations imposed by natural environmental dynamics or human influence.

As stated in the Black Hills Phase II Amendment FEIS (USDA Forest Service 2005),

> *The Black Hills is an isolated, unglaciated, and distinctive group of rugged mountains rising above the surrounding plains. It is variously described as an "island on the plains," and species from diverse environments, including the Rocky Mountains, northern coniferous forests, eastern hardwoods, and the surrounding Great Plains, have populated the "island." As such the area forms an "ecological crossroads" and has been described as one of the nation's greatest national treasures (USDA Forest Service 1996b).*

The Black Hills is ecologically significant for its convergence of grasslands, shrublands, woodlands, forests, and wetlands. As an ecotone between ecological communities, the Black Hills function as a place for intermingling of species from disparate portions of North America.

The Black Hills area is unique for its highly variable climate, its isolation as a mountainous upthrust surrounded by prairie, and its varied topography (USDA Forest Service 1996b). While ponderosa pine dominates the Black Hills, it is present at the eastern edge of its range, isolated from other populations. Other forest ecosystems in the Black Hills include white spruce, aspen, bur oak, paper birch, and Rocky Mountain juniper. The grassland and shrub plant communities that surround the Black Hills intermingle throughout the Black Hills.

Grassland and shrubland ecosystems make up about 10 percent of the Black Hills National Forest, with forested ecosystems comprising the other 88 percent of the area. Generally speaking, grasslands are considered primary range whereas shrublands and forested ecosystems are typically secondary or transitional range for permitted livestock use.

Primary range is preferred by livestock and big game based on forage availability and nearby water sources. Secondary range may also provide adequate forage and browsing opportunities but generally is farther from water sources, provides less total forage, and is in steeper terrain. Secondary range may provide better hiding, security, and thermal cover for big game animals. The term transitional is used to convey the changes associated with plant succession. As forested ecosystems develop and mature, they often develop denser canopies that restrict sunlight and understory growth and provide less forage and browse production; conversely, as canopies are opened up, the understory produces more forage and browse.

The grassland and shrubland ecosystems serve as vital watershed cover, break up continuity of conifer vegetation, and may serve as a fuel break. They can provide a diversity of plants that are vital for ecological integrity and serve as habitat for numerous wildlife species and pollenating insects.

Forest, riparian, wetland, aquatic, and cave ecosystems are addressed in other assessments. Riparian, wetland, aquatic, and cave ecosystems occupy relatively minor areas (collectively about 2 percent) of the Black Hills National Forest but are nonetheless of considerable importance and deliver a broad array of highly valued ecosystem services.

Key Issues for Non-forested Ecosystems in the Black Hills National Forest

The Black Hills National Forest may need plan revisions to provide better direction for management of ecosystems to achieve a desired outcome based upon best available science. The focus should be on managing to maintain resiliency to provide for ecosystem services and buffer anticipated impacts from climate change. Specifically, revisions to the forest plan need to:

- Provide direction for ecosystem management to maintain ecological integrity, including maintaining the existing diversity of grasslands and shrublands while utilizing current and developing approaches to restore and move toward desired ecological conditions.
- Provide direction for management in a changing climate while allowing for flexibility to respond to impacts of climate change.
- Focus management actions to mitigate the impacts of known ecosystem stressors (e.g., high intensity wildfires, non-native invasive plant species, and insect outbreaks) in the Black Hills National Forest and prevents drivers from becoming stressors.
- Allow and provide direction for ecologically sound uses of prescribed fire and wildfire in grasslands and shrublands, while remaining fully aware of the implications and mitigations needed to protect wildland-urban interface developments. In cover types heavily impacted by fire suppression, the revised forest plan should promote continued restoration and/or resiliency treatments.
- Match the variability found in the Black Hills National Forest.
- Address management of unique ecosystems such as montane grasslands.

Use of Best Available Science and Information Gaps

Information sources used for this assessment include data from agency-wide databases including the Natural Resource Manager (Infra) and Forest Activity Tracking System databases, as well as databases specific to the Black Hills, such as the Black Hills Geographic Information System (GIS) database. Monitoring data have been analyzed by the Black Hills National Forest rangeland management specialists, range technicians, and botanists, informed by the Region 2 Rangeland Analysis and Management Training Guide (USDA Forest Service 1996a).

Identification of Non-forested Ecosystems

Non-forested areas make up about 12 percent of the Black Hills National Forest land base (table 1). Of the five ecosystems, grasslands and shrublands comprise approximately 9 to 10 percent of the Black Hills National Forest. This assessment focuses on the grassland and shrubland ecosystems.

Table 1. Area of non-forested ecosystem types in the Black Hills National Forest

[Source: GIS data.]

Non-forested Ecosystem Type	Acres	Percentage of the Black Hills National Forest
Grasslands	104,255	8.4%
Shrublands	6,984	1%
Riparian: Palustrine – marshes, swamps, bogs, fens, and ponds	4,254	<1%
Riparian: Riverine – rivers and creeks	13,581	1%
Aquatic: Lacustrine – lakes and reservoirs	6,862	1%
Total	135,936	Approximately 12%

Chapter 2. Conditions and Trends

Grasslands and Shrublands

The 1996 Final Environmental Impact Statement (FEIS) for the Revised Land and Resource Management Plan categorized four major vegetative complexes: Rocky Mountain Coniferous Forest dominated by ponderosa pine, Northern Coniferous Forest Complex led by white spruce, Deciduous Forest Complex of hardwood trees and shrubs, and a Grassland Complex of the Northern Great Plains. These were updated in the Phase II Amendment to the forest plan for the Black Hills National Forest and are described further in *Black Hills Community Inventory Final Report* (Marriott et al.1999). The upland grasslands and shrublands in the Black Hills are broadly grouped as Dry Plains Shrublands, Dry Mixedgrass Prairies, Mesic Mixedgrass Prairies, and Black Hills Montane Grasslands. Community types for each ecological group are described in appendix A.

The 1996 FEIS states that herbaceous and shrub vegetation has been impacted by four major factors during the last century: high livestock densities reduced the abundance of palatable plants; 2) non-native plant species have become naturalized enough to become substantial floral components; 3) higher conifer densities reduced understory plant production and variety of grasses, forbs, and shrubs; and 4) fire suppression nearly eliminated a rejuvenating process for grasslands and shrublands. Additionally, this fourth item allowed pine to encroach into meadows, further reducing grass and forb abundance.

Historic heavy grazing pressure from late 1870s until creation of the Forest Service in 1905 led to replacement of shrubs and tall native grasses of meadows and prairies (grasslands). It also allowed shrubs such as snowberry (*Symphoricarpos occidentalis*) to become dominant. Combined with fire exclusion, fire-adapted shrubs such as willow (*Salix* spp.) and dogwood (*Cornus* spp.) aged and decreased from mortality.

Rocky Mountain Research Station and other researchers have conducted several studies of Black Hills vegetation. The species composition, density, and productive capacity of the herbaceous and shrub community varies as a function of the soils and overstory canopy density (Uresk and Severson 1998). Production decreases as tree density increases, and conversely may be increased with logging and prescribed fire application.

Grasslands, shrublands, and herbaceous species beneath conifers declined with higher pine and spruce densities and encroachment, but two stressors in the past 25 years had noticeable impact. The two prominent stressors (mid-1990s to mid-2010s) are mountain pine beetle infestations and large wildfires. These stressors have re-opened canopies of mature and densely stocked ponderosa pine stands. They also removed encroaching conifers from grasslands in some areas. Such removal is beneficial for forage

production. However, ponderosa pine is a prolific regenerative species, and new seedlings and saplings are increasingly providing more surface shading, canopy cover closure, and encroachment into grasslands.

The Black Hills Montane Grassland community type described by Marriot et al. (2000) is a plant assemblage unique to the Black Hills. Additional survey and mapping since 1999 have resulted in identification of eight high-quality sites: Gillette Canyon Upper, Smith Draw, Lemming Draw Upper, Redbird Canyon South, West Hell Canyon Upper, Gillette Canyon Headwaters, Redbird Canyon at Sixmile, and Lemming Draw Lower (Marriott et. al. 2000, Marriott 2000, Marriott 2012). In 2000, the forest supervisor issued direction requiring consideration of high-quality montane grasslands before commencing ground-disturbing actions. The following specific activities were covered: logging, skidding, road construction or relocation (reconstruction of an existing prism is allowed), prescribed burning, large recreational group events, and ground-disturbing heavy maintenance or reconstruction of range improvements. Permitted livestock on active permits may continue. That direction has been followed since 2000 but has not been formally incorporated into the forest plan.

The *Range* assessment discusses condition and trends for all rangelands for the Black Hills National Forest, which comprise the grasslands and shrublands. A Forestwide summary of current conditions for both grasslands and shrublands is presented in table 2. These data display progress toward the specific objectives (tiered to the forest plan objectives) identified for each grazing allotment and are collectively considered for condition and trend assessments. Please refer to the *Range* assessment for further discussion regarding rangeland condition.

Table 2. Summary of Forestwide rangeland condition

	Percent of Total Rangeland Acres
Percent of acres meeting or moving toward forest plan objectives (satisfactory)	71%
Percent of acres not moving toward forest plan objectives (unsatisfactory)	22%
Percent of acres with undetermined status	5%

Ecosystem Drivers and Stressors

Timber Harvest

Timber harvest has historically been a dominant ecosystem driver and stressor in the Black Hills for public lands. Commercial and pre-commercial activities often resulted in short-term forage opportunities for permitted livestock and big game wildlife, but they also introduce and exacerbate current infestations of noxious weeds and other non-native invasive plants that stress the ecological integrity of the grasslands and shrublands.

Natural Disturbances

Ecological disturbances may shape non-forest structural diversity and composition at a range of spatial and temporal scales. Weather (e.g., wind, hail, tornados, and snow), wildfire, insects, parasites, pathogens, and wildlife individually and in combination may create openings in conifer canopies and promote vegetative diversity through new herbaceous and shrub growth. Each of these native disturbance agents influences the array of ecosystems in the Black Hills in different ways.

Mountain pine beetle infestations during 1996-2016 have re-opened canopies of mature and densely stocked ponderosa pine stands. This has affected approximately 15 percent of the national forest. They also removed encroaching larger conifers from grasslands in some areas. Such removal increases forage production because less competition for water and nutrients occurs for grasses and forbs. However, ponderosa pine is a prolific regenerative species and seedlings, and saplings are slowly restocking areas opened by fires and mountain pine beetles. This new growth slowly reduces forage production.

Native grasshoppers and Mormon crickets may compete for annual forage production when their populations greatly increase over baseline levels. In 2012, drought conditions facilitated brittle grass vegetation and increased insect use, and regular Black Hills National Forest grazing seasons were moderately to severely reduced, particularly by grass breakage from livestock passage.

In contrast, greater-than-normal, timely precipitation in 2013 allowed for tremendous vegetative production including visible increased plant community diversity. This outcome is believed to have occurred primarily from hoof and trailing impacts from permitted livestock use and big game in 2012, creating favorable soil and litter conditions for vigorous new plant growth.

Other rangeland insect pests include black grass bugs, fall armyworms, and white grubs. Management of grassland infestations may be achieved in some instances by maintaining plant diversity with planned grazing practices, prescribed burning, or foliar insecticides. In recent history, the Black Hills National Forest has not had significant effects from these pests.

Weather, in the form of wind, snow, ice, tornados, and hail, intermittently damages and kills ponderosa pine trees and stands throughout the Black Hills. These weather effects are discussed in the *Forested Ecosystem* assessment. This mortality can and has provided short-term forage increases for permitted livestock and big game, when animal access into these affected areas is not blocked by downed trees. The rate of ponderosa pine mortality from weather and disease may continue and increase because of climate change as severe storms become more common and promote drought-induced tree disease.

For example, the impact from climate change may also affect grassland and shrubland plant community composition, affecting native and non-native species in both cool and warm season categories. Less pine provides more open space for grasses, forbs, and shrub expansion. Depending on the extent of climate change, it may also favor non-native invasive grasses and noxious weeds over native species.

Fire and Fire Exclusion

Wildfire and fire exclusion have been dominant drivers and stressors in forested and non-forested ecosystems, particularly the ponderosa pine and grassland ecosystems in the Black Hills. Fire exclusion likely led to expansion of forests into grasslands in the Black Hills, although change in climate and/or historic livestock grazing may also have contributed (Murphy 2017, Brown and Sieg 1999). Efforts are continuing to return the use of prescribed fire to grasslands throughout the Black Hills National Forest. Restoration of landscape heterogeneity would enhance ecological conditions for a range of plant species and promote ecological resiliency (Brown and Cook 2006).

From the late 1990s and into the early 2010s, several landscape-scale moderate to severe wildfires affected approximately 15 percent of the national forest. Often these fires were high intensity crown fires and completely burned pine stands. For context, within the Phase II Amendment (USDA Forest Service 2005), many ponderosa pine forests of the Western United States, including the Black Hills National Forest, historically experienced frequent fires resulting in open stands with high understory biomass and diversity (Brown 2003). Frequent, low-intensity fires, whether cultural ignitions by native communities of the Black Hills or lightening ignitions, limited stand density, altered understory vegetation, and resulted in high spatial heterogeneity (Brown 2003). However, there is not complete agreement in the literature. Some evidence suggests it is likely that a mixed-severity fire regime, including both crown fires and surface fires, occurred in the Black Hills prior to recent intensive forest harvests (Lentile et al. 2005).

Before European settlement, the average wildfire return interval ranged from 10 to 31 years, depending on elevation (Graham et al. 2021).

It is likely that Rocky Mountain juniper has increased in extent due to fire exclusion, and that other factors such as climate change and grazing have allowed for the expansion of juniper woodlands into meadows, grasslands, and other types (Scher 2002).

Grazing

Proper livestock use that follows established forest plan guidelines is intended to maintain and promote grasslands and shrublands. Livestock and big game grazing, browsing, and trampling that exceed forest plan guidelines can make bare mineral soil seedbeds for conifer establishment into grasslands and shrublands. The same result may occur under forested canopies, enhancing successful pine regeneration (USDA Forest Service 1996b). In both instances such overuse can alter original composition, allow for expansion of less desirable plant species, and lower plant root reserves. Conversely, proper grazing use can stimulate growth and reduce fire hazards by reducing fine fuels and incorporating litter and manure into the soil surface, which aids in watershed protection and site productivity.

Invasive Species

Invasive species are a stressor in grasslands ecosystems. As discussed further in the *Range* assessment, non-native plants are the primary reason areas are not considered to be in satisfactory condition. Despite coordinated noxious weed control treatments by the Forest Service and numerous cooperators in the Black Hills Invasive Plant Partnership, a variety of invasive species have proliferated across the Black Hills National Forest and some private lands, particularly in the northern Black Hills. A variety of vectors enable their active spread despite efforts to restrict or reduce noxious weed proliferation.

Climate Change

Information in this section about the vulnerability of grasslands and shrublands to climate change was obtained from Timberlake et al. (2022).

Ponderosa pine ecosystems have moderate vulnerability to climate change in the Rocky Mountain region, including the Black Hills (Rice et al. 2018). Drought conditions increases the susceptibility of trees to other disturbances, including insects (Rice et al. 2018) and fire.

Climate projections for the Black Hills are generally uncertain for precipitation but suggest that there may be an increase in winter and spring precipitation, which could potentially benefit the herbaceous and browse vegetation associated with ponderosa pine as well as grasslands and shrublands. Higher temperatures will increase risk and frequency of broad-scale fire. Conversely, such climate change may promote non-native invasive grasses. This would conflict with forest plan objectives to maintain and not degrade native grasses and forbs, including those species associated with montane grasslands.

Projections show wide variation in future precipitation and increased variability in year-to-year moisture availability and precipitation. Future variability in moisture availability from year to year may result in increased variability in annual herbaceous forage and browse production compared to the present.

Lower-elevation grassland ecotones may replace ponderosa pine in the Black Hills; the pine may be vulnerable to vegetation type conversion especially following disturbances and subsequent challenges faced by pine regeneration from removal of seed-bearing trees. While Black Hills ponderosa pine is well north of the southern range limits of the species, suggesting low vulnerability to shifts in species distribution, the elevation profile of the Black Hills implies limitations on upslope range shifts as

temperatures increase and life-zones move upward. This implies that warm season grass species and non-native grasses may be capable of reducing or replacing native cool season types in these lower elevations.

One study using a global vegetation model parameterized for the Black Hills indicates that ecotonal areas between prairies and woodlands are projected to experience increased fire frequencies under anticipated 21st century climate conditions. This investigation found that ponderosa pine would continue to persist in these areas in the face of increased fire frequency due to thick bark of older trees and other adaptations that confer resistance to surface fire if large, thick-bark adult pine persist (King et al. 2013). However, ponderosa pine could persist as woodlands and not forests.

King et al. (2013) conclusions countered the findings of climate envelope modeling, which projected a loss of ponderosa pine in the Black Hills region (Rehfeldt et al. 2006). Mechanistic models like that used by King et al. (2013) are generally viewed as more robust than climate envelop modeling (Iverson and McKenzie 2013). Loss of pine may favor increased grasslands and shrublands.

As discussed above, studies conducted across the West indicate that wildfire will become more widespread because of climate change. Grassland and shrubland species associated with ponderosa pine may persist with some species shift to non-native, invasive grasses. Ponderosa pine has structural traits (e.g., thick sloughing bark, self-pruning lower limbs) that confer relatively high resistance to fire (Stevens et al. 2020), and their persistence may help maintain some favorable associated plant communities that also contain grazeable forage and browse species.

The effects of drier conditions on post-fire regeneration are another well-documented climate change vulnerability for ponderosa pine forests and associated grasslands and shrublands, particularly following high severity fires that burn large areas. These types of stand replacement fires have basically created extensive grasslands and some associated minor pockets of shrublands. Limited numbers of seed trees in these areas and climate-driven drought conditions make it difficult for trees to establish (Stevens-Rumann et al. 2018). Studies examining the effects of the Jasper fire, which burned more than 80,000 acres in 2000, suggest limited pine regeneration in areas that burned at high severities (Lentile et al. 2005, Keyser et al. 2008). One study that examined several fires, including the Jasper fire, indicated that climatic stress was one of three factors most strongly associated with post-fire regeneration patterns, along with burn severity and elevation (Korb et al. 2019), thus allowing grasslands and shrublands to persist without pine regeneration.

Key Ecosystem Characteristics and Ecological Integrity of the Ecosystem

Black Hills National Forest grasslands are best summarized as having variable ecological integrity and experience occasional to periodic fires of low to moderate severity. They comprise diverse plant communities and numerous soil types, and they include areas with predominantly native grass and forb species, areas that are a diverse mix of native and some non-native invasive grasses, and other areas dominated by non-native invasive grasses and noxious weeds (as discussed further in the *Range* assessment). While the grasslands Forestwide have variable plant communities, they all provide habitat, forage, browse for numerous wildlife species, and provide other ecosystem services such as watershed protection and pollination opportunities.

One sub-aspect of grasslands ecosystems is the significance of montane grasslands. Per Marriott (2012): *"Due to limited global distribution, rarity of native stands, significant habitat loss in the past, continued habitat loss, and low level of protection afforded remaining stands, Black Hills montane grassland vegetation is ranked* G1S1 [rare at Global and State level due to rarity of native stands] *in South Dakota and Wyoming, "critically imperiled" on a global and local basis."*

Upland shrublands are predominantly dominated by mountain mahogany (*Cercocarpus montanus*), particularly on the western and southwestern portions of the Black Hills National Forest. They generally

reflect stable ecological integrity and are subject to occasional fires of low severity. They provide habitat and browse forage for wildlife and protect soils and watersheds.

Summary of the Assessment of Ecosystem Integrity of Grassland and Shrubland Ecosystems

A summary of terrestrial ecosystem integrity and trends is presented in table 3.

Table 3. Summary of terrestrial ecosystem integrity and trends

Ecosystem	Current Ecosystem Integrity	Likely Future Ecosystem Integrity with Current Forest Plan Direction
Grasslands	Moderate	Low/Moderate
Shrublands	Moderate	Moderate

Transitional rangeland understory production under conifers is affected primarily by the ecological integrity of the ponderosa pine ecosystem. The *Forested Ecosystem Integrity* assessment rates pine as "low" for both current and likely future integrity. Projected even-aged vegetation forest management and reduced harvest levels would result in reduced transitory vegetation. In contrast, there are proposals to increase the use of prescribed fire for fuels reduction. Use of fire in this manner would stimulate short-term flush of herbaceous vegetation and some shrub sprouting. Use of fire has been limited by burdens associated with extended and extensive local, regional, and national fire suppression work, and available burn prescriptive windows.

Key factors in these two ratings are:

- Anticipated climate changes may favor non-native, invasive grasses such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), and smooth brome (*Bromus inermis*). Invasive noxious weeds are expected to continue to proliferate and spread under these climate changes.
- Ponderosa pine is a prolific regenerative species. High intensity fires and climate change may lead to areas devoid of or sparely stocked with pine and would be expected to promote short- and long-term grasslands and shrubland growth.
- Past forest conditions were more uniform and continuous, with fewer gaps and more even spacing, increasing the likelihood of crown fire. This is dissimilar to the uneven-aged and spatially heterogeneous forest structure found historically.
- This change in forest structure also has likely led to a loss in the diversity and biomass of understory grasses and shrubs.
- The extent of ponderosa pine in the Black Hills National Forest has been declining, while several other ecosystems such as white spruce, bur oak, and Rocky Mountain juniper, as well as non-stocked areas, are moving into these vacated areas. This spread would reduce integrity of grasslands and shrublands through encroachment. Future aspen integrity is rated low and some increase of grasslands and shrublands into these acres is expected.

Chapter 3. Ecosystem Services

Ecosystem services are components of nature that contribute to human well-being. Humans benefit from and depend on non-forested ecosystems such as grasslands and shrublands in a variety of ways. They provide vegetative and litter cover to help regulate water quality and quantity, stabilize and develop soil profiles, and support carbon sequestration. Plant species also provide pollination opportunities for native

insects and bees from managed hives. Grassland watersheds often support another terrestrial ecosystem – riparian, which in turn may support favorable stream and creek flows. These flows in turn provide fish habitat for native species, and for introduced catchable species.

Both grassland and shrubland ecosystems are often vital year-round in supporting a variety of wildlife species including small mammals (e.g., pine martens and tree squirrels), big game (e.g., elk, mule deer, and whitetail deer), and watchable wildlife (e.g., raptors and songbirds). Recreational opportunities are present for viewing wildlife, hiking, dispersed camping, and using designated motorized trails and roads with a variety of vehicles. Big game, predator, prairie dog, and upland bird hunting opportunities are present as well. Many plants within grasslands are of cultural and tribal importance; tribal members may seasonally collect plants for medicinal and spiritual uses. Some grassland locations have religious meaning to Native Americans. Grasslands and shrublands also exhibit beautiful scenery and offer opportunities for solitude and spirituality.

Livestock grazing has been, and continues to be, an important use in the Black Hills National Forest. Several of the ranching operations in the area still rely on public lands (e.g., national forests and grasslands, state, and Bureau of Land Management lands) for livestock grazing. Supporting these ranching operations helps ensure the maintenance of open spaces and reduces the number of issues associated with the wildland-urban interface. Maintaining the sustainability of ecological resources is therefore important for continuing the social, cultural, and economic benefits for local communities.

Ecosystems with moderate to high ecological integrity and that are resilient to future disturbances and climate change will continue to provide the ecosystem services that have been historically provided by the Black Hills National Forest. Continued production of ecosystem services may be more difficult and less certain if ecosystems have reduced or low ecological integrity or experience large-scale disturbances.

Chapter 4. Potential Need for Plan Changes to Respond to Terrestrial Ecosystem Integrity Issues

- Consider formally incorporating current management direction that would promote the protection and management of high-quality Black Hills montane grasslands. These unique plant communities are considered critically imperiled both globally and locally.
- Consider desired conditions for a variety of rangeland health indicators: the degree to which the integrity of soil, vegetation, water, and the ecological processes of the rangeland ecosystem is balanced and sustained. Integrity is defined as: maintenance of the composition, structure, and functional attributes characteristic of a particular locale, including normal variability.
- Consider editing the current forest plan definition of satisfactory and unsatisfactory range conditions to include “as influenced by livestock grazing management” or editing the definition to acknowledge the drivers that are completely unrelated to livestock grazing management.
- Consider editing objective 301 so that it considers the potential future variability in forage production expected from climate change.

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Appendix A: Black Hills Community Types

Black Hills community types are described below as they were in the Black Hills Phase II Amendment Final Environmental Impact Statement (USDA Forest Service 2005).

Black Hills Plant Community Types

Marriott and Faber-Langendoen (2000) identified four ecological groups and six community types of the most prevalent upland grasslands and upland shrublands within the Black Hills National Forest (table 4). Detailed environmental and vegetation descriptions of plant associations are provided in Marriott and Faber-Langendoen (2000).

Table 4. Grassland and shrubland ecological groups and plant community types

Ecological Group	Community Type
Dry Plains Shrublands (Generally greater than 50% cover)	Mountain Mahogany/Sideoats Grama
Dry Mixedgrass Prairies	Little Bluestem/Grama/Thread-leaf Sedge Needle and Thread/Blue Grama
Mesic Mixedgrass Prairies	Western Wheatgrass/Green Needlegrass Western Wheatgrass/Needle and Thread
Black Hills Montane Grasslands	Prairie Dropseed – Richardson's Needlegrass – Timber Oatgrass

Dry Plains and Shrublands

The primary community type in the Dry Plains and Shrublands group in the Black Hills National Forest is Mountain Mahogany/Sideoats Grama shrubland. It is best developed east of Newcastle, Wyoming, and occurs on low-elevation, limestone-derived soils. Total vegetative cover is generally greater than 50 percent; herbaceous stratum is relatively sparse generally ranging from 10 to 25 percent (Marriott and Faber-Langendoen 2000).

Dry Mixedgrass Prairies

The most common Dry Mixedgrass Prairie community type in the Black Hills is the Northern Great Plains Little Bluestem Prairie, dominated by little bluestem, blue, and sideoats grama and often thread-leafed sedge. It occurs throughout the Black Hills but stands at higher elevations tend to be reduced in size. The other Dry Mixedgrass Prairie type, Needle-and-Thread - Blue Grama Mixedgrass Prairie, is restricted to the lower elevations (Marriott and Faber-Langendoen 2000).

Mesic Mixedgrass Prairies

Mesic Mixedgrass Prairies are most extensive in the Red Valley and much of the Hogback Rim. Two associations are currently recognized for the Black Hills: Western Wheatgrass – Green Needlegrass and Western Wheatgrass – Needle-and-Thread Mixedgrass Prairies. Stands can be difficult to classify due to shared dominants among both mesic and dry mixed-grass types. Species distribution typically is patchy, with local dominance variable (Marriott and Faber-Langendoen 2000).

Black Hills Montane Grasslands

Black Hills Montane Grasslands are endemic to the Black Hills (i.e., this plant association does not occur anywhere else outside of the area), occurring at higher elevations on the Limestone Plateau and adjacent Central Core (Marriott and Faber-Langendoen 2000). Comprehensive surveys and ranking of Black Hills Montane Grasslands (Marriott 2000, Marriot 2012) have identified high-ranking examples on the southern Limestone Plateau and adjacent Central Core, and on Warren Peaks in the Bear Lodge Mountains). These highest-ranking examples exhibit the following three native species: *Sporobolus heterolepis* - *Achnatherum richardsonii* - *Danthonia intermedia* (prairie dropseed - Richardson's needlegrass - timber oatgrass) (Marriot 2012).

Appendix B: Key Plan Direction

Key plan direction described in this appendix includes the overarching objective of maintaining or moving toward Satisfactory range conditions. The *Other Direction* and *Forest Plan Direction* sections include forest plan goals and objectives that relate to successful permitted livestock grazing practices and use. The following is a comprehensive listing of know directions from the current forest plan and other direction from the Forest Service Handbook.

Other Direction

On August 24, 2000, an internal memo from the Forest supervisor to all district rangers and zone engineers directed careful consideration of high-quality Montane Grasslands before commencing ground-disturbing actions. The following specific activities were covered: logging, skidding, road construction or relocation (reconstruction of an existing prism is allowed), prescribed burning, large recreational group events, and ground-disturbing heavy maintenance or reconstruction of range improvements. Permitted livestock grazing under issued, active permits may proceed. Particular emphasis is placed on the following eight high ecological integrity sites (Overall Rank A or B): Gillette Canyon Upper, Smith Draw, Lemming Draw Upper, Redbird Canyon South, West Hell Canyon Upper, Gillette Canyon Headwaters, Redbird Canyon at Sixmile, and Lemming Draw Lower (Marriott et. al. 1999, Marriott 2012).

Forest Plan Direction

Forest Plan Goals and Objectives Relating to Livestock Grazing

Goal 1: Protect basic soil, air, water, and cave resources.

- Objective 102. Use a qualitative survey which emphasizes riparian condition, such as the Proper Functioning Condition methodology, to refine the preliminary watershed health assessments (FP-FEIS, Appendix J) within the next planning period. This survey would focus first on Class III watersheds and could be supplemented with additional qualitative methods (such as MIM – Multiple Indicator Monitoring), as needed, for the design of watershed improvements. Class I watersheds do not need to be surveyed unless information becomes available which suggests there was an error in classification.
- Objective 103. Maintain or improve long-term stream health. Achieve and maintain the integrity of aquatic ecosystems to provide stream-channel stability and aquatic habitats for water quality in accordance with state standards.
- Objective 104. Maintain or enhance watershed conditions to foster favorable soil relationships and water quality.
    - Achieve and maintain stable stream beds and banks, diverse riparian vegetation, and effective ground cover that control runoff and erosion.

Goal 2: Provide for a variety of life through management of biologically diverse ecosystems.

- Objective 205. Manage for 122,000 acres of prairie grassland and 3,600 acres of meadow during the life of the Plan. Restored acres will not be considered suitable for timber production.
- Objective 213. Maintain or enhance existing riparian area biodiversity, physical structure, and size.
- Objective 216. Manage to conserve or enhance the integrity of the following important botanical areas:

h. McIntosh Fen

- Objective 222. Complete the following habitat projects each year during the plan period as funding allows: Range -- 30 structural and 600 acres of nonstructural improvements.
- Objective 240-HAB. Manage and/or install structures to provide water for livestock and to protect the aquatic, shoreline and upland vegetation around ponds or water catchments containing leopard frogs.

Goal 3: Provide for sustained commodity uses in an environmentally acceptable manner.

- Objective 301. Produce on a sustained basis and make available up to 233 million pounds of forage for livestock and wildlife use each year (weather permitting). The location and amount of forage produced under the forest canopy will vary with the density of the overstory. This may necessitate changes in where and how both livestock and wildlife grazing take place on a local basis over the rotation of a stand of timber.
    a. Livestock use will be up to 127 million pounds of forage per year or approximately 128,000 AUMs.
    b. Wildlife use will be up to 106 million pounds of forage per year or approximate population levels of 70,000 deer and 4,500 elk or other combinations that use the same amount of forage.
- Objective 302: Maintain rangelands in satisfactory range condition.
    a. Management of rangelands determined to be neither meeting nor moving toward satisfactory rangeland condition in an acceptable timeframe, shall cause actions designed to move toward satisfactory rangeland condition within a stated timeframe to be implemented.
    b. In the absence of a site-specific planning process and an Allotment Management Plan, management direction for ongoing rangeland management activities on active allotments needed to address rangeland conditions and trends and species viability will be incorporated into the grazing permits through the AOI.

Goal 7: Emphasize cooperation with individuals, organizations, and other agencies while coordinating planning and project implementation.

- Objective 701. Continue to cooperate with interested parties and organizations in the development of plans and projects.
- Objective 702. Encourage cost sharing as part of cooperative efforts.
- Objective 707. Allow military construction and tactical training exercises, consistent with resource protection, standards and guidelines, and safety of other Forest users.

Goal 9: Provide high-quality customer service.

- Objective 901. Provide customers the kind and quality of services they reasonably want.
- Objective 903. Respond to information needs of the public.

Forestwide Standards and Guidelines Relating to Grazing

Physical Elements: Riparian Areas, Water Influence Zones, Caves, and Wetlands

- 1301. In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition. STANDARD. (Regional WCP Handbook Standard 3)

- 1304. As opportunities arise, and need dictates, relocate or implement mitigation measures for roads, trails, watering tanks, ponds, water catchments, and similar facilities currently located within the Water Influence Zone. STANDARD
- 1401. For caves that have been determined significant or that have not been evaluated for significance [as per 36 CFR 290.3 (c) or (d), manage to protect or enhance biological, cultural, ecological, hydrological, and physical characteristics with the following actions:
- Avoid ground disturbance within 100 feet of an opening of a natural cave (also see standard 3207). STANDARD
- b. Take measures to prevent human-caused changes in cave ecosystem, water sediment, nutrient, chemical, airflow, humidity, or temperature regimes. GUIDELINE
- 2107. Conifer encroachment on areas that have formed over grass, meadow, or hardwood vegetation may be treated (e.g. to conserve habitat for threatened, endangered, and sensitive species, management indicator species and species of local concern, maintain forage base, and landscape diversity.) Consider soils that formed under grass or meadow plant communities and other factors in determining extent of pine encroachment removal. GUIDELINE
- Locate new livestock/wildlife water sites (e.g., drinking structures) outside of hardwood communities, except when no other option is available. STANDARD

FSH 2509.25 – Water Conservation Practices Handbook, Chapter 10

12.1 Management Measure (3)

In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition.

Design Criteria (a): Allow no action that will cause long-term change to a lower stream health class in any stream reach. In degraded systems, progress toward robust stream health within the next plan period.

Design Criteria (b): Allow no action that will cause long-term change away from desired condition in any riparian or wetland vegetation community. Consider management of stream temperature and large woody debris recruitment when determining desired vegetation community. In degraded systems, progress toward desired condition within the next plan period. NOTE: Desired vegetation condition supports robust stream health (USDA Forest Service 1996b).

Design Criteria (e): Locate new concentrated-use sites outside the Water Influence Zone (WIZ) if practicable and outside riparian areas and wetlands. Armor or reclaim existing sites in the WIZ to prevent detrimental soil and bank erosion. NOTE: WRENSS (Water Resources Evaluation of Non-Point Silvicultural Sources, EPA 1980) (II.62), armored water-dependent facilities are accepted.

Design Criteria (f): Manage livestock use through control of time/timing, intensity, and duration/frequency of use in riparian areas and wetlands to maintain or improve long-term stream health. Exclude livestock from riparian areas and wetlands that are not meeting or moving towards desired condition objectives where monitoring information shows continued livestock grazing would prevent attainment of those objectives.

Design Criteria (g): Keep stock tanks, salt supplements, and similar features out of the WIZ if practicable and out of riparian areas and wetlands always. Keep stock driveways out of the WIZ except to cross at designated points. Armor water gaps and designated stock crossings where needed and practicable. NOTE: This measure avoids much serious bank damage (Clary and Webster 1989).

Design Criteria (h): Manage dry meadow and upland plant communities, including Kentucky bluegrass types that have invaded into wetland/riparian areas, in a manner that will contribute to their replacement over time by more mesic native plant communities to the extent practicable. Develop site-specific riparian stubble height standards or use the following default levels for carex and juncos species: 3-4 inches in

spring-use pastures and 4-6 inches in summer or autumn use pastures; to leave adequate residual stubble height to retain effective ground cover. NOTE: Clary and Webster (1989); USFS (1995); USDA Forest Service (1996b). Riparian areas with no Carex and juncos (for example, bluegrass, tufted hairgrass, etc.) require local stubble heights.

Design Criteria (i): Do not allow livestock grazing through an entire growing season in pastures that contain in riparian areas and wetlands. Apply short-duration grazing as practicable (generally less than 20 days) to minimize re-grazing of individual plants, to provide greater opportunity for regrowth and to manage utilization of woody species and reduce soil compaction. During the hot season (mid-to-late summer) manage livestock herds to avoid concentrating in riparian areas and wetlands. Apply principles of the Grazing Response Index to livestock management (USDA Forest Service 1996a). NOTE: USFS (1995).

Design Criteria (j): Design grazing systems to limit utilization of woody species. Where woody species have been historically suppressed, or where the plant community is below its desired condition and livestock are a key contributing factor, manage livestock through control of time/timing, intensity, and duration/frequency of use so as to allow for riparian hardwood growth extension and reproduction. Manage woody species in riparian areas to provide for stream temperature, bank stability and riparian habitat. NOTE: USFS (1995).

Design Criteria (k): Maintain the extent of stable banks in each stream reach at 74% or more of reference conditions. Consider degree of livestock trampling and riparian vegetation utilization on or immediately adjacent to stream banks when timing livestock moves between units. NOTE: USDA Forest Service (1996a).

Design Criteria (l): Adjust management in riparian areas and wetlands to improve detrimental soil compaction whenever it occurs. NOTE: Hummocking and platy surface soil structure are good indicators of soil compaction if more detailed sampling is not available (BLM 1993, 1994; FSH 2509.18).

Biological Elements – Flora: Range – General

- 2503. Developed recreation sites will be closed or restricted to grazing through use of fencing, as opportunities permit. However, grazing may be used as a management tool in these areas. Recreational livestock will normally be fed in designated areas. GUIDELINE
- 2504. The site-specific rangeland analysis necessary for preparation of allotment management plans shall document selected desired conditions and evaluate whether the designated area is at, moving towards, or moving away from, the desired conditions. GUIDELINE

a. Satisfactory range conditions occur when the existing conditions are at, or progressing towards the desired conditions identified through the project planning process.

b. When trends toward satisfactory range conditions are not achieved within 5 years by changes in grazing systems, allowable use or residual guidelines, more restrictive use or residual guidelines, changes to the grazing system shall be adopted, or cattle use be removed or relocated for a period of time.

Range – Proper Use or Residual Levels – Riparian/Uplands

- 2505. Livestock and wild herbivore allowable forage use or residual levels on rangelands by grazing system and range condition are as follows:

Table 1. Proper allowable use guidelines (percent utilization by weight each year)

Season of Use	Satisfactory Condition	Unsatisfactory Condition
Continuous Use Spring/Summer	0-45%	0-40%
Continuous Use Fall/Winter	55-60%	0-55%
Deferred Rotation	0-50%	0-45%
Rest Rotation	0-55%	0-50%

Residual Levels for Wetlands and Riparian Areas

Residual levels (or remaining height of key plant species) can be prescribed for riparian areas in the AMP or the annual letter of operating instructions (AOI) to the livestock permittee. Residual levels will be based upon specific objectives for the location in question and will consider season of use and range conditions. **STANDARD**

Allowable Use and/or Residual Levels

c. Utilization of willow, shrubs, woody vines or young deciduous trees (such as aspen, birch and oak) in any year by livestock or wildlife is limited to browsing only 40 percent of the total individual leaders produced in that year (not to be confused with 40 percent use on each and every leader produced).

d. Remove livestock from the grazing unit or allotment when further utilization on key areas in that year will exceed proper allowable use or prescribed residual level in the Forest Plan, AMP, or AOI for either grass and forbs or shrubs.

e. No authorized utilization will be allowed by domestic livestock on known occurrences of willow emphasis species (e.g., *Salix candida, Salix serissima, Salix lucida*).

f. Implement additional measures to assure avoidance of livestock use on *Carex alopecoidea*. Restrict livestock use of all or portions of 5 of the largest geographically spaced occurrences at site numbers: CAAL8-19, CAAL8-20, CAAL8-22, CAAL8-30, and CAAL8-31. STANDARD

- 2506. Develop site-specific vegetation utilization or residual guidelines during rangeland planning, and document them in allotment management plans (AMPs). In the absence of updated planning, the utilization guidelines as shown or residual guidelines documented in the AOI will apply. GUIDELINE
- 2507. Allow use of forage by livestock and wildlife in fenced riparian pastures so long as it meets the objectives of maintaining, enhancing, or conserving the riparian ecosystem and emphasis species persistence. STANDARD

Biological Environment – Fauna: Endangered, Threatened or Sensitive Species – Protection and Management

- 3103. Manage known sensitive species and species of local concern snail colonies to:
    c. Avoid burning, heavy grazing, off-highway vehicles (OHVs), heavy equipment and other activities that may compact soils or alter vegetation composition and ground cover. STANDARD
- 3104. Do not develop springs or seeps as water facilities where sensitive species or species of local concern exist unless development mitigates an existing risk. STANDARD
- 3111. From April 1 through August 15, minimize additional human-caused noise and disruption beyond that occurring at the time of nest initiation (e.g., road traffic, timber harvest, construction

activities such as new range improvement projects) within one-half mile of all active goshawk nests until the nest has failed or fledglings have dispersed. STANDARD

- 3125. Prescribe burn no more than 60 percent of any contiguous grassland area at a time and burn in early spring or fall. **STANDARD**

General Wildlife and Fish Direction

- 3202. Structures, such as fences and roads will be designed and built so that they do not create unnecessary or unreasonable barriers or hazards for wildlife and people. GUIDELINE
- 3207. Where caves or abandoned mines serve as nurseries or hibernacula for bats, vegetative changes within 500 feet of the opening are allowed only if needed to maintain bat habitat or if topography or other features protect the openings from disturbance. STANDARD
- 3212. Manage for high quality riparian communities.
    a. Provide stable steam banks. GUIDELINE
    b. Retain woody vegetation along streams and lakes to provide shading for aquatic life and terrestrial species. GUIDELINE

Fuels – Prescribed Fire

- 4103. Utilize prescribed fire though planned and natural ignitions to achieve management objectives for each management area (As shown in Table 1, and in the Black Hills National Forest's Land and Resource Management Plan (BHNF LRMP) on pages II-42 through II-44). STANDARD
- 4105. When feasible and appropriate use broadcast burning to dispose of slash to return the inorganic chemicals in the foliage and small woody material to the soil, to reduce fire hazard, and to provide a seed bed for natural regeneration. GUIDELINE (Amended Regional Guide Silviculture Guideline)
- 4107. Defer Prescribed burned areas from livestock grazing for a portion or all of the following growing season to ensure regrowth of forage species. GUIDELINE

Noxious Weeds – General

- 4301. For all proposed projects or activities, determine the risk of noxious weed introduction or spread, and implement appropriate mitigation measures and treatment. STANDARD

Heritage Resources – General

- 6101. Consider long-term Forest management needs in determining appropriate use of mitigation of effects to, or avoidance of, heritage resources during project planning. GUIDELINE

Forest Plan Management Area Standards and Guidelines relating to grazing within the Mystic Range EIS Project

- 3.1 – Botanical Areas

S&G: Rangeland – 3.1-2501. Allow livestock grazing if it does not conflict with the values for which the botanical area was designated. **STANDARD**

S&G: Rangeland – 3.1-2502. Allow new improvements only when they are necessary to maintain, restore or enhance the values for which the botanical area was designated. **GUIDELINE**

S&G: Rangeland – 3.1-2503. Restrict access of domestic livestock to protect the R2 sensitive and species of local concern plant occurrences in designated botanical areas. **STANDARD**

- 3.7 – Late Successional Forest Landscape

(No Goals or S&G for Rangelands)

- 4.1 – Limited Motorized Use and Forest Product Emphasis

S&G: Rangeland - 4.1-2501. Prepare livestock management strategies in the allotment management plan that will be compatible with recreation objectives. GUIDELINE

S&G: Rangeland - 4.1-2502. Locate or design structural improvements to meet Scenery Integrity Objectives. GUIDELINE

- 4.2B – Peter Norbeck Scenic Byway

S&G: Rangeland - 4.2B-2501. Livestock management strategies in allotment management plan should meet the recreational objectives for the management area. GUIDELINE

- 5.1 – Resource Production Emphasis

(No Goals or S&G for Rangelands)

- 5.4 - Big Game Winter Range Emphasis

Goal: Rangeland – 5.4-204. Improve forage on range areas.

S&G: Rangeland – 5.4 -2501. Design livestock management strategies including distribution and stocking rates to be compatible with big-game habitat objective. STANDARD

S&G: Rangeland – 5.4 -2502. Feature big-game use of forage increases, which result from the vegetative improvements, while also allowing for livestock increases. Follow forest-wide proper allowable use guidelines or residual levels documented in AMPs or AOIs for combined use by wildlife and livestock. GUIDELINE

- 5.4A – Norbeck Wildlife Preserve

S&G: Rangeland - 5.4A-2501. Existing livestock grazing may continue; permits may be reissued to existing or new permittees. Do not permit any increase in livestock numbers (animal months) STANDARD

S&G: Rangeland - 5.4A-2502. Take advantage of opportunities to transfer forage use from livestock to wildlife. GUIDELINE

S&G: Rangeland - 5.4A-2503. Prevent habitat degradation adjacent to water sources. (See Appendix E of BHNF LRMP.) GUIDELINE

S&G: Rangeland – 5.4A-2505. Livestock grazing may be used intermittently as a management tool (even in areas designated unsuitable for livestock grazing) to improve habitat conditions, e.g., to control noxious weeds. GUIDELINE

- 8.2 – Developed Recreation Complexes

S&G: Rangeland - 8.2-2501. Livestock management strategies in allotment management plan should meet the recreational objectives for the management area. GUIDELINE