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Forest Service

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Black Hills Resilient Landscapes Project

Draft Environmental Impact Statement

USDA Forest Service

Black Hills National Forest

Commonly Used Acronyms

AMZ	Aquatic management zone
BE	Biological evaluation
BHNF	Black Hills National Forest
BHRL	Black Hills Resilient Landscapes Project
BMP	Best management practice
CDA	Connected disturbed area
CMAI	Culmination of mean annual increment
CTA	Commercial treatment area
CWPP	Community wildfire protection plan
DEIS	Draft environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final environmental impact statement
FRCC	Fire regime condition class
FSH	Forest Service handbook
FSM	Forest Service manual
GIS	Geographic information system
HFRA	Healthy Forest Restoration Act
HUC	Hydrologic unit code
MA	Management area
MIS	Management indicator species
MVUM	Motor vehicle use map
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHPA	National Historic Preservation Act
NLEB	Northern long-eared bat
NRHP	National Register of Historic Places
OHV	Off-highway vehicle
PA	Programmatic agreement
POL	Products other than logs
ROD	Record of decision
ROS	Recreation opportunity spectrum
SDGFP	SD Department of Game, Fish and Parks
SHPO	State Historic Preservation Officer
SIO	Scenic integrity objective
SOLC	Species of local concern
SS	Structural stage
USFWS	US Fish and Wildlife Service
WCPH	Watershed Conservation Practices hdbk.
WUI	Wildland-urban interface

Black Hills Resilient Landscapes Project

Draft Environmental Impact Statement

Custer, Fall River, Lawrence, Meade, and Pennington Counties, South Dakota,
and Crook and Weston Counties, Wyoming

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Abstract: This Draft Environmental Impact Statement documents the detailed analysis of the Proposed Action and No Action Alternative for the Black Hills Resilient Landscapes Project. The project focuses on increasing ecosystem resilience to disturbances such as severe wildfire and mountain pine beetle infestation. Project development and documentation are being carried out in accordance with the Healthy Forests Restoration Act, as amended. The Black Hills National Forest Advisory Board is serving as a collaborator for this project. The Proposed Action includes mechanical and manual fuel reduction, prescribed fire, hazard tree removal, timber harvest, precommercial thinning, pine planting, site preparation, maintenance of quaking aspen, bur oak, and grasslands, and enhancement of within-stand diversity. This document also describes and analyzes an amendment to the Black Hills National Forest Land and Resource Management Plan, as amended.

Comments on this Draft Environmental Impact Statement must be received by October 30, 2017.

It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the EIS. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review.

Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative review or judicial review.

Summary

Purpose and Need

The Black Hills Resilient Landscapes Project area includes most of the Black Hills National Forest (BHNF). Recent mountain pine beetle infestation and response actions have changed forest conditions. The forest is more open and there are many dead trees. Forest structure has moved away from objectives of the BHNF Land and Resource Management Plan (Forest Plan), as amended. The project's purpose is to reduce hazards, move forest structure and composition toward objectives, and increase resilience to disturbance.

The project is within the Healthy Forests Restoration Act (HFRA) Designated Areas as requested by the Governors of South Dakota and Wyoming and is proposed under HFRA authority. Collaboration with the National Forest Advisory Board and involvement of Tribes, agencies, and other interested parties has occurred and is continuing.

Public comments on the initial proposal resulted in identification of issues regarding scenery, noxious weeds, and landscape-level structural diversity.

Proposal

The Proposed Action includes:

- Fuel treatments (manual, mechanical, and prescribed fire)
- Hazard tree reduction
- Enhancement of aspen, grasslands, oak, and uneven-aged pine stands
- Pine structural stage modification (commercial timber harvest, non-commercial thinning, tree planting, and site preparation)
- Road construction and improvement

The Proposed Action would amend the Forest Plan (page 36) to update existing language regarding slash retention with more recent direction found in the Regional Watershed Conservation Practices Handbook.

The No Action alternative was analyzed in detail. Other action alternatives were considered but, for various reasons, were not analyzed in detail.

Environmental Consequences

Ponderosa Pine	The Proposed Action would result in progress toward achievement of forest structure objectives. If no action is taken, progress toward objectives would generally occur more slowly, if at all. Development of dense, older stands would take time. Proposed thinning of small pine would result in an increase in individual tree diameter growth as compared to the No Action alternative. Snags and down woody material would generally continue to exist at Forest Plan objective levels.
Forest Pathogens	Due to the recent mountain pine beetle epidemic and timber harvest, the amount of forest at risk of infestation has been significantly reduced. Even where dense stands still exist, they are at a much lower risk of attack due to surrounding forest conditions. As compared to taking no action, proposed activities would allow new stands to develop at different rates and densities

	and further diversify the forest, delaying redevelopment of landscape-level susceptibility to beetle infestation.
Aspen and Oak	Proposed activities would maintain species diversity in mixed pine/aspen and pine/oak stands and perpetuate aspen and oak stands by reducing competition with conifers. If no action is taken, conifer encroachment would continue to pose a risk to some aspen and oak stands.
Fire and Fuels	As compared to taking no action, the Proposed Action would generally result in more manageable potential fire behavior. Most fires in treated areas would burn on the surface at low to moderate severity with isolated pockets of trees burning. Fire hazard would generally decrease in treated areas. Proposed activities would increase resilience to future wildfires as compared to the No Action alternative.
Botanical Resources	The Proposed Action would not affect threatened or endangered plant species. It may adversely impact individuals of Region 2 Sensitive plant species but would not be likely to result in a loss of viability in the Planning Area nor cause a trend toward federal listing or a loss of species viability range-wide. Plant species of local concern would persist in the Black Hills National Forest.
Range	Livestock grazing occurs in most parts of the project area. As compared to taking no action, the Proposed Action would temporarily increase herbaceous and shrub production, which may result in more use of forested range. Grazing patterns would be temporarily altered from existing conditions while proposed activities are occurring.
Noxious Weeds	The Proposed Action would be likely to increase noxious weed infestation due to soil disturbance and opening of the forest canopy. Costs of needed weed suppression could exceed available funding. The No Action alternative would have no immediate effect on noxious weeds, though increasingly hazardous fuel conditions could result in severe wildfire and subsequent suitable conditions for weed infestation.
Wildlife	The Proposed Action and No Action alternative may affect the federally threatened northern long-eared bat, though neither would be likely to have significant population-level effects. Neither would affect other threatened or endangered wildlife species. The Proposed Action and No Action may adversely impact individuals of Region 2 Sensitive wildlife species but would not be likely to result in a loss of viability in the Planning Area nor cause a trend toward federal listing or a loss of species viability range-wide. Wildlife species of local concern and management indicator species would persist in the Black Hills National Forest. As compared to taking no action, the Proposed Action would increase risks to individuals of some species during project implementation. Over a longer time frame, taking no action could negatively affect habitat for species associated with live pine forest, aspen, and openings while increasing habitat for species associated with snags and burned forest.

Fisheries	Management indicator fish species would be likely to persist. The Proposed Action and No Action alternative would have no effect on two Region 2 Sensitive fish species. Either alternative may adversely impact individuals of another Sensitive fish species but would not be likely to result in a loss of viability in the Planning Area or cause a trend toward federal listing.
Geology	The Proposed Action would generally have few effects on geological resources. Avoidance of caves and sinkholes would minimize potential effects on subterranean ecosystems. Completion of on-site slope stability examinations prior to proposed ground-disturbing activities would allow early identification and avoidance of unstable slopes. Known fossil sites would be protected, and any new discovery of vertebrate fossils would require notification of a geology specialist.
Soil Productivity	Implementation of design features and standard measures would protect the soil resource. Any increases in soil bulk density would remain within allowable limits. Effects of mechanical site preparation would be similar to those of ground-based timber harvest. Very limited to no increase in soil bulk density would occur in the areas proposed for manual treatment activities. Short-term increases of erosion may be associated with National Forest System road reconstruction and temporary road construction. These effects would decrease as disturbed soils revegetate or are rehabilitated following use. Any detrimental erosion would remain within limits specified by the Forest Plan and Regional direction. The No Action alternative would have no immediate effect on soil productivity, though increasingly hazardous fuel conditions could result in severe wildfire and subsequent adverse effects on soils.
Watershed	The Proposed Action would not degrade watershed condition. There would be no effects on impaired water bodies. As compared to taking no action, road-related activities would result in a slight increase in the potential for sedimentation, mainly at stream crossings. These effects would persist until the site revegetates, which generally occurs within five years. Improvement of existing roads would reduce sedimentation rates below existing condition. The Proposed Action would not impair project area streams and would have no more than minor, temporary effects on streamflow. Proposed new road crossings of perennial and intermittent streams would negatively affect parts of the associated riparian areas.
Air Quality	Prescribed burning would temporarily affect air quality. Burning would be subject to prescriptive elements as defined in an approved Prescribed Fire Plan. These measures have proven effective in maintaining smoke emissions at acceptable levels. The Proposed Action (including prescribed burning) would not have long-term or significant impacts on air quality or visibility in Class I airsheds.
Transportation	The Proposed Action would impact individual roads and motorized trails during implementation of proposed activities due to increased truck traffic, construction equipment operations, and additional vehicles using roads as compared to current conditions. Effects may include closures and traffic

	delays. Safety considerations would be included in road design for new and reconstructed roads and during active road work.
Climate Change and Carbon Cycle	At a global, national, or even regional scale, any short-term reduction in carbon stocks and sequestration rates or increase in greenhouse gas emissions due to this project would be imperceptibly small, as are the potential long-term benefits. Management actions that improve the resilience of forests to climate-induced disturbances could help sustain the current strength of the forest's carbon sequestration ability.
Cultural Resources	A total of 705 historic properties have been identified within the project area as of March 2017. An estimated 112 additional historic properties may exist. Roughly 15 to 25 percent of the sites identified in the Black Hills National Forest may be eligible for the National Register of Historic Places. It is ordinarily possible to develop and implement protection measures to safeguard historic properties, thereby eliminating the potential for adverse effects.
Scenery	The recent mountain pine beetle epidemic, response actions, and wildfires have altered scenery in parts of the project area. The Proposed Action would add to some of these effects by increasing acreage of young and open forest. With implementation of project-specific design features and adherence to Forest Plan guidelines, proposed activities would meet assigned scenic integrity objectives. If no action is taken, existing visual evidence of some modifications would decrease over time, while increasing density of young pine stands may limit viewing distance.
Recreation	The project area includes popular recreation destinations. The Proposed Action may cause temporary, localized disruptions of recreational activities but would maintain overall recreation opportunities. Commercial timber harvest and related activities, which have the greatest potential to affect recreation, would occur only in areas with appropriate recreation opportunity designations. Advance coordination with recreation special use permit holders and adherence to permit terms would minimize effects on these uses.
Land Uses	The potential for the Proposed Action to affect most permitted land uses is low. Coordination between special use administrators and project implementation personnel and adherence to Forest Plan direction and design features would prevent adverse effects on permitted land uses.
Ecosystem Services and Economics	The Proposed Action would provide various sectors of the public with multiple values and benefits associated with the maintenance of ecological processes. Perpetuating the resilience of these processes is critical to sustaining multiple-use management and providing a broad range of ecosystem services. The project's focus on forest structural diversity at the stand and landscape scales would contribute toward the forest's capacity to resist change or recover following disturbance. It is estimated that the Proposed Action would support over 1,300 jobs, $55,000,000 in total labor

income, and $64,000,000 in GDP contribution for the local economy on an annual average basis.

The Proposed Action would not result in any irreversible commitments of resources. Possible irretrievable commitments include temporary loss or modification of a percentage of habitat for certain wildlife and plant species; temporary loss of desirable vegetation due to noxious weed infestation; loss of soil productivity where roads are constructed; and temporary impacts on air quality due to prescribed fire.

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Chapter 1. Purpose of and Need for Action

Chapter Summary

The Black Hills Resilient Landscapes Project area includes most of the Black Hills National Forest. Recent mountain pine beetle infestation and response actions have changed forest conditions. The forest is more open and there are many dead trees. Forest structure has moved away from Forest Plan objectives. The project's purpose is to reduce hazards, move forest structure and composition toward objectives, and increase resilience to disturbance.

The project is within the HFRA Designated Areas as requested by the Governors of South Dakota and Wyoming (page 7) and is proposed under HFRA authority. Collaboration with the National Forest Advisory Board and involvement of Tribes, agencies, and other interested parties has occurred and is continuing.

Background

From 1997 through 2015, the Black Hills National Forest (BHNF) experienced epidemic levels of mountain pine beetle infestation. Beetles killed pine trees on approximately 220,000 acres (Allen pers. comm.). The heaviest infestations were in the central Black Hills, with moderate levels of infestation across much of the forest (Figure 1).

Where heavy infestation occurred, there are thousands of acres with few remaining live, mature pine trees. In moderately infested areas, beetles attacked smaller pockets of trees or fewer trees within each pocket. Across the remainder of the Black Hills, beetles infested small, isolated patches or scattered individual trees.

The Forest Service and its partners responded to the epidemic by recovering the value of some of the infested trees, protecting recreation areas, decreasing fuel build-up in certain areas, and reducing stand susceptibility to beetle infestation through thinning of dense pine forest.

The epidemic has now ended (Schotzko and Allen 2016), but the infestation, response actions, and wildfire have left behind a changed landscape. There are many beetle-killed trees, both standing and fallen, which pose an increased hazard to

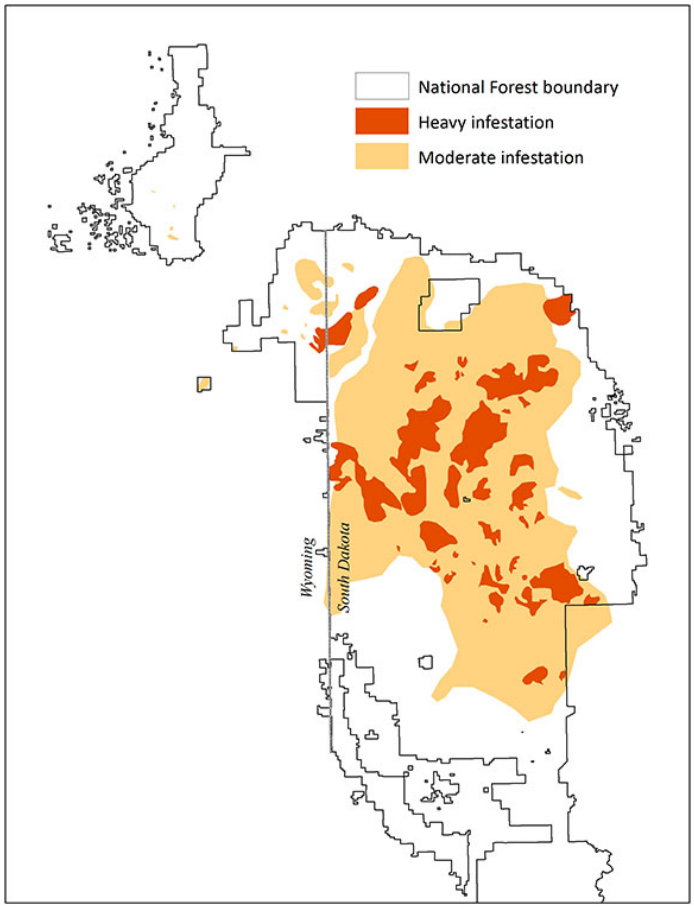


Figure 1. General Areas of Mountain Pine Beetle Infestation, 1997-2015

public health and safety, infrastructure, and communities.

Much of the pine forest now has an open canopy, with fewer live, mature trees, as illustrated below.

Before and after mountain pine beetle infestation (north of Custer, SD)

In the Black Hills, ponderosa pine forest tends to regenerate naturally. Exposing the ground beneath mature pine trees to sunlight usually results in establishment of numerous pine seedlings. This is now occurring in beetle-infested stands and where timber harvest has taken place. Standard thinning practices in the Black Hills have usually retained enough canopy to keep the forest floor mostly shaded, but recent timber harvest conducted in response to the mountain pine beetle epidemic reduced stand density more than usual to decrease stand susceptibility to imminent infestation. In these open stands, sunlight reaches more of the forest floor, allowing naturally occurring pine regeneration to flourish.

Ponderosa pine regeneration under beetle-killed trees

This is resulting in the potential for development of future landscape-scale expanses of even-aged pine forest, similar to the conditions that existed before the epidemic. Forests in this condition are at increased risk of beetle infestation (Graham et al. 2016). When high-risk stands exist across large areas, epidemic levels of infestation may occur. These conditions decrease the forest's resilience to insect infestation, wildfire, and other disturbances.

The Black Hills National Forest Land and Resource Management Plan (Forest Plan) Phase II Amendment analysis (USDA Forest Service 2005a) determined that the desired distribution of stand age and structure would provide a range of habitat to sustain native and desired non-native wildlife species. Distribution of pine forest age and structure has moved away from desired conditions as described in the Forest Plan, as amended (USDA Forest Service 2006a). Prior to the epidemic, acreage of dense, mature pine forest exceeded objectives. Now open, mature forest is over-represented, while several other stages have fallen below objective levels.

In areas infested early in the epidemic, many of the dead trees have already fallen. Stands that were more recently infested are now beginning to deteriorate. This continuing process will create an uncharacteristically high surface fuel loading in affected areas for years to come. Under these conditions, the amount of energy released during a fire increases the difficulty of control. Regrowth of vegetation in areas with numerous fallen trees further increases fire hazard and complicates fire suppression. The complex fuel arrangement is conducive to fast-moving, high-intensity, long-duration wildfires that may result in increased losses, threaten firefighter and public safety, and decrease resilience to further change. Due to the private property, homes, businesses, and critical infrastructure that exist in and adjacent to the BHNF, there are major concerns with respect to wildland urban interface (WUI) and at-risk communities, specifically relating to public safety.

Fallen beetle-killed trees and regenerating ponderosa pine

Project Location

The project area encompasses approximately 1,098,425 acres of National Forest System (NFS) lands and 226,035 acres of non-NFS lands located in two states and seven counties:

- South Dakota: Custer, Fall River, Lawrence, Meade, and Pennington Counties
- Wyoming: Crook and Weston Counties

Proposed activities would occur on NFS lands managed by the BHNF within the areas designated by the Secretary of Agriculture under the amended Healthy Forests Restoration Act (page 7), excluding Inventoried Roadless Areas and certain management areas (Figure 2).

Project Development

In November 2015, BHNF leadership proposed this landscape-level vegetation management project to address the mountain pine beetle epidemic aftermath while improving forest resilience to future disturbance. An interdisciplinary team of resource specialists was convened in February 2016. Guided by the Forest Plan and national initiatives (described below), the team articulated the project's purpose of and need for action and developed the Proposed Action in conjunction with BHNF leadership, the BHNF Advisory Board, and others.

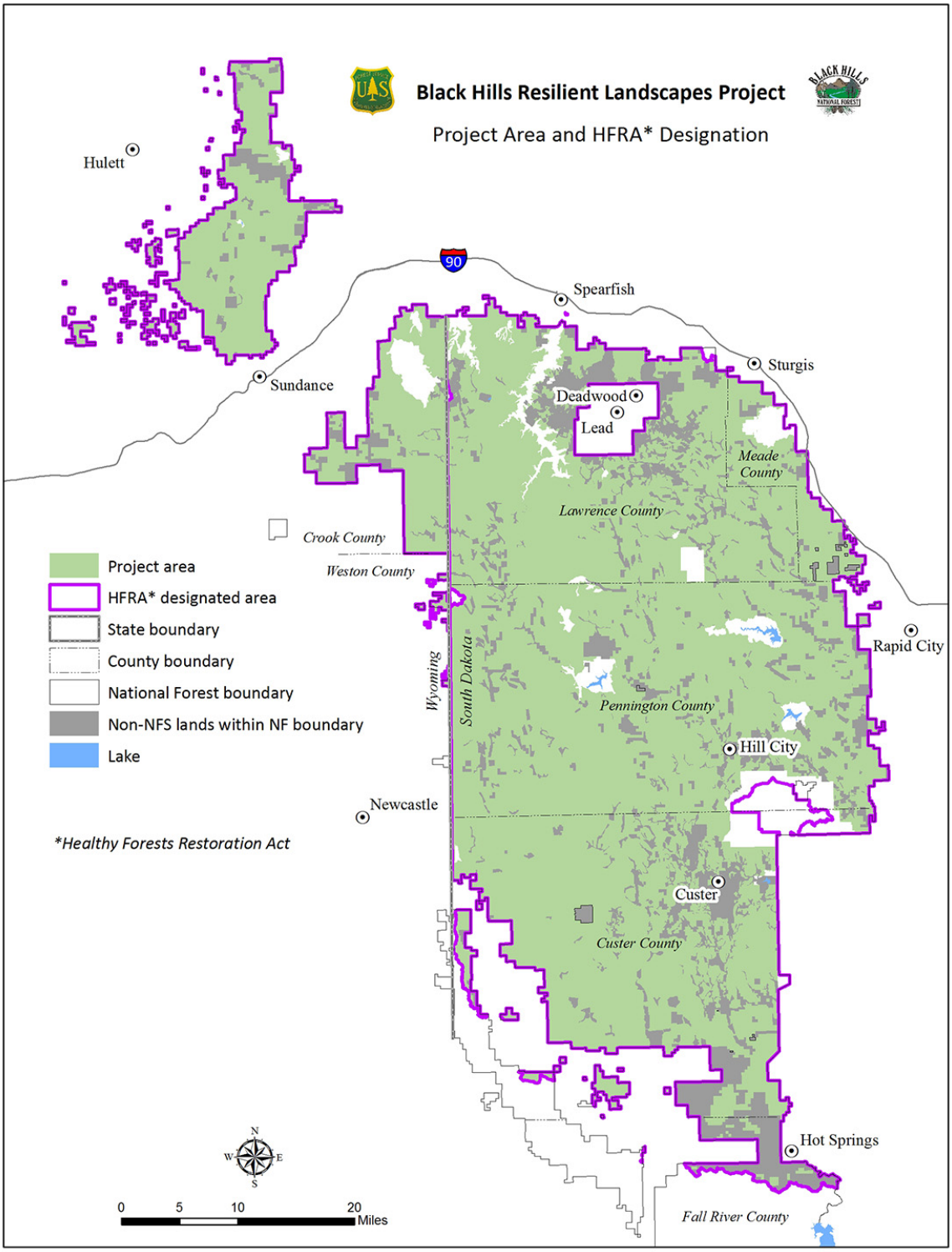


Figure 2. Project Area and HFRA Designation

Forest Plan

BHNF programmatic management direction is provided by the Forest Plan as supported by the Phase II Amendment Final Environmental Impact Statement (FEIS; USDA Forest Service 2005a) and the 1997 Revised Forest Plan FEIS (USDA Forest Service 1996). Development of Forest Plans is required by the rules implementing the Forest and Rangeland Renewable Resources Act of 1974 as amended by the National Forest Management Act of 1976. Forest Plans set forth goals and objectives of management actions and further direct these actions through standards and guidelines. The Black Hills Resilient Landscapes (BHRL) project analysis tiers to the Phase II Amendment FEIS and the 1997 Revised Forest Plan FEIS.

Chapter 3 of the Forest Plan assigns a management emphasis to each area of the National Forest. Land management practices that are appropriate in one management area (MA) may be constrained in another. The BHRL project area includes all or parts of 10 MAs (Table 1; Figure 3).

Table 1. Forest Plan Direction for Management Areas in the BHRL Project Area

MA	Emphasis	Acres	Timber Harvest	Suitable for Timber Production	Fuel Reduction	SS* Objective
3.31	Backcountry motorized recreation	6,870	Allowed only to meet wildlife/recreation goals or to respond to epidemic	No	Allowed	No
3.32	Backcountry non-motorized recreation	8,948	Allowed only to meet wildlife/recreation goals or to respond to epidemic	No	Allowed	No
3.7	Late succession landscapes	18,484	Allowed only to move stands toward late succession conditions	No	Allowed	No
4.1	Limited motorized use and forest products	41,374	Allowed	Yes	Allowed	Yes
5.1	Resource production	558,520	Allowed	Yes	Allowed	Yes
5.1A	Southern Hills forest and grassland	27,845	Allowed	No	Allowed	No
5.2A	Fort Meade VA Hospital watershed	3,299	Allowed	Yes	Allowed	No
5.4	Big game winter range	388,950	Allowed	Yes	Allowed	Yes
5.43	Big game and resource production	10,083	Allowed	Yes	Allowed	Yes
5.6	Forest products, recreation, and big game	34,043	Allowed	Yes	Allowed	Yes

**Structural stage (see page 7)*

The planning team reviewed MA direction and found no reason to reconsider Forest Plan allocations.

Proposed activities vary according to MA direction (see chapter 2).

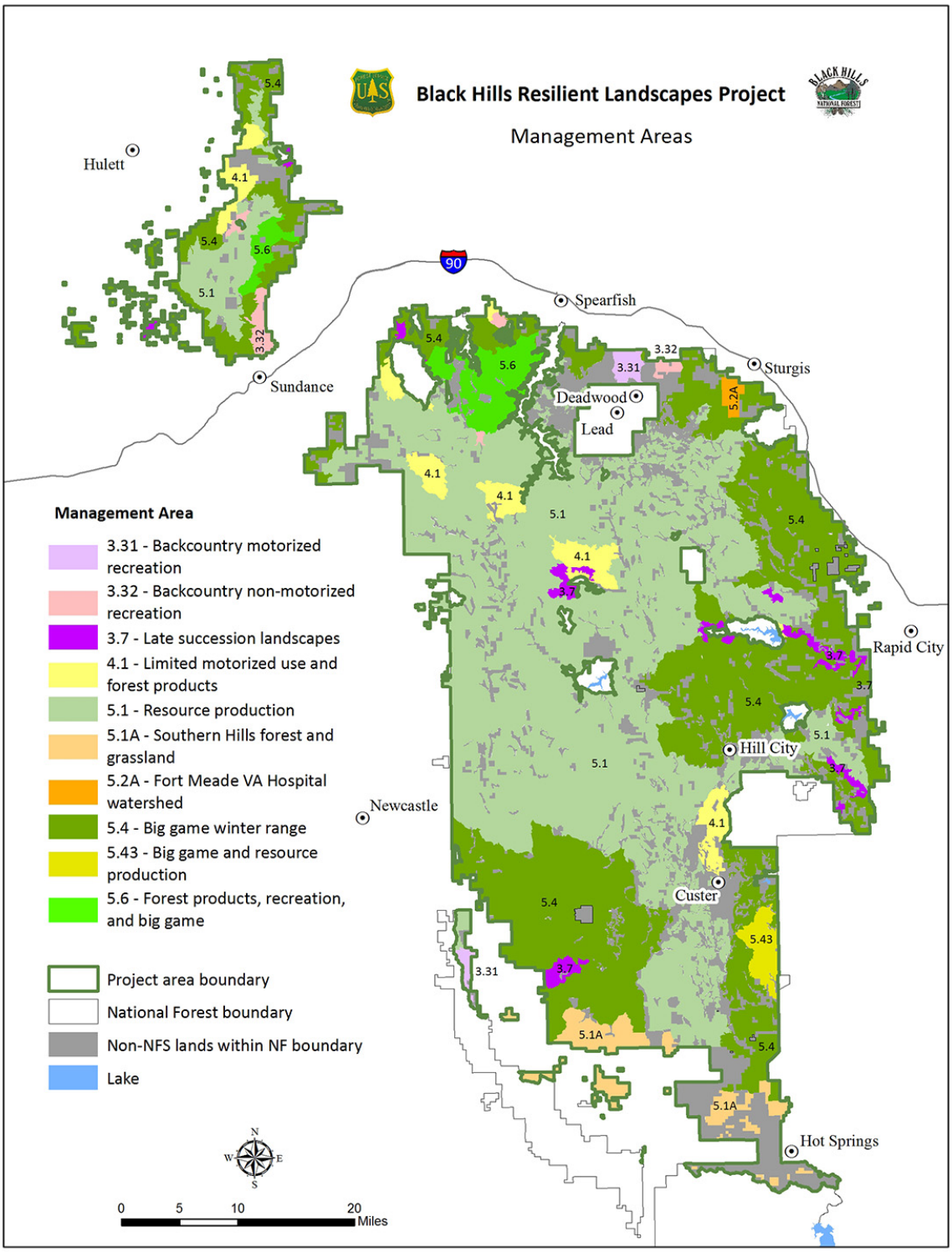


Figure 3. Management Areas

Healthy Forests Restoration Act

Every five years, Congress passes a bundle of legislation, commonly called the "Farm Bill", which sets national agriculture, nutrition, forestry, and conservation policy. Among the 2014 Farm Bill provisions that pertain to the Forest Service is Section 8204, which amends Title VI of the Healthy Forests Restoration Act (HFRA, 16 U.S.C. 6591) by adding sections 602 (Designation of Treatment Areas) and 603 (Administrative Review) to address qualifying insect and disease infestations on NFS lands.

Section 602(b)(1) requires the Secretary of Agriculture to designate treatment areas if requested by the Governor of a state. On May 20, 2014, Secretary Tom Vilsack announced the designation of approximately 45.6 million acres of NFS lands across 94 national forests in 35 states to address insect and disease threats that weaken forests and increase the risk of forest fire.

As requested by the Governors of South Dakota and Wyoming, this designation includes the majority of the BHNF (Figure 2). The BHRL project is proposed within the designated area.

Analysis and documentation will be carried out in accordance with Section 602(d). Projects within the designated areas must "reduce the risk of, or increase the resilience to, insect or disease infestation" (Section 602(d)(1)). The purpose of the BHRL project is to increase resilience to insect infestation and other natural disturbances, as described further on page 7.

HFRA Section 104 requires collaboration with State and local governments and Indian tribes, and participation of interested persons, during the preparation of authorized projects. Collaborative processes associated with this project are described on page 14.

The proposed project is a hazardous fuels reduction project as defined by HFRA, section 101(2), that is subject to subparts A and C of 36 CFR part 218 (Project-level Predecisional Administrative Review Process). In addition to this predecisional review process, HFRA provides for expedited National Environmental Policy Act (NEPA) reviews and guidance on judicial review. This authority for expedited NEPA review, as directed by Congress, does not change or exempt the Forest Service from complying with any other existing law, regulation, or policy such as NEPA, the Endangered Species Act, the Clean Water Act, the Clean Air Act, the National Historic Preservation Act, agency Roadless Rules, or any other law, regulation, and/or policy applicable to the project area.

National Cohesive Wildland Fire Management Strategy

In the Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act), Congress mandated the development of a national cohesive wildland fire management strategy to comprehensively address wildland fire management across all lands in the United States. Shortly after enactment of the FLAME Act, a three-phased, intergovernmental planning and analysis process involving stakeholders and the public was initiated: the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy). Its vision for the next century is "to safely and effectively extinguish fire, when needed; use fire where allowable; and as a Nation, live with wildland fire." The Cohesive Strategy is an effort to work collaboratively among all stakeholders and across all landscapes, using the best available science, to make meaningful progress towards three identified goals: resilient landscapes, fire-adapted communities, and safe and effective wildfire response. The BHRL project is informed by the Cohesive Strategy's identified goal of achieving and maintaining resilient landscapes through fire and non-fire vegetation and fuels management.

Purpose of and Need for Action

Mountain pine beetle infestation, response actions, and wildfire have moved forest structure away from desired conditions. Beetle infestation also resulted in hazardous levels of surface fuels and other hazards to public safety. As beetle-killed trees continue to fall and new pine stands grow, the forest's resilience to wildfire and future infestation is expected to decrease. The BHRL project is proposed to address these conditions.

The Forest Plan includes objectives for distribution of pine structural stages (SS) in MAs 4.1, 5.1, 5.4, 5.43, and 5.6:

> **Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204, and 5.6-204:** Manage for the following percentages of structural stages in ponderosa pine across the management area in a variety of sizes and shapes.

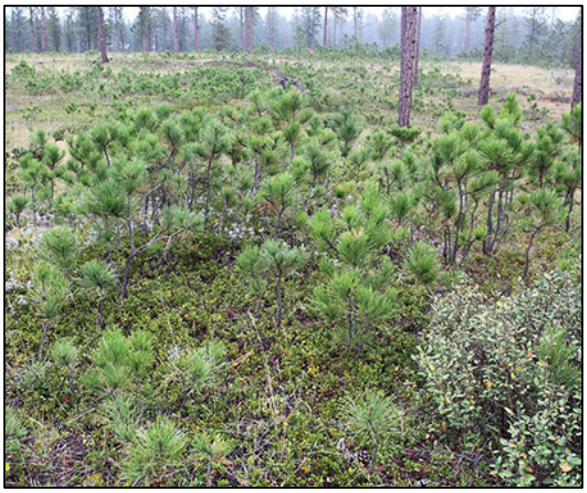
SS 1	5%
SS 2	5%
SS 3A	10%
SS 3B	15%
SS 3C	5%

SS 4A	25%
SS 4B	25%
SS 4C	5%
SS 5	5%

Management of the forest for variety in pine stand structure, size, and shape, distributed across the landscape, is essential to providing for species viability and reduced fire and insect hazard (USDA Forest Service 2005b).

Structural stages are defined and illustrated below and on the following pages. "DBH" indicates tree diameter at breast height (4.5 feet above the ground).

Structural stage 1: Grasses and forbs



Structural stage 2: Seedlings and shrubs (trees less than 1" DBH)

Structural stage 3A: Young, open forest (trees 1 – 9” DBH, crown cover 11 – 40%)

Structural stage 3B: Young, moderately dense forest (trees 1 – 9” DBH, crown cover 41 – 70%)

Structural stage 3C: Young, dense forest (trees 1 – 9” DBH, crown cover 70 – 100%)

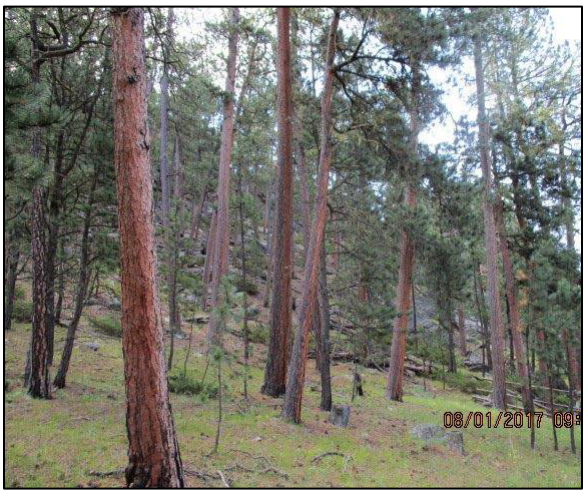
Structural stage 4A: Mature, open forest (trees greater than 9” DBH, crown cover 11 – 40%)

Also structural stage 4A

Structural stage 4B: Mature, moderately dense forest (trees greater than 9” DBH, crown cover 41 – 70%)

Also structural stage 4B

Structural stage 4C (trees greater than 9" DBH, crown cover 70 – 100%)



Structural stage 5 (late succession forest)

In many areas, existing structural stage percentages are above or below the objectives (Figure 4, page 11). As Figure 4 shows, open, mature pine (SS 4A) is well above objective levels while several other stages are below.

In the newly open stands, natural reforestation is occurring as pine seedlings become established. Ponderosa pine regenerates prolifically in the Black Hills, and often there are so many small trees that they become crowded and must compete for limited resources. Growth slows, stems remain thin, and heavy snow can result in damage. Over the next decade, these young stands are likely to develop characteristics such as these, decreasing their resilience to insect infestation, wildfire, and other disturbances. There is a need to manage these new stands to prevent stagnation and allow transition to other structural stages.

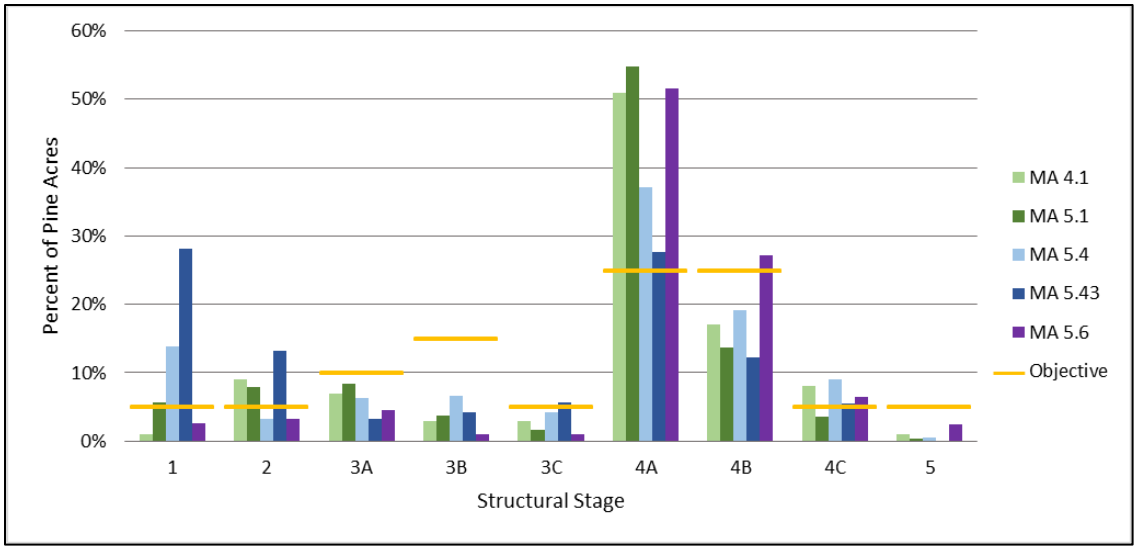


Figure 4. Existing Structural Stage Distribution by Management Area

Figure 5 displays spatial distribution.

Mountain pine beetles most often infest **dense, mature pine stands**. As a result of the epidemic and response actions, acreage of mature, moderately dense pine stands (SS 4B) has decreased below Forest Plan objective levels in most management areas. Except in MA 5.1, mature, dense pine stands (SS 4C) are still slightly above objective levels. Most are concentrated in a few areas that experienced less beetle infestation. There is a need to increase 4B and generally maintain 4C.

Late succession (old growth, SS 5) pine forest is below objective levels in all MAs with structural stage objectives. Known late succession stands are widely scattered across the project area, occurring mainly in the north half (Figure 5, page 12). Stand structure varies; most stands are dense, while others possess an uneven or patchy canopy. Other stands or parts of stands with late succession characteristics are likely to exist. In addition, some mature pine stands are developing late succession characteristics and may be managed to enhance these features. There is a need to maintain existing late succession forest and allow additional late succession to develop.

Ponderosa pine naturally grows in even-aged stands, with most of the trees in each stand about the same age and size. It can also grow in **uneven-aged stands**, with a variety of ages and sizes throughout the stand or clustered in groups. Uneven-aged stands provide diversity of wildlife habitat and scenery. There is a need to perpetuate this structure where it exists and initiate it where appropriate.

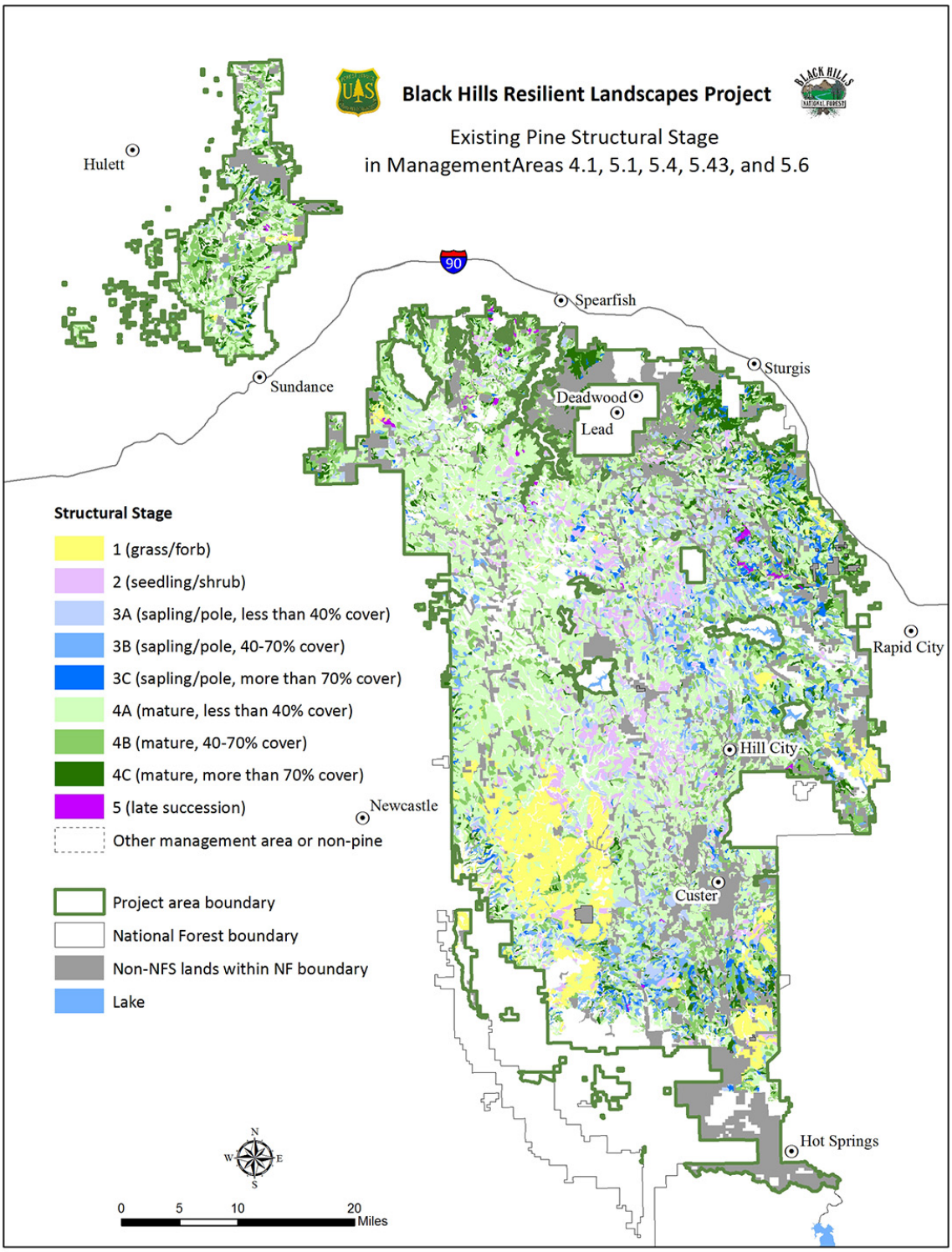


Figure 5. Existing Pine Structural Stage in Management Areas 4.1, 5.1, 5.4, 5.43, and 5.6

Ponderosa pine covers most of the Black Hills. **Other tree species** and **grasslands** diversify habitat and scenery while increasing ecosystem resilience to disturbance. Hardwood trees such as aspen and oak are resistant to fire and to the insects that infest pine. Aspen stands recover quickly from disturbance. Over time, however, these areas can become overgrown with conifers. This encroachment can cause old hardwood stands and grasslands to lose vigor and gradually disappear. There is a need to maintain and perpetuate these ecosystem components.

Conifers encroaching on aspen

There are many dead trees, both standing and fallen, which pose an increased hazard to public health and safety, infrastructure, and communities. The **dead standing trees** can cause injury or damage when they fall. After falling, the trees can block roads, increase fuel loading, and complicate fire suppression.

In response to these needs, the Forest Service is proposing actions to move landscape-level vegetation conditions in the project area toward objectives of the Forest Plan in order to increase ecosystem resilience to insect infestation and other natural disturbances, contribute to public safety and the local economy, and reduce risk of wildfire to landscapes and communities.

Decision Framework

Given the purpose and need, the deciding official will review and consider the Proposed Action, alternatives, public input, and environmental consequences to make the following decisions:

- Whether to implement vegetation management activities, including timber management (silvicultural prescriptions, road work, slash treatment), fuel reduction, management of aspen, oak, and grasslands, and prescribed burning, including design features; what quantity of these actions to implement.
- What specific project monitoring requirements are needed to assure design features are implemented and effective and to evaluate achievement of project objectives.

If an action alternative is selected, project implementation could begin in 2018.

Collaboration and Public Involvement

Collaboration with communities and the public is important to the BHNF and required by HFRA (page 7). The Forest Service is collaborating on the BHRL project with the BHNF Advisory Board. The Wyoming State Forestry Division is acting as a cooperating agency. The Forest Service also has sought input from other State agencies, Tribal governments, and interested organizations and individuals.

National Forest Advisory Board

In late 2015, BHNF leadership proposed a landscape-level vegetation management project to address the mountain pine beetle epidemic aftermath and improve forest resilience to future disturbance. The Forest Supervisor announced the proposal at the March 2016 BHNF Advisory Board meeting. The chartered Advisory Board is serving as the formal collaborative for this project under HFRA authority and consists of community members who represent a cross-section of interests regarding National Forest management. Board membership is balanced so that no particular interest has more weight than any other. Membership qualifications are spelled out in the Board's charter; for example, members must be United States citizens and must have demonstrated professional or personal qualifications or experiences to contribute to the charter and duties of the Board.

During development of the proposal, the Forest Service provided project updates at each Advisory Board meeting and met with the Board's Forest Health Working Group on several occasions. The Working Group prepared draft recommendations in response to the initial proposed action. The full Board adopted these recommendations and submitted them to the Forest Supervisor. The Forest Service used the recommendations to modify and refine the initial proposed action. BHNF continues to work with the Advisory Board in regard to this project.

National Forest Advisory Board field trip (August 17, 2016)

State Government

The Wyoming State Forestry Division is acting as a cooperating agency in regard to this project. In this role, the Division may provide special expertise or data and participate in the NEPA process.

The Forest Service met with representatives of the South Dakota Resource Conservation and Forestry Division during proposal development to gather input on the project. The Division also submitted comments in response to scoping. Communication with State agencies is continuing.

Since early 2009, the Forest has been a signatory to a programmatic agreement (PA) that governs undertakings on National Forest lands in the State of Wyoming. This PA was renewed in 2014. The Wyoming State Historic Preservation Officer (SHPO) is also a signatory to that document. Appendix F of the PA addresses vegetation management projects. Subsection B of Appendix F specifically addresses landscape-scale projects, such as BHRL, where specific effects cannot be identified prior to

the Agency signing a NEPA decision. That stipulation, in addition to others, is cited as the legal authority for this project on NFS lands in the State of Wyoming.

The Forest Service is developing a PA with the South Dakota SHPO specifically for the BHRL project in order to fulfill the Agency's National Historic Preservation Act (NHPA) Section 106 obligations for this undertaking. Stipulations in that document will govern how the Forest Service implements projects under the authority of the BHRL Record(s) of Decision.

If an action alternative is selected, consultation with both SHPOs would continue during the implementation phase based on stipulations in the applicable PAs.

Tribal Governments

The Forest Service regularly consults with Tribal governments regarding projects authorized under NHPA and NEPA. Sixteen Tribes, with tribal headquarters located in six states, have expressed traditional cultural, spiritual, or geographical interests in the Black Hills.

Tribal consultation is currently being conducted for this project via multiple means. Tribal governments were consulted when it was determined that a PA would be necessary for projects that will be implemented on NFS lands in the State of South Dakota. Initial letters of invitation to participate in the development of the PA were sent on February 24, 2017. As of August 2017, representatives of three tribes have responded with an expression of interest in participating.

If an action alternative is selected, Tribal authorities would continue to be consulted when specific project locations associated with BHRL treatments are identified during the implementation phase. This would permit Tribal representatives to submit location-specific comments where desirable.

US Fish and Wildlife Service

The Endangered Species Act (ESA) requires the Forest Service to consult with the US Fish and Wildlife Service (USFWS) on activities that the Forest Service funds, authorizes, or carry out that may affect a federally listed species. The USFWS provided comments in response to scoping for the BHRL project, including recommendations for protective measures to avoid and minimize adverse effects to listed species as well as other species and resources of concern. The Forest Service has considered this input and incorporated elements into the planning process and/or the Proposed Action, as appropriate. BHNF participates on the Northeast Wyoming ESA Level 1 Team along with USFWS and other federal agencies. The Forest Service has provided BHRL project updates and timelines to USFWS through this collaborative effort. Further consultation will occur following USFWS review of the Draft Environmental Impact Statement (DEIS) and prior to release of the draft Record of Decision.

Others

The Forest Service used various means to inform potentially interested parties and the general public of the proposal and to solicit comments and suggestions. These included publication of project information in the BHNF Schedule of Proposed Actions, the Federal Register, and the BHNF website, distribution of scoping letters and a news release, and discussion at Advisory Board meetings, which are open to the public.

In response to scoping efforts, the Forest Service received 29 comment letters. The Forest Service thoroughly analyzed the comments, considered concerns that were raised, and incorporated ideas presented by the Advisory Board, the public, and others into the final Proposed Action (page 17).

Supporting documents, including mailings, notices, and comments, are contained in section 3 of the project analysis file.

Issues

Public comments resulted in identification of the following issues relevant to the analysis.

1. Proposed timber harvest and fuel reduction could negatively affect scenery, particularly in combination with recent timber harvest and mountain pine beetle infestation. Indication of the project's response to this issue is reflected by the degree of achievement of scenic integrity objectives.
2. The Proposed Action includes ground-disturbing activities that could increase noxious weed infestation. Added to the effects of a variety of past and ongoing activities, this could increase costs of weed treatment and displace desirable plant communities. Indicators of the project's response to this issue include projected acreage of weed infestation and cost of treatment.
3. Timber harvest could reduce landscape-level structural diversity by creating or perpetuating large, monotypic stands. Indication of the project's response to this issue is reflected by degree of progress toward Forest Plan structural stage objectives over a 20-year timeframe.

Chapter 2. Proposed Action and Alternatives

Chapter Summary

The Proposed Action includes:

- Fuel treatments (manual, mechanical, and prescribed fire).
- Hazard tree reduction.
- Enhancement of aspen, oak, grasslands, and within-stand structural diversity.
- Pine structural stage modification (commercial timber harvest, non-commercial thinning, tree planting, and site preparation).
- Road construction and improvement.
- A Forest Plan amendment regarding soil quality and fuel loading.

The No Action alternative was analyzed in detail. Other action alternatives were considered but, for various reasons, were not analyzed in detail (page 46).

Alternatives Considered in Detail

HFRA Title I, section 104, requires development of the proposed agency action, the no action alternative, and an additional action alternative if one is proposed during scoping or the collaborative process and meets the purpose and need. No alternatives that met the purpose and need were proposed during scoping or collaboration (project analysis file, section 3.05).

Proposed Action

The Proposed Action's purpose is to move landscape-level vegetation conditions in the project area toward objectives of the Forest Plan in order to increase ecosystem resilience to insect infestation and other natural disturbances, contribute to public safety and the local economy, and reduce risk of wildfire to landscapes and communities.

To achieve this purpose, the Proposed Action includes the following activities:

- Fuel and hazard tree treatments (page 18)
- Pine structural stage modification (page 23)
- Enhancement of non-pine vegetation and within-stand diversity (page 28)
- Road work and other associated activities (page 34)

The Proposed Action also would amend the Forest Plan (page 36).

As described below, each proposed activity would occur on up to a maximum number of acres within a larger, defined area. These defined areas are displayed on maps in this chapter. During project implementation, Forest Service resource program managers and specialists would determine the most appropriate locations for activities within the defined areas. This determination would be based on site visits, priority needs, and desired spatial distribution of conditions across the project area, each management area, and individual watersheds.

Parties responsible for implementation of proposed activities would coordinate activity layout and design with managers of affected resources. For example, timber sale layout foresters would consult with wildlife biologists to ensure protection of known raptor nests. This is a standard practice for all management activities.

All figures are approximate. Actual acres/miles implemented would depend on weather, priorities, funding, and other factors. Mapped stand boundary locations are approximate and stand structure determinations are preliminary. Stand delineation and structure are subject to corrections based on field review.

Detailed maps of the project area and proposed activities may be viewed at http://tinyurl.com/BHRLProject.

Fuel and Hazard Tree Treatments

Objectives: *To increase ecosystem resilience, reduce wildfire hazard to landscapes and communities, and reduce safety hazards posed by standing dead trees.*

Mechanical and Manual Fuel Treatments

Mechanical and manual fuel reduction activities not associated with structural stage modification activities (page 23) would occur on up to 70,000 acres within a defined 400,000-acre area (Figure 6). This defined area includes NFS lands meeting one or more of the following criteria:

- within 300 feet[1] of non-NFS lands
- within 300 feet of egress roads and other authorized roads
- adjacent to critical infrastructure (major transmission lines, communication sites, etc.)
- within 0.5 mile of an At-Risk Community (defined on page 76)

Highest priority for treatment would be areas adjacent to at-risk communities, egress roads, and residences/developments (Figure 21, page 75). Activities would address naturally occurring fuels and those resulting from management activities as needed.

The following activities may occur. Activities may occur in any management area except as noted.

- **Shaded Fuel Break Construction:** Trees and other fuels in pine stands would be thinned to create zones of low fuel-loading adjacent to egress roads and in other critical locations.

Shaded fuel break at Horsethief Lake - Before and after treatment

[1] The Forest Plan Phase II Amendment FEIS, appendix B, page 14, describes wildland-urban interface buffer distances of 300 feet and 1.5 miles. The BHRL project uses 0.5 mile instead of 1.5 miles to focus fuel reduction activities closer to At-Risk Communities. The Proposed Action would address hazardous fuels in areas beyond these buffers through other activities, such as thinning or prescribed fire.

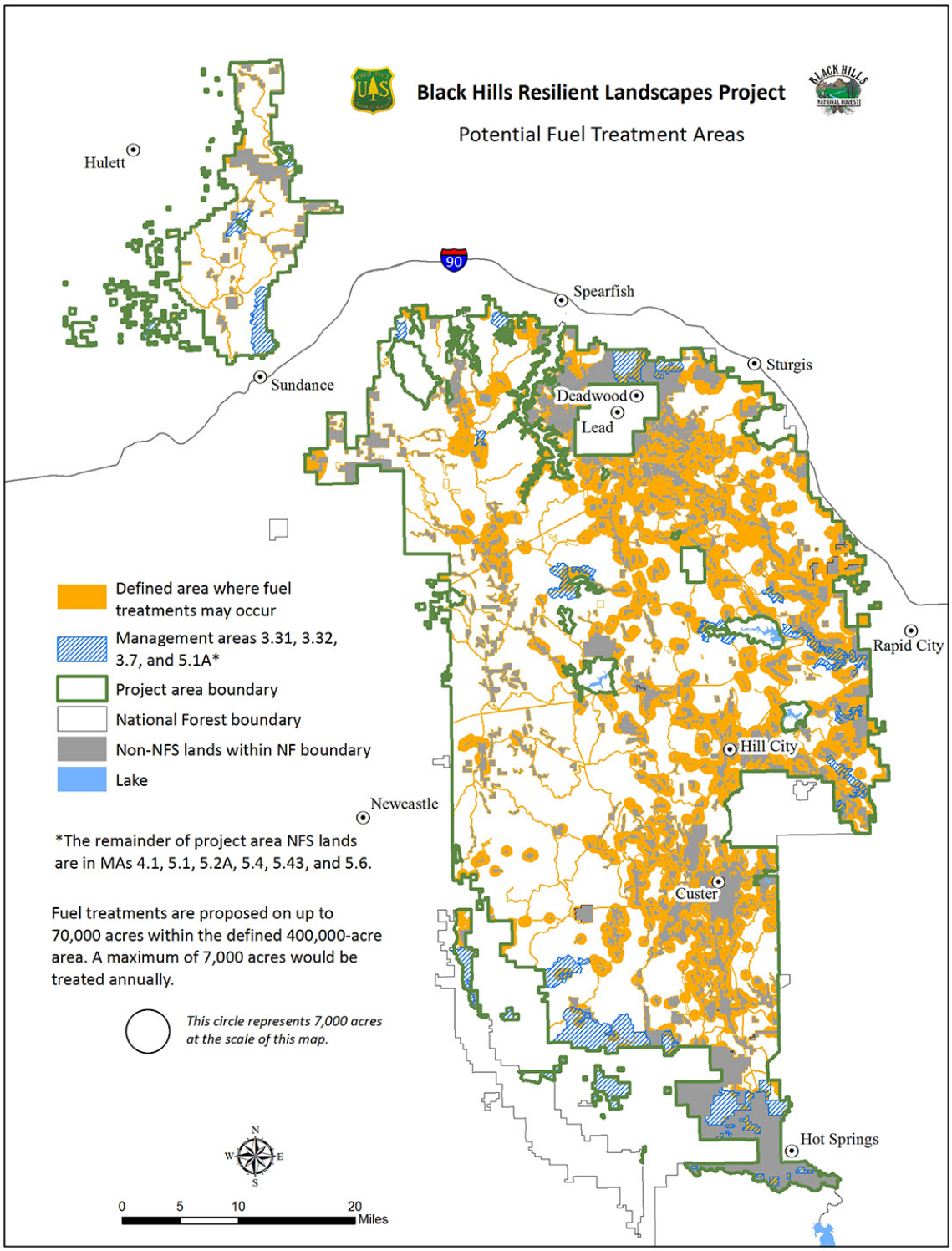


Figure 6. Potential Fuel Treatment Areas

Fuel breaks would be 66 to 300 feet wide. Cut trees and other fuels would be piled and burned, chipped, or otherwise reduced. In MAs 4.1, 5.1, 5.2A, 5.4, 5.43, and 5.6 (Figure 3, page 6), commercial removal of trees from fuel breaks may occur on up to a total of 4,000 acres. Commercial harvest would not occur in MA 3.31, 3.32, 3.7, or 5.1A.

- **Thin, Pile, and Burn Fuels** (other than shaded fuel breaks): Fuels would be thinned and piled manually or using mechanized equipment.
- **Cut, Lop, and Scatter Fuels:** Where conditions require, such as on slopes that are too steep for track-mounted equipment, fuels would be manually cut, lopped, and scattered. If the treatment area is adjacent to private property, slash would generally be piled instead of scattered.
- **Scatter, Shred, or Chip Fuels:** Unpiled fuels would be scattered, shredded, or chipped.

Other proposed activities described in the following sections also would contribute toward fuel reduction goals.

Prescribed Fire

Prescribed fires are intentionally ignited to meet specific objectives. They occur under specified environmental conditions that allow the fire to be confined to a predetermined area while producing the fireline intensity and rate of spread required to attain planned resource management objectives.

Lighting a prescribed fire

Fire has beneficial ecosystem effects not duplicated by mechanical treatments. Both reduce fuel loading, but fire also raises the height of the lowest live tree branches, reducing susceptibility to initiation of crown fire. Low- to moderate-intensity fire increases resilience of mature trees to future fires by causing bark to thicken.

Broadcast prescribed fire would be applied on up to 100,000 acres within a defined 225,000-acre area (Figure 7). Broadcast burning would not exceed 10,000 acres per year. These figures include any burning completed for the purpose of reducing pine encroachment of aspen (page 30) or grasslands (page 32). Prescribed fire is proposed in MAs 3.7, 4.1, 5.1, 5.1A, 5.4, and 5.43. Management areas are shown in Figure 3, page 6.

Fire control line before and after rehabilitation

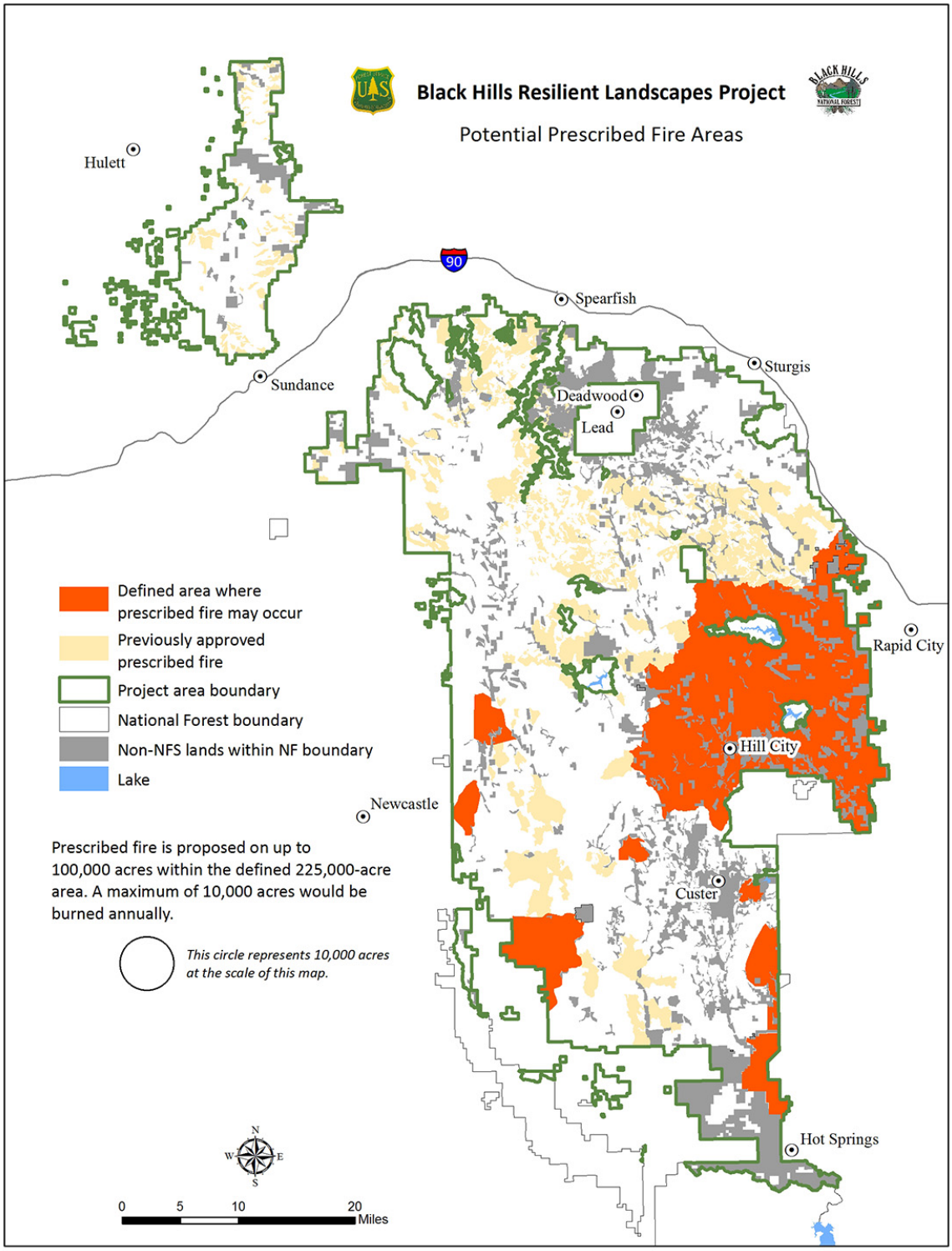


Figure 7. Potential Prescribed Burn Areas

As Figure 7 displays, burning is proposed in the eastern and southern parts of the project area. In the northern half of the project area, prescribed fire was previously approved in various locations as part of other vegetation management projects. A number of these burns have not yet been implemented, and fire managers have not identified a need for further prescribed fire acres in these areas.

Prior to implementation of each burn, fire managers would prepare a detailed prescribed burn plan. A certified silviculturist would review and approve each plan. Fire managers would assess potential smoke effects on communities and apply measures to minimize these effects.

Existing roads and trails would be used as fire control lines whenever possible to minimize ground disturbance and reduce cost. Where necessary, new fire control lines would be prepared using chainsaws, hand tools, and dozers or smaller mechanized equipment. New control lines would be revegetated and blocked to motorized vehicles following use.

Burning of piled fuels would also occur. Following burning, pile sites would be revegetated.

Hazard Tree Removal

Hazardous standing trees, primarily those killed by mountain pine beetles, would be felled by cutting, pushing with mechanized equipment, or other techniques. This activity would occur where dead trees could fall on open roads or trails, structures, private property, or critical infrastructure. It would occur as needed and funded. Slash resulting from this activity would be lopped, scattered, piled, or otherwise rearranged or removed to meet Forest Plan fireline intensity direction.

Beetle-killed trees along road

Pine Structural Stage Modification

Objectives: *To move toward Forest Plan structural stage objectives and address current fuel hazards as well as potential future insect and fuel hazards.*

As described in chapter 1 (page 7), distribution of pine structural stages in each management area has moved away from Forest Plan objectives. The only way to increase some structural stages is to allow time for trees to grow. Most stages, however, can be increased, decreased, or maintained through various management activities. The relation between structural stages and management activities is described below. Details of proposed activities are described starting on page 25.

Structural Stage Transitions and Management Options

To increase temporary openings (SS 1) in forested areas…		• **Remove all trees from patches ranging from one to 10 acres in size (patch clearcut, page 27)**
To increase seedlings and shrubs (SS 2) where forest openings exceed objective levels…		• **Take no action at this time (allow time for natural reforestation)** • **Plant trees (page 28)** • **Burn to remove competing vegetation (prescribed fire, page 20)** • **Expose soil (prescribed fire or mechanical site preparation, page 28)**
To increase seedlings and shrubs (SS 2) where mature, open pine forest exceeds objective levels…		• **Remove most of the mature trees from stands with an adequate number of pine seedlings (overstory removal, page 25)**
To increase saplings and poles (SS 3A/3B) where seedlings or dense, young pine stands (SS 3C) exceed objective levels…		• **Thin seedlings (precommercial thin, page 27) and allow about 10 years for growth** • **Thin dense, young stands (precommercial or products-other-than-logs thin, page 27)**

To increase saplings and poles (SS 3A/3B) where open, mature pine stands exceed objective levels…

- **Remove most of the mature trees from stands with an adequate number of pine saplings or poles (overstory removal)**

To increase dense, young pine forest (SS 3C)…

- **Take no action at this time (allow 10 or more years for seedlings to grow)**

To increase moderately dense, mature forest (SS 4B)…

- **Take no action at this time (allow 20 to 50 years for young forest to grow, or allow 10 to 20 years for growth of open, mature stands with nearly 40 percent canopy)**

To maintain dense, mature and late succession pine forest (SS 4C and 5)…

- **Thin small trees (precommercial thin)**
- **Burn to reduce understory vegetation and small trees (prescribed burn)**

To increase late succession pine forest (SS 5)…

- **Conduct additional field review to identify existing, unmapped late succession stands**
- **Take no action at this time (allow up to 80 years for other mature stands to grow and age)**

In summary, proposed structural stage modification activities include:

- Overstory removal (page 25)
- Precommercial/products-other-than-logs thin (page 27)
- Patch clearcut (page 27)
- Tree planting (page 28)
- Mechanical site preparation (page 28)
- Prescribed fire (page 20)

Overstory Removal

Overstory removal would use commercial timber harvest to convert mature pine stands with open structure to young forest. It would remove most of the mature pine from stands with abundant pine regeneration. To mitigate visual effects, mature trees would be retained in groups of varying size (page 38). Following most removal cuts, seedlings and saplings would be thinned as described on page 27. The purpose of overstory removal and subsequent thinning is to concentrate the site's resources in the new stand so that its growth rate may increase, contributing to sustained timber yield over time and more rapid development of moderately dense, mature forest. Harvest methods used would ensure retention of at least 150 seedlings and/or saplings per acre, well distributed across the stand.

Overstory removal would occur on up to 185,000 acres within a defined 300,000-acre area (Figure 8). This defined area includes most open, mature pine stands in MAs 4.1, 5.1, 5.4, 5.43, and 5.6. The stands that make up the defined area are termed potential **commercial treatment areas (CTAs).**

The figure of 185,000 acres is based on a comparison of the existing acreage of open, mature pine in each of the five MAs to the acreage corresponding to the Forest Plan objective (25 percent of the pine acres in the MA). Proposed treatment levels would bring open, mature pine acreage in each MA close to the objective of 25 percent while increasing the younger stages that are currently deficit.

Because the existing distribution of structural stages is different in each MA, proposed treatment acreage needed to bring the distribution closer to the objectives varies by MA (Table 2).

Table 2. Proposed Overstory Removal Acres by Management Area

MA	Treatment Acres (Approx.)
4.1	7,670
5.1	129,890
5.4	41,210
5.43	250
5.6	6,190
Total	185,210

Proposed uneven-aged management of pine stands (page 32) may also occur in potential CTAs.

Proposed commercial timber harvest may occur using ground-based or suspended yarding systems. Ground-based systems use heavy equipment to drag or carry cut trees to a central processing area. Suspended systems transport logs using cables that suspend one or both ends of the log off the ground and are generally used on slopes that are too steep for ground-based equipment. Most Black Hills timber harvest is conducted using ground-based systems. Cut stands would be distributed to enhance the mosaic of structural stages across the management area and landscape.

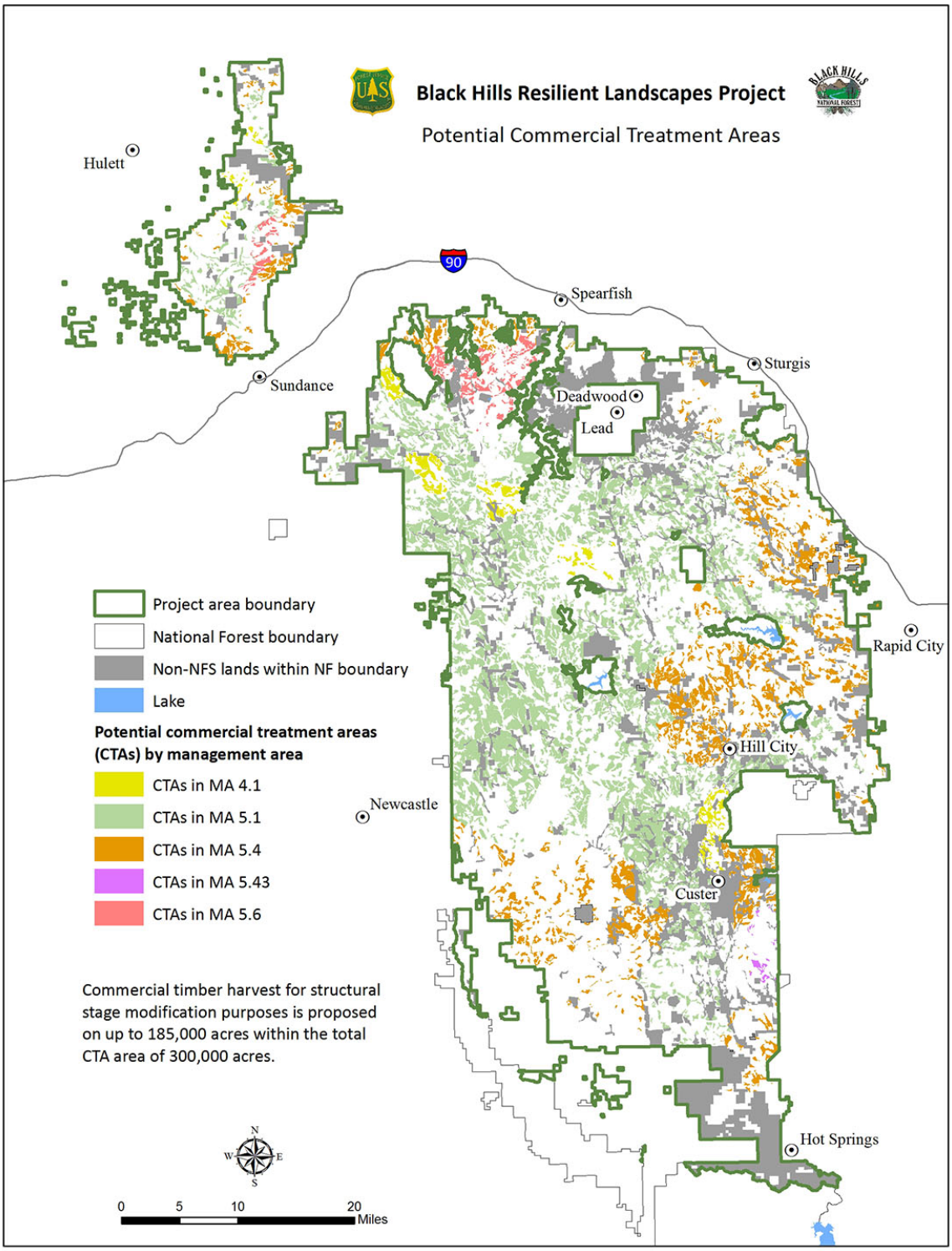


Figure 8. Potential Commercial Treatment Areas

Precommercial and/or POL Thin

Precommercial thin is a non-commercial treatment, while POL (products-other-than-logs) thin removes material for commercial use. The purpose of both is to reduce stocking to concentrate growth in the most desirable trees (SAF 1998). These activities would occur on up to 250,000 acres in pine-dominated stands, both those that are potential CTAs and those that are not.

Precommercial and/or POL thin would occur in young pine stands. Some of these structural stages are below Forest Plan objective levels but are expected to increase rapidly as pine regrows in beetle-killed stands. Additionally, proposed overstory removal treatments would convert open, mature stands to younger stages, further increasing the acreage of young pine forest. In MAs without structural stage objectives, precommercial thinning may occur to meet fuel reduction objectives.

Saplings and poles ranging from one foot in height up to 8.9 inches DBH would be thinned to reduce stocking and concentrate growth in remaining trees. Stems and crowns would generally remain on site. This treatment would retain the largest pine of good form at a rate of approximately 130 to 300 trees per acre, depending on size of trees and whether objectives for the site focus primarily on timber production, fire hazard, or development of specific habitats. Spacing of leave trees would vary from approximately 12 to 24 feet.

After precommercial thin

Patch Clearcuts

Patch clearcuts create grass/forb stage (SS 1) within forested stands by removing essentially all trees on areas up to 10 acres in size. These patches regenerate to pine over time. Patch clearcuts would occur in potential CTAs on approximately 1,300 acres of pine forest in MA 4.1 and 600 acres in MA 5.6 (Figure 9). MAs 4.1 and 5.6 are below Forest Plan objectives for temporary grass/forb openings.

Actions in Late Succession Pine

The Forest Plan calls for late succession forest on five percent of the pine acreage in MAs 4.1, 5.1, 5.4, 5.43, and 5.6. Late succession forest exists on a fraction of the desired acreage. The Proposed Action would retain old growth characteristics in all known late succession stands, work toward identification of unrecorded stands, and conduct activities to maintain or enhance stands that possess or are developing late succession characteristics. These activities would include non-commercial thinning (page 27) or burning of understory vegetation and small trees (page 20) to reduce

competition and crown fire potential. Any burning would occur in the areas displayed in Figure 7 (page 21). These activities may occur in potential CTAs and in other pine stands.

Identification and management of existing or developing late succession forest would occur on up to five percent of the pine acreage in each MA:

MA	4.1	5.1	5.4	5.43	5.6
Acres	1,794	23,940	17,022	485	1,281

Pine Planting

Planting of ponderosa pine seedlings would occur on up to 5,000 acres in the southern Black Hills where large wildfires have recently occurred (Figure 9). These areas are in MAs 5.1, 5.4, and 5.43. This activity would not occur in potential CTAs.

Temporary grass/forb openings (SS 1) are above Forest Plan objectives in management areas where large wildfires have recently occurred. These burned areas no longer have a pine seed source. Reforestation by natural means could take many decades. Planting these previously forested sites would decrease grass/forb stage and the time required to return to a forested, productive condition.

Native ponderosa pine seedlings that come from seed gathered in the appropriate Black Hills seed zone would be germinated at a nursery, grown to the seedling stage, and planted in spring at a rate of approximately 400 trees per acre. Mesh tubing may be placed over every other seedling for protection from wildlife and livestock.

Planted pine seedlings with mesh tubing

Mechanical Site Preparation

Mechanical site preparation would occur in open, mature pine stands on up to 4,000 acres within a defined 47,200-acre area in the west-central Black Hills (Figure 9). Thick sod formed by non-native grasses hinders establishment of pine seedlings in these stands.

Mechanical site preparation

Specific methods may include disking, raking, or scarifying. These actions would expose soil, creating conditions favorable for establishment of pine. Mechanical site preparation may occur in MAs 5.1 and 5.4. It would not occur in the same stands as commercial timber harvest. It would generally occur on slopes of less than 25 percent.

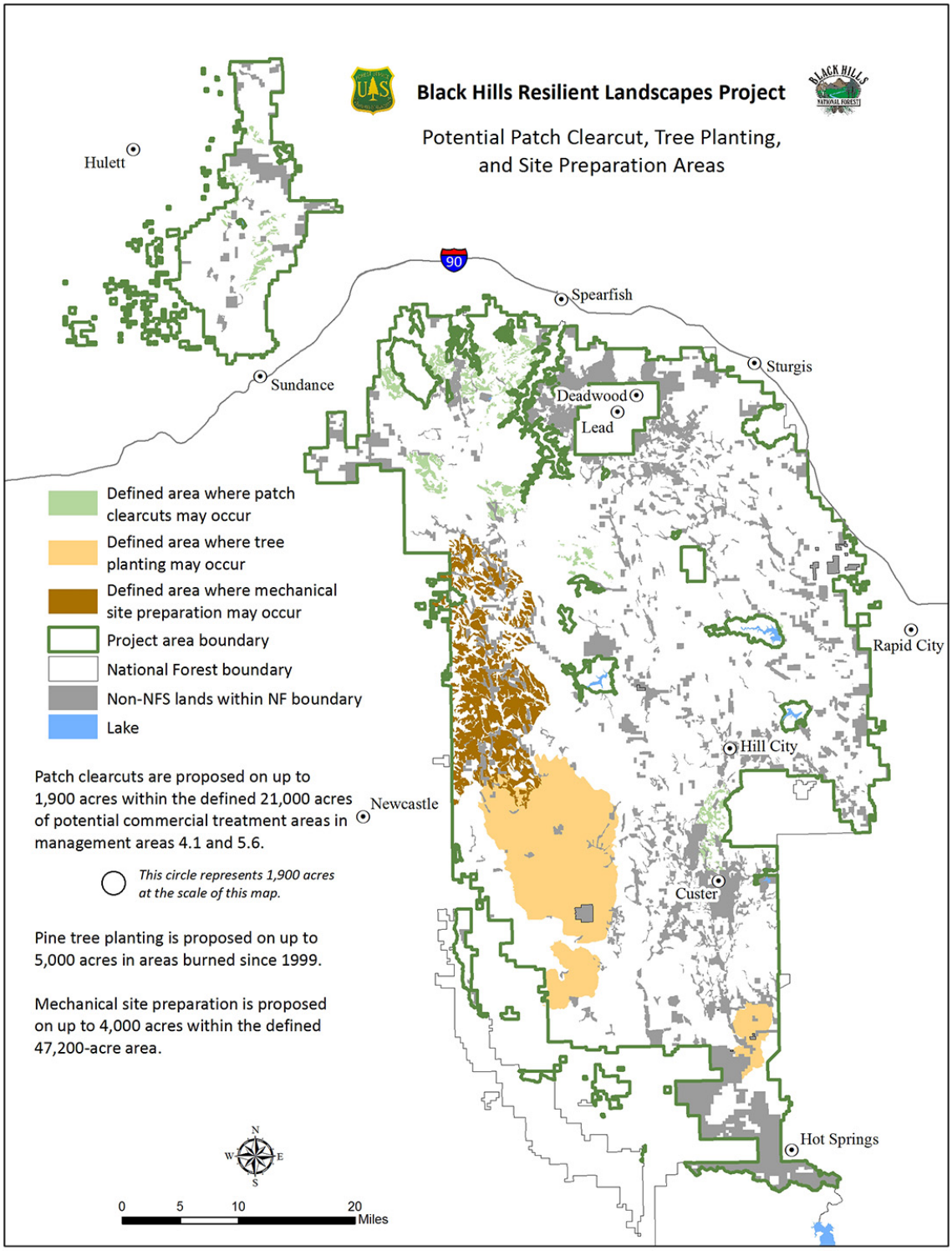


Figure 9. Potential Patch Clearcut, Tree Planting, and Site Preparation Areas

Enhancement of Non-pine Vegetation and Within-stand Diversity

Objectives: *To maintain and perpetuate aspen, oak, grasslands, and uneven-aged pine stands, which diversify habitat and scenery while increasing ecosystem resilience to disturbance.*

Aspen Maintenance and Enhancement

Aspen-dominated Stands: Pine and spruce removal would occur on up to 2,400 acres of mixed aspen/conifer stands (Figure 10). This activity would focus on aspen stands being encroached or suppressed by conifers. It may occur in any management area. Commercial harvest of cut pine would be an option only in MAs 4.1, 5.1, 5.4, 5.43, and 5.6 and only if no new roads would be required.

Aspen regeneration would occur on up to 4,000 acres within the 40,500 acres of aspen stands with minimal pine or oak component (Figure 10). Declining aspen stands may be cut or burned to promote regeneration. Regeneration activities would occur in aspen clones with numerous dead or diseased overstory stems, multiple aspen logs on the ground, and lack of younger age classes (shown by lack of multiple canopy layers and stem sizes). To maximize aspen regeneration response, treatment would generally occur while trees are dormant.

Regeneration activities would *not* take place in multistoried aspen clones, those with intact overstory canopies, or isolated clones with a round globular shape with live branches near the ground on the exterior edges of the clone. Stands with these characteristics are in good condition.

Pine-dominated Stands with Aspen Inclusions: Pine-dominated stands may include a component of aspen. To prevent loss of the aspen component, encroaching or suppressing pine and spruce would be removed from aspen inclusions and the area around the inclusion to a distance of 1 to 1.5 aspen tree heights. Aspen inclusions selected for treatment would be those with numerous conifers in the overstory and adjacent to the inclusion's edge (Shepperd and Battaglia 2002). Treated inclusions would generally be well-stocked clones at least 0.25 acres in size. The intention of this activity is to maintain the diversity of the stand by perpetuating aspen inclusions. Conversion of entire stands from pine to aspen is not proposed.

Pine encroaching on an aspen inclusion

Pine and spruce may be removed and sold from aspen inclusions within the 22,500 acres of these pine stands that are potential CTAs (see page 25; Figure 10). These stands are in MAs 4.1, 5.1, 5.4, 5.43, and 5.6. On an additional 8,400 acres that are not in potential CTAs, treatment may occur but would not involve commercial removal if road construction would be needed. Pine and spruce cutting would occur only in and around the inclusions, which make up a fraction of the total 30,900 acres.

Where commercial harvest does not occur, cut trees would be lopped and scattered, piled and burned, or left intact to form a barrier to ungulates to prevent over-browsing. Slash piles to be burned would be placed at least one tree height from the aspen clone to prevent root damage.

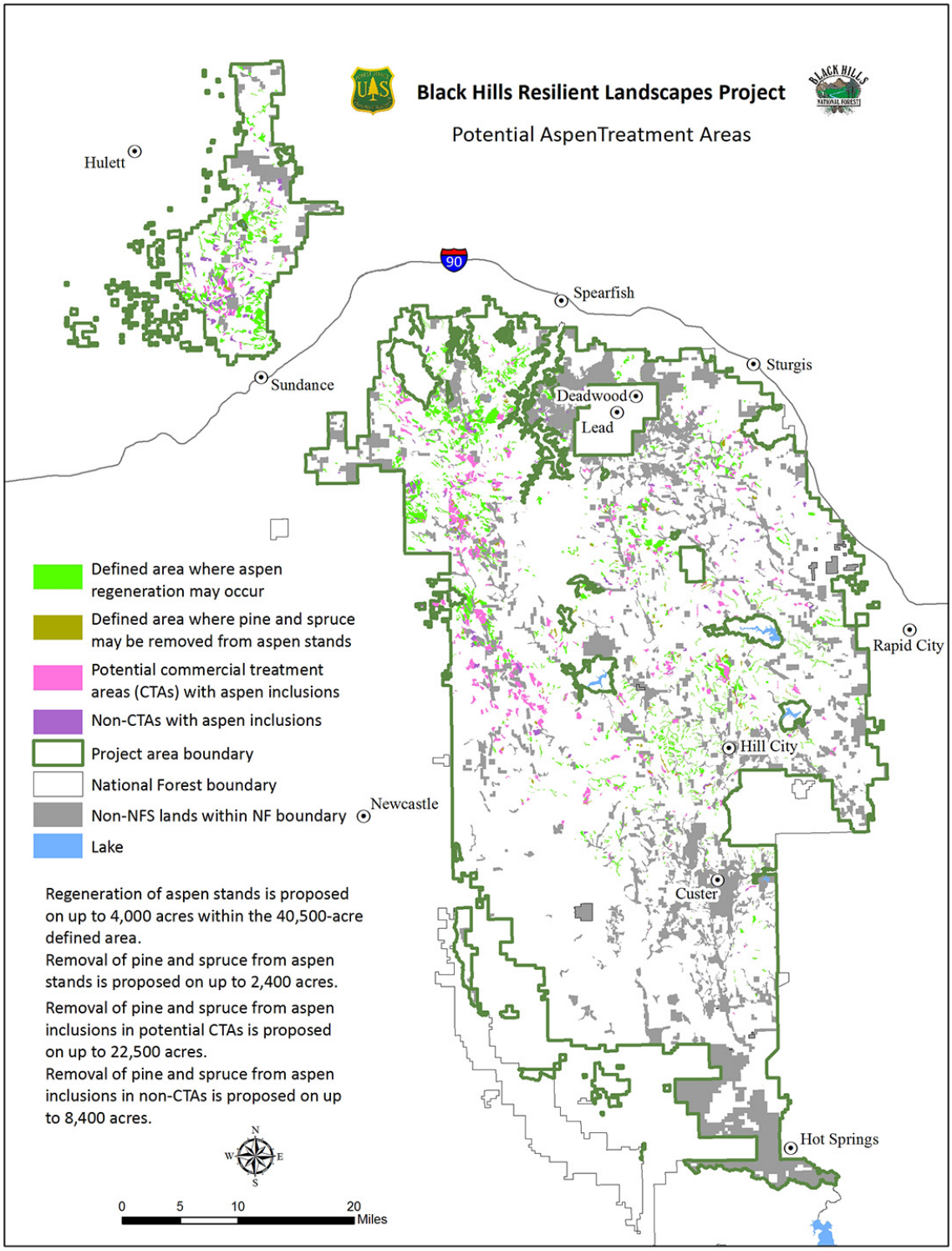


Figure 10. Potential Aspen Treatment Areas

Removal of Encroaching Pine from Oak Stands

Encroaching pine would be removed from bur oak stands on up to 5,400 acres (Figure 11). This defined area includes forested NFS lands in the eastern Black Hills that are dominated by oak or an oak/pine mix. Pine suppressing oak stands would be cut. Pine may also be cut around oak inclusions to a distance of one oak tree height.

Commercial removal of merchantable pine may occur only in MAs 5.1 and 5.4 in locations where no new roads would be required. This activity may occur in MA 3.7 only if no commercial removal is involved. Non-merchantable material would be lopped and scattered or piled and burned.

Removal of Encroaching Pine from Grasslands

Encroaching pine would be removed from grasslands through cutting or burning. This activity would occur on up to 14,200 acres within a defined 71,000-acre area (Figure 11), which includes NFS lands defined as grasslands. The potential treatment acreage refers to the actual encroached area treated rather than the entire acreage of the associated grassland. Commercial harvest of pine may occur in MAs 4.1, 5.1, 5.4, 5.43, and 5.6 if no road construction would be required. Commercial harvest would not occur in MAs 3.31, 3.32, 3.7, 5.1A, and 5.2A. Log landings associated with commercial harvest would be placed outside the grassland if possible. Other slash would generally be piled and burned or removed.

Meadow before and after removal of encroaching pine

Uneven-aged Management of Pine Stands

The following activities would occur in CTAs (page 25) and would involve commercial harvest of timber.

Uneven-aged individual tree selection is designed to create a desired condition in the forest landscape and maintain that condition through time by periodic entries to remove trees of various sizes and in various patterns. The goal is to eventually attain a forest composed of trees of all ages and sizes. Individual trees of all size classes would be removed more or less uniformly throughout the stand to promote growth of remaining trees and to provide space for regeneration.

Group selection is an uneven-aged regeneration method that maintains a multi-aged structure by removing trees in small groups. The resulting stand consists of an aggregation of groups. Trees within the groups are individually of similar age and size. The even-aged groups are scattered over the stand to create a mosaic of age and size classes within the stand.

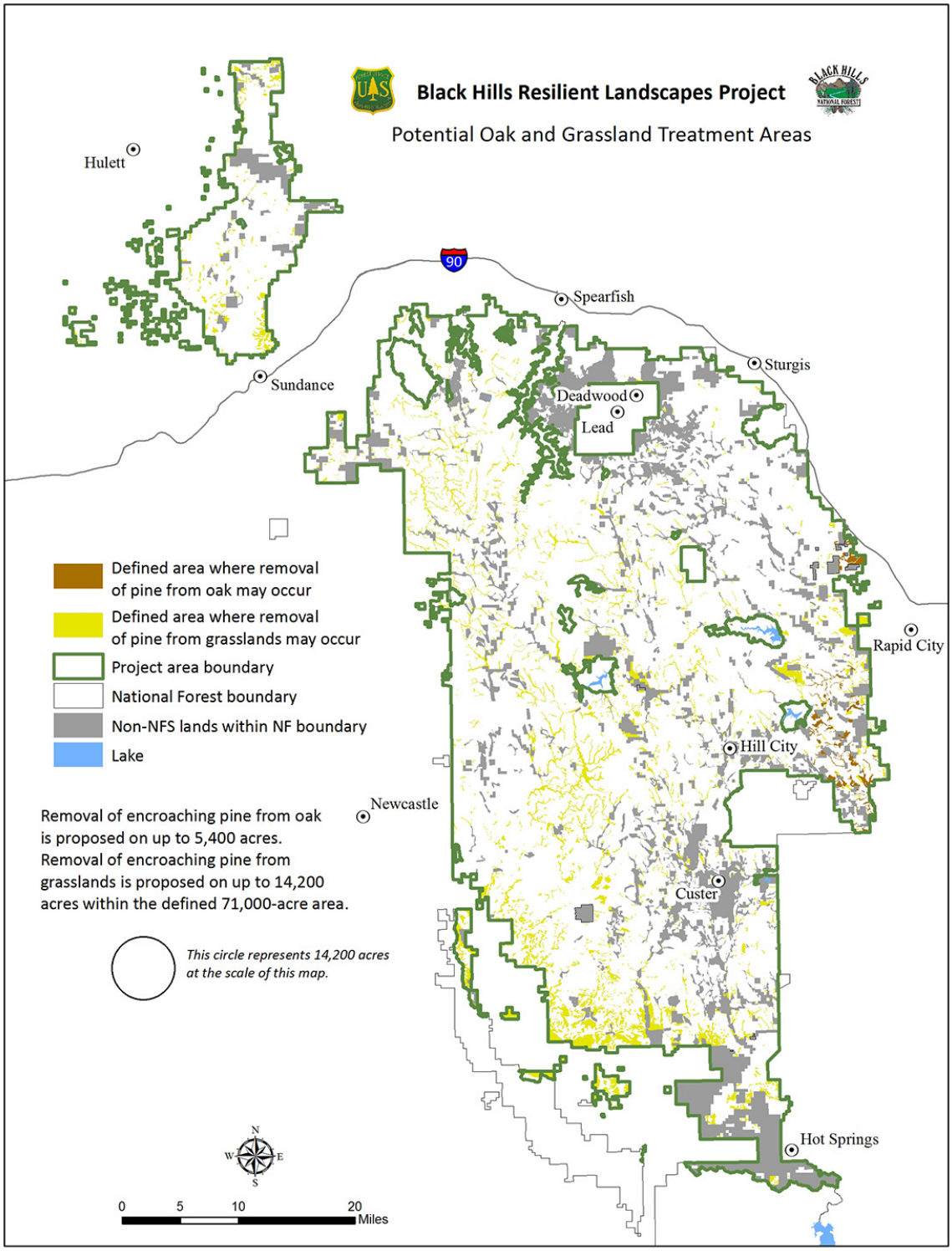


Figure 11. Potential Oak and Grassland Treatment Areas

Associated Activities

The following activities would occur in association with actions described above.

- **Log landings** would be placed in or adjacent to timber sale cutting units. Landings are open areas where timber operators stack logs or whole trees prior to processing and transport to a mill. Sale administrators designate landings at the operator's request, using either existing openings or cleared areas. Slash remaining at landings after logs are removed would be burned, chipped, or otherwise removed or decreased. Landing sites would then be scarified if necessary and seeded to return the site to productivity.

Log landing

- **Skid trails** would be used to move logs or whole trees from timber sale cutting units to landings. After use, erosion control actions and revegetation would occur.
- **Weed and Release:** Non-merchantable cull trees may be cut after commercial treatments depending on site conditions. Cut material would be bucked and scattered.

Road Construction and Maintenance

- **Road Construction:** Existing roads provide access to most of the areas proposed for commercial timber harvest. Construction of up to 18 miles of new, permanent NFS roads may be necessary (Figure 12). The new roads would be added to serve as part of the minimum road system required for long-term use. The NFS roads would be closed to public motorized use following construction until needed for timber sale or related activities and closed to all motorized use (put in storage) on completion of the project.

  Road construction would be minimized in aquatic management zones (page 38). Where new roads are necessary in these areas, transportation engineers would coordinate design and construction with a Forest Service hydrologist. Structures installed at stream crossings would be designed to allow aquatic organism passage.

  In addition, up to 20 miles of the existing, unauthorized roads would be reconstructed as needed and converted to NFS roads to serve as part of the minimum road system. This would occur where it is determined that long-term access is needed. These roads would be closed to all motorized use (put in storage) on completion of use.

- **Temporary Roads:** Where topography allows and long-term access is not necessary, construction of up to 39 miles of temporary roads may occur (Figure 12). In addition, up to 182 miles of existing unauthorized roads may be used as temporary roads. Most of the potential temporary roads would be less than 0.4 mile in length.

  Temporary roads are often used to provide access to landings from main roads. They are used for a limited period of time and are then rehabilitated and returned to production of vegetation after completion of timber harvest and associated activities. Standard removal and rehabilitation actions generally include removing any culverts or temporary bridges, installing erosion control features, ripping or scarifying the template, placing woody material on the template, and/or seeding or planting appropriate vegetation.

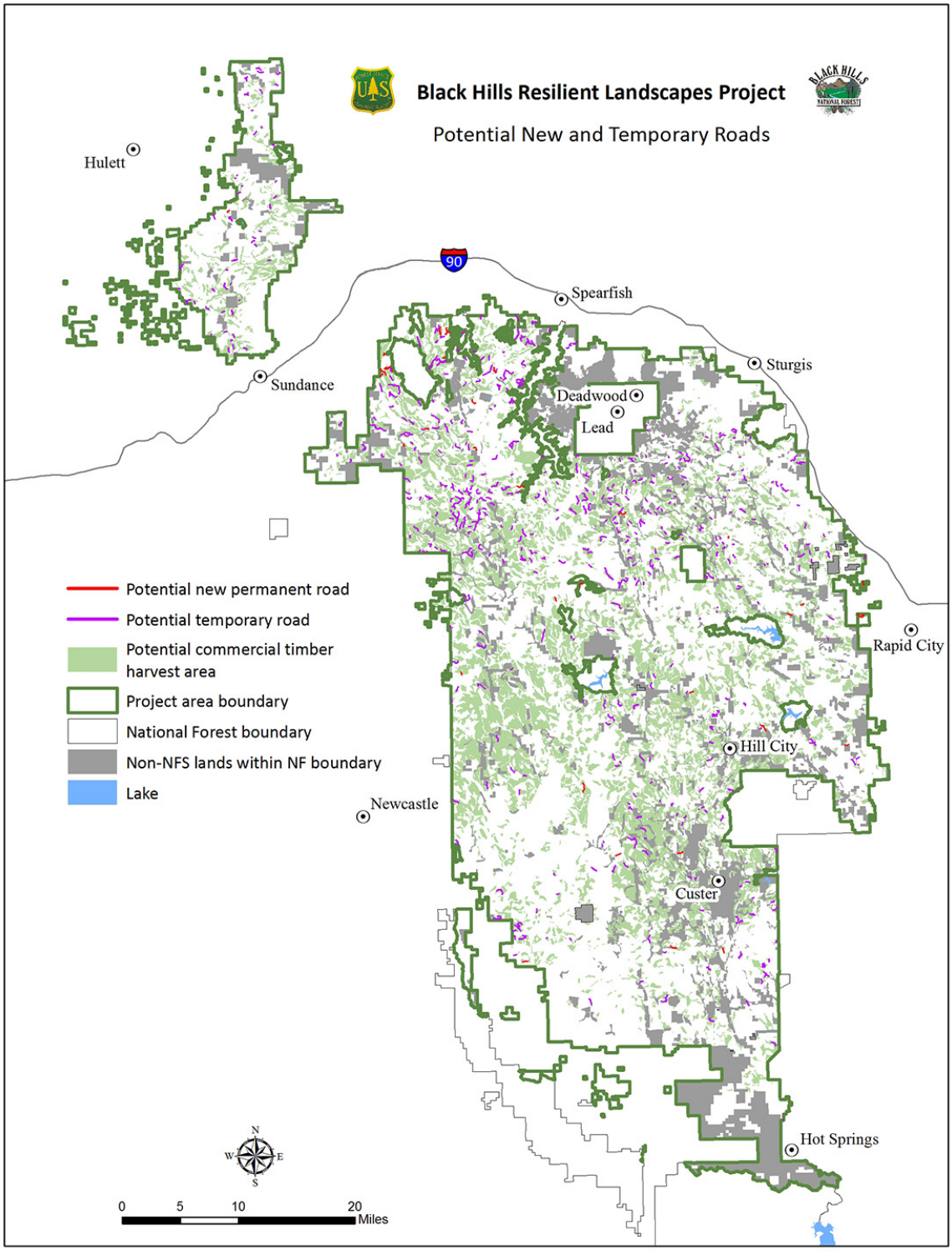


Figure 12. Potential Permanent and Temporary Roads

A temporary bridge or similar structure is generally required where temporary roads cross perennial and intermittent streams. The objective is to minimize damage to the stream and maintain streambank stability.

- **Maintenance** of an estimated 2,500 miles of existing NFS roads would occur before, during, and after commercial timber harvest to ensure the road system is functioning as documented in each applicable Road Management Objective. The objectives of road maintenance are to keep roads safe for vehicle traffic and maintain proper function of drainage systems and other resource protection features. Timber purchasers would be responsible for road maintenance with monitoring conducted by the Forest Service.
- **Reconstruction** of an estimated 375 miles of existing NFS roads would be necessary to accommodate log trucks while protecting resources along the road corridor. Some relocation may be needed to prevent adverse effects on resources.

Forest Plan Amendment

Need for Change: The Record of Decision for the Phase II Forest Plan Amendment was signed by the Regional Forester on October 31, 2005 and included direction from the Regional Watershed Conservation Practices Handbook (WCPH). On May 5, 2006, the WCPH was updated. Therefore, there is a need to update the Forest Plan with updated language in the WCPH.

Proposed Amendment: Replace existing standard and guideline 1102 (page II-4) with the updated language found in the Regional WCPH, as shown below.

CURRENT Forest Plan Language:

1102. Maintain or improve long-term levels of organic matter and nutrients on all lands. STANDARD (Regional WCP Handbook Standard 14)

a) On soils with topsoil thinner than 1 inch, topsoil organic matter less than 2 percent, or effective rooting depth less than 15 inches, retain 90 percent or more of the fine (less than 3 inches in diameter) logging slash in the stand after each clearcut and seed-tree harvest, and retain 50 percent or more of such slash in the stand after each shelterwood and group-selection harvest, considering existing and projected levels of fine slash. GUIDELINE

b) For areas adjacent to roads and trails, retain slash described in (a) at levels that meet guideline 4112. GUIDELINE

4112. Treat activity fuels adjacent to roads and trails as follows:

c) For Forest Development Roads classified as collectors, and Forest Development Trails, manage activity fuels to meet adopted SIO. GUIDELINE

d) For federal, state, county and Forest Development Roads classified as arterials, remove 70 to 90 percent of the activity fuels seen from the road's edge up to a maximum distance of 300 feet. Treat debris within one year of harvest completion. GUIDELINE

PROPOSED Forest Plan Language:

1102. Maintain or improve long-term levels of organic matter and nutrients on all lands. On soils with surface soil (A-horizon) thinner than 1 inch, topsoil organic matter less than 2%, or effective rooting depth less than 15 inches, retain 80-90% of the fine (less than 3 inches in diameter) post treatment logging slash in the stand after each clearcut and seed-tree harvest. Consider need for retention of coarse woody

debris slash in each activity area to balance soil quality requirements and fuel loading concerns. STANDARD (Regional WCP Handbook Standard 14)

Delete:

~~b) For areas adjacent to roads and trails, retain slash described in (a) at levels that meet guideline 4112. GUIDELINE~~

***No Change* to the guidelines at 4112.**

Substantive Requirements (§219.8 through §219.11): To determine if a substantive requirement is directly related to the change being proposed, the purpose for the amendment and the effects of the amendment are considered.

The purpose for the proposed amendment is to replace the existing language at section 1102 with new, updated language found in the Regional WCPH. This new language will better align the Forest Plan with regional guidance.

In addition, the proposed amendment eliminates guideline 1102(b), which references guidelines found at 4112 (page II-45). The guidelines at 4112 have not been changed, modified, or deleted. The reason for deleting 1102(b) is to eliminate confusion, as section 1102 is related to maintaining and improving long-term levels of organic matter and nutrients, while section 4112 is related to meeting scenic integrity objectives. Both sets of standards and guidelines remain in the Forest Plan.

There will be no substantial adverse effects directly related to any of the substantive requirements. The updated language speaks to the soil resource (§219.10(a)(1)) only and continues to balance soil quality requirements and fuel loading concerns.

Design Features

The following documents provide guidance for implementation of vegetation management projects and are incorporated by reference.

- BHNF Forest Plan, as amended (USDA Forest Service 2006a)
- Forest Service Handbooks and Manuals (directives; https://www.fs.fed.us/about-agency/regulations-policies)
- Black Hills National Forest 2003 Noxious Weed Management Plan (USDA Forest Service 2003)
- National Best Management Practices for Water Quality Management on National Forest System Lands (USDA Forest Service 2012b)
- South Dakota (SDSU 2003) and Wyoming (WSFD and WYDEQ 2006) Forestry Best Management Practices

The above documents contain standard design features that apply to this project. These standard design features are not repeated in this document unless the proposal would in some way strengthen or clarify them. Parties responsible for implementation of proposed activities would coordinate activity layout and design with managers of affected resources.

All proposed activities would be implemented in accordance with the following project-specific design features.

1. Noxious Weeds
    a. Ground-disturbing and ground-exposing activities would generally be prohibited in the immediate area of noxious weeds identified as a priority species by the noxious-weed specialist on the relevant Ranger District. This measure also applies to invasive species new to the Black Hills. "Priority species" are noxious weeds that typically occur in relatively small infestations on a Ranger District and have a high potential rate of spread. "Immediate area" means the infestation site and a reasonable buffer if determined necessary by a noxious-weeds specialist. Operations may occur over snow and in other circumstances if practicable and as determined to be acceptable by a noxious-weeds specialist.
    b. If infestations of priority weed species are discovered during project activities, ground-disturbing actions would cease within 50 feet of the infestation. A Forest Service noxious-weeds specialist would be consulted before activities are resumed.
    c. Herbicide application would not occur within 200 feet of fens.
2. Scenery
    a. Management would strive to maintain or create a variety of scenic conditions.
    b. Treatment areas would be designed to maintain natural-appearing transitions between the treated area and adjacent stands, where possible.
    c. Width of highly visible fuel breaks would vary.
    d. Within 300 feet of federal, state, and county roads, recreation sites, and non-motorized trails:
        i. Log landing piles and other slash piles created using heavy equipment would be located to minimize effects on scenery visible from these areas. Piles would be placed as far from these roads and trails as possible without unreasonably constraining the vegetation management activity and would be burned or otherwise removed in a timely manner.
        ii. Disturbed areas (landings, temporary roads, skid trails, forwarder trails, etc.) would be returned to a natural appearance.
        iii. Slash would be reduced to natural-appearing levels.
3. Forest Structural Diversity
    a. Activities would not occur in late succession forest (SS 5) unless they would maintain or enhance late succession characteristics. Allowed activities would include broadcast prescribed fire, piling and burning fuels, and precommercial thin.
    b. In management areas where mature, moderately dense to dense pine stands (structural stages 4B and 4C) are below Forest Plan objectives, these stands would not be treated in a way that changes overall stand structural stage except in shaded fuel breaks. Fuel managers and silviculturists would design shaded fuel breaks in SS 4B/4C stands in coordination with a Forest Service wildlife biologist. Other activities allowed in these stands would include manual and mechanical fuel treatments, prescribed fire, hazard tree removal, and precommercial thin. These stands are not potential CTAs.
    c. Potential CTAs are mature pine stands with canopy cover of mature trees ranging from 10 to 39 percent (SS 4A). Where canopy cover is at the high end of the range, transition to moderately dense, mature conditions (SS 4B) is likely to occur. Therefore, one-third of the

stands with 35 to 39 percent canopy cover would be retained to provide future SS 4B.

d. Silviculturists and wildlife biologists would assess open, mature pine stands (SS 4A) that possess field-verified late succession characteristics, including those of the open savannah type, and provide the District Ranger with a recommendation of whether treatment is needed and appropriate to move these stands toward late succession (SS 5). These stands may be potential CTAs. (See also page 27.)

e. In MAs 5.4 and 5.43, no open, mature pine stands (SS 4A) with an average tree size of "very large" (see page 53) would be cut. In MA 5.1, no more than 24,000 acres of 4A pine stands with an average tree size of "very large" would be cut. These stands may be potential CTAs.

4. Wildlife

a. When human life and/or property are not in immediate danger and when practicable, hazard trees with characteristics preferred by northern long-eared bat (large diameter, cavities/crevices, and/or loose bark) would not be removed during the bat's maternity season (June 1 – August 15).

b. Known northern long-eared bat maternity roost trees would not be cut or removed.

c. Management activities within 150 feet of a known northern long-eared bat maternity roost tree would be coordinated with a Forest Service wildlife biologist prior to implementation.

d. Annual surveys to determine if raptor (except bald eagle) nests are active would not occur prior to June 1 to avoid/minimize disturbance of breeding birds that may result in nest abandonment or reduced reproductive success.

5. Hydrology

a. No new, permanent roads would be constructed in Newton Fork, Slate Creek, Victoria-Rapid Creek, Headwaters Spring Creek, Newton Fork-Spring Creek, or Sheridan Lake-Spring Creek watersheds unless a Forest Service hydrologist determines that the road can be constructed without further decline in watershed conditions. See discussion on pages 153-154 and Figure 27, page 155.

b. The aquatic management zone (AMZ) is the area within 100 feet of each side of perennial and intermittent streams, 100 feet of wetlands, springs, and stream sinks, and 100 feet of each side of ephemeral streams for 500 feet upstream from their intersection with perennial and intermittent streams.

c. Construction of permanent and temporary roads would be minimized in AMZs associated with perennial and intermittent streams. Where road construction in these areas is necessary, transportation engineers and sale administrators would coordinate design and construction with a Forest Service hydrologist. Construction of roads and machine-created prescribed fire control lines would not occur in AMZs associated with wetlands (including fens), springs, or stream sinks. Mechanical site preparation would not occur in AMZs.

d. In AMZs associated with fens:

i. No wheeled or tracked equipment would enter the AMZ.

ii. Treatment would be limited to manual felling of trees and would require assessment by a Forest Service botanist prior to implementation. All woody material would be removed from the fen manually, causing as little disturbance to soil and vegetation as possible.

e. During timber harvest in AMZs not associated with fens:

   i. Landings would not be placed in AMZs. Skid trails would not be placed in the inner half of the AMZ (0-50 feet from the stream, wetland, or spring). Skid trails may be placed in the outer half of the AMZ (50-100 feet from the stream, wetland, or spring) if long-term stream health and riparian ecosystem condition are maintained (riparian vegetation is protected, stream shading is protected, stream banks are protected, and no or minimal sediment reaches stream). Skid trails in the AMZ may not run parallel to the stream. A Forest Service hydrologist would be consulted regarding these skid trails and would monitor their effects.

   ii. Mechanized equipment may operate in AMZs if long-term stream health and riparian ecosystem condition are maintained (riparian vegetation is protected, stream shading is protected, stream banks are protected, and no or minimal sediment reaches stream).

   iii. AMZs around stream sinks would be protected during timber harvest and other ground-disturbing activities.

f. Other:

   i. Skid trails, temporary roads, landings, and slash would not be placed in ephemeral streams unless approved by a Forest Service hydrologist.

   ii. Ground-disturbing activities would avoid karst features by a minimum of 100 feet.

   iii. Spring Creek does not meet beneficial uses due to total suspended solids (page 154). Watersheds containing Spring Creek include Headwaters Spring Creek, Newton Fork-Spring Creek, and Sheridan Lake-Spring Creek. No new road crossings of perennial or intermittent streams would be constructed in these watersheds unless a Forest Service hydrologist determines that no or very minimal sediment would be added to the creek.

   iv. Victoria Creek does not meet beneficial uses due to temperature (page 154). A Forest Service hydrologist would review activities in AMZs in the Victoria Creek watershed during the design phase to ensure stream shading is not reduced.

   v. Water body impairment is periodically reassessed by the States. If impairment status of a given water body changes during project implementation, a Forest Service hydrologist would determine whether additional protective measures are needed.

6. Soil disturbance assessments would be completed prior to mechanical site preparation. Soil disturbance assessments would also be completed prior to other activities when there are specific concerns regarding soils (high hazard rating for erosion, soil rutting, compaction, etc.).

7. To the maximum extent practicable, heavy equipment would be kept out of streams during fish spawning, incubation, and emergence periods to prevent the mobilization and/or input of sediment. Species-specific timing considerations and streams include:

   a. Finescale dace: June 1 through July 15. Cow Creek/Redwater Creek (upstream of Hemler Reservoir/Dam, Wyoming).

   b. Mountain sucker: June 1 through July 15. In South Dakota: Battle Creek, Bear Butte Creek, Boxelder Creek, Castle Creek, Elk Creek, Flynn Creek, French Creek, Horse Creek, Meadow Creek, North Fork Rapid Creek, Rapid Creek, Slate Creek, Swede Gulch and Whitewood Creek. In Wyoming: Beaver Creek, Lytle Creek, and North Redwater Creek.

c. Brook/brown trout: October 15 through April 1 in coldwater streams as designated by the states of South Dakota and Wyoming.

d. Rainbow trout: April 15 through July 31. Castle Creek (upstream of Deerfield Reservoir)/South Fork Castle Creek.

8. Where it can be effectively implemented, conifers that would not be removed commercially from aspen clones would be partly cut, leaving the sections connected by a hinge three to four feet above the ground, to create a barrier to ungulates. If conifers are not available to create a barrier, mature aspen may be hinged around the perimeter in the same manner. If insufficient trees are available or visual effects of this method would be unacceptable, temporary fencing may be installed to prevent browsing.

9. For fuel reduction reasons, the primary yarding method in WUI and adjacent to open roads and critical infrastructure would generally be whole-tree[2] unless prohibited to protect other specific resources. Away from these features, weed infestation potential, soil nutrient retention, and other resource factors would be considered when designating yarding method.

10. Rare Plant Sites

    a. Mechanical site preparation would not occur within 100 feet of known rare plant sites.

    b. If dust abatement is needed within 500 feet of fens or known rare plant sites, neither magnesium chloride nor calcium chloride would be used.

11. Historic properties would be identified and managed as per stipulations in Section 106 of the National Historic Preservation Act or stipulations in programmatic agreements developed in collaboration with the Wyoming and South Dakota State Historic Preservation Officers and interested American Indian Tribes. Programmatic agreements provide alternate procedures (pursuant to 36 CFR §800. 14(b)) by which the BHNF will meet its National Historic Preservation Act Section 106 mandates regarding the identification of historic properties, determination of site significance, and assessment of potential adverse effects. These Programmatic Agreements also contain direction regarding consultation requirements, procedures in the event of unexpected discoveries or inadvertent effects, how to resolve disputes, and what process to follow in the event that adverse effects cannot be avoided.

Monitoring

Table 3 displays proposed monitoring activities.

[2] Cutting and removing an entire upper portion of a tree consisting of trunk, branches, and needles (SAF 1998).

Table 3. Proposed Monitoring Activities

ID	Resource Area	Objective	Methodology and Timing	Reporting	Responsible Party
1	Air	Assess adherence to prescribed burn smoke limits	Spot weather forecast prior to, during, and after ignition, identifying transport wind height and direction, smoke dispersal, 20-foot wind direction and speed, and ventilation index; also monitor data from air quality monitoring stations to ensure standards are being met.	Prescribed burn file; Forest Plan monitoring report	Prescribed fire burn boss
2	Aspen	Determine status of aspen regeneration in conifer removal and aspen regeneration units	Fixed plot surveys conducted in the first, third, and fifth years after treatment	FACTS* database	Silviculturist
3	Fire resistance	Determine whether fuels treatment objectives were accomplished	Review a representative sample of treatment areas after completion of activities	FACTS & fuel tmt. effectiveness dbs.	Fuels specialist and silviculturist
4a	Ponderosa pine	Determine whether removal and regeneration harvest units are stocked with trees	Reforestation surveys conducted in the third and fifth years after harvest	FACTS database	Silviculturist
4b	Ponderosa pine	Assess progress toward Forest Plan structural stage objectives	Annual vegetation structural stage distribution analysis by management area	Forest Plan monitoring report	Silviculturist
4c	Ponderosa pine	Assess spatial distribution of structural stages	Annual spatial vegetation structural stage distribution analysis by management area	Forest Plan monitoring report	Silviculturist
4d	Ponderosa pine	Ensure adherence to timber stand improvement contract specifications	Site inspections conducted daily to weekly while operations are active	Contract inspection report	Silviculturist
4e	Ponderosa pine	Assess survival of planted seedlings	Fixed plot surveys or transects conducted in the first, third, and fifth years after planting	FACTS database	Silviculturist
5a	Soil	Monitor detrimental soil disturbance	Review a representative sample of timber sale units following harvest using national soil disturbance assessment protocol*	Forest Plan monitoring report	Soils and/or hydrology specialists
5b	Soil	Monitor effectiveness of project-specific design features	See 5a, or qualitative site visit conducted during and after project implementation	Forest Plan monitoring report	Soils and/or hydrology specialists
6	Timber	Ensure adherence to timber sale contract provisions	Site inspections conducted daily to weekly while operations are active	Timber sale inspection report	Sale administrator
7a	Transportation system	Ensure adherence to contract and road design specifications during road construction, reconstruction, and maintenance	Site inspections conducted daily to weekly while operations are active	Timber sale engineer report	Engineering representative
7b	Transportation system	Ensure temporary roads are obliterated, temporary bridges removed, and sites rehabilitated as required in contract	Site inspections conducted after timber sale implementation	Timber sale inspection report	Sale administrator or engineering representative
7c	Transportation system	Assure road closure devices are installed where required	Site inspections conducted after all operations are completed	Timber sale engineer report	Engineering representative

ID	Resource Area	Objective	Methodology and Timing	Reporting	Responsible Party
8a	Noxious weeds	Detect and treat noxious weed infestations in treated areas, focusing primarily on areas of soil disturbance	Site visits following activities, focusing on areas of soil disturbance	FACTS database	District noxious weeds manager
8b	Noxious weeds	Monitor effectiveness of noxious weed treatment	Site visits following weed treatment, focusing on areas of soil disturbance	FACTS database	District noxious weeds manager
9a	Water	Monitor implementation and effectiveness of BMPs used for project activities	National BMP evaluation protocols*; review representative sample of timber sale units, road construction, and road reconstruction during and after ground-disturbing activities	BMP monitoring report	Sale administrator, engineering representative, District staff
9b	Water	Monitor effects of skid trails AMZs on stream health and riparian condition	National BMP evaluation protocols; assess skid trails in AMZ during and after timber sale implementation	Forest Plan monitoring report	Hydrologist
9c	Water	Monitor effectiveness of project-specific design features	Methodology variable; conducted during and after timber sale implementation	Project monitoring report	Sale administrator, engineering representative, hydrologist

**2: Forest Service Activity Tracking System*
**5a: USDA Forest Service (2009a, 2009b)*
**9a: USDA Forest Service (in process)*

Tabular Summary of Proposed and Connected Activities

As described above, each proposed activity would occur on up to a specified maximum acreage within a defined area. Combined, all of these defined areas total 746,200 acres. Because each activity would occur on a fraction of its defined area acres, and because more than one activity would occur in some areas, the total area where activities would actually occur is estimated at 357,000 acres. This includes approximately 249,500 acres of mechanized activities.

Table 4 displays maximum activity acres and miles.

Table 4. Summary of Proposed Activities

Fuel and Hazard Tree Treatments	**Maximum Acres**
Mechanical and manual fuel treatments *(shaded fuel break; thin, pile, and burn fuels; scatter, shred, or chip fuels; cut, lop, and scatter fuels); includes up to 4,000 acres of shaded fuel breaks with commercial removal.*	7,000 acres per year (70,000 acres total)
Prescribed fire *(broadcast)*	10,000 acres per year (100,000 acres total)
Hazard tree removal	As needed

Pine Structural Stage Modification	**Maximum Acres**
Overstory removal *By management area:* *MA 4.1: Approximately 7,670 acres* *MA 5.1: Approximately 129,890 acres* *MA 5.4: Approximately 41,210 acres* *MA 5.43: Approximately 250 acres* *MA 5.6: Approximately 6,190 acres*	185,210 acres (total)
Precommercial and/or POL thin	25,000 acres per year (250,000 acres total)
Patch clearcut *By management area:* *MA 4.1: 1,300 acres* *MA 5.6: 600 acres*	1,900 acres (total)
Tree planting *(MAs 5.1, 5.4, and 5.43)*	5,000 acres (total)
Mechanical site preparation	4,000 acres (total)

Enhancement of Non-pine Vegetation and Within-stand Diversity	**Maximum Acres**
Removal of pine/spruce from aspen stands	2,400 acres (total)
Regeneration of aspen stands	4,000 acres (total)
Removal of pine/spruce from aspen inclusions in CTA pine stands	22,500 acres (total)
Removal of pine/spruce from aspen inclusions in non-CTA pine stands	8,400 acres (total)
Removal of encroaching pine from oak stands	5,400 acres (total)
Removal of encroaching pine from grasslands	14,200 acres (total)
Uneven-age individual tree selection or group selection	As stand conditions allow

Road Work	Maximum Miles
Road construction – Specified	18 miles (total)
Road construction – Temporary	39 miles (total)
Temporary roads on existing templates	182 miles (total)
Road conversion (unclassified to system)	20 miles (total; part of 182 miles, above)
Road maintenance	2,500 miles (total; estimated)
Road reconstruction	375 miles (total; estimated)

Required Permits and Licenses

No Federal permits would be needed for this project. Section 404 of the Clean Water Act authorizes the Secretary of the Army to issue permits for the discharge of dredged or fill material into wetlands. Silvicultural activities are exempt from the 404 permit process, as are associated road construction and maintenance that adhere to Best Management Practices (BMPs; CFR 33 part 323.4). Treatment of noxious weeds using herbicide was authorized under a previous decision (USDA Forest Service 2003). Any required permits that are unforeseen at this time would be obtained prior to implementation.

No Action Alternative

This alternative serves as a baseline for comparison of environmental consequences (40 CFR 1502.14) and is a management option that could be selected by the deciding official. Under this alternative, the proposed activities would not occur. Ongoing and reasonably foreseeable actions would continue, including timber harvest, precommercial thinning, prescribed fire, fuel reduction, noxious weed treatment, recreation, development of private land, prospecting and mining, livestock grazing, and use of surface and ground water (page 49).

Comparison of Alternatives Studied in Detail

The following tables compare the response of the Proposed Action and No Action alternative to analysis issues (page 16).

Table 5. Response to Issues 1 and 2

Issue Indicator	Proposed Action	No Action
Degree of achievement of scenic integrity objectives (SIOs; page 191)	Proposed activities would meet assigned SIOs when implemented in accordance with design features and Forest Plan guidelines.	Most NFS lands would continue to meet or move toward assigned SIOs.
Projected acreage of weed infestation (page 97; figures approx.)	9,825 acres of new infestation over 5 years (80,825 acres when combined with existing infestation)	No new infestation from this project.
Projected cost of weed treatment (page 97; figures approx.)	$7,398,200 over 5 years ($60,861,000 over 5 years when combined with treatment of existing infestation)	No new costs from this project.

Table 6. Response to Issue 3

Issue Indicator: Degree of progress toward Forest Plan structural stage objectives over 20 years (page 55) as measured by deviation from objectives (average of all structural stages by management area)

Management Area	Deviation from Objectives (Average of All Structural Stages)		
	Existing	Proposed Action + 20 Years	No Action + 20 Years
4.1	65%	24%	58%
5.1	57%	29%	49%
5.4	63%	34%	48%
5.43	106%	75%	76%
5.6	51%	21%	53%

Alternatives Considered but Not Carried Forward for Detailed Study

Focus on Timber Production

Comments received in response to public scoping requested that the project focus on commercial timber harvest to a greater degree than landscape-level resilience or structural stage distribution. This alternative was considered but was not carried forward for detailed analysis because increasing resilience and moving toward Forest Plan objectives are at the heart of the project's purpose and need (page 8). Assessment of forest conditions across the project area shows that the recent mountain pine beetle epidemic and other factors have moved hazardous fuels and pine structural stage distribution away from Forest Plan objectives and decreased ecosystem resilience. Focusing on timber harvest at the expense of other objectives would not respond to the purpose and need. The Proposed Action would, however, contribute to the local economy in various ways, including by production of commercial timber.

Focus on Mountain Pine Beetle Infestation Risk Reduction

Comments suggested that the project focus on reducing mountain pine beetle infestation risk by treating dense, mature pine stands. This alternative was considered but was not carried forward for detailed analysis because field surveys demonstrate that infestation has decreased to endemic levels in most areas of the Black Hills (Schotzko and Allen 2016). Dense, mature pine forest, which provides wildlife habitat and structural diversity, is currently below Forest Plan objectives in most management areas (page 5). Commercial timber harvest in these stands would generally not move conditions toward Forest Plan objectives. The proposal includes limited treatment of these stands if necessary for public safety (page 18). An alternative focusing on reduction of beetle infestation risk would not address the project's purpose and need.

Other comments suggested reducing mountain pine beetle infestation risk by thinning moderately dense, mature stands (SS 4B) while retaining moderate density. This would reduce stand density without modifying structural stage. This activity was considered but ultimately not carried forward because thinning moderately dense stands while keeping them moderately dense would have minimal effect on landscape-level resilience. Further, the Mountain Pine Beetle Response Project (USDA Forest Service 2012a) focused on infestation risk at the stand level and treated dense, mature pine stands for this purpose.

Unlimited Harvest of Open, Mature Pine Stands

A commenting party requested that the project include an unlimited acreage of commercial timber harvest in open, mature pine stands (SS 4A). This alternative was considered but was not carried forward for detailed analysis because unlimited harvest of these stands could reduce SS 4A acreage below Forest Plan objective levels. In addition, this would forego the opportunity to retain some of the denser 4A stands that could move into a moderately dense, mature (SS 4B) condition in the near future. Moving toward these objectives is essential to the project's purpose and need. In recent years, open, mature pine stand acreage has increased above objective levels due to mountain pine beetle infestation and response efforts. Infestation has now decreased, allowing renewed focus on moving toward structural stage objectives in keeping with the Forest Plan while increasing landscape-level resilience to beetle infestation, disease, and wildfire. Proposed commercial timber harvest acreage in these stands would result in structural stage distribution that is closer to the Forest Plan objectives (page 55).

Replace Prescribed Fire with Mechanical Treatments

A commenting party suggested that mechanical treatments replace most of the proposed prescribed fire. This alternative was considered but was not carried forward for detailed analysis because fire has beneficial ecosystem effects not duplicated by mechanical treatments and because fire can be an economical means of reducing fuels. Prescribed fire reduces fuel loading, as do mechanical treatments, but it also modifies factors related to ignition and propagation of crown fire and increases resilience of mature trees to future fires (page 79). Recent costs of prescribed fire range from $350 to $450 per acre, while mechanical treatments average closer to $1,000 per acre. Use of prescribed fire can therefore allow accomplishment of fuel reduction on more acres than using mechanical treatment alone.

Chapter 3. Environmental Consequences

Past, Present, and Reasonably Foreseeable Actions Relevant to Cumulative Effects Analysis

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analyses in this chapter do not attempt to quantify the effects of past human actions by adding them up on an action-by-action basis. By looking at current conditions, we capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. This approach is supported by the Council on Environmental Quality's June 24, 2005 interpretive memorandum regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

During the scoping process and subsequent analysis of proposed activities, the Forest Service determined that project effects may spatially or temporally overlap effects of present and reasonably foreseeable actions described below.

Timber Harvest: Eighty timber sales are under contract on NFS lands in the BHNF as of June 2017. These include approximately 37,500 acres where logging is in progress or pending. Sale of commercial timber on approximately 40,000 acres is expected to occur between July 2017 and September 2018. Associated precommercial thinning is expected to occur on an average of 10,000 acres annually. Because these actions were analyzed and approved as part of previous site-specific planning efforts, this analysis considers their estimated effects to be part of the existing condition.

Timber harvest, thinning, and related activities occur on non-NFS lands in and adjacent to the project area and are expected to continue to occur. Exact figures are unavailable, but timber harvest on non-NFS lands in and around the Black Hills likely produces no more than a quarter of the total annual output.

Fire and Fuels: Various manual and mechanical fuel treatments not associated with timber harvest are occurring or planned, including piling of fuels (1,100 acres), chipping (2,500 acres), crushing (1,400 acres), and non-commercial thinning (4,700 acres).

Previous decisions approved prescribed fire that has not yet been implemented (Figure 7, page 21). Mountain pine beetle infestation subsequently killed trees in some of these areas, changing fuel conditions. Due to the changed conditions, it may no longer be possible to meet the original objectives of some of the planned burns. Burns in these locations may not be implemented. Others are pending occurrence of specific fuel moisture and weather conditions. Based on fire managers' estimates, the analysis assumes that 20,000 acres of prescribed fire will be implemented on NFS lands within the next several years under these previous decisions. Fuel reduction, broadcast burning, and pile burning also occur on non-NFS lands in and adjacent to the project area.

Transportation System: The 2005 Travel Management Rule (70 FR 68264) required the designation of those roads, trails, and areas that are open to motor vehicle use by the public. The BHNF supervisor signed a Travel Management Record of Decision on May 7, 2010, which designated routes (roads and trails) open to motor vehicle use by the public. The primary change was from a travel status of "open

unless designated closed" to "closed unless designated open." Motorized off-road travel is allowed only for purposes of game retrieval, dispersed camping, and other situations identified by the Travel Management Rule.

Road construction and reconstruction occur annually in the BHNF and are likely to continue to occur. Routine Forest Service construction and maintenance projects are needed to manage the road system for public safety and resource management. These projects are likely to include road surface replacement, road surface grading, bridge and culvert replacements, and maintenance of culverts, cattleguards, and other structures.

County road projects such as bridge and culvert replacements, road realignment, road widening, resurfacing, maintenance grading, right-of-way clearing, and intersection improvements have occurred in recent years. County projects in progress and planned for coming years indicate this activity will continue.

The South Dakota and Wyoming Departments of Transportation annually publish a Statewide Transportation Improvement Program outlining proposed projects for a three- to five-year period (SDDOT 2016, WYDOT 2016). The current plans, extending through 2022, include work within the project area. Projects would be scattered throughout the project area and would affect public use of state-managed roads, many of which would also be used for proposed activities.

Noxious Weed Treatment: Noxious weed control activities occur annually on NFS lands and are expected to continue at stable to declining levels. Weed control efforts vary on lands under other ownership.

Recreation: The proposed 15-mile non-motorized Rushmore Connector Trail would connect an existing trail to Mount Rushmore National Memorial. This project is under analysis with a decision expected in 2018. No other foreseeable recreation-related projects have potential to contribute to cumulative effects.

Other: Development of non-NFS lands within and adjacent to the BHNF has occurred and is continuing to occur. The aerial photos below display residential development on private land in the eastern Black Hills that occurred between 2013 (left) and 2016 (right). The gray line is the boundary between private and NFS lands. This level of development is typical in areas of the BHNF that are close to population centers.

The Forest Service does not have quantified information on the amount of future residential, industrial, or agricultural development that is reasonably certain to occur on non-NFS lands in the project area.

There are hundreds of active mining claims across the BHNF. The term "active" does not necessarily mean that mining is actively being conducted on the claim. A claim is considered active by the Bureau of Land Management when the annual maintenance fees are paid or annual assessment work is completed.

On NFS lands, there are approximately 33 commercial mining operations with approved Plans of Operation. The largest is the Section 30 Limestone Mine near Rapid City, which will include a 94-acre open pit. As of June 2017, this mine is nearing initiation. Exploration and mining are also continuing on non-NFS lands.

Livestock grazing occurs across the project area and is expected to continue. Allotments that are at least partially within the project area contain approximately 1,223,700 acres of NFS lands. Grazing also occurs on most undeveloped, non-NFS grasslands.

There are no known, major utility proposals affecting the project area.

There are no known proposals to create new, large impoundments. Surface and ground water are used and will continue to be used for agricultural, industrial, and residential purposes. Residential uses are increasing with private land development.

Biological Environment

Ponderosa Pine

Summary

The Proposed Action would result in progress toward achievement of Forest Plan structural stage objectives (pages 55-60). Development of dense, older stands would take time. Percentage of stands dominated by very large trees would move toward Forest Plan objective levels (page 60). Proposed thinning of small pine would result in an increase in individual tree diameter growth (page 61). Snags and down woody material would generally continue to exist at Forest Plan objective levels (page 62).

Information Sources

Forest vegetation data were extracted from the Forest Service vegetation database in May 2016 and subsequently verified through aerial imagery interpretation. These data are based on stand-level field inventory, which has occurred in approximately 90 percent of the project area pine stands within the last 20 years. Basic vegetation attributes were updated following timber harvest and other major changes such as stand-replacing fire, either through computer modeling, additional inventory, or interpretation of aerial imagery. Effects of mountain pine beetle infestation on these attributes were estimated based mainly on aerial imagery with some field verification.

Due to beetle infestation and response actions, status of pine regeneration has changed too rapidly in recent years to maintain a comprehensive inventory. Studies and past surveys show that most pine stands in the Black Hills regenerate naturally when disturbed as long as a seed source remains (Shepperd and Battaglia 2002). Furthermore, since mountain pine beetles do not infest pine seedlings, existing regeneration survived the epidemic. Based on these factors and observations by BHNF personnel, it is assumed that many, though not all, infested or recently harvested stands are fully

stocked with pine regeneration or will be within five to 10 years. Because pine regeneration is so widespread, and because its condition may change by the time proposed activities occur, there is no need to collect additional data in specific locations at this time. At the time of proposed activity implementation, pine regeneration would be assessed.

Similarly, snag and down woody material conditions have changed rapidly, but assumptions regarding existing conditions can be made with reasonable confidence based on pre-infestation stand inventory data and the documented fall rates of beetle-created snags (Shepperd and Battaglia 2002, Schmid et al. 2007).

Existing Environment

Ponderosa pine is the dominant tree species in the Black Hills. It occurs at all elevations and on all aspects (Shepperd and Battaglia 2002). It makes up about 92 percent of the forested acres within the BHRL project area.

Structural Stage

Pine structural stages are defined and illustrated in chapter 1, starting on page 8. The Phase II Amendment to the BHNF Forest Plan uses structural stage as an indicator of ponderosa pine forest structure and condition (USDA Forest Service 2006a). The amendment established the Forest Plan structural stage objectives that the BHRL project focuses on (shown on page 8).

As described in chapter 1, structural stage distribution has moved away from the objectives as a result of mountain pine beetle infestation, response actions, and wildfires. Table 7 displays existing distribution by management area.

Table 7. Existing Structural Stage

SS	Objective* (Percent)	Management Area (Existing Percent of Pine Acres)				
		4.1	**5.1**	**5.4**	**5.43**	**5.6**
1	**5**	1	6	14	28	3
2	**5**	8	7	3	13	3
3A	**10**	7	8	6	3	5
3B	**15**	3	4	7	4	1
3C	**5**	3	2	4	6	1
4A	**25**	52	55	37	28	51
4B	**25**	17	14	19	12	27
4C	**5**	8	4	9	6	7
5	**5**	1	<1	<1	0	2

**Forest Plan objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204, and 5.6-204*

Data displayed above assume implementation of timber sales scheduled to be sold from October 2016 through September 2017. This is the best available data.

BHNF uses structural stage as a stand- and landscape-level unit of measure to identify, manage, and monitor forest conditions. Wildlife habitat elements are provided through these objectives.

Tree Size

Structural stage objectives cited above include an element related to tree size:

> *"10% of the structural stage 4 ponderosa pine acreage in the management area will have an average tree size of 'very large'."*

The tree size attribute applies to the stand rather than individual trees. A stand with "very large" tree size has a quadratic mean diameter (the diameter of the trees corresponding to the stand's mean basal area; SAF 1998) of at least 16 inches. In other words, the trees that make up most of the stand's density are at least 16 inches in diameter.

The existing proportion of mature pine forest (SS 4) with tree size "very large" is:

- MA 4.1: 17.1%
- MA 5.1: 12.8%
- MA 5.4: 8.8%
- MA 5.43: 3.7%
- MA 5.6: 28.9%

The acreage of mature pine forest dominated by very large trees has generally decreased over the past 20 years due to mountain pine beetle infestation, timber harvest, and (especially in MA 5.43) wildfire. The *percentage* has, however, remained fairly stable, as total mature pine forest has also decreased. The higher existing percentage in MAs 4.1 and 5.6 is largely due to relatively minor amount of mountain pine beetle infestation in these areas.

Regeneration

Ponderosa pine generally regenerates well in the Black Hills. Abundant seed crops occur every two to five years (Boldt and Van Deusen 1974), though seed production on the Limestone Plateau and portions of the Bear Lodge Mountains (Figure 2, page 4) has been sporadic in recent years (Shepperd and Battaglia 2002). Thick grass or brush may delay pine regeneration (Boldt et al. 1983), which is the case on the Limestone Plateau where the BHRL project proposes mechanical site preparation. In most other areas, experience shows that, even with competition from grass and brush, pine sites will regenerate to full stocking levels within five to 10 years.

The exception is in the case of large, severe wildfires. These can kill the pine seed source and allow establishment of grass. An example is the Jasper wildfire area (Figure 21, page 19). This 83,500-acre fire occurred in August 2000 and resulted in large expanses of grass cover without an adjacent seed source. This is one of the areas where the BHRL project proposes tree planting.

Snags and Down Woody Material

A snag is a dead, standing tree. Snags provide habitat for various species of wildlife. After they fall, snags provide down woody material critical for soil health, moisture retention, and habitat.

The Forest Plan provides direction regarding snags in objective 211:

> *"Within a management area in conifer-forested portions of the Forest, provide an average of 3 hard snags greater than 9-inch dbh and 25 feet high per acre, well-dispersed across the Forest, 25 percent of which are greater than 14-inch dbh."*

The latest BHNF monitoring report (USDA Forest Service 2015b) cites several data sources in concluding that current snag conditions meet objective 211. Many of the existing snags resulted from

the mountain pine beetle infestation. Beetle-killed snags typically stand for only five to seven years (Schmid et al. 2007). After these snags fall, it will be many decades until heavily infested areas have snags meeting the objective 211 definition. Uncertainty exists regarding the ability to achieve objective 211 in parts of MAs 4.1, 5.1, and 5.4 after the mountain pine beetle snags fall.

Objective 212 requires retention of five to 10 tons of coarse down woody material per acre at least once during the life of the stand. Forest Plan monitoring reports do not address this objective, but recent research (Sieg et al. 2016) demonstrates coarse woody debris levels of eight to 30 tons per acre in beetle-infested stands in the Black Hills. This suggests widespread achievement of the objective.

Environmental Consequences

Proposed Action

By Activity

Overstory Removal: Overstory removal would occur in stands with abundant pine regeneration. Most of the overstory trees would be removed to make all of the site's resources available to the new stand. Mature trees would be retained as a seed source in areas with insufficient pine regeneration and for visual and wildlife habitat purposes. Harvest methods used would ensure retention of at least 150 seedlings and/or saplings per acre, well distributed across the stand, in accordance with Forest Plan standard 2416b (*"The minimum level considered adequate for restocking is 150 seedlings per acre for conifers…"*).

The effect would be an increase of approximately 185,000 acres of early successional, younger structural stage pine, scattered across most of the BHNF (Figure 8, page 26). This change would move structural stage distribution toward Forest Plan objectives, increase growth of the remaining pine, and reduce aerial fuels, which would reduce the potential for individual tree torching and associated spotting to spread wildfire.

Uneven-age Individual Tree Selection and Group Selection: The purpose of uneven-aged individual tree selection and group selection is to create a distribution of trees of various sizes throughout a stand and maintain those conditions by continuing the treatments periodically over time. The difference in effect between these activities would be the resulting within-stand tree distribution. Individual tree selection would result in individual trees of all diameter classes distributed relatively evenly throughout a stand. Group selection would result in a mosaic of groups of trees of similar age and size class, distributed across the stand in patches up to about one acre in size. These activities generally do not change overall stand structural stage.

In some stands, mountain pine beetle infestation resulted in uneven-age structure. These and other stands that already exhibit some elements of uneven-age structure would be the focus of proposed uneven-age treatment activities. Starting with these stands rather than typical even-age stands would result in more rapid achievement of true uneven-age structure.

Precommercial and/or POL Thin: These activities would reduce stand density. Thinned seedling stands (SS 2) would remain SS 2. Growth rate of the remaining seedlings would be likely to increase, facilitating more rapid transition to the sapling/pole stage (SS 3). Thinning of dense to moderately dense sapling/pole stands (SS 3C and 3B) would have a similar effect. By allowing increased diameter growth and reducing the potential for stagnation, thinning of sapling/pole stands would result in more rapid development of mature, moderately dense pine stands (SS 4B).

Patch Clearcuts: Patch clearcuts would create the grass/forb stage within forested stands by removing essentially all trees on areas up to 10 acres in size. The patches would provide small areas of grass/forb stage within stands, contribute to grass/forb objectives, and provide browse and edge habitat for wildlife.

The National Forest Management Act specifies that lands treated with regeneration harvest such as patch clearcut must be adequately regenerated within five years after harvest (16 USC 1604(g)(3)(e)). To ensure that this regeneration requirement is met, most patch clearcuts would be less than two acres in size. Patch clearcuts may be as large as 10 acres as long as they are designed so that adjacent pine, with an effective seeding range of approximately 1.5 tree lengths, can provide a high probability of seeding in the patch.

Ponderosa Pine Tree Planting: Artificial regeneration in the form of tree planting would occur in large wildfire-created openings in MAs 5.1, 5.4, and 5.43. This activity would return these areas to pine much sooner than waiting for natural regeneration, which may not occur for decades given the distance to a seed source.

Mechanical Site Preparation: Thick sod has developed in some pine stands in the west-central Black Hills, preventing regeneration of pine. Most of the grass species forming the sod are not native to the area. Planting is not the preferred method of regeneration in these areas since a pine seed source still exists. Mechanical site preparation would provide a seedbed conducive to natural pine regeneration. Over time, as the seedlings grow into trees, increased shade would reduce the sod-forming grass component of the understory.

Prescribed Fire: The application of prescribed fire would further modify forest structures in the project area. Burning can increase both the grass/forb structure (SS 1) and sapling/pole structure (SS 3A and 3B). Patches of pine tree mortality would result in small openings, similar to patch clearcuts, and individual tree mortality would reduce density of seedling/shrub and dense, young pine stands.

Low- to moderate-intensity prescribed fire would occur on up to 100,000 acres over the life of the project, reducing ground fuels and increasing diversity of vegetation in the understory. In dense stands, where understory vegetation is lacking due to shade and needlecast, moderate-intensity fire would reduce inhibiting duff and stimulate residual grasses and forbs. Burning in more open stands would favor grass establishment and reduce conifer regeneration. Prescribed fire would cause a short-term increase in tree growth due to the nutrients released into the soil. Tree mortality would reduce total yield. Based on low levels of mortality observed after past prescribed fires, reduction in yield across the project area should be minimal.

Shaded Fuel Breaks: Shaded fuel break construction would increase diameter growth in remaining trees due to reduced competition and increased crown development and crown diameter. Increased sunlight and soil disturbance associated with the removal of trees within the treated area would be likely to facilitate pine regeneration and, over time, create an overstocked understory. Future thinning or burning would be required to again reduce fuel contiguity and maintain the value of the fuel break.

Structural Stage

Figure 13 through Figure 17 display existing structural stage distribution for each management area, compared to the Forest Plan objective and the projected distributions immediately after implementation of the Proposed Action (post-treatment) and 20 years later. Projections were conducted using the Forest Vegetation Simulator (Crookston and Stage 1999) and assume no other

management actions or major disturbances, such as large wildfires, occur over the next 20 years. Effects of shaded fuel breaks are not evident due to rounding but are discussed following the tables.

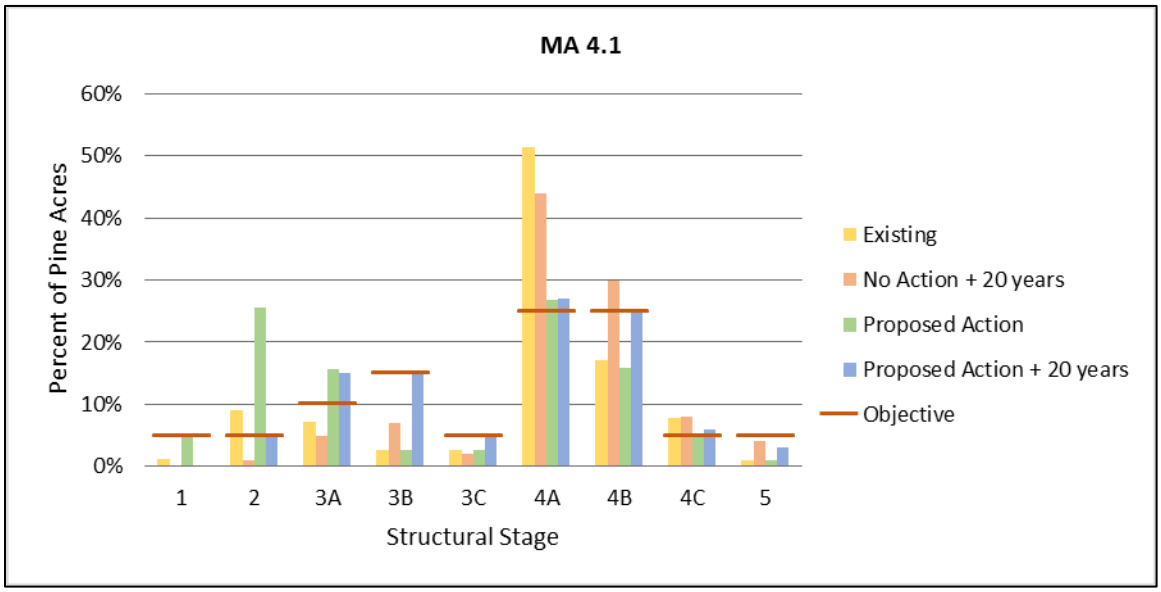


Figure 13. Pine Structural Stage Projections, MA 4.1

On average, existing structural stage levels in MA 4.1 deviate from objectives by 65 percent. Twenty years after implementation of the Proposed Action, this figure would decrease to 24 percent. If no action is taken, the figure would decrease to 58 percent. The Proposed Action would move structural stage distribution closer to objective levels than the No Action alternative.

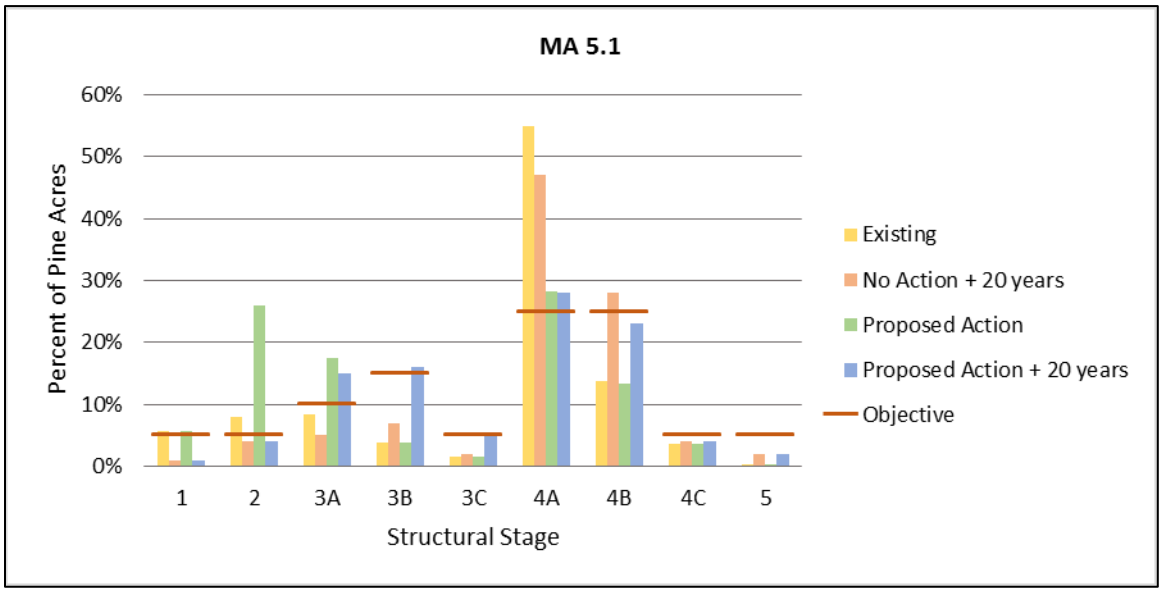


Figure 14. Pine Structural Stage Projections, MA 5.1

On average, existing structural stage levels in MA 5.1 deviate from objectives by 57 percent. Twenty years after implementation of the Proposed Action, this figure would decrease to 29 percent. If no

action is taken, the figure would decrease to 49 percent. The Proposed Action would move structural stage distribution closer to objective levels than the No Action alternative.

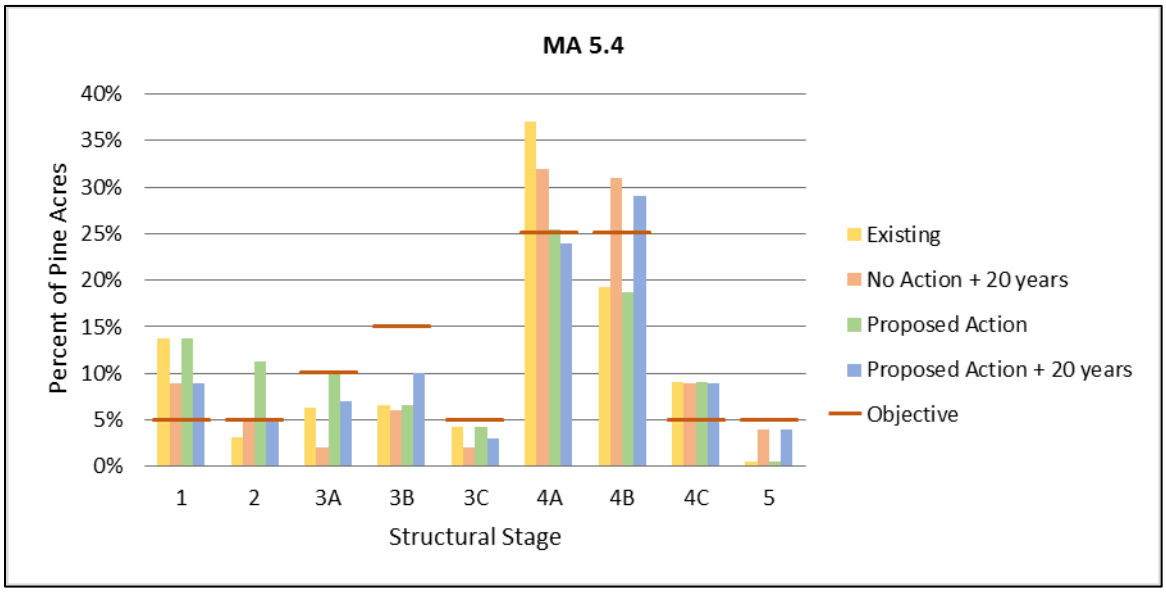


Figure 15. Pine Structural Stage Projections, MA 5.4

On average, existing structural stage levels in MA 5.4 deviate from objectives by 63 percent. Twenty years after implementation of the Proposed Action, this figure would decrease to 34 percent. If no action is taken, the figure would decrease to 48 percent. The Proposed Action would move structural stage distribution closer to the objective levels than the No Action alternative.

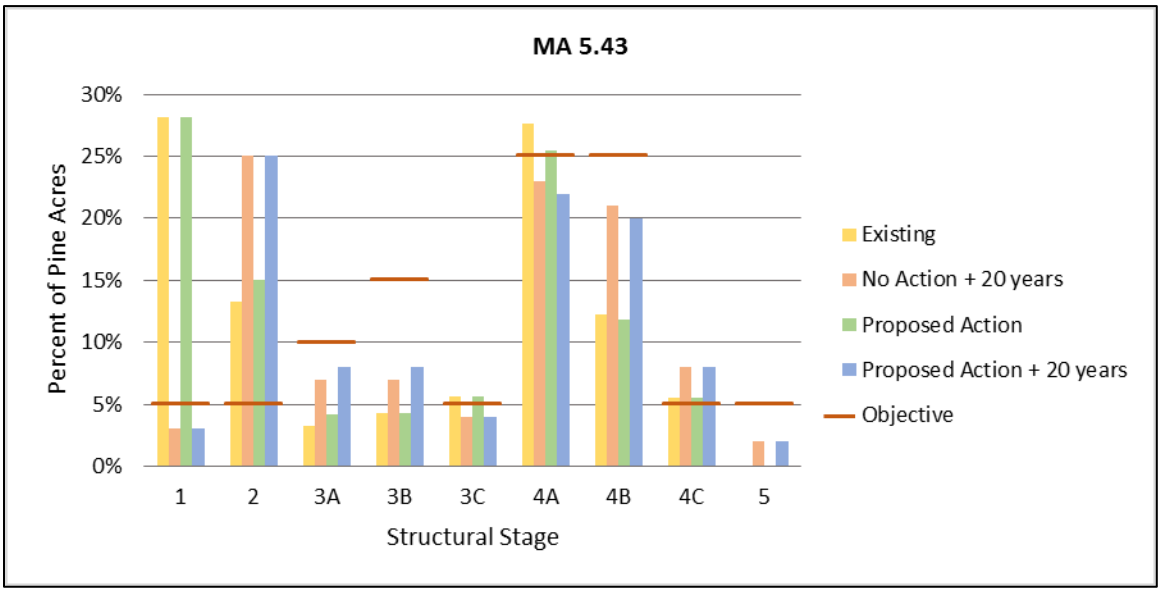


Figure 16. Pine Structural Stage Projections, MA 5.43

Existing SS levels in MA 5.43 deviate from objectives by an average of 106 percent. Twenty 20 years after implementation of the Proposed Action, this figure would decrease to 75 percent. If no action is

taken, the figure would decrease to 76 percent. The primary cause of the large deviation is the oversupply of openings (SS 1) caused by recent wildfires. The effects of the Proposed Action would be similar to those of the No Action alternative.

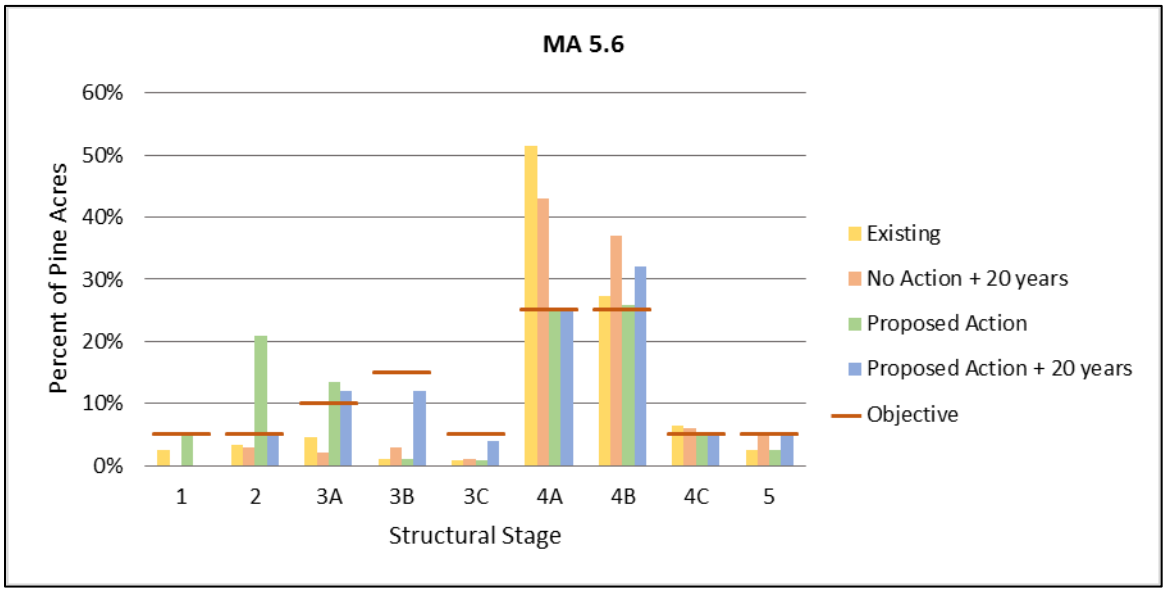


Figure 17. Pine Structural Stage Projections, MA 5.6

On average, existing structural stage levels in MA 5.6 deviate from objectives by an average of 51 percent. Twenty years after implementation of the Proposed Action, this figure would decrease to 21 percent. If no action is taken, the figure would increase to 53 percent. The Proposed Action would move structural stage distribution closer to the objective levels than the No Action alternative.

The Proposed Action would increase **grass/forb stage (SS 1)** in MAs 4.1 and 5.6 due to patch clearcuts. There would be no immediate increase in other MAs, though prescribed fire may create openings that are too small to track as separate stands. Given the prolific pine regeneration typical in the Black Hills, the patch clearcuts would transition to seedling/shrub stage within 20 years. Existing grass/forb stage, outside of the large burned areas, is also likely to reforest. As a result, within 20 years the percentage of grass/forb stage could once again fall below the Forest Plan objective in MAs 4.1, 5.1, and 5.6.

Seedling/shrub stage (SS 2) would increase dramatically after project implementation in all MAs. Removal of overstory pine would release the understory cohort that has regenerated within the past 20 years following mountain pine beetle infestation and timber harvest. The seedling/shrub objective is five percent, but the excess is needed so that sapling/pole stage may increase and move toward objectives over time. Seedlings transition to the sapling/pole stage relatively quickly and, over the next 20 years, the amount of seedling/shrub stage is projected to diminish to near five percent in four of the five MAs. In MA 5.43, seedling/shrub stage would continue to increase as reforestation occurs in recently burned areas.

The Proposed Action would increase acreage of **open, young pine forest (SS 3A)**. Similar to seedling/shrub stage, this would be the result of removing overstory pine and releasing the understory cohort. Within 20 years, many of these stands would develop crown diameters that move densities into denser young forest stages, decreasing the open, young stage to near the Forest Plan

objective level. Ingrowth from seedling/shrub stands could also be expected. The exception is MA 5.4, in which open, young pine forest would decrease below the objective over the next 20 years.

The Proposed Action would have little immediate effect on **moderately dense, young pine forest (SS 3B)**. Most of these stands are the result of past precommercial thinning. Within 20 years, however, the percentage of this stage would increase in all MAs due to ingrowth from seedling/shrub and open, young stands. It would be at or near the objective level in MAs 4.1, 5.1, and 5.6 but remain below in MAs 5.4 (due to a shortage of younger forest) and 5.43 (due to recent fires).

Proposed activities would also have little immediate effect on **dense, young pine forest (SS 3C)**. Most of these stands are the result of growth of seedling/shrub stands. Over the next 20 years, dense, young forest acreage is projected to increase gradually to near the Forest Plan objective level in MAs 4.1, 5.1, and 5.6 due to growth of the seedling/shrub stage that would result from proposed activities and recent beetle infestation. In MAs 5.4 and 5.43, dense, young forest would decrease over the next 20 years as existing young stands grow and are not replaced due to a shortage of seedling forest.

Proposed overstory removal would decrease **open, mature pine forest (SS 4A)** to near the Forest Plan objective level in all MAs. Without disturbance or further treatment, the percentage would decrease slightly over the next 20 years but remain near the objective. The exception is MA 5.43, where open, mature pine forest would continue to decrease due to a shortage of ingrowth from younger structural stages. This is a result of recent wildfires.

Contiguous stands of open, mature pine forest currently exist in blocks of up to approximately 2,000 acres. The Proposed Action would break up many of these blocks by creating seedling/shrub or sapling/pole stands.

Moderately dense, mature pine forest (SS 4B) is below the Forest Plan objective of 25 percent in all MAs except 5.6. Shaded fuel breaks proposed in critical areas would further reduce this stage by a small fraction. Within 20 years, the percentage of this stage would be near the Forest Plan objective level in MAs 4.1 and 5.1 due to ingrowth mainly from younger stands. In MAs 5.4 and 5.6, this stage would be above the objective within 20 years, while in MA 5.43 it would remain below due to recent wildfires.

Proposed fuel breaks would reduce **dense, mature pine forest (SS 4C)** slightly. It is currently near objective levels in MAs 4.1 and 5.6 and would remain so over the next 20 years. In MA 5.1, it would remain below but move toward the objective within 20 years due to ingrowth from younger and more open stands. Dense, mature forest would remain above the objective in MA 5.4 and would increase further above it in MA 5.43. Older dense, mature stands may transition to late succession, while others would move back to a more open condition as competition causes mortality of less-vigorous trees.

The Proposed Action would not reduce **late succession forest (SS 5)**, which is currently below objectives in all MAs. Within 20 years, it is projected to increase as older mature (SS 4) stands grow and age. In MA 5.6, it may reach the Forest Plan objective level in this time period. Projections indicate that late succession forest could reach objective levels in other MAs within 40 years.

Table 8. Identified Structural Stage 5 by Management Area

MA	Objective (acres)	Existing (acres)	Deficit (acres)
4.1	1,794	320	1,474
5.1	23,940	1,449	22,491
5.4	17,022	1,600	15,422
5.43	485	0	485
5.6	1,281	617	664

Figure 18 illustrates effects on overall **canopy closure** in MAs 4.1, 5.1, 5.4, 5.43, and 5.6 combined. Over 20 years, the current open forest is projected to transition to a denser forest. Within this time span (barring other disturbances), moderately dense pine forest would increase from the current 21 percent to nearly 40 percent, which is the Forest Plan objective level.

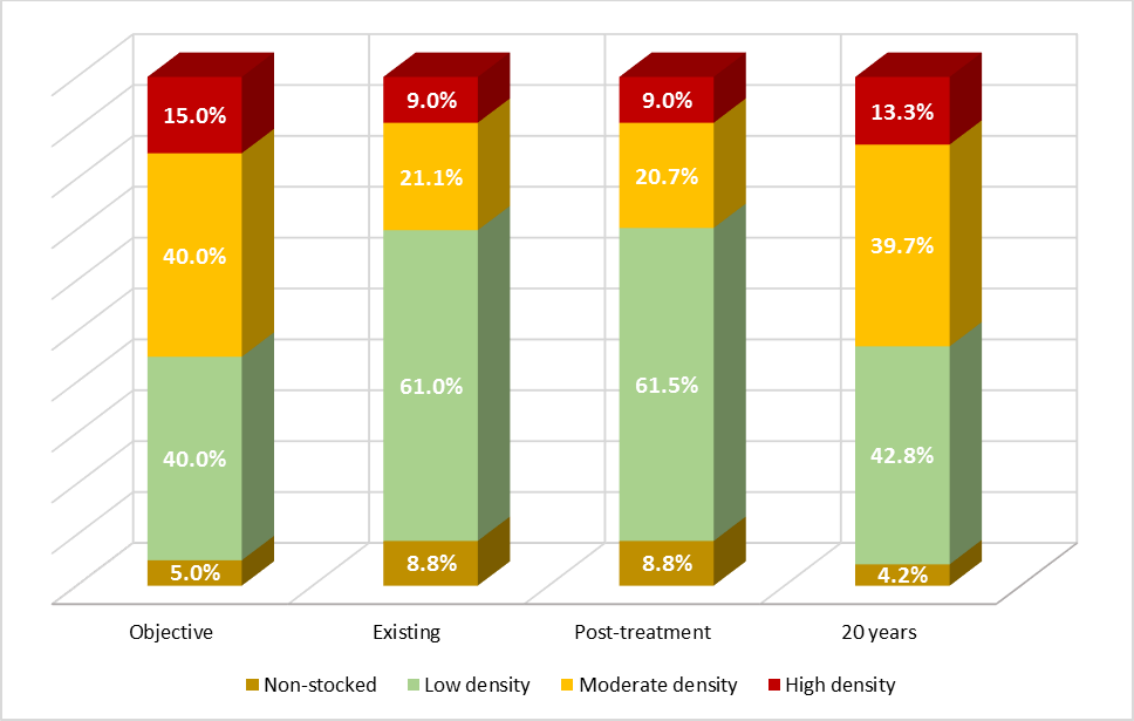


Figure 18. Canopy Closure, Proposed Action

Tree Size

Overstory removal would change tree size to "established" or "small", while patch clearcuts (proposed in MAs 4.1 and 5.6) would change tree size to "non-stocked". Other activities proposed in pine stands would not change stand-level tree size.

In MAs 5.4 and 5.43, acreage of pine stands with "very large" tree size is currently below the Forest Plan objective of 10 percent of mature pine (SS 4) acres. All of these stands would need to be retained to move toward the objective.

In MAs 4.1, 5.1, and 5.6, acreage of pine stands with "very large" tree size is above the Forest Plan objective.

- In MAs 4.1 and 5.6, overstory removal could occur in all of the potential CTAs with "very large" tree size without reducing the percentage below the Forest Plan objective (Table 9).
- In MA 5.1, overstory removal could occur on 22,500 acres in potential CTAs with "very large" tree size while still maintaining "very large" tree size on more than 10 percent of the mature pine acres.

Table 9. Stands with "Very Large" Tree Size, Proposed Action

	MA 4.1	MA 5.1	MA 5.4	MA 5.43	MA 5.6
Existing percentage of mature pine acreage with "very large" trees	17.1%	12.8%	8.8%	3.7%	28.9%
Maximum proposed acreage of overstory removal or patch clearcut in stands with "very large" trees	2,450 ac	22,500 ac	0 ac	0 ac	3,387 ac
Resulting percentage of mature pine acreage with "very large" trees	13.3%	11.3%	10.1%	4.4%	21.5%

In MAs 5.4 and 5.43, the Proposed Action would cause the percentage to increase. This is because acreage of mature pine forest would decrease while acreage of stands with "very large" tree size would remain the same.

By adhering to the above measures (design feature 3(e), page 39), the Proposed Action would contribute toward achievement of the Forest Plan objective.

Regeneration

Natural regeneration of pine would occur where proposed activities reduce shading and expose soil. Mechanical means of timber harvest and yarding usually have these effects, though harvest conducted over snow often does not expose soil or disturb understory vegetation. Competition from other vegetation can sometimes delay regeneration of pine in these areas, especially where sod-forming grasses or bur oak thickets are present. Because most of the proposed timber harvest would occur in stands that are already stocked with pine seedlings and saplings, regeneration problems would be unlikely to result. Proposed prescribed fire would reduce existing small pine but may also create a suitable seedbed for future seedling establishment.

Stocking Levels

Pine stocking levels would decrease in treated areas. Expected effects would include an increase in individual tree diameter growth as a result of reducing competition for sunlight, water, and nutrients. Adequately stocked pine stands would exist for future management, including in the proposed tree planting and site preparation areas where regeneration is currently lacking. The Proposed Action would contribute toward achievement of Forest Plan goal 3 (*"Provide for sustained commodity uses in an environmentally acceptable manner"*) and comply with standard 2408 (regarding acceptable silvicultural systems).

Growth and Yield

Proposed overstory removal harvest would release young stands from competition with older, overtopping pine and reduce stocking levels in overstocked stands. Quality of timber would increase as a result of removal of damaged, diseased, and poorly formed trees and an increase in individual tree growth. Precommercial and POL thinning would allow increased diameter growth in residual

trees, concentrating stand growth on fewer stems. This increased growth is projected to result in potential future increases in yield.

Culmination of Mean Annual Increment

The National Forest Management Act (NFMA, 16 USC 1604(m)) generally prohibits the harvest of stands before they reach their maximum growth rate. This point is known as culmination of mean annual increment (CMAI). Exceptions allow the harvest of individual trees, or even parts or whole stands of trees, before achievement of CMAI to thin and improve timber stands and salvage damaged stands of trees (m(1)). Further exceptions are allowed in order to achieve multiple-use objectives other than timber harvest (m(2)).

The open structure in most mature pine stands that are proposed for treatment resulted from earlier regeneration harvest, thinning to a low basal area during the implementation of the Mountain Pine Beetle Response Project (USDA Forest Service 2012a), or mountain pine beetle infestation. Some, but not all, have achieved CMAI.

Prior to earlier regeneration harvest, analyses and decisions determined that stands had achieved CMAI. In these stands, the Proposed Action would implement an overstory removal harvest. Where open, mature structure resulted from mountain pine beetle infestation or low-density thinning, proposed treatment would produce results similar to those of overstory removal; technically, the silvicultural prescription would be an improvement or liberation cut. The objective is to release the understory pine while modifying stand structure.

These activities would be consistent with the exceptions provided in part m(2) of NFMA. Liberation, improvement, commercial thinning, non-commercial thinning, and removal of pine from aspen, oak, and grasslands are excepted from the CMAI requirement. The purpose of these treatments is to improve stand structure, release understory trees, improve wildlife habitat, improve forest resilience to disturbances, and benefit other forest resources. These activities are proposed to move the project area toward Forest Plan desired conditions and respond to HFRA guidance.

NFMA section m(1) exempts thinning and other stand improvement measures, such as proposed shaded fuel breaks, other fuels-related thinning, and precommercial thinning, from the CMAI requirement. Patch clearcutting also is exempt because its purpose is to increase grass/forb stage and transitory forage for wildlife in response to Forest Plan multiple-use objectives, in accordance with section m(2).

Snags and Down Woody Material

The Proposed Action would result in loss of a percentage of snags. Most of the hazard trees removed to ensure human safety and prevent property damage are snags. Snags and live trees would be cut where necessary to create space for log landings. Proposed activities would not affect most other snags that are not adjacent to roads, infrastructure, or prescribed fire control lines. Existing snags in prescribed fire areas may be burned. Prescribed fire may also create snags, though most would be small-diameter.

As described on page 53, there will eventually be a long-term deficit of snags in areas of heavy mountain pine beetle infestation. The Proposed Action would be unlikely to affect the live trees that remain interspersed in many of these areas because most of these stands are not potential CTAs. These trees may become snags that would provide scattered habitat during the period of time when snags are in short supply across the larger infested area.

In most areas where beetles killed fewer trees, adherence to Forest Plan standards 2301[3] and 2305[4] would maintain snag density at or above objective 211 levels. Retention of large, live trees during proposed activities, including overstory removal, would provide potential future snags. Localized deficits may occur where past commercial timber harvest and other activities have removed most or all large trees.

Proposed fuel reduction would decrease down woody material adjacent to roads, private land, and infrastructure. Commercial timber harvest conducted using whole-tree yarding would generally not decrease existing down woody material but would also not add to it. Prescribed fire would burn dead woody material, though larger logs often are not completely consumed. Other activities would add to down woody material. In most areas, adherence to Forest Plan guideline 2307 (leave large woody debris on site) and standard 2308 (page 115) would contribute toward achievement of objective 212.

No Action Alternative

Natural processes of growth and regeneration would continue to cause structural stage transitions (see figures starting on page 56). Dense stands would remain dense for the foreseeable future. Heavily stocked areas of pine seedlings and saplings would continue to grow until stagnation, disturbance, or self-thinning occurs. Open stands would continue to regenerate but would remain dominated by mature trees. Pine regeneration would continue to occur very gradually in large openings created by fire and in pine stands with thick sod.

Stocking would continue to increase, with a resulting decline in diameter growth and crown development. Height growth may increase in response to competition. Future potential yield would decrease. Adequately stocked pine stands would be projected to remain in most areas for future management.

The No Action alternative would have no immediate effect on percentage of mature pine stand acreage with "very large" tree size. Over time, the percentage may increase as mature trees grow or decrease as pine seedlings and saplings fill in open, mature stands, shifting average tree size downward.

There would be no immediate effect on existing snags, trees that may become snags in the future, or down woody material. As with the Proposed Action, there will be few snags in heavily infested areas after the beetle-killed trees fall. Down woody material would increase from existing levels.

Cumulative Effects

The cumulative effects analysis area for ponderosa pine is all NFS lands within the BHRL project area boundary (1,098,425 acres). This area is selected because the project's direct and indirect effects on components of ponderosa pine forest addressed here are unlikely to overlap in space or time with effects of activities taken outside the project area or on other ownerships. The timespan for cumulative effects analysis is the present through 2048, or 20 years after the projected completion of proposed activities. By this time, growth modeling indicates that the project's effects on structural

[3] *"a) Retain all snags greater than 20-inch dbh unless a safety hazard. If snag densities within a project area are below Objective 211, retain all snags unless they are a safety hazard. If large snags (>14 in dbh) are not available, retain snags in the largest size class available. This standard does not apply to areas salvaged under Objective 11- 03…"*

[4] *"All soft snags should be retained unless they are a safety hazard."*

stage and other characteristics of pine forest would become difficult to distinguish from those of other activities and events.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Recent and ongoing timber sales consist mainly of thinning and thus are moving mature pine stands from dense to open conditions. Estimated changes were incorporated into structural stage data displayed in this document as the existing condition. Planned precommercial thinning will move young stands from dense to open conditions. Other ongoing and foreseeable activities will reduce density and occurrence of small pine while increasing merchantable volume growth rates. Fire suppression can generally be expected to allow stand development and pine encroachment to continue.

The additive effect of the Proposed Action on structural stage is disclosed on pages 55-60. The cumulative effect would be general progress toward achievement of Forest Plan structural stage objectives. With some exceptions, the Proposed Action would bring structural stage distribution closer to the Forest Plan objective levels within 20 years than would the No Action alternative.

Ongoing and foreseeable activities will have minimal effect on the percentage of mature pine stands with "very large" tree size, so the Proposed Action's effects on this characteristic would not be additive.

Recent and ongoing activities that have reduced density of mature stands are likely to result in pine regeneration and increased stocking. The Proposed Action's fuel breaks, patch clearcuts, pine planting, and mechanical site preparation would add to this effect. Increased contiguity of young forest plus fire suppression could raise future risk of mountain pine beetle infestation and severe wildfire (see also cumulative effects on forest pathogens, page 68, and on fuels, page 81). Proposed precommercial thinning and prescribed fire would result in a decrease of this cumulative effect.

Thinning would add to growth and yield effects of ongoing and foreseeable activities. The cumulative effect would be an increase in timber volume production over the long term as compared to the No Action alternative.

Proposed activities may, in combination with other actions, result in additional localized snag deficits as compared to the No Action alternative. In general, adherence to Forest Plan standards would maintain snag density and down woody material occurrence at or above objective levels.

Forest Pathogens

Summary

Due to the recent large mountain pine beetle epidemic as well as response actions and wildfire, the amount of pine forest at high risk of infestation has significantly decreased. Even where dense stands still exist, they are at a much lower risk of attack due to surrounding forest conditions. Proposed thinning of seedlings and saplings would allow new stands to develop at different rates and densities. Proposed burning and pine-removal treatments would further diversify the forest and delay redevelopment of landscape-level susceptibility to beetle infestation.

Information Sources

Forest pathogen status is based on remote sensing data and field surveys (Allen et al. 2017). Aerial imagery interpretation conducted during the recent mountain pine beetle epidemic provided infestation data at the stand level. Potential for further infestation is based on stand-level field inventory of forest vegetation, which has occurred in approximately 90 percent of project area pine stands within the last 20 years. Basic vegetation attributes were updated following timber harvest and other major changes such as stand-replacing fire, either through computer modeling, additional inventory, or interpretation of aerial imagery. Effects of mountain pine beetle infestation on these attributes were estimated based mainly on stand-level infestation data with some field verification.

Affected Environment

Insect Pathogens of Pine

The **mountain pine beetle** (*Dendroctonus ponderosae*) is the top insect killer of pines throughout the western United States. The beetle is a native species whose hosts include most western species of pine. Mountain pine beetle populations usually occur at endemic levels, killing and reproducing in stressed or weakened trees. Less than one tree killed per acre per year is considered an endemic level of infestation.

For reasons not fully understood, mountain pine beetle populations can occasionally increase dramatically to epidemic levels. The Black Hills have experienced several major mountain pine beetle infestations over their recorded history. Starting in the mid-1990s, beetle populations began to increase, eventually reaching epidemic proportions. By 2016, populations had returned to endemic levels across the BHNF (Allen and Schotzko 2016). The numerous trees killed by beetles now are habitat for other insects, such as pine engraver and woodborers.

The susceptibility of ponderosa pine stands in the Black Hills to mountain pine beetle attack can be rated based on stand conditions. Research conducted in the BHNF over the past 30 years has shown that stands are considered to be most susceptible when 75 percent of the stand has an average tree diameter over seven inches and stand density is over 120 feet of basal area per acre (Stevens et al. 1980, Schmid and Mata 1992, Schmid et al. 1994). Other results indicate that, at times, aggressive thinning to further reduce density and more frequent stand entries may be needed to reduce susceptibility to attack. Stands thinned to 80-90 square feet of basal area per acre (moderate density) have sometimes incurred heavy losses when surrounded by dense pine forest (Schmid and Mata 2005). Research continues to emphasize that lower residual stand density leads to greater reduction in

beetle-caused mortality in both even- and uneven-aged stands (Schmid et al. 2007, Negron et al. 2008).

In addition to mountain pine beetle, other insects may cause occasional or future problems in BHNF pine forests, including pine engraver beetle, red turpentine beetle, and two species of pine tip moth.

The **pine engraver beetle** (also referred to by the genus name *Ips*) typically attacks freshly cut logs and slash, fire-scorched trees, and storm-damaged trees; it then moves into stressed green trees. Endemic populations of these beetles kill individual trees and small groups of trees. Populations can build up in slash or damaged material and then proceed to attacking and killing healthy trees.

A given year's percentage of average precipitation, particularly in the spring, is often an indicator of engraver beetle activity for the year. If precipitation is below 75 percent of average in spring and early summer, engraver beetle activity will likely be above average. Outbreaks are usually of short duration, typically only a year depending on moisture. During extreme drought, however, damage may continue for two to three years.

The **red turpentine beetle**, native to the Black Hills, is not aggressive and is not generally the primary cause of ponderosa pine mortality (Shepperd and Battaglia 2002). However, red turpentine beetle is a secondary cause of ponderosa pine mortality, attacking trees already weakened by fire, drought, other insects, and lightning. Red turpentine beetle can damage wood products.

Two species of **pine tip moth** occur in the Black Hills: the western pine tip moth and the southwestern pine tip moth. They are of occasional concern on the BHNF (Shepperd and Battaglia 2002). These moths generally attack ponderosa pine seedlings that are less than 10 feet tall, boring into new shoots and feeding on the tissues of the needles.

Environmental Consequences

Proposed Action

Management actions can directly affect the vegetation and environment upon which mountain pine beetle and other forest pathogen insects depend. Management alternatives that change the mix of age classes and densities of forest stands generally limit pathogen effects on Black Hills environments.

Mountain pine beetles generally affect stands with high densities. Extensive areas of forested habitat in these structural stages are at greater hazard of an epidemic than are forested areas that include a mixture of structural stages, densities, and species diversity. Infestation hazard is low in young and open forests. Native wildlife inhabiting the forest evolved with a range of structural conditions, including late succession forest, so the diversity required by these species will carry with it some component of infestation risk. The recent mountain pine beetle epidemic and response actions (page 1) substantially reduced the amount of high-hazard forest. Where dense stands still exist, they are at a much lower risk of attack due to surrounding forest conditions.

Fuel and Hazard Tree Treatments

In young pine stands that could eventually become the next generation of high-hazard forest, the effect of treatments proposed for reducing fuels, such as thinning and prescribed burning, would be to reduce immediate infestation hazard and reduce the potential for development of future hazard.

Providing engraver beetles with a suitable food source during their flight period can increase the likelihood of attacks on surrounding live trees. Chipping or lopping and scattering fuels between the months of October and February minimizes the amount of suitable material available for engraver

beetles to infest. These activities would, however, also be likely to occur outside this time period, so temporary increases in engraver beetle populations may occur in localized areas.

If large, contiguous areas are treated within a short time span, the amount of slash or stressed trees may allow engraver beetle populations to increase enough to spill over into larger saplings or pole-size trees. Compared to mountain pine beetle attacks, pine engraver infestation typically occurs in smaller groups of trees, and the overall epidemic is much shorter. The long-term infestation hazard reduction effects of thinning would be likely to outweigh the effects of any short-term infestation.

Trees scorched by prescribed fire can become habitat for engraver beetles and may be killed. Typically, this does not lead to widespread expansion of infestation beyond the areas of stressed trees, but there can be minor levels of infestation in surrounding trees. Scorched trees are also more susceptible to attack by red turpentine beetle, which can kill trees that may have otherwise survived. At the same time, prescribed fire can reduce stand density and competition, potentially increasing vigor and resistance of remaining trees.

Removal of hazard trees would not affect risk of insect infestation of live forest.

Hardwood and Grassland Enhancement

Treatments that remove all pines from hardwood stands or grasslands would remove potential for bark beetle infestation. Promoting grasslands and hardwood species would also create a more diverse forest, which is less susceptible to large-scale epidemics long term.

Pine Structural Stage Modification

Risk of mountain pine beetle infestation is generally low throughout much of the project area. Moderate- and high-risk stands are widely scattered within the main areas of infestation (Figure 1, page 1) and remain more common outside these areas, mainly on the periphery of the project area. Proposed structural stage modification activities would have little effect on mountain pine beetle infestation risk in these stands. Due the scattered nature of mature, dense pine stands and the overall prevalence of low-density stands, the risk of attack and further epidemic is currently low.

Dense areas of seedlings and saplings can be susceptible to engraver beetles, particularly during drought. Under these circumstances, pine regeneration could become highly susceptible to infestation. Proposed precommercial and POL thinning would increase growth and vigor of the remaining trees, decreasing susceptibility to insects and disease. Proposed prescribed fire may have a similar effect.

Proposed vegetation treatments would increase forest age class diversity and species diversity. Increased diversity and vigor reduce likelihood of large-scale insect infestation.

Proposed road construction, reconstruction, maintenance, and conversion would not directly affect insect activity. The main impact of road work comes from the ability to reach areas for treatment in the future as it becomes necessary.

No Action Alternative

The risk of mountain pine beetle attack would remain low in most of the forest. Natural processes of growth would cause risk to increase over time. Dense stands of seedlings and saplings would remain susceptible to engraver beetles.

Cumulative Effects

Standard practices for thinning of mature pine stands in the Black Hills have usually retained enough canopy to keep the forest floor mostly shaded. Recent timber harvest conducted in response to the mountain pine beetle epidemic reduced stand density more than usual to address stand susceptibility to imminent infestation. In these open stands, sunlight reaches more of the forest floor, allowing pine regeneration to flourish. In combination with pine regeneration in beetle-killed stands, this is resulting in the potential for future development of landscape-scale expanses of even-aged pine forest, similar to the conditions that existed before the epidemic.

The Proposed Action would not add to this effect. Remaining dense, mature stands would not be thinned except to create approximately 4,000 acres of shaded fuel breaks. Thinning of seedlings and saplings would allow the new stands to develop at different rates and densities. As compared to taking no action, these and other proposed activities would diversify the forest and delay redevelopment of landscape-level susceptibility to beetle infestation.

Aspen, Oak, and Other Tree Species

Summary

Proposed activities would maintain species diversity in mixed pine/aspen and pine/oak stands and perpetuate aspen and oak stands by reducing competition with conifers.

Information Sources

Forest vegetation data were extracted from the Forest Service vegetation database in May 2016 and subsequently verified through aerial imagery interpretation. These data are based on stand-level field inventory, which has occurred in approximately 95 percent of mixed pine/aspen and pine/oak stands within the last 20 years. Basic attributes have been updated following timber harvest and other major changes such as stand-replacing fire, either through inventory, modeling, or interpretation of aerial imagery.

Existing Environment

Tree species other than ponderosa pine dominate the forest on approximately 166,273 acres in the project area (Table 10).

Table 10. Dominant Tree Species Other than Ponderosa Pine

Dominant Vegetation	Acres	Percent
Quaking aspen	39,963	3.64%
Bur oak	13,212	1.20%
Mixed pine and aspen	56,512	5.14%
Mixed pine and oak	28,049	2.55%
Paper birch	4,248	0.39%
White spruce	24,289	2.21%
Total	*166,273*	*15.13%*

Quaking aspen is found throughout the central and northern Black Hills and Bear Lodge Mountains (Figure 10, page 31). Forest Plan objective 201 calls for a minimum of 92,000 acres of aspen. Acreage has remained fairly constant over the past 10 years but may increase as aspen and other early successional species become established in areas of heavy mountain pine beetle infestation. An increase in aspen can also be achieved by removing pine or spruce from mixed conifer/aspen stands.

Bur oak is found on the eastern and northern fringes of the Black Hills and in the Bear Lodge Mountains (Figure 11, page 33). Oak stands have increased gradually over the past 20 years as a result of removing pine from mixed pine/oak stands. Forest Plan objective 201 calls for a minimum of 16,000 acres of oak.

Mixed stands of ponderosa pine and aspen are found throughout the project area. Aspen often established itself in the understory of pine stands in the higher elevations of the Black Hills. Aspen clone remnants exist throughout the Black Hills, and after disturbance these clones sprout prolifically. Where aspen has successfully become established and is well intermixed with pine, the site is considered pine/aspen.

Mixed stands of ponderosa pine and oak are common. According to Forest Plan objective 201, increases in oak are to be focused away from the Bear Lodge Mountains. Removal of pine from oak is therefore proposed only in the eastern Black Hills.

Paper birch is in good condition across most of the Black Hills (Blodgett and Allen 2009). The southernmost stands show some signs of decline. Forest Plan direction is to conserve and manage birch (objective 204).

Environmental Consequences

Proposed aspen enhancement activities would maintain species diversity where aspen inclusions occur in pine stands and increase vigor of aspen stands that are being overgrown by pine or spruce. Removal of conifers would reduce competition and shading, returning the site to an earlier successional stage.

Proposed aspen regeneration activities would take advantage of aspen's tendency to sprout prolifically after cutting or other disturbance. These activities would restore aspen clones that may otherwise be lost due to age or competition with other species. Implementation of design features (page 41) would minimize the potential for loss of regenerating clones to excessive browsing by deer, elk, and cattle.

Proposed oak enhancement activities would maintain species diversity and increase vigor of oak communities by reducing competition with conifers.

The area in which fuel reduction activities may occur (page 19) includes several birch stands. Because birch is naturally fire-resistant, fuel reduction is unlikely to be needed in these stands. Birch communities are generally avoided during ground-disturbing vegetation management activities as a standard procedure. Proposed temporary roads, however, may cross certain birch stands. Ten potential temporary road sections (total of 0.59 mile) that may cross birch stands are existing unauthorized roads. In addition, two new temporary roads (total of 0.13 mile) may cross birch stands. If these roads are used, transportation engineers would consult with Forest Service silviculturists and botanists prior to road design and construction to minimize effects on the birch communities. The Proposed Action would contribute toward achievement of Forest Plan objective 204 (*"Conserve and manage birch/hazelnut, lodgepole pine, limber pine, and Douglas-fir"*).

If no action is taken, hardwood stands and inclusions that are encroached or suppressed by pine would continue to decline. Over time, aspen and oak could be replaced by conifers.

The management activity with the greatest past, ongoing, and foreseeable effect on these species is fire suppression. Resulting dominance of pine and spruce diminishes aspen and other early successional species. The Proposed Action would not add to these effects.

Fire and Fuels

Summary

In general, the Proposed Action would result in more manageable potential fire behavior as compared to the No Action alternative. Most fires in treated areas would burn on the surface at low to moderate severity with isolated pockets of trees burning. Fire hazard would generally decrease in treated areas. Proposed activities would increase resilience to future wildfires.

Information Sources

Fuel loading data are based on existing information from plot surveys and ocular estimates conducted by Forest Service fire and fuels managers in numerous locations across the project area. Fuel conditions are also represented by stand inventory data, which have been collected in approximately 90 percent of project area pine stands within the last 20 years and updated as described on page 51. Information on aerial and surface fuels was inferred from stand data in combination with the detailed mapping of mountain pine beetle infestation that occurred each year during the epidemic. Sources of information on live, small-diameter fuels (pine seedlings and saplings) are discussed on page 51. Information on values at risk were provided by local government, utility providers, and Forest Service corporate data sets.

Existing Environment

Mountain Pine Beetle Epidemic Effects on Fuels

Surface fuel loading resulting from mountain pine beetle infestation

The recent mountain pine beetle epidemic left behind dead trees on approximately 220,000 acres in the BHNF. Needles have fallen from almost all of the infested trees, greatly decreasing crown fire hazard. In the areas that were infested early in the epidemic, many of the dead trees have already fallen. Stands that were more recently infested are now beginning to deteriorate. This continuing process will create an uncharacteristically high surface fuel loading in affected areas for years to come.

Post-infestation fuel loading is characterized by coarse woody debris, which is standing or down dead woody material generally greater than three inches in diameter, plus the presence of fine (small-diameter) surface fuels. Uninfested stands average about five tons of coarse woody debris per acre. Sieg et al. (2016) found eight to 30 tons per acre five years after infestation. The photo above displays a Black Hills post-infestation stand with 82 tons per acre.

Accumulations in excess of 30 to 40 tons per acre are assumed to result in high to extreme fire hazard (Brown et al. 2003). Increasing the amount of energy released during a fire increases the probability of spot fires and ignition of remaining live tree crowns. Decaying coarse woody debris is prone to ignition from firebrands and can smolder and create spot fires ahead of the flaming front. These factors increase the difficulty of fire control.

In heavily infested stands, the newly open canopy is allowing grass, natural pine regeneration, and other vegetation to flourish. This combination of pine seedlings and saplings with heavy accumulations of woody debris (right) further increases fire hazard and complicates fire suppression. The complex fuel arrangement is conducive to fast-moving, high-intensity, long-duration wildfires that may result in increased losses and threaten firefighter and public safety.

Beetle-killed trees with pine seedlings and saplings

As the forest rebounds from the mountain pine beetle epidemic, several stand characteristics will continue to change, including canopy fuels, down woody fuels, duff, ladder fuels, herbaceous fuels, and microclimate. These changes will, in turn, alter fire hazard and potential fire behavior. Although the potential for crown fire has decreased because there are fewer closed-canopy stands, increased fuel loading means that more of the BHRL project area is susceptible to, and may potentially be affected by, large, intense wildland fires.

Due to the private property, homes, businesses, and critical infrastructure that exist in and adjacent to the BHNF, there are major concerns with respect to the wildland urban interface (WUI) and at-risk communities, specifically relating to public safety.

Fire Regime and Condition Class

As described in the **Ponderosa Pine** section (page 52), this species dominates the Black Hills landscape. Interspersed throughout the project area are quaking aspen, bur oak, paper birch, and white spruce. As a result of decades of fire suppression and past management activities, ponderosa pine has encroached on aspen, oak, and grassland communities. This also resulted in the dense, closed-canopy pine stands that were common prior to the mountain pine beetle epidemic.

Historically, Black Hills fires burned more frequently and most were less severe than today's fires. Both lightning and humans ignited fires. This promoted growth of fire-tolerant vegetation, controlled their regeneration, maintained an open forest structure, reduced biomass, decreased the impacts of insects and disease, and maintained habitat for wildlife species associated with open stand structures (Graham et al. 2004). In the early 1900s, however, the era of aggressive fire suppression and prevention began. Fire suppression, grazing, and intensive forest management have trended the forest outside the historic range of variability, creating uniformly forested landscapes with numerous

even-aged stands, many of which are dense or have thick carpets of pine seedlings and saplings (Hunter et al. 2007). This has led to an increase in prevalence of severe wildfires and susceptibility of stands to mountain pine beetle infestation.

Fire regime characterizes the role fire plays in an ecosystem in the absence of modern human intervention while taking into account possible influence from aboriginal fire use (Barrett et al. 2010). Fire regime is described at a coarse scale because of the variability of fire over time and space. Currently, there are three general types of fire regimes in the Black Hills (USDA Forest Service 2005a).

- *Frequent, low-severity fire regime:* Fires occur at approximate intervals of 10 to 50 years. Effects on the tree canopy and soil are minor. Severity of effects on understory vegetation vary. Evidence of historical surface fires is found throughout the Black Hills. They occurred most frequently at low-elevation prairie/forest edges.
- *Mixed-severity fire regime:* Fires occur at variable intervals of 10 to more than 100 years. They result in intermixed patches of a range of effects.
- *Infrequent, high-severity fire regime:* Fires occur at intervals of 100 to more than 500 years. Effects on the tree canopy and understory are severe, while effects on soils vary. The existence of large areas of even-aged and dense forest and of closed-canopy, mature or old-growth forest at the time of settlement is evidence of historic widespread disturbance, such as infrequent, high-severity fire (Graves 1899, Shinneman and Baker 1997).

Further information on fire regimes can be found in the Fire and Fuels Specialist Report (project analysis file, section 05.03) and the Forest Plan FEIS (USDA Forest Service 1996).

The mixed-severity fire regime is proposed as the dominant model for ponderosa pine forests of the Black Hills. Under this model, surface fire is the background process that creates forest structure and landscape-level vegetation patterns. Fires sometimes burn at mixed severity, with both surface fire and stand-replacing fire components. Forest patches are variable in size and contain variable structure (Lentile et al. 2005).

Condition class describes the degree to which the composition and structure of vegetation have departed from historical fire regimes. Three condition classes describe vegetation conditions within the fire regime groups. The risk of loss of key ecosystem components due to wildfire increases with condition class.

The combination of fire regime and condition class (FRCC) can be used to describe the degree of departure from the historic fire regime (also known as the "reference condition") that may result in changes to key ecosystem components such as vegetation characteristics, fuel composition, fire frequency, severity, and pattern, and other associated disturbances (Barrett et al. 2010). Table 11 displays components of FRCC ratings.

Coarse-scale national data characterize the Black Hills as primarily in FRCC 3, indicating a high relative risk of significantly altering or losing key components of the ponderosa pine forest system. These conditions substantially increase the probability of a surface fire transitioning to a crown fire with increased burn severity and tree mortality. A number of Black Hills wildfires occurring within the past 20 years have demonstrated the potential for large, high-intensity surface fires and, given the right conditions, stand-replacing fires.

Table 11. Fire Regime and Condition Class Ratings

Component	Fire regime/condition class rating		
	1	2	3
Fire regime	Within historic range	Moderately altered	Substantially altered
Risk of losing key ecosystem components	Low	Moderate	High
Vegetation attributes	Intact and functioning within historic range	Moderately altered from historic range	Substantially altered from historic range
Fire frequency	Within historic range	Missed one or more return intervals	Missed multiple fire return intervals
Fire size, intensity, severity, and landscape patterns	Within historic range	Moderately altered	Substantially altered

Source: Barrett et al. (2010)

Figure 19 illustrates stand structure and fire effects typical of each FRCC rating. In general, condition class 3 stands contain more trees per acre, especially in smaller diameter classes, and are likely to experience greater mortality during a fire due to the fact that denser, multi-structured stands are more susceptible to torching and crowning than open stands.

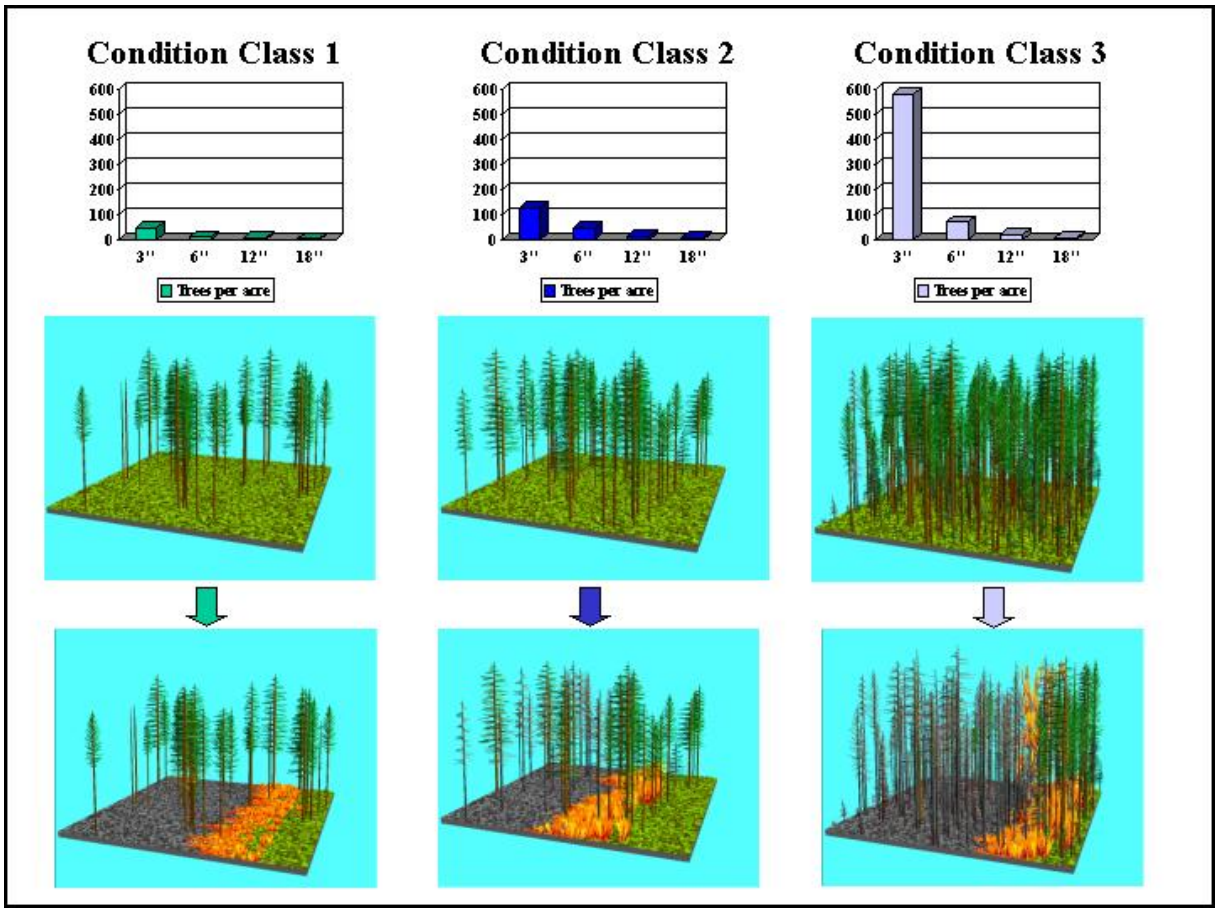


Figure 19. Fire Effects by Condition Class

Fire History 1970-2016

More than 5,700 fires occurred in the Black Hills area from 1970 through 2016. These fires ranged in size from less than one-quarter acre to 85,000 acres, with 96 percent affecting less than 10 acres. The most common ignition source was lightning (70 percent of fires). Arson accounted for just three percent, but these include some of the largest fires. Figure 20 displays the locations of large fires that occurred during this time period.

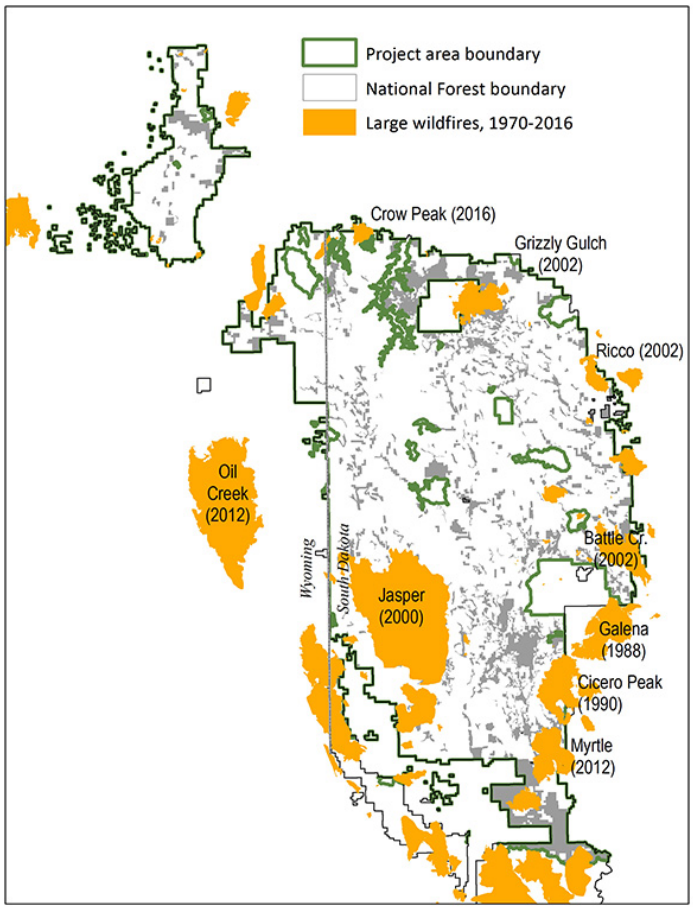


Figure 20. Large Wildfires, 1970-2016

The number of fires on NFS lands in the Black Hills averages 123 per year. This has remained fairly constant over the last several decades. The number of fires escaping initial attack has also remained constant. The escaped fires have, however, become larger and more difficult to control, with the average large-fire size increasing from under 1,000 acres per fire in the early 1900s to nearly 10,000 acres per fire in the last 20 years. Approximately 267,000 acres have burned since 1986. This was in part influenced by the drought that occurred from 2000 through 2007.

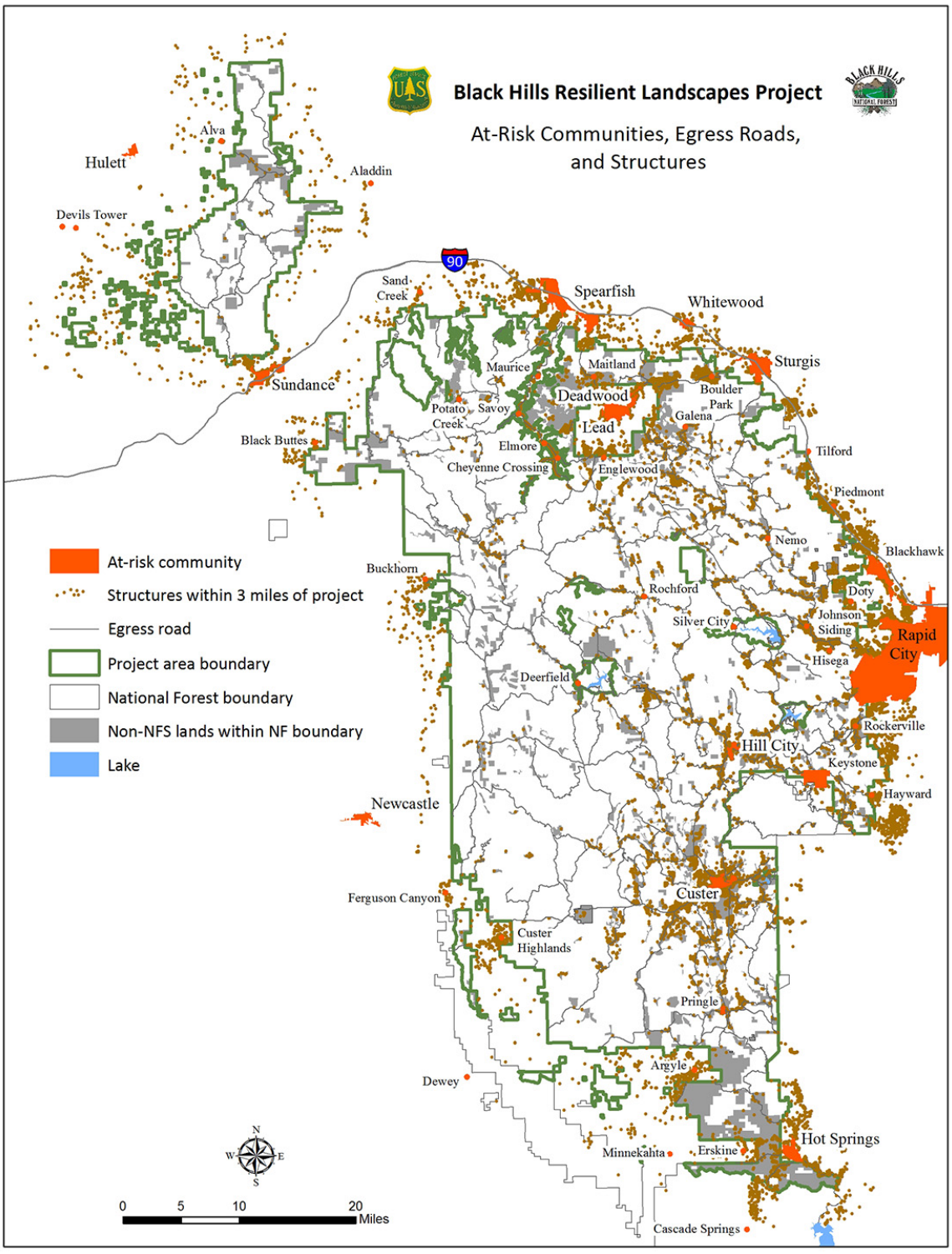


Figure 21. At-Risk Communities, Egress Roads, and Structures

Values at Risk

The Forest Plan glossary defines "values at risk" as natural resources, improvements, or other values that may be jeopardized if a fire occurs. Values at risk include:

- Approximately 29,335 structures (in and within three miles of the project area; Figure 21, page 75)
- Quality of water, air, and scenery
- Public water supplies
- Utility lines
- Communication sites (cell towers, radio towers)
- Recreational sites and facilities
- Timber stands, including past investments in thinning and reforestation
- Range improvements (fences, water systems)
- Wildlife habitat, including snags, forage, riparian areas, security cover, and mid- to late-seral ponderosa pine stands
- Two key items relating to community wildfire preparedness are **at-risk communities**[5] and **Community Wildfire Protection Plans**[6] (CWPPs). Fifty-six at-risk communities exist within or adjacent to the BHRL project area (Figure 21, page 75). All seven counties containing portions of the BHNF (page 3) have an approved CWPP.

Fire Hazard

Fire hazard is defined as a "fuel complex" that determines the ease of fire ignition and the fire's probable resistance to control. A fuel complex is the combination of ground, surface, and canopy fuel layers in a given location.

Fire hazard ratings indicate the type of fire that may occur under a given set of circumstances and how the fire would affect human values. Although fire hazard ratings are commonly thought of in terms of the potential for crown fire[7], they are also based on a fire's potential rate of spread, intensity, creation of spot fires, resistance to control, and persistence. Forest Plan objective 10-01 calls for low to moderate fire hazard in 50 to 75 percent of the WUI and in 50 percent of the remainder of the BHNF, excluding certain MAs.

[5] An area (A) that is comprised of —(i) an interface community as defined in the notice entitled "Wildland Urban Interface Communities Within the Vicinity of Federal Lands that are at High Risk from Wildfire" issued by the Secretary of Agriculture and the Secretary of the Interior in accordance with Title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009) (updated 66 Fed. Reg. 43384, August 17, 2001); or (ii) a group of homes and other structures with basic infrastructure and services (such as utilities and collectively maintained transportation routes) within or adjacent to Federal land; (B) in which conditions are conducive to a large-scale wildland fire disturbance event; and (C) for which a significant threat to human life or property exists as a result of a wildland fire disturbance event. (Forest Plan glossary)

[6] A CWPP is a collaborative plan for at-risk communities that meets specific standards developed by Wildland Fire Leadership Council and is agreed to by applicable Federal, State and local government agencies affected by its composition. It identifies and prioritizes areas for hazardous fuel reduction treatments, recommends the types and methods of treatment on Federal and non-Federal land, and includes actions that will protect one or more at-risk community and essential infrastructure. CWPPs also include recommendations for reducing ease of ignition of public and private property in the at-risk community.

[7] A fire that advances through the tops of trees or shrubs, more or less independently of the surface fire.

Fire hazard rating increases with the amount and contiguity of surface and canopy fuels. As the amount of fuel on a given landscape increases and fuel profiles become more horizontally and vertically contiguous, the intensity of a wildfire in that landscape is expected to increase. Areas with a high fire hazard rating have the potential to exhibit more extreme fire behavior with more severe effects than those with a low hazard rating.

The mountain pine beetle epidemic altered fuel profiles across the landscape. Crown fire hazard is no longer a concern in many stands due to lack of mature trees, but surface fuel hazards are a growing concern.

The Forest Plan uses structural stage to represent fire hazard. In mature (SS 4) pine stands, the prevalence of small-diameter pine growing under the mature trees is also a factor. Fire hazard rating indicates stand-level fire hazard and torching/crowning susceptibility. Table 12 displays the relationship between pine structural stage and fire hazard rating.

Table 12. Structural Stage and Fire Hazard Rating

Structural Stage	Fire Hazard Rating
1	Low
2	Moderate
3A	Moderate
3B	High
3C	Very high
4A with few small trees	Moderate
4A with many small trees	Very high
4B with few small trees	High
4B with many small trees	Very high
4C	Very high
5	Very high

Source: USDA Forest Service 2006a

Ratings are similar for spruce stands except SS 4A has a "high" rating and SS 4B has a "very high" rating regardless of the presence of smaller trees. Cover types other than pine or spruce are assigned a fire hazard rating of "low".

Current fire hazard ratings on NFS lands in the project area[8] are as follows:

- Very high: 40 percent
- High: 10 percent
- Moderate: 28 percent
- Low: 23 percent

Fire Behavior

Predicting potential behavior and effects of wildland fire is an essential task in fire management. **Fire behavior fuel models** are used for this purpose. A fuel model is a set of inputs for a mathematical fire

[8] Minus MA 3.7, to which objective 10-01 does not apply.

spread model, including fuel type, weight, diameter, and depth. The following fuel models were used during analysis to represent existing conditions in the project area (Scott and Burgan 2005).

- High Load Activity Fuel or Moderate Load Blowdown (SB3): The primary carrier of fire is heavy dead and down slash or moderate numbers of fallen trees. There are 7-12 tons per acre of small-diameter fuels, mainly less than 0.25" in diameter and more than one foot deep. Fire spread rate and flame length are high.
- High Load, Dry Climate Shrub (SH5): The primary carrier of fire is woody shrubs and shrub litter. Shrubs are four to six feet deep. Fire spread rate and flame length are very high. This fuel model represents closely spaced pine seedlings and saplings.
- Moderate Load, Dry Climate Grass (Dynamic) (GR4): The primary carrier of fire is continuous, dry-climate grass. Fuel loads are moderate. Fuel depth is about two feet.

Environmental Consequences

Proposed Action

By Activity

The Proposed Action would affect fuel profiles and potential fire behavior across the BHRL project landscape.

Overstory removal, uneven-age individual tree selection, precommercial thinning, POL thinning, patch cuts, and removal of encroaching pine would all break up the horizontal and vertical contiguity of the fuels in both ladder fuels and the canopy. This would reduce the likelihood of crown fire initiation and spread by creating openings in the canopy as well as reducing canopy bulk density[9], decreasing the fire hazard associated with torching and crowning.

If whole-tree yarding is used, tree branches and tops would be piled at centralized log landings, minimizing accumulation of surface fuels throughout the treated area. If other methods are used, surface fuels would increase, and post-harvest fuel reduction may be required to keep fuel loading within bounds set by the Forest Plan (guideline 4110, etc.). Road construction and improvement associated with these activities would increase access for fuel treatment and fire suppression.

If the Forest Plan is amended to revise standard 1102 as described on page 36, whole-tree yarding would be allowed in additional areas. This would reduce accumulation of logging slash in these treated areas, particularly those in WUI. Slash retention requirements would continue to apply to patch clearcuts on relevant soils, but this activity would affect only scattered areas, each less than 10 acres in size, in localized parts of the project area (Figure 9, page 29).

Mechanical and manual fuel treatments would break up fuel contiguity and reduce surface fuel loading. Piling and burning fuels would decrease the potential for a wildfire to transition into the forest canopy or create spot fires outside the main fire, as well as reducing flame length, fireline intensity, and resistance to control.

Shredding, scattering, or chipping surface fuels would modify the vertical and horizontal distribution of fuels. These activities compact fuels, removing the fuel "ladder" that can allow a surface fire to move into the crowns of trees. They would reduce potential wildfire rate of spread, spotting potential, flame length, fireline intensity, duration, crown fire potential, and resistance to control. Fuel treatments would reduce existing coarse woody debris toward the optimum range of

[9] The mass of available canopy fuel per unit canopy volume.

five to 20 tons per acre. These conditions are considered to represent moderate to low fire hazard.

Prescribed fire would also reduce coarse woody debris and surface fuel loading. It would raise canopy base height[10], decrease crown density, and increase thickness of bark on mature trees. Prescribed fire would also reduce density of seedlings and saplings. These changes would be likely to increase the flame length required to ignite tree crowns, the wind speed required to propagate crown fire, and the resilience of mature trees to future fires (Graham et al. 2004).

These activities would meet the intent of the National Cohesive Wildland Fire Management Strategy (Wildland Fire Leadership Council 2012) by 1) helping to restore and maintain landscapes so they are resilient to fire-related disturbances, 2) creating fire adapted communities, and 3) making wildfire response safer, more effective, and more efficient. It would also meet objectives of CWPPs, reducing hazardous fuel loadings to protect at-risk communities and essential infrastructure.

Fire Regime/Condition Class

The Proposed Action would move FRCC from class 3 to class 2. Where multiple treatments occur, such as thinning followed by prescribed burning, class 1 may result. These landscapes would have the greatest resilience to future disturbance events such as wildfire or insect infestation. The reduced class may persist for up to 20 years without further treatment.

Fire Hazard

Figure 22 displays existing and expected post-treatment fire hazard ratings as a percentage of the BHRL project area. Figures do not include MA 3.7, where Forest Plan objective 10-01 does not apply.

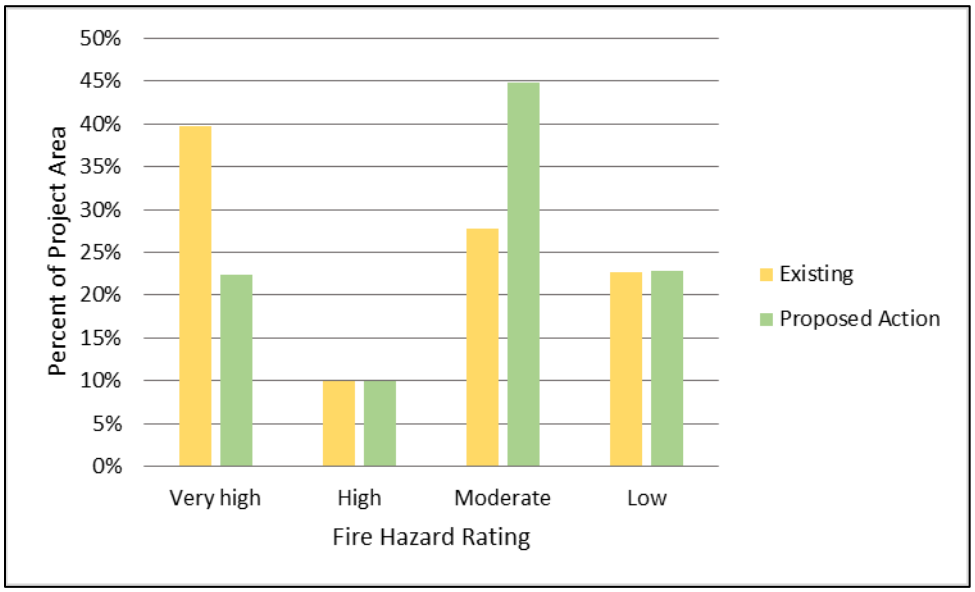


Figure 22. Fire Hazard Rating, Proposed Action

The Proposed Action would decrease fire hazard. Proposed activities would contribute toward achievement of objective 10-01 by increasing the total of moderate and low fire hazard to approximately 67 percent of the project area. Figure 22 does not take prescribed fire into account.

[10] The lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy.

Prescribed fire would further decrease fire hazard by reducing understory density and woody debris while creating small openings.

Most proposed fuel reduction activities would remain effective in reducing fire hazard for approximately 20 years. Within this time, potential wildfire resistance to control would increase as pine seedlings and other vegetation grow. Surface fuels would also begin to accumulate. Without maintenance treatments, fuel contiguity would eventually redevelop, enabling torching, spotting, and crown fire initiation.

Fire Behavior

As displayed by Table 13, fire behavior modeling indicates that proposed activities would transition existing fuel models SB3 and SH5 (page 77) to the following:

- *Low-load activity fuel (SB1):* The primary carrier of fire is light dead and down slash. The load of small-diameter fuels is 10-20 tons per acre, primarily in fuels 1-3" in diameter. Fuel depth is less than one foot. Fire spread rate is moderate and flame length is low.
- *Long-needle litter (TL8):* The primary carrier of fire is moderate-load long-needle pine litter. Spread rate is moderate and flame length is low.

Table 13. Fire Behavior Model Outputs

Pre-treatment Fuel Model	Flame Length (Feet)	Fireline Intensity (Btu/foot/second)	Post-treatment Fuel Model	Flame Length (Feet)	Fireline Intensity (Btu/foot/second)
SB3	9.6	774	SB1	3.2	73
SH5	16.1	2,373	TL8	3.6	91
GR4	9.8	819	GR4	9.8	819

Model: Behave Plus 5.0.5 (USDA Forest Service 2011g).
Based on 90th percentile weather data from Fire Family Plus 4.1 (USDA Forest Service 2013b).

Potential flame length and fireline intensity would decrease in most treated areas. In the grass fuel model (GR4), fires would still have the potential for high rates of spread. Grass production would increase after implementation of proposed activities. Reduced canopy cover would enable fuels on the surface to receive more sunlight and become drier.

In general, the Proposed Action would moderate potential fire behavior. Most fires in treated areas would burn on the surface at low to moderate severity with isolated pockets of group torching. Likelihood of this outcome would be greatest where whole-tree yarding and/or broadcast burning occurs. These conditions would allow increased strategic and tactical firefighting opportunities, which would increase the probability of success during initial attack, improve firefighter and public safety, reduce wildfire risk to communities, WUI, and natural resources, and reduce suppression costs.

The Proposed Action would not treat fuels in all areas of heavy mountain pine beetle infestation. In untreated areas, difficulty of fire control may occur as described on page 70, but the Proposed Action would break up the contiguity of these areas. This would facilitate fire suppression.

No Action Alternative

Under the no action alternative, ongoing and planned activities would continue to occur. Fire suppression would continue. Fuel profiles and fire hazard in the project area would generally continue to move away from desired conditions. Fuels would continue to accumulate. Wildfire

hazard related to at-risk communities, WUI, and natural resources would gradually increase. Lack of prescribed fire would further the area's departure from historic fire return intervals.

In areas affected by the mountain pine beetle epidemic, wildfires may be very difficult to suppress (page 70) and may cause long-term damage to soils (**Soils** analysis, page 152). Lack of treatment to break up contiguous areas of heavy fuel loading may allow fires to spread.

Areas of pine regeneration would continue to increase in height and density, possibly stagnating due to competition. This could result in large areas of extremely dense, brush-like forest susceptible to intense, fast-moving fire.

Cumulative Effects

The cumulative effects analysis area for fire and fuels is the project area plus a half-mile buffer. This area includes 1,584,000 acres, including 1,165,000 NFS acres. It is selected because fire may occur anywhere in the project area and may cross boundaries. The timespan for cumulative effects analysis is the present through 2038, or 10 years after the probable completion of proposed activities. By this time, it is estimated that the project's effects on fire and fuels would begin to diminish.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Fire suppression will continue to allow fuel accumulation, increases in pine stand density, and encroachment of pine into other vegetation communities. Prescribed fire and precommercial thinning generally reduce pine stand density and modify fuel loading or arrangement in ways that reduce fire hazard. Prescribed fire increases resilience to wildfire and promotes fire-adapted vegetation communities.

The Proposed Action would add to the above effects of past, current, and foreseeable timber harvest, fuel reduction, and prescribed burning. Effects of these activities would be starting to decrease as the BHRL project is implemented, meaning effects would not be strictly additive.

The Proposed Action would not add to the effects of fire suppression.

Cumulative effects of the Proposed Action would contribute toward achievement of Forest Plan goal 10[11] by establishing or maintaining a mosaic of vegetation conditions that may reduce occurrences of large, high-intensity fires and facilitate fire suppression. Added to the effects of other activities, the Proposed Action would respond to objective 10-01 (see page 76) by increasing the proportion of the area with low or moderate fire hazard from 50 to 68 percent. Fuel reduction activities would be focused in the WUI, so the change in WUI would be greatest. In addition, these effects would contribute toward achievement of goal 11[12] by enhancing or maintaining the natural rate of recovery after fire or other natural events while maintaining a mosaic of fuel-loading conditions to facilitate future fire suppression activities.

[11] *"Establish and maintain a mosaic of vegetation conditions to reduce occurrences of catastrophic fire, insect, and disease events, and facilitate insect and disease management and firefighting capability."*
[12] *"Enhance or maintain the natural rate of recovery after significant fire and other natural events while maintaining a mosaic of fuel-loading conditions to facilitate future fire suppression activities."*

Botanical Resources

Summary

Threatened and endangered species: Neither alternative would affect Leedy's roseroot or Ute lady's tresses.

Region 2 Sensitive species: With design features and standard measures fully implemented, the Proposed Action may adversely impact individuals of the following species but would not be likely to result in a loss of viability in the Planning Area nor cause a trend toward federal listing or a loss of species viability range-wide: Prairie moonwort, narrowleaf grapefern, foxtail sedge, mountain lady's slipper, yellow lady's slipper, trailing clubmoss, large round-leaf orchid, sage willow, autumn willow, bloodroot, narrowleaf peatmoss, highbush cranberry, and great-spurred violet. The No Action alternative would have no impact on these species.

Species of local concern: With design features and standard measures fully implemented, the following plant species of local concern would persist in the BHNF under both alternatives: Common maidenhair, leathery grapefern, southwestern showy sedge, beaked spikerush, downy gentian, broadlipped twayblade, stiff clubmoss, fivestamen miterwort, alpine mountainsorrel, arrowleaf sweet coltsfoot, limber pine, northern hollyfern, greenleaf willow, and shining willow.

Information Sources

Data are derived from botanical surveys for Region 2 Sensitive plant species and plant species of local concern. Surveys have been conducted annually by Forest Service botanists and contractors since 2001 to provide up-to-date information for design and implementation of management activities. Botanical surveys locate and record occurrences of rare plants, identify and map plant community types, and determine the probability that an area supports rare plant species. Botanical surveys often occur in forested habitats but also cover other habitats with high potential to support sensitive plant species, including riparian areas, wetlands, and meadows. Focus areas for surveys are determined through aerial imagery, topographic data, local knowledge, and professional judgement. Less intensive surveys are conducted in habitats with lower potential for supporting rare species. If species are designated as Region 2 Sensitive or SOLC after surveys in a given area are complete, additional, focused surveys are performed on the basis of site priority to ensure the area has been surveyed for all managed plant species. Botanical survey data are stored in the BHNF plants database (USDA Forest Service 2016a).

If the Proposed Action is selected for implementation, field review of areas not previously surveyed and verification of conditions would occur as needed.

Affected Environment

The BHNF is situated in the Middle Rockies ecoregion, surrounded on all sides by the Great Plains ecoregion (Omernik and Griffith 2014). Often referred to as an island in the plains, the Black Hills encompass an area of 5,121 square miles (approximately three million acres). The varied topography, geology, and climate result in a corresponding variety in plant communities, including such diverse elements as ponderosa pine (*Pinus ponderosa*) forests typical of the western mountains, grasslands typical of the Great Plains, and white spruce (*Picea glauca*) forests typical of the boreal north. Midwest hardwood types are represented by stands dominated by oak, ash, and elm. Approximately 30 percent of the plant taxa in the Black Hills have their primary ranges to the west, though taxa

associated with the midwest, east, and north are also significantly represented in the local flora (McIntosh 1931).

The Black Hills Community Inventory by the Nature Conservancy's Midwest Conservation Science Center and the Midwestern Resources Center was the first systematic classification to describe the vegetation of the Black Hills by adopting the standardized National Vegetation Classification (Marriott et al. 1999, Marriott and Faber-Langendoen 2000). Although further refinement of the Black Hills Community Inventory is needed, approximately 70 native plant communities have been described in the Black Hills.

Because the potential treatment areas for the BHRL project span most of the BHNF, the BHNF in its entirety is considered the affected environment for this discussion.

The majority of plant species considered rare in the Black Hills are best described as boreal disjuncts (species that became isolated in the cooler, moister forest and riparian areas of the Black Hills as glaciers retreated and the Great Plains environment became established). The closest populations of these species those in the Black Hills are generally found in Canada and the northeastern United States.

No Botanical Areas or Research Natural Areas are included in the BHRL project area. However, Botanical Areas and Research Natural Areas are located adjacent to the project area boundary and have potential to be impacted by the proposed treatments. Potential impacts to these special designation areas are addressed in the BHRL Project Botany Report (project analysis file section 05.01).

There are eight sites (comprising approximately 550 acres) identified as montane grasslands, which are recommended for conservation in the Survey and Mapping of Black Hills Montane Grasslands report (Marriott 2012). Approximately 440 of the 550 acres recommended for conservation are co-located with areas proposed for treatment in the BHRL project. Treatments proposed in these areas include commercial timber harvest, non-commercial thinning, pine removal from grasslands and aspen/oak stands, and fuel reduction. Potential impacts to these special designation areas are addressed in the BHRL Project Botany Report (project analysis file section 05.01).

Species Considered and Evaluated – Federally Listed Plant Species

The U.S. Fish and Wildlife Service (USFWS) lists of Threatened and Endangered species for South Dakota and Wyoming were accessed on January 24, 2017. In Wyoming, the agency provides a list of species for the entire state. In South Dakota, lists are available at the county level. All reports pertinent to the project area were accessed. Table 14 displays results.

Table 14. BHNF Federally Listed Plant Species and Suitable Habitat

Scientific Name	Common Name	Known To Occur In Project Area	Suitable Habitat Present in Project Area
Rhodiola integrifolia subsp. *leedyi*	Leedy's roseroot	No	No
Spiranthes diluvialis	Ute lady's tresses	No	No

As of July 2017, there is one federally listed Threatened plant species known to occur in one county within the BHNF (USFWS 2015, 2017a, 2017b, 2017c, 2017d, 2017e). Leedy's roseroot occurs in a county included in the project area. The known population is located in the Black Elk Wilderness (Management Area 1.1A), which is not included in the project area. Leedy's roseroot occurrences

and/or suitable habitat are not located within or in the vicinity of the project area, resulting in no effects (direct, indirect, or cumulative) to the species. A determination of "no effect" (FSM 2671.44) to this Threatened species has been confirmed.

Another Threatened species, Ute lady's tresses, is identified as having potential to occur in the Black Hills in Wyoming (USFWS 2015). The species is associated with alluvial banks, point bars, floodplains, or ox-bows along perennial streams. Numerous surveys for botanical resources have been conducted in the project area and no occurrences of Ute lady's tresses have been observed (USDA Forest Service 2016a). Project area habitat is considered marginally suitable for the species (USFWS 2015). Ute lady's tresses occurrences and/or suitable habitat are not located within or in the vicinity of the project area, resulting in no effects (direct, indirect, or cumulative) to the species. A determination of "no effect" (FSM 2671.44) to this Threatened species has been confirmed.

Candidate species have sufficient information on their biological status and threats to warrant a proposal to list as endangered or threatened, but development of a listing regulation is precluded by other, higher priority listing activities. Candidate species for listing under the Endangered Species Act (ESA) are automatically placed on the Region 2 (Rocky Mountain) Regional Forester's Sensitive species list. The analysis and determination of effects for candidate species are included as part of the Biological Evaluation for Sensitive species. No current candidate plant species are known to occur in the BHNF (USFWS 2016). No further analysis is required for species not known or suspected to occur in the project area.

The project botanist determined that implementation of either of the two alternatives as described would not affect any threatened or endangered plant species or designated critical habitat.

Region 2 Sensitive Plant Species

The Forest Service Manual defines sensitive species as those plant and animal species identified by a Regional Forester for which population viability is a concern, as shown by:

- Significant current or predicted downward trends in population numbers or density.
- Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (Forest Service Manual 2670.5, 19).

All Region 2 Sensitive plant species confirmed as occurring in the BHNF were considered in this evaluation. Known populations and corresponding suitable habitat exists in the BHRL project area for several Region 2 Sensitive plant species. The Region 2 Sensitive plants list was last updated in August 2015 (USDA Forest Service 2015a). No further analysis is needed for species not known or suspected to occur in the project area, and for which no suitable habitat is present (project analysis file section 05.01). Determinations for all other species are found below in the Determinations section.

Analysis was conducted on the effects of the Proposed Action on Region 2 Sensitive species known to occur or for which suitable habitat occurs in the BHRL project area. This analysis considers management activities of the Proposed Action and associated design features as set forth in Chapter 2 (page 37). Table 15 displays Region 2 Sensitive plant species and whether they have been confirmed to occur in the project area.

Table 15. Region 2 BHNF Sensitive Plant Species and Suitable Habitat

Scientific Name	Common Name	Known to Occur in Project Area	Suitable Habitat Present in Project Area
Botrychium campestre	Prairie moonwort	Yes	Yes
Botrychium lineare	Narrowleaf grapefern	Yes	Yes
Carex alopecoidea	Foxtail sedge	Yes	Yes
Cypripedium montanum	Mountain lady's slipper	No	Yes
Cypripedium parviflorum	Yellow lady's slipper	Yes	Yes
Epipactis gigantea	Giant helleborine	No	No
Lycopodium complanatum	Trailing clubmoss	Yes	Yes
Platanthera orbiculata	Large round-leaf orchid	Yes	Yes
Salix candida	Sage willow	Yes	Yes
Salix serissima	Autumn willow	Yes	Yes
Sanguinaria canadensis	Bloodroot	Yes	Yes
Sphagnum angustifolium	Narrowleaf peatmoss	Yes	Yes
Viburnum opulus var. *americanum*	Highbush cranberry	Yes	Yes
Viola selkirkii	Great-spurred violet	Yes	Yes

Plant Species of Local Concern

A Species of Local Concern (SOLC) is described in the Forest Service Manual as plant, fish, or wildlife species (including subspecies or varieties) that is locally rare and does not meet the criteria for regionally Sensitive status. These may include species with declining trends in only a portion of Region 2, or those which are important components of diversity in a local area. The local area for the purposes of this document is defined as NFS lands within the BHNF. To be eligible for designation as SOLC, the species (or subspecies, variety, or stock) must be recognized through an established scientific process and must be known to occur on NFS lands within the BHNF. The SOLC list was last revised in 2011 (USDA Forest Service 2011b).

Table 16 displays plant SOLC and whether they have been confirmed to occur or may occur in the project area. The primary habitat for the 10 plant SOLC that occur or for which suitable habitat exists in the project area can be largely categorized as white spruce- and hardwood-dominated drainages and wet meadows. The same habitats have high potential for supporting Region 2 Sensitive plant species. No further analysis is needed for species which are not known or suspected to occur in the project area and for which no suitable habitat is present.

Table 16. BHNF Plant Species of Local Concern and Suitable Habitat

Scientific Name	Common Name	Known To Occur In Project Area	Suitable Habitat Present in Project Area
Adiantum capilus-veneris	Common maidenhair	No	No
Botrychium multifidum	Leathery grapefern	Yes	Yes
Carex bella	Southwestern showy sedge	No	Yes
Eleocharis rostellata	Beaked spikerush	No	No
Gentiana puberulenta	Downy gentian	Yes	Yes
Listera convallarioides	Broadlipped twayblade	Yes	Yes
Lycopodium annotinum	Stiff clubmoss	Yes	Yes
Mitella pentandra	Fivestamen miterwort	Yes	Yes
Oxyria digyna	Alpine mountainsorrel	No	No
Petasites frigidus var. *sagittatus*	Arrowleaf sweet coltsfoot	Yes	Yes
Pinus flexilis	Limber pine	No	No
Polystichum lonchitis	Northern hollyfern	Yes	Yes
Salix lasiandra var. *caudata*	Greenleaf willow	Yes	Yes
Salix lucida	Shining willow	Yes	Yes

Environmental Consequences

Proposed Action

Analysis was conducted of the effects of the Proposed Action on Region 2 Sensitive plants and plant SOLC known to occur, or for which suitable habitat occurs, in the BHRL project area. This analysis considers management activities of the Proposed Action and associated design features as set forth in Chapter 2 (page 37).

No field reconnaissance or survey was performed specifically for this project, though all botanical survey data available on the BHNF were considered. Forest-wide survey specifically for Region 2 Sensitive plant species and BHNF plant SOLC has occurred since 2001. Since that time, the list has been revised several times and some current listed species may not have been considered in earlier surveys. The most recent lists became effective in August 2015 (Region 2 Sensitive) and June 2011 (SOLC) (USDA Forest Service 2015a, 2011b). Data collected during botanical surveys have provided information on distribution and habitat associations for targeted species and has contributed to effects analysis. The focus of botanical surveys includes identifying and mapping community types and determining the probability that an area may support plant Region 2 Sensitive plants or plant SOLC, in addition to locating and recording occurrences of these plants. Botanical surveys often occur in forested habitats, but also cover other habitats with high potential to support Region 2 Sensitive plants and plant SOLC, including riparian areas, wetlands, and meadows. Areas identified for focus during surveys are determined by a combination of aerial imagery, topographic maps, local knowledge, and professional judgement during field reconnaissance. Less intensive surveys are also conducted in habitats with lower potential for supporting Region 2 Sensitive plants and plant SOLC. All botanical survey data are stored in the BHNF plants database (USDA Forest Service 2016a). Impacts and risks to Region 2 Sensitive plants and plant SOLC on the BHNF were evaluated using the best available science and data.

The majority of forested landscapes in the BHNF have been surveyed for botanical resources, either through contracted survey, Forest Service botanist survey, or field review in support of projects occurring across all Ranger Districts. It is recognized that Region 2 Sensitive plants and plant SOLC are not always observed when present, even where botanical survey has occurred. In some cases, plants may not be in an identifiable growth stage or they may be dormant or difficult to see among surrounding vegetation.

The analysis assumes that areas that have not been surveyed for botanical resources are occupied, as directed by FSM_R2_2670_2015-1 (USDA Forest Service 2015a).

Habitats with greatest potential to support the species analyzed for this project include moist and shaded white spruce-dominated slopes, moist to mesic hardwood stands, drainages with spruce and/or hardwoods, grasslands, and riparian areas. Some of the analyzed species are known to occur beyond these areas, but generally as outlier individuals.

As a standard practice, mechanical vegetation treatments and other potentially ground-disturbing activities do not take place where R2 Sensitive or SOLC plants are known to occur. In habitat suitable for these species, ground-disturbing activities do not occur unless approved by a Forest Service botanist. Adjacent to this habitat, consultation with a botanist occurs prior to implementation of ground-disturbing activities.

Fuel Reduction, Prescribed Fire, and Hazard Tree Removal

Locations identified for potential fuel reduction and/or prescribed fire include portions of most of the habitats with higher suitability for supporting Region 2 Sensitive plants and plant SOLC. Areas identified as aspen, oak, pine/aspen mix, aspen/oak mix, and grasslands equal around 250,000 acres in the project area. Fuel treatments could occur across approximately a third (82,000 acres) of these communities. Identification and extent of hardwoods, grasslands, and fuels are preliminary and approximate.

Proposed mechanical fuel treatments, prescribed fire, and hazard tree removal would increase ecosystem resilience and reduce the potential for landscape-level wildfires. Prescribed fire may negatively impact Region 2 Sensitive plants and plant SOLC by direct contact with fire or radiant heat or through increased exposure to sediment and ash via runoff. The resulting effects would largely be determined by the frequency, intensity, and season of prescribed fire, along with climatic patterns affecting moisture availability and any other pre-fire stressors to vegetation. Areas supporting Region 2 Sensitive plants and plant SOLC in the Black Hills are often associated with drainage bottoms, north-facing slopes, and spruce and/or hardwood overstories; these areas typically have a higher soil moisture content, which may reduce fire intensity. Effects of lower intensity fire are generally short-term, present from the time burning occurs until approximately the following growing season. However, higher intensity burns have the potential to affect below-ground biomass and alter species composition, possibly causing mortality of Region 2 Sensitive plants or plant SOLC. Aside from short-term negative impacts, prescribed fire can provide long-term benefits for understory vegetation, including Region 2 Sensitive plants and plant SOLC. Long-term benefits may become apparent within several months of treatment through removal of non-native and/or invasive plant species, reduction in competition for resources, and removal of decadent, growth-inhibiting grass and other vegetation. These benefits persist until the ecosystems again reach pre-implementation conditions, a timeframe which can be highly variable and driven by many factors (Neary et al. 1999).

Fuel treatments reduce the risk of catastrophic wildfires (page 78). With heavier fuel loads, fire tends to smolder and burn in a given area for a longer time, resulting in greater mortality of vegetation

(Neary et al. 1999). Fuel treatments provide the benefits of nutrient cycling, removal of decadent growth, and natural disturbance through a managed process. Although proposed fuel treatments could impact individual Region 2 Sensitive plants and plant SOLC and their habitat, the negative effects would be likely to persist for a short time, with lasting benefits becoming apparent within five to 15 years of treatment.

Enhancement of Hardwoods and Grasslands

The project would cut encroaching pine from areas of hardwoods and grasslands to enhance the quality of these habitats. Region 2 Sensitive plants with higher potential to occur in hardwoods and grasslands include prairie moonwort, narrowleaf grapefern, foxtail sedge, yellow lady's slipper, large round-leaf orchid, sage willow, autumn willow, bloodroot, and highbush cranberry. Plant SOLC with higher potential to occur in hardwoods and grasslands include downy gentian and arrowleaf sweet coltsfoot. Other analyzed species are unlikely to occur in these areas.

The action of removing pine and spruce from hardwood stands is capable of providing a long-term benefit of retaining these stands as more suitable Sensitive plant habitat. The impacts to Region 2 Sensitive plants and plant SOLC associated with the action depend on the methods used. Manual cutting of pine or spruce would cause the least amount of disturbance, still presenting the possibility of rare plants being crushed by falling trees or covered by dropped trees and debris.

Mechanical treatments to remove pine or spruce from hardwoods would result in more extensive impacts to understory vegetation as a result of the passage of wheeled or tracked heavy equipment. This machinery may also cause soil compaction and exposure of bare soil. These impacts have the potential to lower the suitability of the habitat for Sensitive plants by altering the understory/forb community. Where pine or spruce are removed from the overstory, more sunlight would reach the understory, potentially changing micro-habitats by increasing temperature and evapotranspiration. Impacts to mycorrhizal fungi in the soil could impact Sensitive species dependent upon relationships with these organisms.

An increase in sunlight and exposure of bare soil creates favorable conditions for migration of non-native and/or invasive plant species to new areas. These species have potential to out-compete native and Sensitive plant species and can alter species composition to a point where it is no longer considered suitable Sensitive plant habitat.

Removal of encroaching pine from grasslands would provide the long-term benefit of retaining a site as a grassland, offering more habitat suitable for certain Sensitive plants. Impacts on Sensitive plants would be similar to those discussed above (for hardwood enhancement) and would depend upon the method by which the result is achieved. Potential impacts from the action include crushing Sensitive plants, covering them with debris, and introduction or spread of non-native or invasive plant species. To minimize these effects, managers of ground-disturbing activities in meadows and grasslands consult with Forest Service botanists and/or specialists in range, soils, and invasive species control during activity design.

Pine Structural Stage Modification

Structural stage modification activities would occur in pine forests. In general, pine forests are not considered highly suitable for supporting Region 2 Sensitive plants or plant SOLC in the Black Hills. Where species are known to occupy pine stands, individuals usually occur on the periphery of core occurrences located in inclusions of more suitable habitat (white spruce, aspen/birch, etc.). These

inclusions of spruce and hardwoods within pine stands have potential to be impacted by activities occurring in surrounding or adjacent areas.

Heavy equipment associated with mechanical treatments can directly impact understory plants by crushing or uprooting, or by compacting soil or otherwise altering the forest floor. The equipment can also loosen and displace soil, which can then collect in drainages and other low-lying areas suitable for Region 2 Sensitive plants or plant SOLC. Microsite hydrology and fungal communities can be affected by heavy equipment to a point where Region 2 Sensitive species (such as prairie moonwort, narrowleaf grapefern, yellow lady's slipper, mountain lady's slipper, and large round-leaf orchid) and plant SOLC (including leathery grapefern and broadlipped twayblade) could be inhibited from establishing.

Mechanical site preparation to promote the establishment of pine seedlings would result in exposing bare soil on up to 4,000 acres in open, mature pine stands. Although site preparation would create conditions favorable for pine establishment, it would also provide opportunity for establishment and spread of non-native and/or invasive plant species. Once established in the mechanically prepared areas, these species would have the potential to spread into nearby areas of suitable rare plant habitat.

Use of existing roads for hauling may resulting in an increase in erosion (page 161) and dust. Sensitive plant individuals that may occur along roads could experience reduced photosynthetic capacity due to a coating of dust. Removal of timber may unintentionally increase access for livestock and illegal off-road vehicle use. New use in areas increases not only the potential for unauthorized collecting, trampling, and other losses of individuals but also increases susceptibility to non-native and/or invasive plant species invasion.

Other Actions

Roads and skid trails have the potential to alter ground surface by crushing and/or uprooting vegetation, compacting or otherwise altering soil, exposing bare soil, and introducing non-native and/or invasive plant species. Slash piles are often situated outside of pine stands in openings or grasslands/meadows. Multiple passages to these areas by heavy equipment can compact soil and devegetate pathways. Piles have the potential to be placed on undocumented occurrences of Region 2 Sensitive plant species, most notably prairie moonwort and narrowleaf grapefern, and/or plant SOLC. Piling of slash results in alteration of the site below via blocking of sunlight and other resources and general surface disturbance. Pile burning results in high temperatures below and surrounding piles and further surface disturbance. Although an approved seed mix is usually distributed across affected areas, non-native and/or invasive plant species commonly colonize pile sites after burning (Haskins and Gehring 2004).

The Proposed Action may indirectly create habitat for narrowleaf grapefern, prairie moonwort, and other species associated with historically disturbed areas. Temporary roads and skid trails, if effectively closed to motorized vehicles, treated for invasive species, and left undisturbed for a decade could become suitable habitat for these Region 2 Sensitive species.

Dust Abatement

Use of dust abatement (water, magnesium chloride, calcium chloride, etc.) causes a decrease in airborne dust, which can adhere to photosynthetic surfaces and decrease the growth of individual plants. The addition of salt to dust abatement treatments allows the treatment to be effective for a longer period of time, but high concentrations of ions in the soil matrix caused by the addition of

magnesium chloride or calcium chloride can decrease plant growth and survival (Goodrich et al. 2009). These ions usually move downslope from treated roads, but impacts can be observed upslope and relate to application rate (Goodrich et al. 2008, Piatt and Krause 1974). The distance from a treated road surface to affected vegetation tends to increase with the surface area to which the treatment was applied, application rate, and average precipitation (Goodrich et al. 2008, Goodrich et al. 2009). On average, chloride ions can move downslope from the site of application approximately six meters and magnesium can move three meters from application site regardless of the soil type (Goodrich et al. 2009).

Aspen (*Populus tremuloides*) growing downslope from application sites could show necrosis of leaf margins, crown damage, and mortality depending on the application rate and surface area treated upslope from the tree (Goodrich et al. 2009). In coniferous tree species, high concentrations of ions in needle tissue can cause an increase in susceptibility to agents such as fungus, insects, and mechanical damage caused by frost and snow (Goodrich et al. 2009). In grasses, germination generally decreases with increased concentration of magnesium ions present in the soil (Ryan et al. 1975).

Impacts to Habitat

Standard coordination requirements ensure that consultation with a qualified, professional botanist occurs prior to ground disturbance in suitable Sensitive plant habitat (page 37). The intent is to minimize impacts to the habitat and any occurrences of Region 2 Sensitive plants and/or plant SOLC located in the habitat. If impacts of ground disturbance on suitable habitat cannot be avoided, the possible impacts to the habitat itself are discussed below. Impacts to Region 2 Sensitive plants and plant SOLC are discussed separately.

White Spruce: Impacts to spruce stands would be minimal because the treatment areas target ponderosa pine stands, hardwoods, and grasslands. White spruce stands outside treatment areas could be affected if landings, log decks, roads, or debris piles were constructed in them to facilitate timber harvest. Ponderosa pine could potentially be removed from white spruce inclusions that may occur within pine stands. If either of these potential impacts to white spruce stands occurs, impacts to the habitat include removal of white spruce and damage to standing white spruce, including damage to root structures, during felling and removal of ponderosa pine. Road construction in white spruce habitat could alter the local hydrology, create a vector for non-native and/or invasive plant introduction, and create a source of erosion. In addition to the impacts discussed in the Dust Abatement section above, use of chemicals can cause needle burn or mortality of white spruce along the road, particularly downslope, and the risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Changes in the overstory of white spruce stands would cause changes to the under- and midstory, which in turn impact the habitat required by certain Region 2 Sensitive and SOLC plant species.

Hardwood Habitats, Including Paper Birch, Aspen, and Bur Oak: Impacts to hardwood habitats are discussed above (see **Enhancement of Hardwoods and Grasslands**). Beyond what is noted there, impacts to this habitat may include damage to standing hardwoods and their root structures during felling and removal of ponderosa pine. Changes in the overstory of hardwood stands would alter the under- and midstory, which in turn would impact the habitat required by certain Region 2 Sensitive and SOLC plant species.

Riparian Habitats, Including Wetlands and Fens: Plant species in wetlands, riparian areas, and seeps could be impacted by changes in hydrology and water quality. Roads that currently exist in the water influence zone of wetlands can cause increased erosion, which can modify stream bank

geometry and cause an increase in overland flow. Increases in overland flow would have the net effect of maximizing runoff and minimizing infiltration. While the increased runoff results in overall greater water yield, the storm water is delivered relatively quickly through surface processes rather than through sustained subsurface flows, which are often critical to wetland hydrology (Moore et al. 2006). Impacts specific to fens are discussed in the Botany Specialist Report (project analysis file, section 5.02).

While direct impacts to riparian habitat are possible, moist soils and riparian areas are protected during timber harvest and new road-building on NFS lands through implementation of applicable Watershed Conservation Practices design criteria identified in FSH 2509.25 (USDA Forest Service 2006). In addition to the impacts discussed in the Dust Abatement section, above, use of these chemicals can cause leaf necrosis or mortality of forbs and grasses along the road (Ryan et al. 1975), particularly downslope, and the risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Design features (page 37) prohibit the use of these chemicals within 500 feet of fens, which would prevent or minimize impacts on these wetlands.

Meadows: Impacts to meadows are discussed in the **Enhancement of Hardwoods and Grasslands** section, above. In general, landings, log decks, roads, or debris piles have potential to impact meadows and Region 2 Sensitive and plant SOLC occupying the habitat. Impacts to suitable rare plant habitat may include loss of habitat, alteration of local hydrology, and introduction of non-native and/or invasive plant species. If ponderosa pine trees are removed from meadows, equipment used during harvest could crush or uproot vegetation and cause short-term soil compaction. Road construction, conversion, or maintenance in meadows could crush, bury, remove, or uproot vegetation. Roads can also create erosion channels that further impact soil structure and moisture, both of which are vital qualities of meadows that provide habitat for some Region 2 Sensitive and SOLC plants. In addition to the impacts discussed in the **Dust Abatement** section above, use of these chemicals can cause leaf necrosis or mortality of forbs and grasses along the road (Ryan et al. 1975), particularly downslope, and risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Changes in meadow habitat could alter habitat quality such that certain Region 2 Sensitive plants and plant SOLC would no longer be able to survive.

No Action Alternative

Taking no action at this time would maintain suitable rare plant habitat and protect biodiversity by not implementing actions with potential to affect these resources. Over time, the project area would experience an increase in ponderosa pine, including further encroachment into stands of hardwoods, riparian areas, and grasslands.

Cumulative Effects

For the purpose of this analysis, cumulative effects are bound in space by the BHNF boundary. This area is selected because it contains the proposed activities and is the area affected by Forest Service management decisions. Cumulative effects are bound in time by 20 years (10 years prior to project implementation and 10 years into the future) because this encompasses the impacts related to the most recent planning efforts and the foreseeable impact of the BHRL project.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Most have the potential to affect Region 2 Sensitive and SOLC plants through direct mortality, habitat alteration, or spread of invasive species.

Under the Proposed Action, the annual impact to botanical resources in the BHNF from timber harvest activities would remain similar to recent years. Most notable for botanical resources is that the Proposed Action includes no activities in Botanical Areas, Research Natural Areas, or the Wilderness Area. These areas include suitable habitat and some of the highest densities of Region 2 Sensitive and SOLC plant occurrences in the BHNF.

If mechanical site preparation results in an increase of non-native and/or invasive plants over existing levels, these species may spread to other areas where they would not have otherwise been as likely to reach. Cumulative effects are further discussed in the **Noxious Weeds** section (page 98). The cumulative effect on botanical resources could be alteration of plant communities and reduction in suitability of rare plant habitat.

Determinations of Effect and Rationale

Determinations of effect on Region 2 Sensitive and SOLC plant species were made based on information gathered in the pre-field review, field reconnaissance, survey results, and effects analysis for the Proposed Action. These determinations are based on effects of proposed activities on known populations and impacts to populations that could occur in areas that are have not been surveyed for all Region 2 Sensitive plants and plant SOLC. Determination language is set forth in FSM 2670.

The Forest Plan includes objectives, standards, and guidelines to conserve Region 2 Sensitive species located on the BHNF. The Proposed Action would contribute toward achievement of objectives and comply with standards and guidelines applicable to those species and habitats found in the BHRL project area.

Design features described in Chapter 2 (page 37) are integral to effects determination. Deviation from these measures would require further analysis and a revised effects determination. Design features include avoiding treatments in areas known to contain Region 2 Sensitive plants and plant SOLC.

With full implementation of project-specific design features and standard procedures as described above, a determination of ***"may adversely impact individuals, but not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing or a loss of species viability range-wide"*** is made for the following Region 2 Sensitive plant species for the Proposed Action:

- Prairie moonwort, narrowleaf grapefern, foxtail sedge, mountain lady's slipper, yellow lady's slipper, trailing clubmoss, large round-leaf orchid, sage willow, autumn willow, bloodroot, narrowleaf peatmoss, highbush cranberry, great-spurred violet

For the same species, a determination of ***no impact*** is made for the No Action alternative.

With full implementation of project-specific design features and standard procedures as described above, plant SOLC would persist in the BHNF.

Range

Summary

Livestock grazing occurs in most parts of the project area. The Proposed Action would temporarily increase herbaceous and shrub production, which may result in more use of secondary range. Grazing patterns would be temporarily altered while proposed activities are occurring.

Information Sources

Information on grazing allotments and range improvements was derived from the BHNF range spatial database.

Affected Environment

The Black Hills is a highly productive area from the standpoint of forage resources, with an average of approximately 466 million pounds of forage produced across the BHNF each year. At an average proper-use level of 50 percent, up to 233 million pounds are available for harvest each year by livestock and wildlife (USDA Forest Service 1996).

The project area contains all or portions of 133 grazing allotments. Table 17 summarizes range improvements within these allotments.

Table 17. Grazing Allotments and Developments in the Project Area

Rangeland Component	Ranger District				Project Area Total
	Bearlodge	Hell Canyon	Mystic	Northern Hills	
Allotments	33	37	30	33	133
Fences (miles)	317	467	413	298	1,495
Water pipelines (miles)	13	74	25	7	119
Livestock drinking water tanks	130	143	148	201	622
Water storage tanks	12	60	17	2	91
Ponds	108	572	489	139	1,308
Developed springs	87	87	193	113	480
Water wells	6	22	15	13	56

Environmental Consequences

Proposed Action

Most proposed activities would reduce tree canopy and associated needle cast, allowing increased herbaceous and shrub production. The initial quantity of this vegetation usually increases distribution of cattle throughout primary and secondary rangelands (Uresk and Severson 1988). Exceptions include tree planting and mechanical site preparation, which would decrease herbaceous production as trees grow and cast shade on an increasing percentage of the site.

Proposed road construction may allow livestock to access previously ungrazed areas, though this effect would be minimal due to the extent of the existing road system. Livestock grazing permit holders would continue to be provided administrative access to conduct range management activities.

The Proposed Action would result in openings in the forest that would temporarily increase forage available for livestock, but changes to permanent carrying capacity would not be expected. Tree planting and site preparation also would not change the permanent carrying capacity because these activities would occur on timber production sites that were accounted for during development of permitted carrying capacities. Any changes would be specific to the allotment and made in communication with the permit holder.

Range improvements, such as fences and water tanks, would be protected during implementation of proposed activities. If temporary fence openings are needed, project managers would coordinate with range specialists to minimize depreciation of the investment and potential grazing permit compliance issues.

Grazing patterns would be likely to change during the period of time when proposed activities result in an increase in forage (Uresk and Severson 1988). Range structures would continue to be protected, maintained, and improved as necessary to continue livestock use at its current scope and intensity, subject to Forest Plan standards and guidelines. Fences would still need to be cleared of trees and brush and remain accessible for repairs and maintenance. The Proposed Action would reduce the number of trees in treated areas, which may decrease fence maintenance needs since fewer trees would be available to fall on fences. It is also possible that additional fencing would be necessary in areas where proposed activities remove existing barriers to livestock movement.

Aspen regeneration resulting from proposed activities may need protection from grazing until it becomes established (page 41). Down trees can afford this protection if enough are present. If protection is critical or conifers are insufficient to provide adequate cover, conventional fencing may be needed. Exclosure fences and down trees can impede cattle access and movement. These activities would be coordinated with range program managers to ensure that cattle distribution is not unnecessarily affected.

No Action Alternative

The No Action alternative would have no immediate effects on rangeland. If large-scale wildfires were to take place in areas heavily infested by mountain pine beetle, production of desirable forage could diminish for the foreseeable future (see **Soils** analysis, page 152). Fire could also disrupt grazing use and damage or destroy range improvements.

Cumulative Effects

The cumulative effects analysis area for range resources is the area of all grazing allotments that are at least partially within the project area. This area includes 1,422,500 acres, including 1,223,700 NFS acres. It is selected because activities in one part of an allotment may affect management of the entire allotment. The timespan for cumulative effects analysis is the present through 2038, or 10 years after the probable completion of proposed activities. By this time, it is estimated that the project's effects on increased forage in treated areas would begin to diminish.

Past activities such as fire suppression, timber harvest, removal of encroaching pine, grazing, deer and elk management, and prescribed burning have interacted with natural events and processes to result in existing rangeland conditions. Relevant current and foreseeable activities include fire suppression, post-sale activities, and planned prescribed burns.

Fire suppression will continue to allow pine to encroach on grasslands. Recent and ongoing timber sales are likely to temporarily increase forage availability. Planned burning will reduce pine encroachment and may temporarily improve forage conditions. Timber harvest and burning could also increase noxious weeds (page 98), which may degrade rangeland.

The Proposed Action would add to the above effects of past, current, and foreseeable timber harvest, removal of encroaching pine, and prescribed burning. Because forage production decreases as tree canopy recovers, effects of past and ongoing timber harvest may not be discernable by the time the BHRL project's indirect effects occur. Nevertheless, the cumulative effect would be a changing pattern of forage conditions and livestock distribution. There are no anticipated cumulative effects that would impair or unduly influence short-term range management. The Proposed Action would not add to the effects of fire suppression.

Noxious Weeds

Summary

Noxious weed infestation is likely to increase over time under either alternative. The Proposed Action could, however, result in greater increases due to soil disturbance and opening of the forest canopy. Costs of needed treatment could exceed available funding.

Information Sources

Noxious weed control activities are mapped and resulting data are stored in the FACTS database. Weed occurrence data are collected annually via on-the-ground surveys and are also stored in the FACTS database. Occurrence data exist for most of the project area but are not comprehensive. Each growing season, new infestations appear and some existing occurrences expand while others contract due to ongoing control actions. Conditions change too rapidly to maintain a high level of accuracy. Available information is, however, sufficient to demonstrate the scale of the issue. If the Proposed Action is selected, weed occurrence would be assessed and updated in each activity area at the time of implementation.

Affected Environment

Noxious weeds are typically non-native, invasive plants that adversely affect native plant communities by aggressively competing for nutrients, water, and sunlight (CWMA 2002). Background information regarding the status of noxious weeds on the BHNF is presented in the Forest Plan FEIS (USDA Forest Service 1996), the Phase II Amendment FEIS (USDA Forest Service 2005a) and the BHNF Noxious Weed Management Plan EA (USDA Forest Service 2003).

Ground-disturbing activities in or adjacent to areas infested by noxious weeds can facilitate the establishment and spread of noxious weeds. Forest canopy openings can also encourage establishment of weeds. Many noxious weeds out-compete native and other desirable species because

they quickly invade disturbed areas, produce abundant seeds, grow rapidly, and/or exploit the soil profile for nutrients and water. Some produce chemicals that discourage growth of other plants. Many noxious weed species have no natural enemies and are not palatable to grazing animals (Sheley and Petroff 1999). Left untreated, weeds can continue to spread, resulting in establishment of new weed populations in adjacent areas. Control activities using herbicide and other methods occur annually.

The most recent BHNF monitoring and evaluation report states that approximately 180,000 acres of NFS lands in the BHNF are infested by various noxious weeds (USDA Forest Service 2015b). Within the defined areas where proposed activities may occur, there are approximately 152,000 acres of known noxious weed infestations (Table 18). Weed infestation appears to be heavier in the northern and central parts of the project area.

Table 18. Noxious Weed Species Documented in the Project Area

Common Name	Scientific Name	Acres
Canada thistle	*Cirsium arvense*	70,881
Houndstongue	*Cynoglossum officinale*	26,398
Common mullein	*Verbascum thapsus*	26,766
Musk thistle	*Carduus nutans*	10,941
Leafy spurge	*Euphorbia esula*	6,608
Yellow toadflax	*Linaria vulgaris*	2,706
Oxeye daisy	*Chrysantheumum leucanthemum*	2,329
Common tansy	*Tanacetum vulgare*	2,106
Spotted knapweed	*Centaurea maculosa*	1,488
St. Johnswort	*Hypericum perforatum*	1,250
Henbane	*Hyoscyamus spp*	463
Dalmation toadflax	*Linaria genistifolia*	100
Diffuse knapweed	*Centaurea diffusa*	4
Bull thistle	*Cirsium vulgare*	4
Whitetop	*Cardaria draba*	2
Caragana	*Caragana arborescens*	2
Salt cedar	*Tamarix ramosossima*	1
Total		*152,049*

Some of the potential treatment areas have not experienced soil disturbance or reduction of forest canopy in many years. Nearby areas where disturbances have occurred may be infested with noxious weeds, providing a ready seed source. Some areas contain multiple noxious weed species.

Relevant Forest Plan objectives include 230 (*"Eradicate or limit spread (acres) of new introductions of non-native pests (insects, diseases, plants) to minimize ecosystem disruption"*) and 231 (*"Prevent new infestations and manage to reduce established noxious-weed infestations…"*).

Environmental Consequences

Proposed Action

Disturbed areas such as roads, skid trails, landings, and burn piles are susceptible to weed infestation. A review of timber sales indicates that between 2.0 and 3.5 percent of the total timber sale acres are likely to become infested (USDA Forest Service 1996, page III-192). Considering current weed infestation levels and recent impacts from the mountain pine beetle epidemic, weed infestation levels at the high end of the range may be expected. As an example, if the treatment area is 1,000 acres, weeds could be expected to become established on approximately 35 additional acres.

For new roads, an area including the width of the road and approximately five feet on either side of its running surface is capable of supporting noxious weeds until re-vegetation occurs. New road construction and reconstruction result in approximately 0.12 acres of new weed infestation per mile of road (USDA Forest Service 1996). Therefore, if 50 miles of road were built, six acres of infestation would be assumed to result.

Noxious weed infestation is likely to increase over time whether or not proposed activities occur. The Proposed Action could, however, result in greater increases due to soil disturbance and opening of the forest canopy. Mechanized activities such as commercial timber harvest, certain fuel treatments, and prescribed fire control line construction would disturb soil and reduce canopy cover. Associated movement of vehicles could transport weeds. Equipment cleaning is generally required before entering new timber sales, which may decrease the potential for new infestations. Treatment of existing weed infestations prior to additional ground disturbance occurs when feasible. Project-specific design features (page 37) would also prevent the occurrence or expansion of some infestations.

Fire may facilitate weed infestation if it kills most vegetation on the site (USDA Forest Service 1996). Slash pile burning has this effect, but broadcast prescribed fire generally occurs at low to moderate intensity. It may kill small areas of vegetation and create patches of bare soil, though these effects would be isolated (see **Soils** analysis, page 149). Most invasive species are extremely efficient at exploiting the initial decrease in competition that follows a disturbance such as fire, especially one that is hotter than normal due to an increase in fuel load (Hobbs and Huenneke 1992).

The total area in which proposed activities may occur is approximately 746,200 acres. Actual treated area, accounting for estimated overlap among implemented activities, would be approximately 357,000 acres. Based on GIS analysis of available weed occurrence data, it is estimated that approximately 71,000 acres within this area currently have some level of noxious weed infestation.

The figure of 357,000 acres includes all activities regardless of degree of expected ground disturbance. Out of this total, activities likely to include incidental ground disturbance would occur on approximately 276,000 acres. Mechanical site preparation, the only proposed activity other than road construction that would intentionally disturb soil, would occur on up to 4,000 additional acres.

Using the previously stated assumption that an average of 3.5 percent of all treated acres would become infested, the Proposed Action could be expected to result in an additional 9,800 acres of infestation. Road-related infestation would add roughly 25 acres.

The current average cost of conventional herbicide application is $205 per acre. Required monitoring adds another $19 per acre.

Table 19 displays estimated weed treatment and monitoring costs based on these figures. Calculations assume a five-year treatment span and a 20 percent annual reduction in the total

inventoried acres of weeds. While weed treatment associated with an individual timber sale usually occurs over a five-year period, this project would result in various activities spread out over 10 or more years. Therefore, in reality, weed treatment would occur over a longer time span, meaning Table 19 figures may be somewhat overestimated. Figures do not account for inflation.

Table 19. Estimated Noxious Weed Infestation Acres and Treatment Costs – Proposed Action

Potential Noxious Weed Treatment	Year					Total
	1	2	3	4	5	
Acres	9,825	7,860	6,288	5,030	4,024	33,028
Cost	$2,200,800	$1,760,640	$1,408,512	$1,126,810	$901,448	$7,398,209

Proposed design features (page 37) and weed treatment would reduce the likelihood of introduction of new species and substantial spread of existing infestations. Given the amount of activity and expected ground disturbance, however, weeds would be likely to appear in new areas.

The persistence of new and existing infestations would depend in large part on availability of funding for treatment. From 2012 through 2016, using congressionally appropriated funds, the BHNF treated an average of 404 acres of weeds annually at an approximate cost of $82,820 per year. Funds collected from timber sale receipts paid for treatment of an average of 5,650 acres annually over that same time ($1,158,250 per year) for a total of 6,054 acres. These figures are less than the estimated future need. Though future funding levels cannot be predicted, the trend has been downward in recent years.

No Action Alternative

The No Action alternative would have no immediate effect on noxious weeds. Over time, fuel profiles and fire hazard would generally continue to move away from desired conditions. Wildfire severity and suppression difficulty would increase. Any resulting loss of vegetation and alteration of soils would provide suitable conditions for weed infestation.

Cumulative Effects

The cumulative effects analysis area for noxious weeds is the area where proposed activities would occur (357,000 acres). This area is selected to clearly demonstrate the Proposed Action's additive effect on potential weed infestation and treatment costs. The timespan for cumulative effects analysis is the present through 2033, or five years after the projected completion of proposed activities. By this time, the project's direct and indirect effects would diminish and blend in with effects of other activities and events.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Timber, fuels, fire, grazing, and recreation activities have exposed and are expected to continue to expose varying amounts of soil and transport weed seeds. Weed treatment is expected to eliminate some infestations and reduce the size of others, but overall infested acres may continue to increase.

It is estimated that the Proposed Action would add to effects of past, current, and foreseeable activities by increasing acreage of weed infestation (Table 20).

Table 20. Estimated Noxious Weed Infestation Acres and Treatment Costs – Cumulative

Potential Noxious Weed Treatment	Year					Total
	1	2	3	4	5	
Acres	80,825	64,660	51,728	41,382	33,106	271,701
Cost	$18,104,800	$14,483,840	$11,587,082	$9,269,658	$7,415,726	$60,861,096

With treatment of weeds, cumulative effects would contribute toward achievement of Forest Plan objectives 230 and 231. If weed treatment funding is insufficient, the cumulative effect could be a movement away from achievement of these objectives.

Wildlife

Summary

Threatened and Endangered Species:

Both alternatives were determined to have no effect on black-footed ferret (page 101). Both alternatives may affect the northern long-eared bat (page 101), though neither would be likely to have significant population-level effects.

Region 2 Sensitive Species:

A determination of no impact was made for both alternatives for the following species.

American peregrine falcon (page 103)
Burrowing owl (page 107)
Loggerhead shrike (page 111)
Long-billed curlew (page 112)
Black-tailed prairie dog (page 115)
Regal fritillary (page 118)

A determination of "may impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" was made for both alternatives for the following species.

Bald eagle (page 104)
Northern goshawk (page 104)
Flammulated owl (page 108)
Lewis's woodpecker (page 108)
Black-backed woodpecker (page 110)
Yellow-billed cuckoo (page 112)
Fringed myotis (page 113)
Townsend's big-eared bat (page 113)
Hoary bat (page 113)
American marten (page 114)
Bighorn sheep (page 115)
Northern leopard frog (page 116)
Black Hills redbelly snake (page 117)
Cooper's Rocky Mountain snail (page 118)
Western bumble bee (page 119)

Determinations of "beneficial impact" (the Proposed Action) and "no impact" (the No Action alternative) were made for the following species.

Northern harrier (page 105)
Grasshopper sparrow (page 110)

Determinations of "may impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" (the Proposed Action) and "no impact" (the No Action alternative) were made for monarch butterfly.

Species of Local Concern (page 120) and **Migratory Birds** (page 129) are expected to persist in the BHNF under either alternative.

Management Indicator Species (page 125): The Proposed Action would contribute toward achievement of habitat objectives for these species. The project's intent to balance structural stages related to forest-dependent species is expected to trend toward a range of ecological conditions to meet these species' needs. For species that rely on mature ponderosa pine forest, the Proposed Action has been designed to avoid/minimize the further reduction of this habitat, mostly associated with fuel hazard reduction treatments in the WUI, along roads, and near infrastructure, while also promoting an increase in these habitat types where they are below objective.

The Phase II Amendment FEIS determined that adequate habitat for maintaining viable wildlife populations would exist if Forest Plan standards and guidelines are followed and conditions move toward habitat objectives. The following analyses therefore address habitat trends and compliance with Forest Plan direction.

Information Sources

Wildlife and fish species occurrence data were obtained from a variety of sources, including surveys conducted primarily by Forest Service biologists and contractors, State resource agencies, and researchers/academia. These data are generally stored and accessed electronically via the Forest Service corporate database (NRIS-Wildlife) and/or as spatial data in the form of species-specific Geographic Information System (GIS) shapefiles which may be filed on the corporate computer system at either the Ranger District or National Forest level. For select species, site-specific surveys are typically conducted prior to vegetation treatments in order to determine whether mitigation, such as limiting work during a certain time of year, is needed. Under some circumstances, it is acceptable to analyze and document expected effects based on the assumption that a certain species is present, in lieu of conducting site-specific surveys (USDA Forest Service 2015a).

General Effects Overview

Vegetation management activities that generate loud noise from motorized equipment may disturb and/or displace wildlife such as goshawks and other nesting raptors. These effects tend to be more adverse when they occur during reproductive seasons when adults and young are more vulnerable to disturbance or during the winter when species may be stressed due to weather and reduced food supplies.

Overall, proposed vegetation management activities are expected to move most targeted habitats toward desired conditions identified in the Forest Plan. The "coarse-scale" approach to provide diversity for forest-dependent species is represented by the structural stage objectives. Dense, mature pine forest (which is below objectives in some management areas due to past wildfires, the mountain pine beetle epidemic, and subsequent response treatments) may require decades to increase to objective levels. Forest structural diversity design features (page 38) promote the retention of some existing mature forest in treatment areas when opportunities arise. Snag abundance, which is currently above levels specified by Forest Plan objective 211 (page 53), will decline in the future under both alternatives as existing snags fall to the ground. The Proposed Action would remove some snags that pose a safety hazard to human life and property or during prescribed burning operations, but otherwise complies with standards 2301 and 2305 (page 63) to retain snags.

In general, prescribed fire is expected to have positive effects on wildlife habitat. Prescribed fire may create some smaller-diameter snags for wildlife use, depending on the mortality level identified in the burn prescription. For a species like the black-backed woodpecker, which is adapted to natural disturbance events, prescribed fire has some benefit, but not to the same degree as wildfire and insect

epidemics (Rota et al. 2014a). The timing of prescribed burning typically occurs outside the breeding season for most wildlife species, with some exceptions, thereby avoiding the time of year when adults and young may be more susceptible to injury/direct mortality or disturbance/displacement. Prescribed fire prescriptions typically result in lower flame heights, reduced burn intensity, slower rate of spread, and thus less heat/smoke than wildfire. This in turn reduces tree mortality, impacts on soils, and general severity of effects. Based on these factors, negative effects on most wildlife species are avoided or minimized. Some ground-based species with limited mobility, such as land snails, are more susceptible to adverse effects from prescribed burning.

Road-related activities may affect wildlife and its habitat. Similar to vegetation management activities, construction, maintenance, and use of roads may generate loud noise from heavy equipment that may disturbance and/or displace wildlife, with effects being more harmful during breeding seasons and winter. Species lacking mobility, such as land snails, may be vulnerable to injury or mortality from road construction at any time of year. Road use may have greater seasonal impacts on species like the Black Hills redbelly snake, which may bask on roads or cross roads when moving to and from winter hibernacula. The proposed 18 miles of new roads would not increase open road density because they would be closed to public motorized use after the project.

Road construction is likely to result in the modification of wildlife habitat. In the case of permanent roads and conversion from unclassified to system roads, this change may be permanent. An estimated 25 acres of vegetated habitat is predicted to be permanently modified due to roads. Impacts from new temporary roads (39 miles) are typically short-term as revegetation occurs during the growing season after use has ended.

Threatened and Endangered Species

Threatened, endangered, or proposed wildlife species that are found in the BHNF (USFWS 2015, 2017a, b, c, d, e) and may be affected by this project are the black-footed ferret (endangered) and northern long-eared bat (threatened).

Black-footed Ferret

The black-footed ferret is a nocturnal, solitary carnivore of the weasel family with the narrowest range of ecological tolerance of any North American predatory mammal (USDA Forest Service 1996). In the Black Hills, as elsewhere, the key habitat component for black-footed ferrets is the distribution and abundance of prairie dogs (Forrest et al. 1985). Vacated prairie dog burrows provide shelter and are where ferrets spend most of their time.

There are 11 prairie dog towns in the BHNF, covering about 225 acres (USDA Forest Service 2015b). Black-footed ferrets were recently released as part of an experimental population in Wind Cave National Park, adjacent to the southeastern part of the project area. There are no prairie dog towns in the BHNF large enough to independently support ferrets nor are there any prairie dog towns in the BHNF adjacent to Wind Cave National Park. There is no designated critical habitat for black-footed ferrets in the BHNF.

Determination: Either alternative is expected to have no effect on black-footed ferrets because the ferret or suitable habitat does not occur in the project area.

Northern Long-eared Bat

Northern long-eared bats are forest-dwelling and insectivorous. They hibernate in suitable cave, mineshaft, and adit habitats. The hibernation season on the BHNF has been defined as October 1-May

15 (USDA Forest Service 2015c). During the summer, bats use live and dead trees for daytime roosting. Females with young pups congregate in larger trees and snags in communal maternity roosts. Males have shown less specificity and will choose a variety of snag sizes and cavities in both live and down dead trees. A study conducted in the Black Hills indicated that this bat selects the largest snags available and sites with a greater abundance of snags when compared to random sites (Cryan et al. 2001). This species selects moderately dense forest with large trees in the Black Hills (Abernathy et al. 2015). There is no designated critical habitat for northern long-eared bat in the BHNF.

In June-July 2017, researchers from the University of Wyoming identified eight to 10 northern long-eared bat maternity roost trees (unpublished data) on the Bearlodge Ranger District, BHNF. A number of the roost trees were live ponderosa pine with large burn scars that had started to rot out. Many of these burn scars also had old woodpecker cavities that bats were observed exiting at some roosts.

As described by the BHNF northern long-eared bat Programmatic Biological Assessment (BA; USDA Forest Service 2015c), activities of the types proposed by this project may have positive or negative effects on northern long-eared bat. "On the landscape scale, activities to make forested stands more resilient to catastrophic wildfires and insect and disease epidemics are likely to have an overall positive effect, though these natural disturbance events do create snags that may become suitable roost trees. Maintaining a mosaic of forest stand structure through vegetation management activities has more benefit in the long-term for bat conservation than an 'ocean of snags' that may be present on the landscape for a relatively short time following large scale wildfires and mountain pine beetle infestations" (pages 88-89).

The Programmatic BA also concluded that implementation of Forest Plan snag conservation measures should ensure that northern long-eared bats will continue to have adequate roosting habitat. The Proposed Action would retain snags consistent with Standards 2301a-b and 2305. Therefore, the Proposed Action is not expected to directly reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Direct mortality could result if unknown, occupied maternity roost trees are cut. Of the eight to 10 known roost trees described above, one is within a potential CTA and a 150-foot buffer around it includes part of an another CTA. Aspen regeneration treatments may potentially affect two known bat maternity roost trees in a 131-acre stand. One additional maternity roost tree is within a non-CTA stand that may be treated to enhance aspen. Lastly, one roost tree is within a proposed fuel treatment area. In total, five known maternity roost trees are within potential treatment areas. Design features to protect known roost trees and the adjacent habitat (page 39) should maintain roost site suitability.

Cryan et al. (2001) concluded that timber harvest and tree thinning activities are not expected to decrease the long-term suitability of these areas as northern long-eared bat roosting habitat (as studied in the southern Black Hills). Prescribed burning is expected to have negligible effects on the bat given the timing of these burns (generally during the hibernation season) and burn plans that mitigate the effects from smoke and heat.

Proposed vegetation management activities would create noise that may disturb roosting bats during the active season. This noise disturbance may result in adverse effects if female bats flee maternity roost trees, resulting in abandonment or reduced survival of their young.

The No Action alternative would cause no immediate effects to the bat or its habitat. Neither alternative is likely to result in the introduction or spread of the fungus that causes white-nose syndrome, the primary threat to the bat's continued existence.

Determination: The Proposed Action may affect the northern long-eared bat. Pursuant to the *Optional Framework to Streamline Section 7 Consultation for the Northern Long-Eared Bat*, each action agency must make a two-step determination as to whether its activity is excepted from incidental taking prohibitions in the final 4(d) rule. To that end, the Proposed Action would not purposefully take the bat. Second, the BHRL project area is located wholly outside the white-nose syndrome zone. In the absence of white-nose syndrome, none of the proposed activities, alone or in combination, would be likely to have significant population-level effects**.** Overall, adherence to Forest Plan standards and guidelines would conserve the bat and its habitat. The No Action alternative would not affect this species.

Sensitive Species

Sensitive species are those plants and animals for which there are population viability concerns, as identified by the Regional Forester. For these species, there are significant current or predicted downward trends in population numbers or density or downward trends in habitat capability that would reduce the species' existing distribution (FSM 2670.5). The list was most recently updated in May 2015 (USDA Forest Service 2015a).

American Peregrine Falcon

In the Black Hills, the peregrine falcon is an uncommon spring and rare fall migrant and rare winter visitor. Nest sites may occur in deep rocky canyons or other places with tall cliffs. Historical records indicate peregrine falcon nesting occurred in the Black Hills in the 1960s. Efforts to reestablish a breeding population through cross-fostering[13] and hacking[14] in the late 1970s and late 1990s (Sharps and O'Brien 1985) were unsuccessful. Between 2001 and 2007, the Monitoring the Birds of the Black Hills program did not detect peregrines in the Black Hills (Giroir et al. 2007). In 2017, the South Dakota Department of Game, Fish and Parks located two pairs of breeding peregrines in the Black Hills, but the exact nest locations are unknown to us at this time. Peregrine falcons eat mostly birds, though mammals and other species may be taken. When hunting, peregrines start by watching from a high perch or by flapping slowly or soaring at great height. Aerial dives begin above their prey and end either by grabbing the prey or by striking it with their feet hard enough to stun or kill it.

No direct or indirect effects on nesting habitat are anticipated under either alternative because of the inaccessibility of rock cliffs preferred for nesting and the lack of proposed activities in these areas. The No Action alternative would not affect foraging habitat or nesting behavior. Under the Proposed Action, implementation of standard 3204 (which protects raptor nests) in coordination with the South Dakota Department of Game, Fish and Parks, is expected to prevent disturbance that would disrupt normal nesting behavior.

Determination: Both alternatives would have ***no impact*** on peregrine falcons because nest sites would not be disturbed and nesting/foraging habitat or behavior would not be modified to a degree that would adversely impact individuals...

[13] Fostering one species to another.
[14] Controlled release of young falcons from an artificial eyrie.

Bald Eagle

Bald eagles are primarily winter residents in the Black Hills, usually arriving in early November and leaving by March or April. Bald eagles are often associated with large lakes and rivers. The bald eagle population is in an upward trend (Burns 2012).

An unsuccessful nesting attempt was reported adjacent to the southern BHNF in 2004. In 2007, another unsuccessful nesting attempt occurred at Deerfield Lake in the central Black Hills. This was the first recorded nesting attempt in the BHNF in recent times. The nest has continued to be active with young successfully fledged. Suitable nesting habitat occurs in dense, mature pine stands near major lakes and streams in the project area (Burns 2012).

In 2006, a winter night roost was discovered at Pactola Reservoir (USDA Forest Service 2007a). Approximately 18 to 22 eagles were observed at the roost on four separate occasions between late December 2005 and late January 2006. The roost covers at least 100 acres of mature to late-successional ponderosa pine forest on very steep slopes. Large trees and snags are abundant. The lake was not completely frozen over at the time.

No direct mortality would occur at the Deerfield Reservoir nest because it is in MA 8.2 (Developed Recreation Complexes), which is not within the project area. Some individual bald eagles may avoid treatment areas when proposed activities are in progress, but alternative roosting/foraging habitat is likely available nearby. Indirect effects may occur if suitable nesting/roosting habitat is removed through vegetation management activities. Potential nesting/roosting habitat around Pactola, Deerfield, and Sheridan Reservoirs is excluded from the project area (Figure 2, page 4) and would not be affected by proposed activities. Potential nesting habitat near other water bodies may decline, but this is not likely a limiting factor. The Proposed Action would not affect the availability of carrion, which is the primary winter food source. Proposed activities may be restricted within one mile of the communal roost at Pactola Reservoir from November 1 through April 1 (Forest Plan standard 3101c). Any newly discovered nests would be protected through avoidance and timing restrictions (standards 3204 and 3101). The project would contribute toward achievement of Forest Plan objective 221[15] by conserving bald eagle habitat.

The No Action alternative would have no effect on bald eagles or their habitat.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** This alternative would comply with Forest Plan standards relevant to bald eagle protection. The No Action alternative would have ***no impact***.

Northern Goshawk

Habitat Associations: The northern goshawk is a large predatory bird. It is easily disturbed, secretive, and very defensive of its young. In the northern Rocky Mountains, a typical goshawk nest area is a single-storied, mature or late successional coniferous stand with a dense canopy and clear forest floor on a north-facing, moderate slope (Hayward and Escano 1989, Squires and Ruggiero 1996, Kennedy 2003). Goshawks tend to select stands that have relatively large trees and relatively high canopy closure (Kennedy 2003). Reynolds et al. (1992) characterized the nest area as mature and old stands with canopy closure greater than 50 percent. Dense, mature ponderosa pine stands (SS 4C and 5) at least 30 acres in size likely best meet these conditions in the Black Hills. Moderately dense,

[15] *"Conserve or enhance habitat for R2 sensitive species and species of local concern (SOLC). Monitoring will be conducted at a Forest-wide level, not at the project level, and will be done for habitats or populations."*

mature pine forest (SS 4B) may also provide some additional nesting habitat. Goshawks return to the same territory year after year.

Assessment of Existing Black Hills Habitat: Reynolds (USDA Forest Service 2000) estimated the BHNF could potentially accommodate 300 territories. Approximately 132 territories have been documented.

In the Black Hills, goshawks nest in dense, mature stands, primarily those with basal area ranging from 130 to 245 square feet per acre (Bartelt 1977, Erickson 1987). Preferred nest trees are ponderosa pine, often the largest tree in the stand (Erickson 1987). In the first long-term study of goshawks in the Black Hills, Knowles and Knowles (2010) documented that nest stands in mature and old-growth ponderosa pine stands averaged 266 trees per acre, a basal area of 128 square feet per acre, and an average tree diameter of 10.2 inches.

Goshawks use a mosaic of structural stages for foraging (Kennedy 2003). Goshawks hunt in diverse habitats and are considered generalist predators, feeding mostly on prey that occupies the ground through lower canopy zones. Snags, downed logs, and woody debris are an important component of the post-fledging family and foraging habitat. The BHNF currently has more than three snags per acre, of which at least 25 percent are greater than 14 inches in diameter (objective 211, USDA Forest Service 2015b). Many of the existing snags resulted from the mountain pine beetle infestation. Because beetle-killed snags typically stand for only five to seven years (Schmid et al. 2009), areas with high levels of tree mortality due to beetle infestation are expected to have few standing snags in the near future. Expected effects on snags are discussed on page 62.

Structural stage objectives for MAs 4.1, 5.1, 5.4, 5.43, and 5.6 were designed to provide a diversity of ponderosa pine habitats where vegetation management activities are most likely to occur, with the intent of providing a balance of conditions for goshawk foraging and nesting habitat (among other species) across the BHNF. Graham et al. (2015) alluded that prey availability may be a more important factor than a shortage of nest sites when it comes to goshawk reproduction. Due to mountain pine beetle infestation, timber harvest, and wildfire, structural stages that may provide nesting habitat are currently below objectives (see Table 2). The objectives' desired condition for dense, mature pine totals 35 percent of the pine forest area. These structural stages currently form approximately 22 percent of the pine forest area in the five management areas with structural stage objectives. Most of this habitat is in the northern and eastern Black Hills and the Bear Lodge Mountains (Graham et al. 2015). Very little exists in the central Black Hills, and areas such as the Jasper Fire (83,500 acres) in the southern Black Hills is low-quality nesting habitat. Due to the habitat's range in quality and uneven distribution, along with the territorial nature of goshawks, not all of the existing potential nesting habitat is occupied.

According to Forest Plan standard 3108, at least 180 acres (36 percent) of the half-mile buffer around a goshawk nest or group of nests should consist of potentially suitable nesting habitat. As part of the BHRL project analysis, BHNF wildlife biologists assessed existing conditions in known goshawk territories. Using data from nest surveys, the BHNF vegetation database, and aerial imagery, the biologists identified potentially suitable nesting habitat (dense, mature pine) within one-half mile of each individual nest or concentration of nests in a single territory.

The assessment revealed that, on average, approximately 18 percent of each half-mile buffer is potentially suitable nesting habitat. Twenty-four of the 132 known territories include at least 180 acres of suitable nesting habitat. Over the last 20 years, most nest areas have undergone a significant reduction in dense, mature pine habitat due to mountain pine beetle infestation, timber harvest, and wildfire. Most of the existing suitable habitat is in the northwestern part of the BHNF, where beetle

infestation and associated timber harvest have been less extensive. Thinning of dense, mature stands is continuing in some areas as part of previously authorized projects and this is captured in the existing condition in Table 2.

Forest Plan standard 3108 requires that any vegetation management occurring within the 180-acre nest area maintain or enhance the stand's value for goshawk. In some situations where thinning to address beetle infestation was considered critical, activities that did not maintain or enhance habitat values have occurred.

Forest Plan standard 3111 directs the Forest Service to minimize additional human-caused noise and disruption beyond that occurring at the time of nest initiation within one-half mile of active goshawk nests from April 1 through August 15 or until fledglings have dispersed or the nest has failed. In some cases, due to the urgency associated with activities in beetle-infested stands, this timing restriction has been lifted if biologists find no evidence of goshawk activity. Disturbance during courtship and brooding can cause nest failure or cessation of nest construction (Lynch pers. comm. 2017).

Direct and Indirect Effects: The Proposed Action would have the potential to cause mortality and loss of nesting and foraging habitat. Known goshawk nest areas would be protected in accordance with Forest Plan standards 3108 and 3111.

Adverse effects could occur if there are existing, unknown goshawk nest areas that are not detected prior to implementation of proposed activities. Knowles and Knowles (2010) reported that 29 of 30 active nests were abandoned when commercial timber harvest occurred within one-quarter mile. If new nests are found during implementation, adherence to Forest Plan standard 3115 (*"R2 sensitive species or species of local concern located after contract or permit issuance will be appropriately managed…"*) would protect the nest from further disturbance.

Potential nesting habitat may decrease by up to 4,000 acres due to proposed fuel break construction in dense stands. The Phase II Amendment FEIS determined that adequate habitat for maintaining a viable goshawk population would exist if standards and guidelines are followed and conditions move toward habitat objectives. Due to mountain pine beetle infestation and response actions, moderately dense, mature pine forest is currently below Forest Plan objectives in most management areas (page 55). In addition, dense, mature pine forest is below the objective in MA 5.1, and late succession forest is below objectives in all MAs that have objectives. No activities that may decrease late succession characteristics would occur in late succession stands (design features, page 38). Fuel breaks may occur in various management areas but would be focused on MA 5.4 (page 18), which has a higher percentage of dense forest than other MAs (page 55). Close coordination with wildlife biologists would be required during layout and implementation to assess tradeoffs between potential habitat and fuel break location. While potential habitat is likely to decrease, the above measures would prevent loss of known nest areas, decrease the likelihood of adverse effects on unknown nest areas, and maintain most existing, potential nesting habitat while increasing potential public and firefighter safety in key locations focused in the WUI, along roads and near infrastructure.

Foraging habitat in treated areas would differ by treatment and over time. This may increase goshawk prey associated with open habitat, such as flickers and chipmunks, and decrease prey associated with closed canopy habitat, such as red squirrels and northern flying squirrels. Goshawks may be disturbed in foraging areas by proposed activities. Spring prescribed fire may result in nest abandonment, though Reynolds et al. (1992) recommend prescribed fire to perpetuate forests of different ages as this may enhance nest stand characteristics, provide habitat for goshawk prey, and improve hunting habitat. Thinning of small trees in potential and current goshawk nest stands would

help maintain desirable nest stand characteristics. Road construction and use may cause nest abandonment if conducted near unknown nests during nesting season. Aspen and oak enhancement activities would maintain or improve these habitats for goshawk foraging.

Over time, the No Action alternative could result in loss of some foraging and nesting habitats as density of small pine and other understory vegetation increases. Additional closed-canopy potential nesting habitat would be likely to develop in the long term as some of the open, mature pine stands toward denser conditions and as young forest continues to mature. Increased difficulty of fire suppression and potential for high-severity fire could raise the risk of habitat loss.

The Proposed Action would conserve habitat in the short term for this species in accordance with Forest Plan objective 221 by minimizing any further reduction of dense, mature pine forest and promoting an increase in late succession forest, and in the longer term as structural stage percentages become more aligned with the desired condition.

Determination: The combined representation of potential goshawk nesting habitat is below management area structural stage objectives. The Proposed Action would add minimally to these losses in the interest of public safety by constructing shaded fuel breaks. It may result in harm to individual goshawks, though adherence to Forest Plan standards is expected to minimize this potential. At the same time, the Proposed Action would reduce density of regenerating pine and other understory vegetation through precommercial thinning, prescribed fire, and other fuel reduction activities, facilitating development of mature stands and enhancing goshawk foraging habitat. The No Action alternative could result in an eventual decrease in suitability of foraging and nesting habitats. As a result, both alternatives ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** With implementation of Forest Plan standards and guidelines, goshawks would persist in the BHNF.

Northern Harrier

The northern harrier is an uncommon migrant and summer resident in the Black Hills area. Harriers are open-country hawks associated with prairies, wetlands, marshes, meadows, croplands, and shrublands (Slater and Rock 2005). Preferred topography is generally flat. Large open areas with wetlands and marshes are limited in the BHNF, which probably is the main limiting factor for harriers. There are approximately 79,610 acres of grassland and meadow habitat in the project area, but much of this occurs in linear meadows or isolated patches that are likely too small to support harriers. Larger blocks of grassland habitat occur in the southern and central Black Hills, in part due to past wildfires. Forest Plan standard 3204 requires protection of known raptor nests. Harrier nesting has not been documented in the project area.

Under the Proposed Action, removal of pine from grasslands on 14,200 acres may maintain or enhance potential harrier foraging habitat. Any harrier nests would be protected consistent with Forest Plan standard 3204. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving habitat for harriers.

Determination: The Proposed Action may have a slight ***beneficial impact*** by creating and enhancing open habitat for foraging. The No Action alternative would have ***no impact***.

Burrowing Owl

The western burrowing owl is a grassland specialist of western North America, occupying open areas with short vegetation and bare ground (Klute et al. 2003). Burrowing owl nesting habitat typically consists of level, open landscapes with sparse grassland vegetation that either has low structure or is

heavily grazed, either by cattle or prairie dogs (McDonald et al. 2004). They depend on burrowing mammals, particularly prairie dogs, for vacant burrows for nesting and roosting. Habitat for burrowing owls on the BHNF is limited. Availability of black-tailed prairie dog colonies may be the greatest limiting factor (Johnson and Anderson 2002).

Burrowing owls were observed in 2004 and 2006 during breeding bird monitoring (USDA Forest Service 2010c). The 2004 observation was associated with a prairie dog town on the Hell Canyon Ranger District. In 2007, two adults and three chicks were observed at two nests (Burns 2012).

Neither alternative would affect burrowing owls. Proposed activities would not occur in prairie dog towns nor would they create large, open grasslands of sufficient size to be used by prairie dogs or burrowing owls. The project would contribute toward achievement of Forest Plan objective 221 by conserving burrowing owl habitat.

Determination: Both alternatives would have ***no impact*** on burrowing owls**.**

Flammulated Owl

Flammulated owls are associated primarily with ponderosa and Jeffrey pine habitats. Only ponderosa pine occurs in the Black Hills. Flammulated owls select older seral stages for breeding and nesting (Hayward and Verner 1994). Clumped tree distributions, multi-layered canopy, and a well-developed shrub component contribute to internal forest edge. Low to moderate canopy closure prevails in most sites used by this species (Hayward and Verner 1994). Flammulated owl nesting and foraging habitat is best represented by mature and late succession ponderosa pine forest.

Flammulated owls appear to prefer denser vegetation for roosting. Roosting habits are unknown in the Black Hills, but if range-wide patterns hold true here, the species may roost in spruce or in mixed pine/spruce stands. Nest site characteristics across three studies in New Mexico and Oregon documented owl nests in snags that averaged between 19 and 28 inches in diameter. Snags this large are relatively rare in the project area (USDA Forest Service 2015b).

There have been two unverified reports of flammulated owls in the Black Hills in recent years. These may represent periodic use by transient individuals or the beginning of a range expansion. In 2003, an effort was made to verify flammulated owls at the two observation sites and other seemingly suitable habitat, but none were detected (Fauna West Wildlife Consultants 2003). At present, there is no indication suggesting that flammulated owls are established or breeding in the Black Hills.

If flammulated owls are present in the Black Hills, the Proposed Action could cause direct mortality and decrease suitable habitat by removing large trees and snags (in the form of hazard trees) and thinning dense stands. The Proposed Action would treat 187,000 acres of open, mature pine forest, but the remaining acreage would still be above the desired structural stage percent. Dense, mature pine forest may decrease on up to 4,000 acres for shaded fuel breaks, but this impact would be reduced by retaining the best habitat when possible through coordination of activities with wildlife biologists. A percentage of snags would be lost through hazard tree cutting, typically adjacent to roads and infrastructure, which is not considered the highest value habitat. Any decrease in dense, mature pine acreage in MA 5.1 would move conditions further from Forest Plan objective 5.1-204.

The Proposed Action would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

The project would contribute toward achievement of Forest Plan objective 221 by conserving potential flammulated owl habitat, unless dense, mature pine forest is decreased in MA 5.1. Because activities in dense, mature forest are to be focused away from this management area (page 18), any decrease is expected to be minor.

Selection of the No Action alternative may eventually result in increased potential flammulated owl habitat in the form of dense forest.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing***, though the risk is very low given the unconfirmed status of a breeding population in the BHNF. The No Action alternative would have ***no impact***.

Lewis's Woodpecker

Lewis's woodpecker is an edge specialist that prefers open, mature pine forests, mature cottonwood forests, and areas with large burned trees (Tobalske 1997). Burned stands are used most often after they have aged several years (Tobalske 1997). A well-developed shrub layer is usually present (Anderson 2003, Abele et al. 2004). In the Black Hills, this woodpecker is most often observed in burned pine forests but can also be found in mature to late-successional ponderosa pine stands that have an open canopy. Lewis's woodpeckers typically excavate nest cavities in large, soft ponderosa pine or cottonwood snags.

Black Hills monitoring conducted between 2001 and 2009 detected an average of six birds each year (White and Giroir 2009). Breeding Bird Survey data suggest that many populations of Lewis's woodpeckers have declined since the 1960s (Sauer et al. 2011, Tobalske 1997).

The project area includes approximately 410,000 acres of open, mature or late succession ponderosa pine forest. Pockets of open forest also occur within the denser structural stages in the project area. Suitable open habitat exists well above desired objectives.

The Proposed Action could result in direct mortality if occupied nest trees are cut, but adherence to standards 2301 and 2305 (page 63) would prevent cutting of snags except those that are a safety hazard. Mature trees and open, mature pine forests preferred by Lewis's woodpeckers would decrease. Acreage of these stands would remain above Forest Plan objectives (page 55) and are not expected to be a limiting factor.

The Proposed Action would not reduce snag occurrence below Forest Plan objective 211 levels (page 62). Activities other than patch clearcut would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

The No Action alternative would have no direct effects. Over time, some currently open pine stands may become too dense to provide suitable woodpecker nesting habitat. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving Lewis's woodpecker habitat.

Determination: Both alternatives ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.***

Black-backed Woodpecker

Habitat Associations: Black-backed woodpeckers are associated with montane coniferous forests (Anderson 2003). They feed primarily on bark beetle larvae. In the Black Hills, black-backed woodpeckers are highly associated with pine forests that have recently burned and those that are infested with mountain pine beetle. Home range in the Black Hills is estimated to be between 75 and 100 acres (Kistler and Fager 1981, Rota et al. 2014). Another essential habitat for this woodpecker is dense, mature or late successional ponderosa pine forest.

Mohren and Anderson (2001) found black-backed woodpeckers in both immature and mature ponderosa pine stands with dense canopy (3C, 4C, 5). This third habitat type is important when recently burned areas and infested stands are unavailable.

Assessment of Existing Habitat: The Black Hills population is somewhat isolated from the rest of the North American population (Anderson 2003) and has been petitioned for listing under the Endangered Species Act as a distinct population segment. The US Fish and Wildlife Service is expected to make a listing decision in September 2017.

BHNF black-backed woodpecker densities peaked during the second year after the 83,500-acre Jasper Fire (August 2000), with observation of one bird per 36 acres (Panjabi 2003). As expected, relative densities in the burned habitat declined in subsequent years (Hutton et al. 2007). Densities again spiked upward in 2009 (White et al. 2010), probably due to the mountain pine beetle epidemic. Matseur (2017) assessed the abundance of black-backed woodpeckers in relation to disturbance and forest structure in the BHNF. Findings included an increased population estimate, twice as high as conditions in 2000, which is likely a result of the high levels of disturbance the BHNF has experienced in the past 15 years.

As burned areas age and beetle numbers return to endemic levels, preferred habitat will decline. Woodpecker numbers are also expected to decline. The BHNF currently meets Forest Plan objective 211 regarding snag habitat (page 53).

Because the mountain pine beetle epidemic has ended, woodpecker reliance on dense pine forest (both young and mature) will increase. The epidemic, timber harvest, and wildfire have decreased dense, mature forest in some management areas below objective levels. Time is needed for development of additional late successional forest. Dense, young forest is currently below Forest Plan objectives but is expected to increase dramatically within 10 to 20 years (page 55) as infested and harvested stands regenerate.

Direct and Indirect Effects: Implementation of the Proposed Action could cause direct mortality and loss of potential habitat in the form of snags (hazard tree removal) and live, dense forest. In accordance with Forest Plan standards 2301 and 2305 (page 63), snags would be retained unless they pose a hazard. The Proposed Action does not include post-fire salvage.

Proposed fuel break construction would decrease potential habitat in the form of dense, mature stands of live pine by up to 4,000 acres, but this impact would be reduced by coordination with wildlife biologists to retain the best habitat when possible. The Phase II Amendment FEIS determined that adequate habitat for maintaining viable populations would exist if standards and guidelines are followed and conditions move toward habitat objectives. Due to mountain pine beetle infestation and response actions, dense, mature pine forest is below the Forest Plan objective level in MA 5.1, and late succession pine forest is below objectives in all MAs that have objectives (page 52). No activities that may decrease late succession characteristics would occur in structural stage 5 stands (design features, page 38). Fuel breaks may occur in various management areas but would be focused on MA 5.4 (page

18), which has a higher percentage of dense forest than other MAs (page 55). Close coordination with wildlife biologists would be required during layout and implementation to assess tradeoffs between potential habitat and fuel break location. The Proposed Action would conserve most of the suitable black-backed woodpecker habitat in live forest while increasing potential public and firefighter safety in key locations.

Proposed precommercial thinning, prescribed fire, and fuel treatments would reduce density of stands of small trees, facilitating growth of residual pine seedlings and saplings. Instead of stagnating, thinned stands would transition into mature forest within 20 to 40 years (page 55).

The Proposed Action would reduce the potential for large, stand-replacing wildfires, which create preferred black-backed woodpecker habitat. It may also decrease the potential scale of a future mountain pine beetle infestation. Under both alternatives, however, stand-replacing fires and beetle infestations will continue to occur. The objective of the Proposed Action is to reduce the scale of these events and the severity of their effects, where possible. It would conserve habitat for this species in accordance with Forest Plan objective 221 by minimizing the additional loss of dense, mature forest while trending toward the desired structural stage percentages in the long term.

Over time, the No Action alternative would allow development of additional closed-canopy forest. Increased difficulty of fire suppression and potential for high-severity fire could result in large, stand-replacing fires that would create black-backed woodpecker habitat.

Determination: Due to mountain pine beetle infestation, response actions, and wildfire, the BHNF has moved away from objectives for dense, mature pine forest (potential black-backed woodpecker habitat). The Proposed Action would add minimally to these losses in the interest of public safety by constructing shaded fuel breaks. It may result in harm to individual woodpeckers, though adherence to Forest Plan snag standards is expected to minimize this potential. At the same time, the Proposed Action would reduce density of regenerating pine, facilitating development of future mature stands. As a result, the Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** With implementation of Forest Plan standards and guidelines, black-backed woodpeckers would persist in the BHNF. The No Action alternative would have ***no impact***.

Grasshopper Sparrow

Grasshopper sparrows are well distributed in the native mixed-grass prairies of the southern Black Hills and Elk Mountains and locally in the isolated prairies further north. The most recent density estimates indicate increasing populations (USDA Forest Service 2015b).

Current grassland acreage across the BHNF is approximately 19 percent below objective 205 levels. Efforts to reduce pine regeneration and encroachment into grassland and meadow habitats are continually needed to meet objectives (USDA Forest Service 2015b).

The Proposed Action may result in direct mortality. Proposed removal of encroaching pine from grasslands and prescribed fire would maintain treated grassland habitats in the project area. The project would contribute toward achievement of objective 221 by maintaining or enhancing grasshopper sparrow habitat.

The No Action alternative would have no immediate effects. Preferred habitat may decrease over time due to pine encroachment.

Determination: Although there may be direct impacts, risk is low overall. The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area,***

nor cause a trend toward federal listing. Proposed activities are expected to have long-term benefits. The No Action alternative would have ***no impact.***

Loggerhead Shrike

The loggerhead shrike is rare or casual (out of normal range) in the Black Hills. Breeding records occur near the periphery of the Black Hills but not in the interior or at higher elevations. It is associated with open habitats with scattered or clustered shrubs or trees. Preferred habitats are limited in the Black Hills but are provided mainly by mixed-grass prairies, mountain mahogany shrublands, and grassy or brushy areas with scattered juniper or ponderosa pine. The combination of habitat features described above is distributed primarily along the southern flank of the Black Hills, especially in the southwestern portion.

The Proposed Action would not affect preferred shrike habitat. Potential for impacts is negligible. The No Action alternative would have no effect. The project would contribute toward achievement of objective 221 by conserving habitat for loggerhead shrike.

Determination: Either alternative is expected to have ***no impact*** to the northern shrike and its habitat.

Long-billed Curlew

Long-billed curlews are native-prairie specialists, nesting primarily in shortgrass or mixed-grass prairie habitat with flat to rolling topography (Sedgwick 2006). They prefer short vegetation and generally avoid habitats with trees, abundant shrubs, or tall, dense grass. Long-billed curlews have been observed nesting in suitable habitat in the BHNF, mostly in the southern Black Hills (USDA Forest Service 2010c). Populations in South Dakota have declined (Sedgwick 2006).

The Proposed Action would not affect long-billed curlews due to lack of activities in native short-grass or mixed-grass prairies. The No Action alternative would have no effect. The project would contribute toward achievement of objective 221 by conserving habitat for this species.

Determination: Either alternative is expected to have ***no impact*** on long-billed curlews or their habitat.

Yellow-billed Cuckoo

Yellow-billed cuckoo breeding habitat in the Black Hills occurs mainly in low-elevation riparian areas. This habitat is very limited in the project area and has most potential to occur where narrowleaf cottonwood or bur oak riparian corridors exist along the BHNF boundary. Breeding has been documented in the Bear Lodge Mountains and likely occurs elsewhere at lower elevations (Panjabi 2003). The documented breeding site was a mature, bur-oak woodland that had a well-defined understory and very large-diameter trees (Panjabi 2003). Yellow-billed cuckoos are extremely sensitive to habitat alterations (Nicholoff 2003, Wiggins 2005b).

The Proposed Action may cause direct mortality. Risk is considered to be low because this bird nests along riparian areas, which would largely be avoided during management activities (page 165). Proposed commercial timber harvest, thinning, and prescribed fire may indirectly benefit this species by maintaining and enhancing hardwood habitat, particularly oak. The No Action alternative would have no direct or immediate indirect effects. Over time, lack of activity could result in gradual decline of potential habitats due to pine encroachment. The project would contribute toward achievement of objective 221 by conserving habitat for yellow-billed cuckoo.

Determination: The Proposed Action and No Action alternative ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** Overall, proposed activities would have long-term benefits.

Sensitive Bats: Fringed Myotis, Townsend's Big-eared Bat, and Hoary Bat

Three Sensitive bat species may occur in the project area. Each is described separately below, followed by a combined analysis of effects on all species.

Fringed Myotis: The fringed myotis is an insectivorous, year-round resident bat of the Black Hills. It can be found during the summer but is very difficult to locate when hibernating in winter (USDA Forest Service 2000). The Black Hills population of fringed myotis is a disjunct population recognized as a distinct subspecies, *Myotis thysanodes pahasapensis*. In the Black Hills, this species is known in Custer, Fall River, Lawrence, and Pennington counties (South Dakota) and Crook and Weston Counties (Wyoming) at elevations ranging from 3,800 to 6,200 feet (Schmidt 2003a).

In the Black Hills, this bat tends to occur along borders between ponderosa pine and oak/juniper forests (Schmidt 2003a). Riparian areas and water sources are important habitat features. Maternity roosts recorded for this species include rock crevices and ponderosa pine snags (Cryan et al. 2001, Keinath 2004). The fringed myotis has been documented using ponderosa pine snags for roosts in the Black Hills (Cryan et al. 2001).

The fringed myotis is more closely associated with the forested environment than other bat species and may be fairly sensitive to forest management, particularly those activities affecting availability of snags (USDA Forest Service 2000).

Townsend's Big-eared Bat: Townsend's big-eared bat is an insectivorous, year-round resident in all South Dakota Black Hills counties and is reported to be the most numerous bat species in Crook County, Wyoming (Schmidt 2003b). Maternity roosts have been documented in the Black Hills (USDA Forest Service 2015b).

Townsend's big-eared bats occupy a variety of habitats but are closely associated with caves and mines (Schmidt 2003b, Gruver and Keinath 2006). They forage in riparian areas. In the Black Hills, maternity roost sites are often in steep drainages with nearly vertical walls. These bats are extremely sensitive to loud noises and other disturbances in the vicinity of their roosts (Schmidt 2003b). Potential habitat exists throughout the project area in the form of caves, mines, snags, and riparian areas.

Hoary Bat: Hoary bats generally roost in medium to large trees with dense foliage that provides overhead cover. They prefer open conifer and deciduous habitat mosaics and feed along habitat edges (Tigner and Stukel 2003). Rapidly changing habitat conditions are considered a substantive and imminent threat to the hoary bat (USDA Forest Service 2011a).

Hoary bats have been documented as breeding or occurring in most Black Hills counties (Higgins et al. 2000, Tigner and Stukel 2003). Potential forest habitat exists throughout the project area.

Direct and Indirect Effects: The Proposed Action could result in direct mortality due to tree and snag (hazard tree) felling. Activities conducted when maternity roosts consist of females with pups that cannot yet fly pose the greatest mortality risk to bats. Potential loss of occupied daytime roost trees may negatively impact individuals. The Proposed Action would reduce the number of large trees and snags, primarily hazard trees, while increasing open forests. It would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that

may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Adherence to Forest Plan standards 1401, 3102, and 3207[16] would protect known and potential nurseries and hibernacula. The project would contribute toward achievement of objective 221 by conserving habitat for these bat species.

The No Action alternative would have no direct or immediate indirect effects. Over time, formation of additional snags may increase roosting habitat.

Determination: The Proposed Action ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing***. The No Action alternative would have ***no impact***.

American Marten

Martens were reintroduced into the Black Hills beginning in 1981. They are found in a narrow range of habitat types associated with coniferous forests (Buskirk 2002) and require late successional stands of mesic conifers, especially those with complex physical structure near the ground (Buskirk and Powell 1994). Potential marten habitat in the Black Hills is based on the distribution of white spruce. Ponderosa pine is not considered optimal habitat, although there is evidence that martens use pine habitat in the Black Hills. Rocks, low-lying branches, fallen logs, and stumps (Davis 1983) and lush forb and shrub vegetation on or near the ground and subnivean[17] sites (Buskirk 2002) provide thermal and protective cover as well as hunting habitat. They stay close to overhead cover, and are intolerant of habitat types with less than 30 percent canopy cover (Buskirk and Powell 1994).

According to Fecske (2003), the greatest marten concentrations in the Black Hills appear to be in the northern part of the BHNF and in and around the Norbeck Wildlife Preserve. These two dominant subpopulations are likely to be very important in maintaining species persistence in the Black Hills (Burns 2012).

Due to the limited distribution of spruce in the Black Hills, most marten territories contain some drier pine sites (Buskirk 2002). Mature and late-successional pine stands also help maintain connectivity between spruce stands. In the Bear Lodge Mountains, where spruce is absent, martens use dense, mature pine habitat.

Marten population trend was relatively stable in the Black Hills through 2003 (USDA Forest Service 2004). The BHNF is conserving marten habitat (spruce) (USDA Forest Service 2015b), but population trends since 2003 are unknown. Mature, dense pine habitat has decreased since that time.

[16] 1401: *"For caves that have been determined significant or that have not been evaluated for significance… 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 (see also Standard 3207); Take measures to prevent human-caused changes in cave ecosystem, water, sediment, nutrient, chemical, airflow, humidity, or temperature regimes…"*
3102: **"***Where caves are important nurseries or hibernacula for sensitive and local concern bat species protect the caves and maintain their microclimates when designing management activities (e.g., timber harvest, road construction, recreation facilities). Protect known bat day and night roosts."*
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."*
[17] Below the snow

The Proposed Action could cause direct mortality. The greatest threat the BHRL project poses to martens is additional fragmentation and loss of habitat. Although not specifically targeted, spruce may be treated in shaded fuel breaks and mixed stands. Spruce-dominated habitat would remain above the Forest Plan objective of 20,000 acres. Potentially suitable habitat for marten and their prey species in mature, dense to moderately dense ponderosa pine stands may decline by up to 4,000 acres due to creation of shaded fuel breaks. Generally, this would occur in the WUI, along roads, and near infrastructure, areas not typically considered the most desirable marten habitat. Snags (hazard trees) and coarse woody debris would decrease due to fuel reduction and other activities, though Forest Plan objectives would continue to be met (see page 62).

Proposed road construction and conversion in or adjacent to marten habitat would reduce marten habitat by about five acres per mile of road (Rowland et al. 2004). Activities occurring in or near spruce or suitable dense, mature pine habitat may cause some disturbance to marten.

The Proposed Action would comply with relevant Forest Plan standards, including 2308, 3117, and 3215[18]. The Proposed Action would not decrease spruce below 20,000 acres and thus would contribute to achievement of the spruce objective. Dense, mature pine forest may decrease by up to 4,000 acres. Any decrease in 4C acreage in MA 5.1 would move conditions further from Forest Plan objective 5.1-204 and may affect marten habitat or connectivity corridors. A sufficient quantity and distribution of habitat would remain in the spruce zone so that marten would persist in the BHNF.

The Proposed Action would contribute toward achievement of Forest Plan objective 221 by conserving potential marten habitat, except where dense, mature pine forest is decreased in MA 5.1. Because activities in dense, mature forest are to be focused away from this management area (page 18), any decrease is expected to be minor.

The No Action alternative would have no immediate effects. It may eventually result in increased habitat in the form of dense forest.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** The No Action alternative would have ***no impact***.

Rocky Mountain Bighorn Sheep

The Rocky Mountain bighorn sheep was introduced to the Black Hills in 1924 after the native Audubon's bighorn sheep was extirpated. Bighorn sheep occur in small areas of the Black Hills, with seven sub-herds occupying portions of the Norbeck Wildlife Preserve, Custer State Park, Elk Mountain, Spring Creek, Rapid Creek, and the Deadwood area. Monitoring indicates that the bighorn sheep population increased from 2004 through 2006 and remained stable through 2009, with approximately 350 animals (Burns 2012). The BHNF is conserving habitat for the bighorn sheep consistent with objective 221 based on the trend in bighorn sheep numbers (USDA Forest Service 2015b), though some populations have been reduced due to disease, primarily pneumonia.

[18] 2308: "*During vegetation management activities on ponderosa pine forested sites, retain an average of at least 50 linear feet per acre of coarse woody debris with a minimum diameter of 10 inches. On white spruce forested sites retain an average of at least 100 linear feet per acre of coarse woody debris with a minimum diameter of 10 inches.*"
3117: *"In vegetation treatment units, leave 1 pile of woody material per 2 acres to create near-ground structure for small mammal species, except within 300 feet of buildings."*
3215: *"In areas identified as important connectivity corridors for marten, maintain canopy closure of at least 50 percent."*

Merwin (2000) suggested bighorn sheep selected areas with good visibility (less than 40 percent canopy closure) within suitable distance of water and escape terrain. Limits to persistence include limited availability of habitat in the Black Hills, vulnerability of habitat on private land to residential development, and disturbance from recreation (Benzon and Halseth 1999). Within the project area there are approximately 740,000 acres of habitat providing good visibility (grass/forb, seedling/shrub, and open forest), though not all of it is in close proximity to escape terrain.

The Proposed Action may disturb and displace bighorn sheep during treatment activities. Open forest conditions that provide good visibility and additional foraging habitat for bighorn sheep would increase. If open forest conditions occur in bighorn sheep use areas near water and escape terrain, habitat could improve. The project would contribute toward achievement of Forest Plan objective 221 by conserving and enhancing bighorn sheep habitat.

The No Action alternative would, over time, result in a decrease in preferred open habitat. This habitat is not currently a limiting factor.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing***. The No Action alternative would have ***no impact***. Bighorn sheep and their habitat would persist under either alternative.

Black-tailed Prairie Dog

Black-tailed prairie dogs are associated with shortgrass and mixed-grass prairies and require sites with soils conducive to burrowing. Suitable prairie dog habitat on the BHNF is limited to non-rocky grassland soils in the southern Black Hills (Burns 2012). The BHNF manages for 200 to 300 acres of prairie dog towns in at least three separate towns (Forest Plan objective 237). There are currently 11 known prairie dog colonies in the BHNF, covering approximately 225 acres of NFS land (USDA Forest Service 2015b).

The potential for prairie dog expansion in the BHNF is limited because their towns tend to quickly encounter private land or rocky soils that make burrowing difficult. Large areas (greater than 1,000 acres) of potentially suitable prairie dog habitat are not present in the BHNF. Existing colonies are comparatively small and disjunct from adjacent colonies (Burns 2012). Prairie dog town acreage has remained stable or increased in size, but the BHNF is at the lower limit of objective 237 (USDA Forest Service 2015b).

The Proposed Action proposes no treatments within prairie dog towns and would not affect prairie dogs. The project would contribute toward achievement of Forest Plan objective 221 by conserving prairie dog habitat. The No Action alternative would have no effect.

Determination: Both alternatives would have ***no impact*** on prairie dogs.

Northern Leopard Frog

The northern leopard frog occupies a variety of habitats (Fischer et al. 1999, Smith 2003). It is found throughout northern North America except on the West Coast (Behler and King 1979). Breeding habitat is limited to permanent water at least six inches deep that does not freeze solid. After maturing, sub-adult frogs migrate to suitable feeding sites, usually adjacent uplands. These dispersal movements may be along riparian corridors or upslope areas (Burns 2012). Adult frogs are highly mobile, moving at night or when vegetation is wet (Smith 2003). They have been found up to two miles from water (Smith 2003).

Limited data suggest that the BHNF is conserving habitat for the leopard frog (Forest Plan objective 221) (USDA Forest Service 2015b). Additional site monitoring is needed to determine if this is a long-term trend. Suitable habitat exists for the northern leopard frog in riparian areas throughout the project area.

The Proposed Action may cause direct mortality of frog eggs, larvae, and adults. Road use can cause substantial direct mortality (Smith 2003, Smith and Keinath 2007). Ground-disturbing activities may contribute sediment into waterbodies that support frogs. Adherence to Forest Plan standards (1110, 1113, etc.), WCPs, and BMPs (see pages 160-165) that minimize ground disturbing activities in riparian areas and sediment input into aquatic habitat would prevent substantial or widespread adverse effects on frog habitat. Repair of existing "connected disturbed areas" as part of proposed road work would reduce sedimentation compared to existing levels (page 161). Commercial timber harvest and other proposed activities are not expected to cause a detectable change in streamflow (page 164).

The No Action alternative would have no new effects. Disturbed areas connected to streams would continue to exist. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving leopard frog habitat.

Determination: Both alternatives ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.***

Black Hills Redbelly Snake

The redbelly snake occurs in moist woodlands with adequate cover, such as rocks, logs, tree bark, sphagnum bogs, or leaf litter. It is often found in or adjacent to riparian habitat. It is inactive from November through March (Behler and King 1979). Many Black Hills redbelly snakes have been found in riparian areas, aspen stands, mesic meadows, or meadow fringes near rocky outcrops and under various cover objects (Smith and Stephens 2003). Stumps and downed woody material are important in maintaining moist conditions; as roots of stumps decay, they provide cover (USDA Forest Service 2000, Smith and Stephens 2003). Activities that enhance riparian and aspen habitat improve habitat for the redbelly snake (USDA Forest Service 2015b).

The greatest threat to redbelly snakes populations may be the loss of moist habitats (Smith and Stephens 2003). The northern Black Hills provides more suitable habitat than other areas of the BHNF (USDA Forest Service 2000).

The Proposed Action may cause direct mortality. Aspen enhancement activities, especially in riparian areas, would improve potential redbelly snake habitat. If any proposed new roads would run between wetlands and potential hibernacula, the road would be moved, not constructed, or coordinated with a wildlife biologist (Forest Plan standard 3116). Adherence to this and other Forest Plan standards (1301, 1304, 1306, 3106), WCPs, and BMPs focused on protection of streams and riparian areas would prevent substantial or widespread adverse effects on riparian habitat (page 165). Although the Proposed Action may negatively affect individual snakes, the dominant effect would be enhancement of potential snake habitat.

The No Action alternative would cause no new effects. Over time, continuing encroachment of pine into moist aspen habitats may reduce potential habitat. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving redbelly snake habitat.

Determination: Both alternatives ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.***

Regal Fritillary

The Black Hills are at the western margin of the regal fritillary butterfly's range. This species requires open prairies (Royer and Marrone 1992) and wet meadows (Selby 2007). In South Dakota, regal fritillary is most likely to be found in native tall-grass prairies composed of big bluestem, western wheatgrass, and green needlegrass (Royer and Marrone 1992). Contiguous prairies of at least 1,000 acres may be required for stable populations (Royer and Marrone 1992). Most of the project area is forested and contains only relatively small patches of suitable habitat, most of which are in the lower elevations along the outer BHNF boundary. Suitable habitat may also exist in interior prairies, though tall-grass species do not dominate these areas (Burns 2012).

Regal fritillary caterpillars feed exclusively on violet leaves. Adults require a continuous source of nectar-producing flowers, such as coneflowers, fleabanes, and thistles (Royer and Marrone 1992). Forest Plan guideline 3105 requires consideration of habitat needs of regal fritillary prior to prescribed burning in meadows and grasslands.

Neither alternative would affect native mixed-grass or tall-grass prairie. Because the project area contains limited habitat for this butterfly, the Proposed Action would have no more than negligible effects on this species. The project would contribute toward achievement of Forest Plan objective 221 by conserving regal fritillary habitat.

Determination: Both alternatives would have ***no impact*** on regal fritillary.

Monarch Butterfly

This large, familiar, orange and black butterfly occurs from southern Canada in North America south to northern South America (Marrone 2002). The monarch depends on milkweed as a larval host plant and is known for its long annual migrations and overwintering in large groups. One female monarch tagged in Bowdle, South Dakota was later reported 1,776 miles away near Sierra Chincua, Mexico (Marrone 2002). Potential monarch habitat in the Black Hills region consists of open areas, including prairie, forest meadows, fields, marshes, and roadsides (Marrone 2002).

The Proposed Action may result in direct mortality. These activities may also increase suitable habitat through thinning, burning, and road work, which would disturb soil and set back habitat into earlier successional stages in which milkweed may occur. Increased open habitat may provide nectar sources and travel corridors for these habitat generalists. The project would contribute toward achievement of Forest Plan objective 221 by conserving and enhancing monarch habitat.

The No Action alternative would have no immediate effects. Eventually, lack of action could result in loss of some open habitats.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** The No Action alternative would have ***no impact.***

Cooper's Rocky Mountain Snail

The Cooper's Rocky Mountain snail is found in moist environments especially spruce and mixed spruce/pine, in lowland wooded areas, riparian toe slopes, or talus slopes, generally with north to east exposure. This snail is loosely tied to calcareous soils and limestone outcrops. It forages on decayed deciduous tree leaves and degraded herbaceous vegetation. In suitable habitat, this snail can be found crawling on decaying woody debris (Frest and Johannes 2002). Forest litter is an important habitat component.

Populations are found mainly at certain sites in the northwestern Black Hills. Many of the colonies, including most of the largest, are found in ponderosa pine with a partially closed canopy, secondary deciduous tree component, and diverse understory. White spruce is a component at some sites. Colonies are also found in riparian woodland communities, often adjacent to steep, rocky slopes.

Threats to this species are habitat loss due to logging, grazing, forest fires, road construction, and other disturbances that alter moist microclimates. Timber harvest and grazing may affect snails by altering the amount of litter, soil moisture, or temperature (Anderson 2005). Road construction and maintenance can affect snails by eliminating habitat or killing snails. Roadside brushing or weed spraying can negatively affect snails or their habitat (Anderson 2005). Snails often depend on undisturbed forest and riparian habitat, making them especially vulnerable to the effects of habitat degradation and environmental change (Frest and Johannes 2002).

The Proposed Action may cause direct mortality and change microclimates, damaging or destroying unknown snail colonies. Management of known colonies consistent with Forest Plan standard 3103[19] would protect microsite conditions and minimize adverse effects on these colonies.

The No Action alternative would have no direct effects. The potential for high-intensity surface fire resulting from existing fuel conditions (page 80) would remain elevated; this type of wildfire could eliminate snail habitat. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving Cooper's Rocky Mountain snail habitat.

Determination: The Proposed Action and the No Action alternative ***may adversely impact individuals, but are not likely to result in a loss of species viability on the Planning Area, nor cause a trend toward federal listing***.

Western Bumble Bee

Western bumble bees typically nest underground in cavities such as abandoned rodent burrows (Koch et al. 2012). They are generalist foragers (Koch et al. 2012) and have been reported visiting a wide variety of flowering plants. Bumble bees require plants that bloom and provide adequate nectar and pollen throughout the colony's life cycle, which for this species is from early February to late November (depending on elevation) (Hatfield et al. 2015).

Western bumble bee populations are experiencing dramatic declines (Koch et al. 2012). This bee is also faced with other stressors, including habitat loss and alteration due to agricultural intensification, urban development, conifer encroachment resulting from fire suppression, grazing, logging, and climate change (Hatfield et al. 2015). Insecticides and herbicides both pose serious threats to bumble bees. Of particular concern are neonicotinoids, whose toxins are persistent and accumulate in the nectar and pollen of plants and have both lethal and sublethal effects on bumble bees (Hatfield et al. 2015).

In forested areas such as the BHNF, bumble bees are commonly found around flowers along streams, in meadows, recently burned or logged area, and along roadsides (Koch et al. 2012).

[19] "*Manage known sensitive species and species of local concern snail colonies to: a) Retain overstory sufficient to maintain moisture regimes, ground level temperatures and humidity. b) Retain ground litter, especially deciduous litter. 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. d) If prescribed burning is unavoidable, burn when snails are hibernating, usually below 50 degrees Fahrenheit, and use fast-moving fires to minimize effects to snails. e) Control invasive weeds, but use herbicides when snails are not on the surface, and treat individual plants rather than broadcast application.*"

The Proposed Action could result in direct mortality of bumble bee eggs, larvae, or adults. Soil-disturbing activities could destroy burrow habitat. Proposed activities would result in conditions favorable for flowering plants, which could provide increased pollen and nectar opportunities. An increase in open habitats may provide additional suitable habitat and travel corridors for these habitat generalists. Neonicotinoid herbicides are not used for noxious weed control on the BHNF. The project would contribute toward achievement of Forest Plan objective 221 by conserving western bumble bee habitat.

The No Action alternative would have no immediate effects. Eventually, lack of action could result in loss of some open habitats.

Determination: The Proposed Action ***may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*** The No Action alternative would generally have ***no impact.***

Species of Local Concern

Species of Local Concern (SOLC) are plant, fish, and wildlife species (including subspecies or varieties) that do not meet the criteria for sensitive status. These include species with declining trends in only a portion of Forest Service Region 2 or those that are important components of diversity in a local area. The local area is defined as NFS lands within the BHNF. All SOLC species in the BHNF and/or their habitats occur in the project area.

American Dipper

The Proposed Action would conserve habitat for dippers in accordance with Forest Plan objective 221 through fuel reduction treatments that would reduce fire hazard in watersheds with known or potential dipper habitat. Proposed activities would result in no more than minor, temporary increases in streamflow (page 164). Adherence to Forest Plan standards (1113, 1203, 1301, etc.), WCPs, and BMPs (see pages 160-165) focused on protection of streams and riparian areas would prevent substantial or widespread adverse effects on dipper habitat. The No Action alternative would have no effect on dippers.

Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving dipper habitat. This species is expected to continue to persist in the BHNF under either alternative.

Black-and-white Warbler

The Proposed Action could result in direct mortality. Proposed activities would increase open, diverse, and resilient forests. Enhancement of oak woodlands by removing pine may benefit warblers. At lower elevations in and near oak woodlands, these effects would conserve and improve habitat for this species (Forest Plan objective 221).

The No Action alternative would have no immediate effects. Eventually, lack of action could result in loss of some suitable habitat due to pine encroachment. Should a high intensity fire occur, oak is a prolific sprouter, and would rapidly increase and expand in the absence of pine competition to the benefit of warblers.

This species would persist under either alternative.

Broad-winged Hawk and Cooper's Hawk

The Proposed Action may result in direct mortality if unknown nests are affected by proposed activities. Adherence to Forest Plan standard 3204 (protection of known raptor nests) would prevent negative effects on known nests. Proposed fuel breaks in dense, mature pine stands could reduce potential nesting habitat. Generally, these treatments would occur in the WUI, along roads, and near infrastructure, which is not the most sustainable nesting locations for these species. Site-specific coordination with a wildlife biologist to design treatments would help to avoid/minimize the loss of nesting habitat. Proposed aspen treatments may improve foraging habitat and, for broad-winged hawk, nesting habitat. New roads could result in disturbance of unknown nests.

See page 104 for discussion of potential effects of both alternatives on dense, mature pine forest habitat. Effects on broad-winged and Cooper's hawks would be similar. Because proposed activities would protect known nests, conserve most potential nesting habitat, and enhance foraging habitat, the Proposed Action would contribute toward achievement of objective 221 for these hawks. The No Action alternative would not affect these species or their habitat. Broad-winged and Cooper's hawks would persist in the BHNF under either alternative.

Northern Saw-whet Owl

The Proposed Action may result in direct mortality or disturbance if unknown nests are affected by proposed activities. Adherence to Forest Plan standard 3204 would protect known nests. Proposed fuel breaks in dense, mature pine stands could reduce potential nesting habitat. Overstory removal would move open, mature pine stands to younger stages, conserving habitat diversity (USDA Forest Service 2015b). Precommercial thinning and prescribed fire would decrease density in young pine stands, which this owl uses for roosting. Foraging habitat, which consists of diverse, open stands and forest edges, would increase.

See page 104 for discussion of potential effects of both alternatives on dense, mature pine forest habitat. Effects on saw-whet owls may be similar, though this species nests in a variety of habitats (Johnson and Anderson 2003). The Proposed Action would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcut would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Because proposed activities would protect known nests, conserve most potential nesting habitat, and enhance foraging habitat, the Proposed Action would contribute toward achievement of objective 221 for the saw-whet owl. The No Action alternative would have no immediate effects. Over time, roosting and foraging habitat could decrease as pine stands age and become denser. This species would persist in the BHNF under either alternative.

Pygmy Nuthatch

The Proposed Action may result in direct mortality or disturbance if unknown nests or roosts are affected by proposed activities. The Proposed Action would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain some live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest. Preferred mature pine habitat would also decrease, though not to the extent of becoming a limiting factor.

Because proposed activities would conserve most snags and foraging habitat, the Proposed Action would contribute toward achievement of objective 221 for the pygmy nuthatch. The No Action alternative would have no effect. This species would persist in the BHNF under either alternative.

Sharp-shinned Hawk

The Proposed Action may result in direct mortality or disturbance if unknown nests are affected by proposed activities. Adherence to Forest Plan standard 3204 would protect known nests. Proposed overstory removal would increase preferred nesting habitat (dense to moderately dense, young pine forest), as would regeneration of previously infested and thinned stands. At the same time, proposed precommercial thinning and prescribed fire would reduce density in some of the same stands. Projections indicate that preferred forest structures would increase over the next 20 years (page 55). Foraging habitat would remain stable, with management activities providing a variety of structural stages and cover types used by diverse prey species. The project would contribute toward achievement of Forest Plan objective 221 by conserving and enhancing sharp-shinned hawk habitat.

Because proposed activities would protect known nests and conserve potential nesting and foraging habitat, the Proposed Action would contribute toward achievement of objective 221 for the sharp-shinned hawk. The No Action alternative would have no immediate effect. Over time, nesting habitat could decrease as young pine stands age. This species would persist in the BHNF under either alternative.

Bats: Long-eared Myotis, Long-legged Myotis, Northern Myotis, and Small-footed Myotis

The Proposed Action could result in direct mortality due to tree and snag (hazard tree) felling. Activities conducted when maternity roosts consist of females with pups that cannot yet fly pose the greatest mortality risk to bats. Potential loss of occupied daytime roost trees may negatively impact individuals. The Proposed Action would reduce the number of large trees in open, mature pine stands and snags (hazard tree removal) while increasing open forests. Proposed activities would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Maintenance of aspen and oak would perpetuate foraging habitat. Insect prey populations may increase with understory vegetation in treated areas. Adherence to Forest Plan standards 1401 and 3207 would protect known and potential nurseries and hibernacula in accordance with standard 3102 (see page 114). The project would contribute toward achievement of Forest Plan objective 221 by conserving and enhancing habitat for these bat species.

The No Action alternative would have no direct or immediate indirect effects. Over time, formation of additional snags may increase roosting habitat.

These bats are likely to persist in the BHNF under both alternatives due to protection of caves and mines as well as the availability of foraging habitat and expected snag densities.

Meadow Jumping Mouse

The Proposed Action may result in direct or indirect mortality. This effect would not occur at a scale that could result in population decline across the BHNF. Adherence to Forest Plan standards 1301, 1302, and 3106 (protection and avoidance of riparian areas), in addition to WCPs and BMPs, would conserve habitat in accordance with objectives 213 and 221 (pages 160-165). Proposed mechanical site

preparation and tree planting would decrease moderately suitable jumping mouse habitat (dry upland areas dominated by grass) in the southern portion of the project area.

The No Action alternative would have no immediate effects. Preferred meadow and grassland habitat would decrease over time due to pine encroachment.

This species is likely to persist in the BHNF under both alternatives due to protection of riparian and meadow habitats.

Mountain Goat

The Proposed Action would increase preferred open forest conditions. If this effect occurs near cliffs that serve as escape terrain, it may result in improved foraging habitat for mountain goats. No activities are proposed in Norbeck Wildlife Preserve, where the majority of the goat population occurs. The project would contribute toward achievement of Forest Plan objective 221 by conserving mountain goat habitat.

The No Action alternative would have no immediate effects. Preferred open habitats may decrease over time due to pine encroachment.

Mountain goats would persist in the BHNF under either alternative.

Northern Flying Squirrel

The Proposed Action may result in direct mortality and could displace flying squirrels. These effects would not occur at a scale that could result in population declines across the BHNF. Diversity in pine habitats would increase in treated areas. Proposed activities may remove roost trees and snags (hazard trees) and decrease occurrence of large, live trees that could provide future snags. Proposed activities would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Dense, mature pine forest may decrease by up to 4,000 acres in shaded fuel breaks. Site-specific coordination with a wildlife biologist may retain some of this habitat where it would not compromise the effectiveness of the treatment. Any decrease in 4C in MA 5.1 would move conditions further from Forest Plan objective 5.1-204. Because activities in dense, mature forest are to be focused away from this management area (page 18), any decrease is expected to be minor.

The No Action alternative would have no immediate effects. Preferred dense forest and snag habitats may increase over time. Both alternatives would contribute toward achievement of Forest Plan objective 221 by conserving northern flying squirrel habitat.

Because flying squirrels can exist in a variety of habitats, they would persist under either alternative.

Butterflies: Atlantis Fritillary and Tawny Crescent

The Proposed Action may result in direct mortality of adults and larvae, particularly in meadow and riparian areas. Most activities would maintain or enhance preferred open forests, aspen and oak habitats, and grasslands in accordance with objective 221. Mechanical site preparation and tree planting in the southern Hills would decrease open areas. The project would contribute toward achievement of Forest Plan objective 221 by conserving Atlantis fritillary and tawny crescent habitat.

The No Action alternative would have no immediate effects. Preferred habitats may decline over time.

The Atlantis fritillary and tawny crescent would persist in the BHNF under either alternative.

Snails: Callused Vertigo, Frigid Ambersnail, Mystery Vertigo, and Striate Disc

The Proposed Action may cause direct mortality and change microclimates, damaging or destroying unknown snail colonies. Management of known colonies consistent with Forest Plan standard 3103 (page 119) would protect microsite conditions and minimize adverse effects on these colonies. The project would generally contribute toward achievement of Forest Plan objective 221 by conserving snail habitat.

The No Action alternative would have no immediate effects. Fire hazard may increase over time; high-severity wildfire could threaten snail colonies.

These snail species would persist in the BHNF under either alternative.

Rocky Mountain Elk

Analysis of project effects on elk is not required but is included here due to strong public interest in the general subject. Recent estimates place the South Dakota elk population level at about 3,200 (Huxoll 2010), which is a decline from 2001 levels. No population estimates are available for the Wyoming portion of the Black Hills. The Wyoming elk herd appears to be growing but at a slower rate than in the past (Sandrini 2012). The BHNF has committed to managing habitat for 4,350 elk, which is the combined population objective established by the two state game agencies in 1996 (objective 217).

Elk use a wide variety of habitats but show a preference for forested riparian areas, forested stringers in meadows, and stands of birch or aspen (SAIC 2003). Elk find thermal and hiding cover in denser stands of conifers (in summer and winter) and hardwoods (in summer only). They forage in open stands, meadows, and prairies (SAIC 2003).

Roads negatively affect elk in various ways. According to Rowland et al. (2004):

- The loss of habitat to road construction is often estimated at five acres per linear mile.
- Roads may affect habitat by reducing the number of forest cover patches that are large enough to function effectively as elk habitat.
- Roads may also affect elk habitat by facilitating the spread of invasive, exotic vegetation.
- Roads and motorized trails can also impact animals directly. In addition to mortality from collisions with vehicles, elk avoid areas near open roads, are more vulnerable to hunter harvest, and exhibit higher stress levels in areas of higher road density.

Several studies in the Black Hills have shown that elk are adversely affected by roads (Millspaugh et al. 2000, Millspaugh 1999, Rumble et al. 2005). Rumble et al. (2005) found that elk movements increased with human activity during the hunting season. They suggested this response to hunters may reflect a pattern of elk responses to human disturbance during other times of the year.

The Proposed Action may result in direct mortality and displacement. Calves would be most vulnerable from approximately May to July. Proposed activities would also create more diverse and open conditions suitable for foraging. Dense forest would decrease while aspen may expand. Aspen enhancement would maintain or increase preferred calving habitat.

Suitability of elk habitat would decline in the vicinity of roads temporarily opened during implementation of the Proposed Action. This decline would persist as long as the roads are open to motorized vehicles.

Elk population response to habitat changes depends on the arrangement of cover and forage. Elk may not use potential foraging areas if lack of cover increases susceptibility to predation or disturbance. The arrangement of cover and forage resulting from this project would depend on the exact locations of proposed activities, which would be determined in an interdisciplinary setting (page 17). Adherence to guideline 3203 would provide big game screening along at least 20 percent of the edges of arterial and collector roads.

The No Action alternative would have no immediate effects. Security and thermal cover may increase over time while foraging areas decrease.

Elk would be likely to persist in the BHNF under either alternative.

Management Indicator Species

In principle, trends in management indicator species (MIS) populations or habitat represent trends in other species associated with the same habitat and can indicate overall changes in the forest ecosystem. MIS are generally monitored based on trends in habitat, but population trend data may be used when available. USDA Forest Service (2015b) contains the latest monitoring data. This analysis addresses species that occur, or for which habitat occurs, in the project area.

White-tailed Deer

White-tailed deer inhabit a wide variety of habitats and are extremely adaptable, making this species the most widespread deer in North America. The Forest Plan designates white-tailed deer as an indicator for early successional ponderosa pine forests. In the Black Hills, aspen and birch stands are prominent features in white-tailed deer selection of home ranges and use of sites within these ranges (Stefanich 1995). Kennedy (1992) suggested aspen stands are highly selected during fawning. There are 44,211 acres of aspen and birch habitat in the project area. There are also 56,512 acres of mixed pine and aspen that contribute to deer habitat. Forage production can be increased through prescribed burning and reduction of pine shading and litter (DePerno et al. 2002).

Road construction and road density can affect deer habitat. High open road density alters both human and animal behavior, contributing to animal displacement and stress (SAIC 2003). Screening cover along roads can reduce this effect (guideline 3203).

White-tailed deer numbers are increasing across the Black Hills. In the South Dakota portion of the BHNF, 2016 population was estimated at 51,000 animals (Robling 2017). In the Wyoming Black Hills, the white-tailed deer population was estimated at 52,080 in 2015 (Sandrini 2016). White-tailed deer are currently above the population objective in South Dakota and five percent below the objective in Wyoming. Across the BHNF, foraging habitat is increasing and security and thermal cover are decreasing (USDA Forest Service 2015b).

Proposed activities would result in younger, more open forest, indicating an increase in deer foraging habitat and a decrease in security and thermal habitat. Activities that remove or thin pine would reduce screening cover for up to a decade and thermal cover for up to 20 years. Aspen enhancement would increase preferred summertime habitat, while oak enhancement would benefit fall and winter habitat. The project would contribute toward achievement of Forest Plan objectives 217 (*"Maintain habitat for game and fish populations at the state objectives in effect in 1996"*) and 238a (maintain or enhance habitat for MIS) by conserving or enhancing white-tailed deer habitat.

The No Action alternative would have no immediate effects. Security and thermal cover may increase over time while foraging areas decrease.

Beaver

The American beaver was selected as an MIS because of its influence on riparian/aquatic habitat conditions and its status as a keystone species (USDA Forest Service 2005a). General requirements include suitable riparian habitat dominated by stands of willow, aspen, or cottonwood.

In Wyoming and South Dakota, beaver are widely distributed and ranked apparently secure (S4), and secure (S5), respectively (NatureServe 2017). Limits to persistence may include degradation or loss of riparian shrubs and forests due to historical management activities as well as loss of hardwood forest on adjacent uplands.

Beavers were heavily trapped in the Black Hills and by the late 1800s were restricted to remote areas (Parrish et al. 1996). During the 1930s, efforts were made to increase beaver populations; harvest restrictions were imposed and populations were supplemented with animals from the eastern part of South Dakota. Beavers are still periodically transplanted into the BHNF in cooperation with state game and fish agencies.

A 2007 survey estimated about 38 beaver colonies in the BHNF (USDA Forest Service 2010c). A survey conducted in 2012 documented 60 caches (USDA Forest Service 2015b). The BHNF is meeting objective 238a based on the increase in beaver abundance and distribution between 2007 and 2012 (USDA Forest Service 2015b).

Proposed aspen enhancement near streams and wetlands would increase potential foraging habitat. Proposed activities would not result in a measurable increase in streamflow (page 164). Proposed activities would contribute toward achievement of objective 238a by maintaining or enhancing beaver habitat.

The No Action alternative would have no immediate effects on beavers. Foraging habitat may decrease over time.

Black-backed Woodpecker

Black-backed woodpecker is selected as an MIS because of its association with dense, mature live and burned pine forest. See species discussion and effects on page 110. The Proposed Action would contribute toward achievement of Forest Plan objective 238b (maintain or enhance habitat for MIS) by implementing treatments that would move the forest toward the desired structural stages. Post-wildfire salvage is not proposed. Snag management consistent with objective 211 and standard 2301 (page 63) is expected to conserve black-backed woodpecker habitat.

Brown Creeper

The brown creeper is selected as an MIS because of its association with old-growth ponderosa pine stands. Creepers prefer large, unfragmented, mature and old-growth stands with dense canopies and large live and dead trees (Hejl et al. 2002, Wiggins 2005a). Hejl et al. (2002) suggested that the most critical feature related to the selection of breeding areas is the presence of large trees and snags.

Breeding bird surveys in the BHNF have revealed that well over 90 percent of observations of brown creepers during the breeding season are in mature or old-growth forests, primarily spruce and late-successional ponderosa pine (Panjabi 2001, 2003, Giroir et al. 2007). Creepers are very sensitive to habitat fragmentation and changes in forest structure resulting from all forms of tree harvesting (Dykstra et al. 1999, Hutto 1995). Brown creepers generally prefer unburned forests (Hutto and Young 1999, Kotliar et al. 2002) but also use moderately burned forests. Matseur (2017) found the bird closely linked with white spruce and four- to five-year-old wildfire areas.

In 2005, data suggested that brown creepers were well distributed throughout the Black Hills (USDA Forest Service 2007a). Relative density decreased between 2013 and 2014, the most recent year for which data are available (USDA Forest Service 2015b). It is unknown whether this was a temporary drop or the beginning of a downward trend. Efforts to determine population trend are ongoing. Overall, the species appears to occur in very low densities, being most abundant in late successional pine forests and spruce habitats (Matseur 2017).

The Proposed Action would have the potential to cause loss of nesting and foraging habitat in ponderosa pine. Adherence to snag standards and the limited treatment of spruce (which is above the Forest Plan objective) would address this to some degree. The BHNF currently meets Forest Plan objective 211 regarding snag habitat (page 53). The Proposed Action would not reduce snag occurrence below Forest Plan objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Structural stage objectives for MAs 4.1, 5.1, 5.4, 5.43, and 5.6 were designed to ensure wildlife population viability and provide a balance of habitat conditions across the BHNF. Due to mountain pine beetle infestation, timber harvest, and wildfire, structural stages providing brown creeper habitat are currently below objectives. The objectives state that dense, mature pine should form a combined 10 percent of the pine forest area. In the five MAs combined, these structural stages currently form approximately six percent of the pine forest area. Most of this habitat is in the northern and eastern Black Hills and the Bear Lodge Mountains. Very little exists in the central Black Hills.

Potential nesting habitat may decrease by up to 4,000 acres due to proposed fuel break construction in dense stands. These treatments are focused in the WUI, along roads, and near infrastructure in areas typically less sustainable for dense nesting habitat. No activities that may decrease late succession characteristics would occur in late succession pine stands (design features, page 38). Fuel breaks may occur in various management areas but would be focused on MA 5.4 (page 18), which has a higher percentage of dense, mature forest than other MAs (page 55). Close coordination with wildlife biologists would be required during layout and implementation to assess tradeoffs between potential habitat and fuel break location. While potential habitat may decrease, the above measures would decrease the likelihood of adverse effects on nests and maintain most existing, potential nesting habitat while increasing potential public and firefighter safety in key locations.

The No Action alternative would have no immediate effects. Over time, additional preferred habitat would develop. Increased difficulty of fire suppression and potential for high-severity fire could provide the recently burned habitat used by the species. Both alternatives would conserve habitat for this species in accordance with Forest Plan objective 238a.

Golden-crowned Kinglet

In the Black Hills, golden-crowned kinglets are found primarily in spruce forests (Panjabi 2003, Giroir et al. 2007, White et al. 2010). This is the basis for its MIS selection. They may also use late-successional ponderosa pine, aspen, and wet meadows (Panjabi 2003). Populations are probably limited by the abundance, distribution, and condition of spruce habitat. BHNF spruce acreage appears to be relatively stable or slowly increasing (USDA Forest Service 2015b). Spruce habitat in the Black Hills is naturally patchy and of low abundance. It occurs at high elevations, on north aspects, and in shaded canyons, dominating approximately 24,289 acres in the project area. The BHNF is

currently meeting Forest Plan objective 239-LVD regarding spruce acreage[20]. Relative density has declined since 2009 (USDA Forest Service 2015b).

Proposed prescribed fire, shaded fuel breaks, and removal of conifers from aspen may result in incidental decreases in spruce habitat, though these activities would be unlikely to occur in spruce-dominated stands. The project would contribute toward achievement of Forest Plan objective 238c by conserving spruce habitat. The No Action alternative would have no immediate effects. Preferred habitat may increase over time.

Grasshopper sparrow

See species discussion on page 110.

Grasshopper sparrow represents prairie grassland habitats. Proposed removal of encroaching pine from grasslands and prescribed fire would maintain grassland habitats in the project area. The Proposed Action would contribute toward achievement of objective 238a by maintaining or enhancing grasshopper sparrow habitat. The No Action alternative would have no immediate effects. Preferred habitat may decrease over time due to pine encroachment.

Ruffed Grouse

Ruffed grouse represent aspen habitats. Along with their preferred habitat, they are most abundant in the northern Black Hills. Sapling-pole aspen is considered optimal habitat (Wiggins 2006). Grouse populations decline when aspen is removed, even if alternative food sources are plentiful. Conifers in close proximity to aspen stands may be desirable for winter cover (DeGraaf et al. 1991). Ruffed grouse are fairly sedentary and tend to spend their entire lives within one mile of the natal nest site.

Long-term habitat and population trend data for grouse suggest declining aspen habitat and grouse numbers (USDA Forest Service 2015b). On the other hand, harvest data (Sandrini 2005) suggest ruffed grouse numbers are increasing.

Proposed activities would maintain and increase aspen habitat. The Proposed Action would contribute toward achievement of Forest Plan objective 238a by conserving and enhancing ruffed grouse habitat. The No Action alternative would have no immediate effects. Preferred habitat may decrease over time unless it is regenerated by wildfire.

Song Sparrow

In the Black Hills, the song sparrow is strongly associated with riparian habitats (Giroir et al. 2007). Song sparrows are found throughout the project area but, along with surface water, are more common in the northern portions. Habitat trend across the BHNF is not known because data on riparian condition is not collected, but projects are frequently implemented to improve riparian condition (USDA Forest Service 2015b). Breeding Bird Survey data showed sparrow populations were stable to slightly increasing in the Black Hills (Sauer et al. 2011).

Proposed activities would result in no more than minor, temporary increases in streamflow. Adherence to Forest Plan standards (1301, etc.) as well as WCPs and BMPs (see page 165) would prevent substantial or widespread adverse effects on riparian habitat. The Proposed Action would contribute toward achievement of Forest Plan objective 238a by conserving song sparrow habitat. The

[20] *"Manage for 20,000 acres of spruce across the Forest using active management to achieve multiple-use objectives. Treat spruce within 200 feet of buildings, where spruce has encroached into hardwoods, and for emphasis species management."*

No Action alternative would have no immediate effects. Preferred habitat is likely to remain stable over time.

Migratory Birds

The U.S. Fish and Wildlife Service partitions North America into 37 Bird Conservation Regions (USFWS 2008). The Black Hills is included in BCR 17 (Badlands and Prairies). Twenty of the 38 bird species of conservation concern found in BCR 17 are not expected to occur in the Black Hills due to lack of habitat. Eleven are on the Region 2 Sensitive species list and are evaluated above if they have potential to occur in the Black Hills. Of the remaining species, four may occur in the project area.

Golden Eagle

Golden eagles inhabit open country. They prefer to nest on cliff ledges but will occasionally use trees. Hilltops, cliff ledges, and trees are used for roosting (DeGraff et al. 1991). Contiguously forested habitats such as those found in the project area are not preferred habitat but may be used for roosting or perching if suitable nesting or foraging habitat is nearby. Forest Plan standard 3204 provides protection for golden eagle nests.

The Proposed Action could disturb nesting birds. Hunting success may increase due to the creation of more open habitat. Reduction of pine overstory in treated areas would improve habitat for many eagle prey species. Proposed commercial timber harvest would reduce the number of potential nest trees, but trees large enough to be used for nesting are not a limiting factor. The No Action alternative would have no impact on the eagle. Golden eagles would persist under either alternative.

Red-headed Woodpecker

Red-headed woodpeckers prefer open, park-like woodlands, particularly in riparian areas. They use open and edge habitats more than some other woodpeckers but still depend on snags and decaying trees (Anderson 2003). In the Black Hills, they are generally uncommon to rare. Currently they occur in very low densities across the BHNF, with higher densities possible in burned areas (White et al. 2010).

The Proposed Action would not reduce snag occurrence below objective 211 levels (page 62). Activities other than patch clearcuts would retain live trees that may provide future snags. Patch clearcuts would be relatively small (less than 10 acres each) and scattered within a matrix of live forest.

Proposed activities would maintain or expand existing aspen and oak habitats. Though use of the project area by red-headed woodpeckers is rare, these effects may benefit the species through increased mast production and decreased forest density (Anderson 2003).

The No Action alternative would have little effect on this species. Potential habitat may eventually decrease if forest becomes denser and encroaches on openings. Red-headed woodpecker would persist under either alternative.

Black-billed Cuckoo

This species favors low, dense, shrubby vegetation (DeGraff et al. 1991). It will also inhabit open woods, avoiding extremely dense woods and high elevations (Haldeman 1980).

The Proposed Action may disturb nesting birds. Reduction of pine canopy cover may result in an increase in understory vegetation productivity, which may enhance potentially potential habitat.

Suitable habitat would remain under either alternative. The No Action alternative may eventually allow pine overstory to increase, decreasing potential cuckoo habitat. This species is likely to persist under either alternative.

Prairie Falcon

Prairie falcons are year-round residents of Wyoming and far western South Dakota. They nest on cliffs (Tallman et al. 2002, DeGraff et al. 1991). Hunting occurs in open areas. Observations in the Black Hills are primarily along the outer edges where cliffs provide nest sites adjacent to open grasslands (Panjabi 2003).

The Proposed Action would maintain or expand open habitats. Though prairie falcons are rare or absent in most of the project area, this effect may enhance habitat where it occurs near the edge of the Black Hills. The No Action alternative would have little effect on this species. Potential habitat may eventually decrease if forest continues to encroach on openings. Prairie falcons would persist under either alternative.

Cumulative Effects

The cumulative effects analysis area for wildlife includes the breeding territory or home range of each species. These vary widely in size and may include non-NFS lands, including those outside the BHNF boundary. Available information regarding ongoing and foreseeable activities on non-NFS lands is discussed starting on page 49. No large-scale land use changes are currently foreseen. Therefore, this analysis primarily considers cumulative effects related to activities on NFS lands. The timespan for cumulative effects analysis is the present through 2038, or 10 years after the probable completion of proposed activities. By this time, it is likely that the project's effects on wildlife species and habitat would become difficult to distinguish from those of other activities and events.

Fire suppression will continue to allow fuel accumulation, increases in pine stand density, and encroachment of pine into other vegetation communities. Timber sales have reduced pine stand density and the number of large trees and snags. Post-sale activities and prescribed fire are also generally expected to reduce pine stand density. Proposed prescribed fire and removal of conifers from aspen are likely to promote fire resistance and non-conifer vegetation communities. Proposed construction of new roads would increase the amount of wildlife habitat lost or modified due to roads. Disturbance to wildlife from motor vehicle use generally ends after the roads are rehabilitated or closed to public use, though increased habitat fragmentation may persist. Residential development of private lands has displaced some species and altered habitats.

Post-wildfire salvage in the BHNF has been limited because the timber must be removed almost immediately or value is lost due to wood-boring insects. Other constraints, such as steep slopes and watershed protection measures, have also limited salvage. Any post-fire salvage that occurs in the reasonably foreseeable future would follow the *Post-Wildfire Forest Plan Implementation Guidance* (USDA Forest Service 2017b) associated with meeting Forest Plan objective 11-03[21]. Through this objective, the BHNF strives to provide recently burned habitat for species, in particular the black-backed woodpecker, that are associated with post-fire conditions while allowing some removal of

[21] *"Following a wildfire, dead trees will be available for value recovery. Retain 50 percent of the recent (0 to 5 years) stand-replacing fire acreage up to 10,000 acres Forest-wide. Generally the highest priority areas to retain are those with greater than 70-percent pre-fire canopy closure. The following will be included in determining if the 10,000-acre figure has been met: stand-replacing fire and associated out-year fire/insect mortality, and relatively large blocks of stand-replacing insect outbreaks that can be combined into 1,000-acre areas. Standard 2301a does not apply to the salvaged area."*

damaged trees for commercial or safety reasons. The top priority for retention is moderate/ high-severity burned pine stands that were dense, mature forest prior to burning.

The Proposed Action would add to the above effects of timber sales, prescribed fire, removal of conifers from aspen, and road construction. As discussed on page 55, it would reduce acreage of dense, mature forest as compared to the No Action alternative through construction of shaded fuel breaks. It would also reduce the number of large trees and snags (through hazard tree removal), though efforts to retain some of the denser canopy open, mature pine stands so that they may increase in density, and the designation of some open, mature stands as late succession, would have a positive effect. Because the additive effects would remain within or trend toward Forest Plan desired conditions, these changes would not threaten the persistence of any species in the BHNF. The Proposed Action would not authorize post-wildfire salvage, though some treatment of burned habitat could occur if live trees in a harvest unit/treatment area that was already under contract are subsequently burned before treatment activities are completed.

Fisheries

Summary

Direct effects on fisheries would generally be limited to in-water activities associated with road-stream crossings. These effects would be localized and minimized by seasonal restrictions to avoid in-water activities during fish spawning seasons. Indirect effects on aquatic/riparian habitat would be avoided and minimized through implementation of Forest Plan standards/guidelines and Watershed Conservation Practices. Three Sensitive fish species occur in the BHNF: finescale dace, lake chub, and mountain sucker. Both alternatives would have no impact on finescale dace and lake chub. Both alternatives may adversely impact individual mountain suckers neither is likely to result in loss of viability in the planning area, nor trend toward listing. The mountain sucker is also a Management Indicator Species. The Proposed Action is predicted to maintain habitat quality and connectivity, consistent with Forest Plan objective 238d (maintain or enhance habitat for MIS), and is expected to have a neutral effect on population trend of mountain sucker across the BHNF.

Information Sources

See page 100.

Management Indicator Species

Trends in management indicator species (MIS) populations or habitat represent trends in other species associated with the same habitat and can indicate overall changes in the forest ecosystem. MIS are generally monitored based on trends in habitat, but population trend data may be used when available. USDA Forest Service (2015b) contains the latest monitoring data. This analysis addresses species that occur, or for which habitat occurs, in the project area.

Mountain Sucker

The mountain sucker occurs most often in cool, clear mountain streams with moderate water velocities. Stream substrate associated with mountain sucker habitat varies widely and ranges from mud to sand, gravel, and boulders, though cobbles are most common. This species is found on the

stream bottom and is closely associated with cover (exposed roots, undercut banks, logjams, and boulders). Mountain suckers are bottom feeders and their diet is primarily simple plants like diatoms and green algae. Mountain sucker adults spawn over gravel riffles and use lower velocity, deeper habitats during non-breeding periods. Young-of-year mountain sucker require shallow low velocity habitats (Belica and Nibbelink 2006).

Mountain suckers are native to the Black Hills, which is the easternmost extent of the species. Belica and Nibbelink (2006), Isaak et al. (2003) and Schultz (2011) assessed the status of the mountain sucker in the Rocky Mountain Region and the Black Hills. Schultz (2011) studied the environmental factors affecting long-term trends in mountain sucker populations and their thermal tolerance on the South Dakota portion of the Black Hills. Factors negatively affecting mountain sucker populations included non-native trout, recurrent droughts, and stream fragmentation. Overall, results of this study indicate that the mountain sucker is currently not limited by water temperature in the Black Hills, but some areas that are currently suitable for mountain sucker may be lost due to climate change (Hirtzel 2012). Fisheries surveys indicate that the population trend for mountain sucker has declined since the 1960s (Schultz 2011).

Potential direct effects of the Proposed Action relate to in-water actions, such as culvert installation or repair at road-stream crossings that may kill or injure mountain suckers. Adult mountain sucker usually swim away to avoid harm, but eggs or very young fish are more vulnerable. These impacts would be largely avoided through design features to minimize in-water construction activities during the mountain sucker spawning season (page 40). No new road-stream crossings are proposed on streams where mountain sucker are known to occur, but some existing crossings may need to be improved in occupied habitat. The reconstruction of existing road-stream crossings may have the indirect benefit of improving fish passage and stream connectivity if the existing culvert being replaced is a barrier to fish passage. Other indirect effects generally relate to ground-disturbing activities with potential to add sediment to the stream network, impact streambank stability, or degrade riparian habitat. Increased sediment delivery to streams, whatever the source, tends to result in less diverse physical habitats, decrease water quality, denude spawning substrates, and decrease availability of deep pools (Isaak et al. 2003). These impacts would be mitigated through the implementation of Forest Plan standards and guidelines, WCPs, and other design features that ensure non-point source water pollution is controlled at levels that maintain water quality standards and fisheries beneficial uses. Some beneficial changes would occur; a more resilient landscape would be likely to reduce the potential for watershed-scale adverse effects on aquatic habitat due to high-severity wildfire, though it should be noted that mountain suckers have persisted over time in the Black Hills despite its disturbance ecology.

The No Action alternative would not result in direct effects. Indirect effects may include increases in tree biomass. This may increase tree evapotranspiration but the effect would probably be overshadowed by precipitation patterns. Therefore, no discernable effect on flow regimes (see also page 164) or mountain sucker habitat would occur. Fire hazard and risk of mountain pine beetle infestation may increase over time. Some sediment input may occur from natural erosion processes and other activities but effects on aquatic habitats would be minimal.

Consistent with Forest Plan objective 238d, either alternative would be likely to maintain habitat quality, quantity, and connectivity at the National Forest level. Therefore, the mountain sucker would be likely to persist under either alternative.

Sensitive Species

Sensitive species are those plants and animals for which there are population viability concerns, as identified by the Regional Forester. For these species, there are significant current or predicted downward trends in population numbers or density or downward trends in habitat capability that would reduce the species' existing distribution (FSM 2670.5). The list was most recently updated in May 2015 (USDA Forest Service 2015a).

Finescale Dace

Finescale dace occur in the Redwater Creek drainage in the Wyoming portion of the project area (Isaak et al. 2003). They seem to do best in standing water habitats, such as beaver ponds. This species has been transplanted to various sites in the BHNF but the only population that persists is upstream of Hemler Reservoir, in ponded habitat near the headwaters of Redwater Creek. The drainage area of this watershed is slightly less than 1,600 acres.

The Proposed Action would not result in direct mortality because no in-water activities would occur in the headwaters of Redwater Creek. Indirect impacts are usually associated with ground-disturbing activities and occur later in time and/or away from the actual area of disturbance. A more thorough discussion of these effects is included in the watershed section (page 158). Proposed ground-disturbing activities have the potential to contribute sediment into waterbodies if surface water flows transport sediment into waterbodies. No new roads are proposed in the finescale dace watershed, so no new road-stream crossings or reconstruction of existing crossings are anticipated. Design features in the form of Forest Plan standards and guidelines, WCPs, and other measures would reduce non-point source water pollution from ground disturbance to levels that maintain water quality standards and fisheries beneficial uses. It is unlikely that proposed vegetation management activities would affect flow regimes to a degree that would have a detectable effect on stream flows or beaver pond levels (page 164).

The No Action alternative would not result in direct effects. Indirect effects may include increases in tree biomass; this may increase tree evapotranspiration but the effect would probably be overshadowed by precipitation patterns. Therefore, no discernable effect on flow regimes or finescale dace habitat would occur. Fire hazard and risk of mountain pine beetle infestation may increase over time. Some sediment input may occur from natural erosion processes and other activities but effects on aquatic habitats would be minimal.

Determination: The Proposed Action would have ***no impact.*** The No Action alternative would generally have ***no impact.***

Lake Chub

Lake chub occur across Canada and the northern United States. In the Black Hills, lake chub occur in Deerfield Reservoir, which is a 414-acre impoundment on Castle Creek completed in the late 1940s. Historically, lake chub were more widely distributed in the Black Hills. Deerfield Dam and reservoir water levels are regulated by the U.S. Bureau of Reclamation. The South Dakota Department of Game, Fish and Parks (SDGFP) manages fisheries in the reservoir. The lake chub population in Deerfield Reservoir is in decline (USDA Forest Service 2015b). Spawning occurs in the spring in shallow waters over cobble substrates (Isaak et al. 2003). No spawning migrations upstream into Castle Creek or other tributaries to Deerfield Reservoir have been documented.

The Proposed Action would not cause direct mortality because no in-water activities are proposed in Deerfield Reservoir. Indirect impacts relate to management activities upstream/upslope from

Deerfield Reservoir that might affect habitat in the lake. Vegetation treatments upstream of the reservoir would not affect the amount of lake chub habitat because the U.S. Bureau of Reclamation operates the reservoir to maintain a fairly constant pool elevation. Ground-disturbing activities associated with tree removal, prescribed fire, road building, and other activities have the potential to contribute to or mobilize stream sediment. MA 8.2, in which Deerfield Reservoir is located, is excluded from the project area, providing an approximate 3,200-acre buffer area around the lake. Over five miles of perennial stream feeding into Deerfield Reservoir are also within the excluded area. Implementation of Forest Plan standards and guidelines, WCPs, and project-specific design features would be anticipated to prevent or minimize non-point source water pollution, primarily sediment from ground-disturbing activities, from entering into streams that flow into the reservoir. Therefore, any sediment entering the reservoir from further upstream is unlikely to affect lake chub spawning habitat, prey availability, or water quality.

The No Action alternative would not result in direct mortality. No discernable effect on flow regimes or water yield into Deerfield Reservoir would occur. The US Bureau of Reclamation generally operates Deerfield Reservoir at a fairly constant water level, thereby maintaining the quantity of lake chub habitat. Fire hazard and risk of mountain pine beetle infestation may increase over time. Aquatic habitats in Deerfield Reservoir would be largely maintained.

Determination: The Proposed Action is predicted to have ***no impact.*** The No Action alternative would generally have ***no impact.***

Mountain Sucker

See species discussion on page 131.

Determination: The Proposed Action and No Action alternative ***may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.***

Physical Environment

Geology

Summary

This section examines effects on caves and karst, geologic hazards, and paleontology. Avoidance of karst features by a minimum of 100 feet would minimize potential effects on karst ecosystems. Completion of on-site slope stability examinations prior to ground-disturbing activities, as required by the Forest Plan, would allow early identification and avoidance of unstable slopes. Known fossil sites would be protected, and any new discovery of vertebrate fossils would require notification of a geology specialist.

Caves and Karst

Information Sources

Karst vulnerability was determined using published geologic and aquifer data and results of field surveys. Field surveys, completed by geologists, field crews, and local cavers, locate and record locations of karst features (caves, sinkholes, stream sinks). These data were used to select geologic formations that have an abundance of karst features, are soluble, and provide recharge to aquifers.

Affected Environment

Karst is a term that describes the complex geologic environment in which surface waters and groundwater intertwine to create unique physiographic and hydrologic features and landforms (Taylor 2008). In the Black Hills area, these features develop through dissolution of soluble rock, primarily limestone and dolomite (carbonates) and gypsum and anhydrite (evaporites), resulting in sinking streams (streams that sink into the stream bed or karst features), closed depressions, sinkholes, collapsed channels, and caves. Caves are numerous and provide specialized habitat for many species and a protected environment able to preserve cultural and paleontological resources.

The rapid flow of water through a karst system is significant to management practices. As a result, karst groundwater systems can rapidly transport pollutants or sediments from roads or other disturbed areas to groundwater wells and springs. Transport of water from sinkholes to groundwater in the Black Hills is discussed further on page 158.

Some parts of the karst landscape are more sensitive than others to surface activities and groundwater contamination. These differences in vulnerability may be a function of the extent of karst development, the openness of the karst systems, and the sensitivity of other resources that benefit from karst groundwater systems (USDA Forest Service 2008b). High-vulnerability karstlands are generally those underlain by the Madison and Englewood formations (Figure 23, page 136).

Environmental Consequences

Activities that would reduce density of vegetation (timber harvest, thinning, fuel treatments) could initially increase flow through karst systems followed by a decrease due to regrowth of vegetation (Aley and Aley 1993). These changes in flow could increase turbidity and change water chemistry through the karst system (Aley and Aley 1993). Approximately half of the potential CTA acreage and

a third of potential fuel treatment acreage are on high- or moderate-vulnerability karstlands. Adherence to design features requiring avoidance of karst features by a minimum of 100 feet (page 40) would minimize potential effects on karst ecosystems.

Vegetation management activities that may disturb soil (timber harvest, mechanical fuel treatment, site preparation) may temporarily increase erosion and transportation of sediment and debris into karst ecosystems. All of the potential site preparation areas are on high or moderate vulnerability karstlands. Adherence to design features requiring avoidance of karst features by a minimum of 100 feet would minimize potential effects on karst ecosystems.

Prescribed fire's potential to affect karst ecosystems depends on the severity of the burn. Prescribed burns are generally conducted under conditions that prevent widespread severe effects. Moderate-severity burning would result in little erosion (page 148). Any burn-related sediment effects would decrease as vegetation recovers (Driscoll et al. 2004).

Proposed road construction, conversion, and new prescribed fire control lines would disturb soil and may temporarily increase erosion of sediment and transportation of sediment and debris into karst ecosystems. Adherence to design features requiring avoidance of karst features by a minimum of 100 feet would minimize potential effects on karst ecosystems.

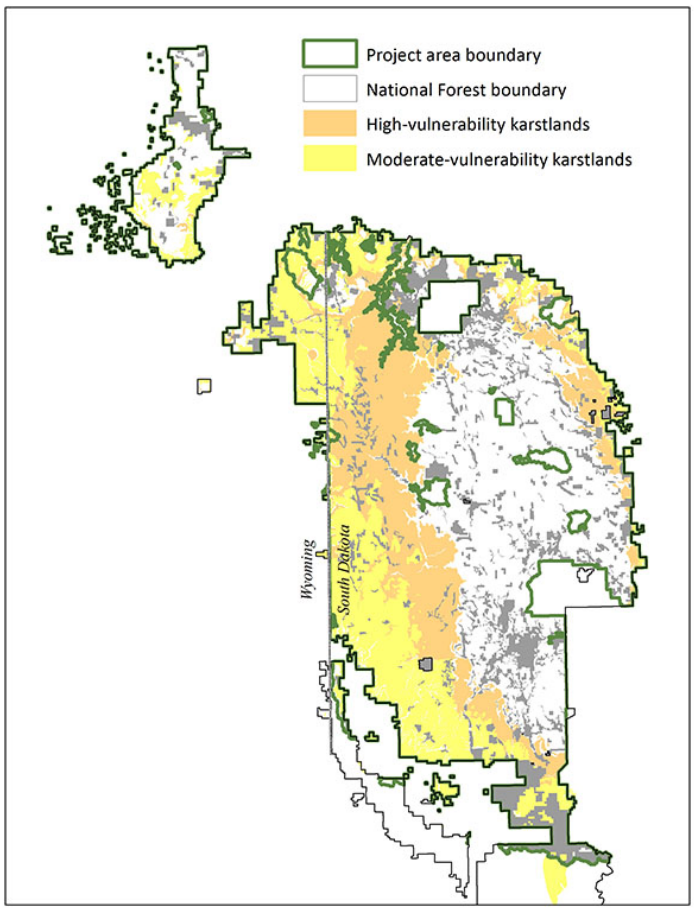


Figure 23. Moderate- and High-Vulnerability Karstlands

The **No Action alternative** would have no effect on karst ecosystems.

Cumulative Effects: Because the Proposed Action incorporates protective measures for caves and karst features, it would not add to effects of past, present, or foreseeable activities.

Geologic Hazards

Information Sources

Soil stability data were obtained from NRCS soil surveys of Wyoming and South Dakota counties (USDA NRCS 2017). Additional information was derived from slope stability surveys, which since 2011 have been conducted on approximately 65,000 acres of potentially unstable slopes in the BHNF by Forest Service physical resources professionals and technicians. In Wyoming, the State Geological Survey has collected and published landslide data (Wyoming State Geological Survey 2017). These information sources, together with professional judgement, were used to develop a "Methodology for Determining Slope Stability" specific to the BHNF (Emanuel 2015). This document

identifies geologic formations prone to slope stability issues and allows them to be identified on US Geologic Survey maps.

If the Proposed Action is implemented, slope stability surveys would occur prior to road work and timber harvest in areas with elevated risk of instability in accordance with Forest Plan guideline 1108.

Affected Environment

Landslide is a term often used interchangeably with mass movement or slope stability. It describes the downslope movement and detachment of soil, rock and organic materials as a result of gravitational stress and also describes the resulting landform (Highland and Bobrowsky 2008). Landslides are categorized by type of movement and type of material.

The displacement of material can occur gradually or rapidly. Heavy rainfall, rapid snowmelt, and changes in groundwater and surface-water levels can saturate the soil and initiate landslides (Highland and Bobrowsky 2008). Landslides can also be induced by human activities, such as undercutting or overloading slopes. Management activities can change soil moisture and contribute to saturated conditions by removing vegetation and by channeling water and concentrating it onto slopes. Landslides triggered by human activities are classified as detrimental soil disturbance and may result in significant long-term changes in soil productivity.

The Forest Plan identifies Lakoa, Larkson, Citadel, Rockoa, and Mathias soils on slopes over 30 percent and all other soils on slopes over 55 percent as potentially unstable, requiring on-site slope stability examination. These examinations have identified additional unstable lithologies, as documented by Emanuel (2015).

Forest Plan guideline 1108 requires reduction of resource damage and investment loss in areas with mass movement potential. If surveys indicate that road work or other activities could increase mass movement potential, planned activities are modified, relocated, or cancelled.

Environmental Consequences

Vegetation on slopes acts as an anchor for soil and a sponge for water. **Proposed timber harvest and related activities** could affect slope stability by removing some of this vegetation and temporarily preventing infiltration of water. Forest Plan guideline 1108 requires reduction of resource damage and investment loss in areas with mass movement potential and completion of on-site slope stability examination in these areas. The Proposed Acton would adhere to these measures, allowing early identification and avoidance of unstable areas.

Proposed burning would remove a percentage of vegetation and may temporarily prevent infiltration, increasing potential for instability. Because the effects of prescribed fire on soils are generally of low to moderate severity (see **Soils** analysis, page 149), creation of low-infiltration soils, extensive areas of bare soil, and possible increased risk of instability would not occur (Driscoll et al. 2004).

Up to 7.5 miles of permanent **road construction** and 15 miles of temporary road construction would occur on potentially unstable areas. New roads can affect slope stability and increase the risk of landslides if they undercut or overload slopes or have inadequate drainage (Highland and Bobrowsky 2008). New **prescribed fire control lines** may have similar effects, though control lines are unlikely to be placed across steep slopes. Completion of on-site slope stability examination prior to harvest would allow early identification and avoidance of unstable areas. Adherence to standard

engineering guidelines would result in adequate road drainage. Rehabilitation of temporary roads after use would allow revegetation and stabilization.

Other proposed activities would not affect slope stability or result in geologic hazards.

The **No Action alternative** would cause no new effects on slope stability or existing geologic hazards.

Cumulative Effects: Because the Proposed Action incorporates Forest Plan requirements for pre-activity surveys and measures to reduce the potential for mass movement, it would not add to effects of past, present, or foreseeable activities.

Paleontology

Information Sources

Vertebrate paleontological resources were identified using published geologic data and US Geological Survey maps.

Affected Environment

Fossils are paleontological resources recognized for their scientific, educational, and recreational value. A fossil can be anything that preserves evidence of past life, from shells and bones to footprints, burrows, and trails (Bureau of Land Management 2015). Fossils are rare and nonrenewable resources.

The Black Hills include sedimentary rock layers that contain fossils. Most of these fossils are common or otherwise hold little scientific value. The Morrison and White River formations contain rather rare vertebrate fossils. These formations are found on approximately 28,750 acres at the northern and southern edges of the project area.

Environmental Consequences

Construction of roads and prescribed fire control lines has the potential to disturb vertebrate fossils in the Morrison and White River Formations. Less than 0.5 mile of new temporary road construction would occur on these formations, plus use of up to 1.5 miles of existing templates as temporary roads. One proposed prescribed burn block includes approximately 63 acres of the White River formation. Known sites would be protected, and any new discovery of vertebrate fossils would require notification of a geology specialist. Potential for adverse effects is expected to be minor due to the small scale of activities proposed on these formations.

The No Action alternative would have no effect on paleontological resources.

Cumulative Effects: The cumulative effects analysis area for paleontological resources is extended to the exposures of the Morrison Formation and White River Group and is selected because these formations as a whole preserve significant paleontological resources. The timespan of cumulative effects analysis is from the present to 10 years after ground-disturbing activities cease. It is anticipated the project's effects would begin to diminish after this time.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Road construction, mining, other past ground-disturbing activities, and natural conditions have resulted in the existing exposures of the Morrison Formation and White River Group. Many of these activities have potential to expose or damage paleontological resources.

The Proposed Action may add to the above effects of past, present, and foreseeable activities, though the potential for additive effects is small due to the limited extent of activities proposed on relevant geological formations. Protection of known paleontological resources and any newly discovered sites would minimize the potential for adverse cumulative effects.

Soil Productivity

Summary

Specified design features and standard measures would protect the soil resource. Any increases in soil bulk density would remain within allowable limits. Cable logging would generally result in fewer localized impacts on soil resources than ground-based harvest. Temporary roads, skid trails, and landings associated with commercial timber harvest would be rehabilitated. Effects of mechanical site preparation would be similar to those of ground-based timber harvest. Very limited to no increase in soil bulk density would be expected within the areas proposed for manual treatment activities.

If the Forest Plan is amended to revise standard 1102, slash retention requirements would apply to patch clearcuts on relevant soils. Where other types of commercial timber harvest would occur on these soils, a need to reduce fuel loading may take precedence over slash retention. Nutrient availability and site conditions would remain adequate for soil microorganism persistence.

Application of design features would generally protect soils from erosion that otherwise could result from implementation of the Proposed Action. Erosion may be associated with NFS road reconstruction and temporary road construction. Short-term increases of erosion may occur. Monitoring indicates that these effects would decrease as disturbed soils revegetate or are rehabilitated following use. Any detrimental erosion would remain within limits specified by the Forest Plan and WCPH.

Forest management activities may disturb soil. Excessive disturbance can affect site productivity and hydrologic response. This section addresses potential effects on soil quality and site productivity. The **Watershed** section (page 153) addresses effects on hydrologic response.

Information Sources

Soil information specific to the Black Hills was obtained from the Natural Resource Conservation Service using sources at https://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/. The Forest Service has sampled pre- and post-harvest soil bulk density levels in numerous BHNF timber harvest areas and, since 2010, has completed a number of soil disturbance evaluations using an agency-approved protocol as documented in BHNF monitoring and evaluation reports (USDA Forest Service 2013a, 2015b, etc.).

If the Proposed Action is selected for implementation, future soil disturbance evaluations would be prioritized in soil units with elevated potential for detrimental impacts as a result of management activities (page 40). Elevated potential may be indicated by high erosion hazard, rutting hazard, or other characteristics. Less intensive review, based on observation criteria developed during the quantitative evaluations, would take place in areas with a lower likelihood of impacts.

Affected Environment

Soil productivity is the ability of the soil to supply the water and nutrients needed to sustain plant growth. Variables that influence soil productivity include physical soil characteristics, organic matter, and soil biological activity.

Physical Soil Characteristics

Physical soil characteristics include soil depth, pore space, and bulk density. Changes occur when ground-based heavy equipment makes repeated passes over the soil. These activities compress or compact soils and, if soils are wet enough, can result in rutting and puddling. Clay and loam soils generally compact more than sandy soils (USDA Forest Service 2006b, page 25). These changes to physical soil characteristics reduce the pore space volume and water-holding capacity, reducing infiltration rates, slowing soil drainage, impeding root growth, and reducing water and nutrients available to plants. Physical soil disturbances also decrease gas exchange, affecting both plants and soil biota.

Organic Matter

Organic matter contributes to soil productivity. Humus is decomposed organic matter. Duff and litter are partially decomposed leaves, needles, and twigs on the surface of the soil. Coarse woody debris consists of woody stems greater than three inches in diameter. Organic matter provides nutrients and can retain moisture for soil organisms and plants.

Soil Microorganisms

Soil microorganisms, including fungi and bacteria, are required by and drive the nutrient cycling process by decomposing organic matter components and releasing the nutrients for use by plants. Soil organisms depend on organic matter for the nutrients they need to carry out their life processes. Decomposed coarse woody debris provides important habitat for the survival of mycorrhizal fungi. These fungi form a symbiotic relationship with roots of trees and other plants, increasing water and nutrient uptake by the plants and the fungi.

Soil Erosion

Soil erosion is the movement of soil particles by water, wind, or ice. In forested sites on steep slopes, water is generally the most common driver of erosion. Generally, depending on a variety of site characteristics, potential for erosion increases with slope. Erosion is generally infrequent on undisturbed forest soils for two primary reasons: (1) these soils are generally protected by a layer of organic matter, which limits the impact of raindrops and allows water to infiltrate; and (2) the soil just below the organic layer is by nature generally porous, allowing water to infiltrate and move through the soil profile.

Soil erosion can occur when the surface soil is compacted or when the loose surface soil and its protective layer of organic material are changed or removed. Compaction, rutting, and puddling can affect infiltration to the point that water is channeled and concentrated rather than infiltrating. As a result, water runoff (overland surface flow) increases and carries soil particles away. Natural disturbances, such as fire, can remove organic material from the soil surface. When surface organic matter is removed, soil pores can become plugged by material (particles) resulting from raindrop impact, resulting in overland surface flow and increased rates of soil erosion.

Mass Failure

Mass failure is discussed in the **Geology** section (page 136).

Project Area Soil Map Units

Proposed activities would occur within two Major Land Resource Areas (MLRAs) of the Black Hills Ecoregion: MLRA 61 (Black Hills Footslopes) and MLRA 62 (Black Hills). Brief descriptions of these MLRAs can be found in the project analysis file (section 5.12). Additional MLRA information can be accessed via the MLRA Explorer (NCSS 2017). Black Hills soil resource information is publicly available for MLRAs 61 and 62 and can be accessed through various online information sites, such as Web Soil Survey and Soil Data Viewer.

A **soil map unit** is an area dominated by one or more major kinds of soil or miscellaneous areas such as rock outcrops or water. Map units are identified and named according to the taxonomic classification of the dominant soils. Inclusions of other soils occur within map units but in limited amounts. As an example, Figure 24 displays map units and characteristics of the Grizzly soil series.

Soil Series: Grizzly

Mapped in MLRA 62 in the Central Crystalline Area (Igneous). A dominant soil component in map units: Q0106E, Q0108E, Q0110E, Q0110G, Q0112G, Q0114D, Q0144E, and Q0114F.

Taxonomic Classification: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

Figure 24. Example Soil Series Photos and Description

The BHRL project area includes 293 soil map units. These are described in the project analysis file (section 5.12).

Environmental Consequences

Proposed Action

The Forest Plan FEIS (USDA Forest Service 1996) and Phase II Amendment FEIS (USDA Forest Service 2005a) analyze effects of activities similar to those proposed. Effects on soil resources would therefore be similar to those described in those documents. Monitoring of the effects of similar

activities has occurred. Results are summarized below and are available in BHNF monitoring and evaluation reports, available at http://tinyurl.com/BHNFMonitoring.

Extensive monitoring conducted in the Black Hills over the past 15 years has demonstrated that timber sales and associated skid trails, landings, and temporary roads generally have minor effects on soil compaction, erosion, and other elements of soil productivity (USDA Forest Service 2013a, 2015b, etc.). Observed effects ranged from adequate ground cover and infiltration with no erosion to a finding of 25 percent of transects with moderate to severe disturbance related to skid trails, landings, and roads. Revegetation of landings and temporary roads can require up to five years due to level of disturbance. The majority of sites were found to be in good condition, with overall effects consistent with Forest Plan standard 1103[22], National Best Management Practices (USDA Forest Service 2012b), and Regional direction (USDA Forest Service 2006b).

Monitoring has focused on timber sales and burned areas. Because mechanical fuel reduction is conducted using various motorized equipment, effects are likely to be similar to those of timber sales, though to a lesser degree since there are no skid trails, landings, or temporary roads and little hauling of heavy loads.

This analysis assumes that all proposed activities would be implemented in accordance with applicable Forest Plan standards and guidelines and WCPH design criteria and that field reviews would occur prior to activity implementation.

FSM 2500 (USDA Forest Service 2010a) defines soil quality guidelines in terms of detrimental soil disturbance, which includes compaction, rutting, displacement, severe burning, surface erosion, and soil mass movement (mass failures). It is important to understand that not all soil disturbance is detrimental (resulting in substantial soil impairment). For example, not all soil compaction results in loss of the inherent ecological capacity of hydrologic function.

Figure 25 (page 143) provides a generalized overview of proposed activities in relation to their potential to disturb soil or impair soil function. Activities at the higher end of the scale would be implemented in conjunction with design features and standard measures expected to minimize actual soil disturbance and impairment.

[22] *"Manage land treatments to limit the sum of severely burned and detrimentally compacted, eroded, and displaced land to no more than 15 percent of any land unit. "Land treatments" are human actions that disturb vegetation, ground cover or soil. "Land unit" is a mapped land-type polygon or a mapped soil unit."*

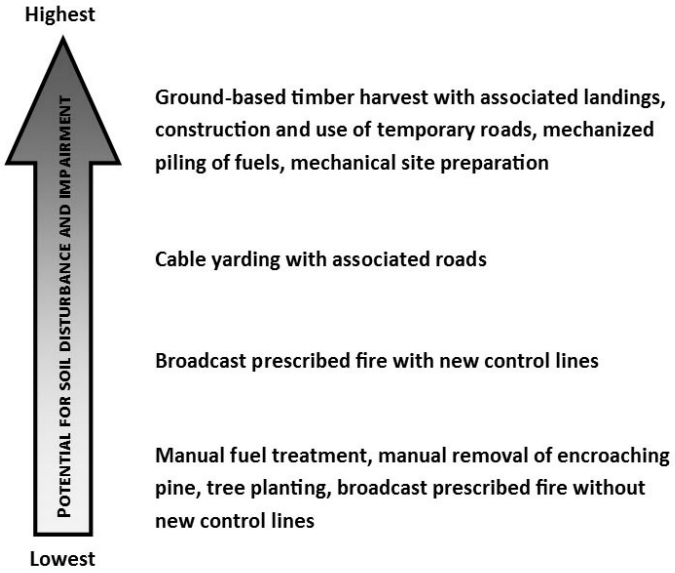


Figure 25. Potential of Proposed Activities to Disturb Soil or Impair Soil Function

This continuum is based on field observations in the BHNF, which are consistent with those of Reeves et al. (2011). In both cases, winter ground-based timber harvest was shown to result in significantly less detrimental soil disturbance than summer ground-based harvest. In the Black Hills, timber harvest during dry to droughty conditions has been shown to result in no to very little increase in soil bulk density (USDA Forest Service 2015b).

Physical Soil Characteristics

Forest management activities can compact soil. Compaction is measured in terms of soil bulk density. Compaction is generally more likely to occur and reach detrimental levels when soils are wet.

All soils can compact, but some are much more susceptible to compaction than others. Compaction hazard is rated as severe for at least one of the dominant soil map units in soil survey map units totaling approximately 688,250 acres, or 63 percent of the BHRL project area (Figure 26; also project analysis file, section 05.12). Within the area where activities may occur, they total 466,628 acres (61 percent of the activity area).

Uncertainties exist regarding the length of time detrimental soil compaction persists in the Black Hills. Soil bulk density sampling has occurred in timber harvest areas at various locations across the BHNF (USDA Forest Service 2013a, 2015b). This monitoring provides evidence to support the following conclusions.

- Soil compaction can occur when timber harvest or similar activities involving off-road use of heavy equipment take place when soil moisture exceeds certain limits.
- Conducting timber sale operations during dry soil conditions can limit or prevent soil compaction.
- Soil can recover from detrimental compaction within one year. (Evidence is limited to a specific area and sampling methodology, and reasons for recovery are not fully understood.)
- Conducting timber sale operations when the ground is frozen can prevent detrimental soil disturbance.

These effects are consistent with WCPH chapter 10 and FSM 2550 (Soil Management Manual).

Effects of Fuel Reduction and Hazard Tree Removal: Proposed manual fuel treatments (page 18) would result in little to no ground disturbance. Organic matter would generally left distributed throughout the area. Associated use of relatively low-weight ground-based equipment (such as chippers) would not cause detrimental compaction.

The effects of shaded fuel break construction involving removal of commercial timber are discussed with those of ground-based timber harvest, below.

Prescribed fire would not, in itself, compact soils. The associated control lines may result in compaction if they are constructed when soils are damp. Because prescribed fire occurs in fall or early spring, when soils are usually dry or frozen, control line construction would not result in detrimental soil compaction. Additionally, existing roads would be used as control lines whenever possible (page 20).

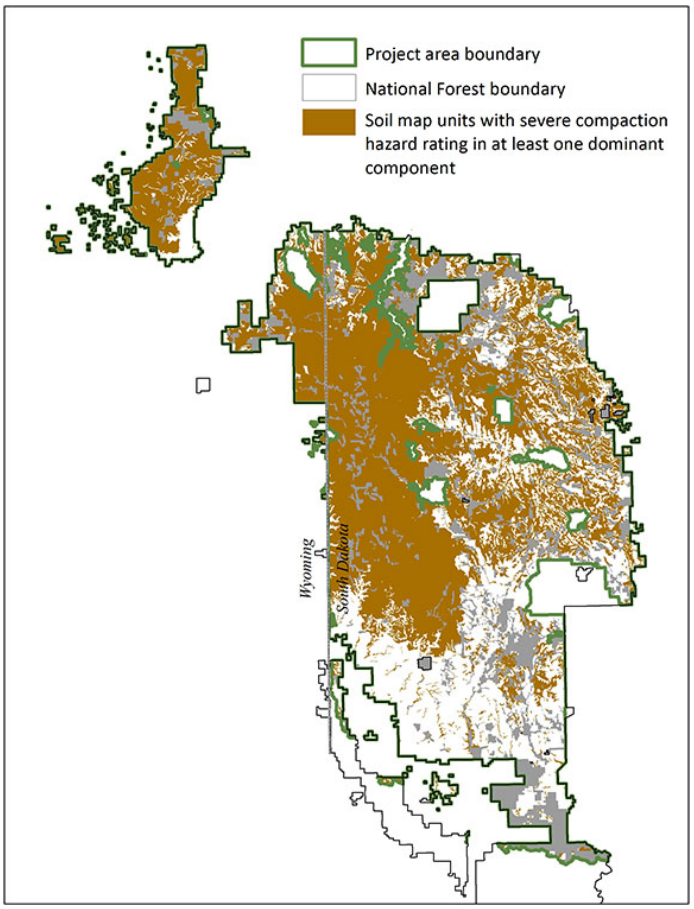


Figure 26. Soils with Severe Compaction Hazard

Burning of large, machine-created slash piles usually involves use of heavy equipment. Dozers move debris as it burns to maximize consumption. Because this activity occurs in winter, it would not increase soil bulk density. Frozen soil and snow cover limit the potential for soil compaction.

Effects of Hardwood and Grassland Enhancement: Where these activities include commercial harvest, ground-based or cable yarding methods would occur. Effects on soil compaction would be similar to those described below.

Where these activities do not include a commercial timber harvest component, effects on soil compaction would be similar to those of fuel reduction or prescribed fire.

Effects of Ground-based Commercial Timber Harvest: Ground-based harvest is used where slopes are generally less than 40 percent. It would result in localized direct and indirect effects on soil physical characteristics in the area within and immediately adjacent to timber sale units.

Skid trails, temporary roads, and landings may cause detrimental effects on soil physical characteristics. Forest Plan direction and standard measures require minimizing or reusing skid trails and landings and operating only on dry or frozen soils. Rutting and puddling are more likely to occur when heavy machinery is operated on wet soils. Restricting operations to times when soils are dry or frozen would limit detrimental soil disturbance.

Operating logging equipment over slash is often effective in buffering soils from damage. Whole-tree yarding removes most of the slash. Where other harvest systems are used and slash is retained, detrimental effects would be less likely to occur.

Disturbed areas such as landings would be rehabilitated in accordance with design features, Forest Plan direction, and standard measures. The basic intent of this rehabilitation is to improve the potential for tree seedling establishment, survival, and growth by restoring soil conditions that support biological processes.

Effects of Cable Timber Harvest: Cable or skyline harvest involves partial or complete suspension of logs during yarding. This method is used primarily on slopes over 40 percent. In the BHNF, cable systems have been observed to cause only very localized compaction. This is generally consistent with findings of Reeves et al. (2011).

Effects of Other Proposed Activities: Effects of precommercial and POL thinning would be similar to those of manual fuel treatments or ground-based timber harvest.

In recent years, tree planting has occurred in some of the areas burned by large wildfires. Trees have been planted by hand and this analysis assumes that the same method would continue to be used. Manual planting results in little ground disturbance and no compaction.

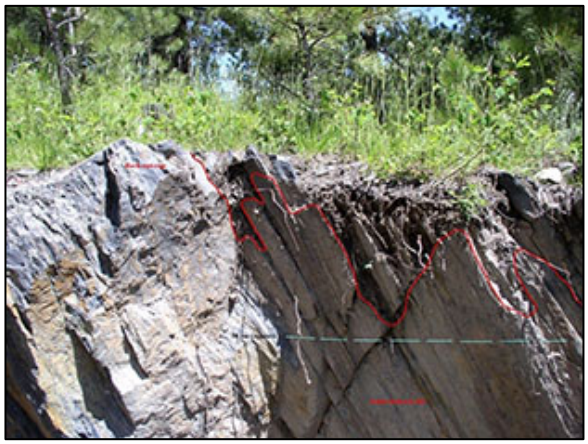
In 2008, the BHNF Supervisor issued a memo specific to mechanical site preparation (USDA Forest Service 2008a). The memo stated that mechanical site preparation is generally not necessary and should occur only in rare situations. The Proposed Action includes up to 4,000 acres of mechanical site preparation within a 47,200-acre area. Soils covering nearly all of this area are prone to detrimental compaction when wet. While uncertainties exist, effects of mechanical site preparation would be similar to those of ground-based commercial timber harvest, above.

Design features and standard measures for all proposed ground-based mechanical activities on soil map units with at least one dominant soil component having a greater likelihood for detrimental compaction include operating only when soils are dry or frozen. By adhering to this measure, the potential for detrimental soil disturbance would be low. Depending on the results of field examinations to be conducted prior to mechanized site preparation (page 40), the implementation team may need to modify the proposed treatment to ensure compliance with Forest Plan standard 1103 (page 142).

Organic Matter

Proposed activities would leave varying amounts of organic matter on the surface of the soil. Reduced organic matter can be associated with reduced soil nutrient levels and, potentially, site productivity.

Certain soils naturally have a limited capacity to retain nutrients, along with a reduced ability to buffer potential productivity losses associated with nutrient cycling. These soils generally have a naturally small amount of organic matter in the soil profile, little to no topsoil, or a restricted depth (shallow soil over bedrock; right).



Pactola soil (rooting depth less than 15 inches)

Soils with these characteristics can be found in various areas of the Black Hills. Primary locations include rocky ridgetops and the central crystalline core area of the Black Hills. They are dominant

components in a number of soil map units but also occur as inclusions or minor components (approximately 10 percent or less) within other soil map units in the project area. These map units total approximately 556,549 acres, or 51 percent of the BHRL project area (project analysis file, section 05.12). Within the area where activities may occur (minus grasslands), they total 358,682 acres (47 percent of the activity area). Soil map units where the dominant soil components formed under grasslands, riparian areas, or other non-pine vegetation are not considered likely to be managed for long-term timber production and were not assessed for organic matter properties.

Forest Plan standard 1102 (subpart guideline 1102a) requires retention of fine slash when implementing specific activities on nutrient-poor or shallow soils. A proposal has been brought forward to amend the Forest Plan by incorporating a revised measure (page 36). It is needed because removal of slash is essential to the fuel reduction effect of commercial timber harvest adjacent to developed lands and in other wildland-urban interface areas. It is also needed to increase Forest Plan consistency with current Regional direction.

Effects of Commercial Timber Harvest: Some of the proposed commercial timber harvest would remove the whole tree from the stand (whole-tree yarding). Both ground-based and cable systems may use this method. Whole-tree yarding is often preferred from a fire-prevention standpoint because it removes logging slash that would otherwise contribute to surface fuel loads. In shaded fuel breaks, cut material not removed commercially is usually piled and burned or may be chipped and either left on site or removed.

If the Forest Plan is amended to revise standard 1102, the slash retention requirement would apply to all patch clearcuts on relevant soils. Where other types of commercial timber harvest would occur on these soils, a need to reduce fuel loading may take precedence over slash retention. Concern regarding fuel loading is highest in wildland-urban interface and near critical infrastructure. In these areas, whole-tree yarding is likely to be the preferred harvest method. Slash retention would vary based on individual site characteristics.

As a result, it is possible that long-term effects on nutrient cycling could occur in localized areas. Protection of the soil resource would generally occur through application of design features and standard measures selected prior to implementation. Therefore, nutrient cycling on sites considered suitable for timber production would generally remain within Forest Plan limits. Where slash remains on-site, adverse effects on soil nutrients would be unlikely to occur. Where whole-tree yarding occurs and most slash is removed from the site, adherence to Forest Plan standard 2308a[23] would provide coarse woody debris distributed throughout treated sites.

If the Forest Plan is not amended, subpart guideline 1102a would apply to proposed patch clearcuts, overstory removal, and group selection. At least 50 percent of the fine slash would need to be retained in these treatment areas on relevant soils.

Effects of Other Proposed Activities: The Forest Plan/WCPH direction described above does not apply to proposed fuel treatments, hazard tree reduction, or hardwood and grassland treatments.

Soil Microorganisms

Proposed vegetation management activities would retain varying quantities of organic material on-site (see above). Retention of organic material would provide substrate and habitat for soil microorganisms. Whole-tree yarding would remove most logging slash but would have little effect

[23] *"During vegetation management activities on ponderosa pine forested sites, retain an average of at least 50 linear feet per acre of coarse woody debris with a minimum diameter of 10 inches."*

on pre-existing down woody material. If the Forest Plan is amended as discussed above, whole-tree yarding would probably occur on some soils with limited capacity to retain nutrients. Remaining live trees, stumps, and roots would supply some level of woody material and microorganism habitat. In addition, adherence to direction regarding snags and down woody material (see page 62), retention of small slash piles (standard 3117), and revegetation (standard 1110) would provide appropriate substrate and habitat.

Soil compaction can reduce soil capacity to exchange oxygen and carbon dioxide, thus potentially affecting soil microorganism survival, abundance, or persistence. Because all proposed activities would be implemented in accordance with design features and standard measures, soil disturbance is not expected to exceed allowable levels. As a result, favorable habitat for soil microorganisms is generally expected to be maintained.

Effects of Fuel Treatments: The purpose of these treatments is to address fuel concerns. Treated areas would have low levels of substrate material for soil microorganisms. Prescribed fire would consume some of the existing substrate. In all treated areas, remaining live trees would continue to drop needles and branches, which together with stumps and roots of cut trees would provide microorganism habitat. Compliance with Forest Plan direction as described above would also provide areas of substrate.

Effects of Commercial Timber Harvest: Organic substrate remaining after commercial timber harvest would vary with harvest system. As discussed above, whole-tree yarding would remove most of the slash resulting from harvest. Other harvest systems would leave limbs and needles on site. In either case, if the commercial treatment were followed by thinning of pine seedlings and saplings, the cut material would provide organic substrate. Where fuel loading concerns are high, this thinning may involve piling or chipping of cut material. The result could be an open forest floor with little organic substrate. See also previous paragraph.

Effects of Mechanical Site Preparation: Mechanical site preparation is used to remove or reduce the amount of live and dead vegetation on site to meet reforestation objectives (USDA Forest Service 2012b, page 138). Site preparation would alter existing organic substrates, such as breaking woody material (logs or limbs) into smaller chunks. Creation of furrows in the soil could allow it to dry more quickly, reducing availability of moisture and possibly affecting microorganism activity. Uncertainties exist regarding the degree to which mechanical site preparation may remove or reduce organic substrates supporting microorganisms associated with conifer systems.

Effects of Other Proposed Activities: Hazard trees felled for safety reasons would generally be left on site or moved a short distance (for instance, off of a road surface or out of the road's clearing limits). This activity would not decrease substrate for soil microorganisms.

The purpose of hardwood and grassland enhancement activities is to perpetuate aspen, oak, and grasslands. In hardwood enhancement areas, living and dead hardwoods would remain on site. That material would continue to provide substrate associated with soil microorganisms. Though little is known about Black Hills grassland soil microorganisms, removal of encroaching pine would expand or restore their habitat.

Tree planting would not affect woody substrate for microorganisms associated with conifer systems.

Summary: Application of design features and standard measures would minimize detrimental physical soil changes. Organic matter would remain (in various forms and levels) in treated areas. The soil organic layer would be retained in most treated areas. Compliance with Forest Plan standards and guidelines regarding coarse woody material, snags, and slash pile retention would

result in retention of various levels of microorganism substrate. Therefore, nutrient availability and site conditions would remain adequate for soil microorganism persistence.

Soil Erosion

Erosion related to the transportation system can affect water quality and is addressed in the **Watershed** section (page 160).

All soils can erode, but some are more susceptible to erosion than others. Erosion hazard ratings used for this project (USDA NRCS 2017) indicate the hazard of soil loss when 50 to 75 percent of the soil is exposed. These ratings apply to areas other than roads and trails and are based on slope and the soil erosion factor "K", which reflects the soil's susceptibility to erosion and amount and rate of runoff. A rating of "severe" indicates that erosion is very likely to occur when soils are disturbed and that erosion-control measures, including revegetation of bare areas, are advised. "Very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Erosion hazard is rated as severe or very severe for at least one of the dominant soil map units in soil survey map units totaling approximately 261,749 acres, or 24 percent of the BHRL project area (project analysis file, section 05.12). Within the area where activities may occur, they total 172,040 acres (23 percent of the activity area).

Most of the dominant soils within these soil map units are located on slopes over 40 percent. The Proposed Action would be implemented in accordance with Forest Plan direction, standard measures, and project-specific design features, including use of log-suspension (cable) systems on sustained slopes over 40 percent.

In general, erosion hazard increases with slope:

- Less than 15 percent slope: Low or slight erosion hazard
- 15-40 percent slope: Moderate erosion hazard
- Greater than 40 percent slope: Severe to very severe hazard

Soils with certain characteristics, however, may have a moderate erosion hazard on slopes of less than 15 percent. For example, soils with a high proportion of mica (such as those around the town of Custer) may be moderately erosive even on 10 percent slopes. Granitic soils on 25 percent slopes can have a severe erosion hazard rating. Conversely, soils with extensive surface rock on slopes over 45 percent may be only moderately erosive; the rock acts as a baffle, slowing runoff on its progress down the slope.

Effects of Ground-based Commercial Timber Harvest: Ground-based timber harvest would generally occur on slopes of less than 40 percent, where erosion hazard is low to moderate. Localized direct and indirect soil erosion may occur within treatment areas. Erosion would be most likely to occur on skid trails and temporary roads. Compliance with Forest Plan guideline 1104 and standard 1105[24] would limit skid trails and temporary roads to the minimum number needed and restrict operations to dry or frozen soils or snow (see **Physical Soil Characteristics** section, page 143). These

[24] 1104: *"Minimize soil compaction by reducing off-road vehicle passes, by skidding on snow, frozen or dry soil conditions, or by off-ground logging systems."*
1105: *"Limit roads and other disturbed sites to the minimum feasible number, width, and total length consistent with the purpose of specific operations, local topography and climate."*

measures, particularly operating over snow, would limit ground disturbance and maintain vegetation, reducing the potential for erosion.

Skidding logs over slash, as discussed on page 145, is generally effective at buffering the effects of equipment on mineral soil and would limit detrimental erosion. The timber sale contract includes standard provisions for minimizing erosion (USDA Forest Service 2006c).

Effects of Cable Timber Harvest: Timber harvest using systems that fully or partially suspend logs would result in limited potential for erosion. Ground disturbance, except at landings and roads, is generally less compared to ground-based harvest. Disturbance does occur, as on irregular slopes where logs may scrape against protrusions on their way up. This may expose mineral soil in isolated spots.

Effects of Manual Fuel Treatments: These activities involve minimal ground disturbance and would result in very little erosion. Thinned woody material left on site would add protective cover to the soil surface. Effects of burning manually piled fuels are addressed below.

Effects of Prescribed Fire: Depending on fuel and weather conditions at the time of implementation, broadcast burning can consume fuels and expose mineral soil. Generally, however, prescribed burns are conducted during conditions that prevent full consumption of organic material.

Photos below display effects of a prescribed fire conducted in October 2016 in the southern Black Hills. Burning of fuel accumulations resulted in areas of exposed mineral soil. Despite this, down logs and intact vegetation remain on most of the site, and regrowth occurred in most areas by the next spring.

AntiHorse prescribed burn, unit J, photo point 1, Sept. 14 and Oct. 27, 2016

May 12, 2017

This mosaic pattern is typical of prescribed burns in the Black Hills. The remaining down woody material and live plants, along with the soil seed bank, contribute to revegetation and minimal erosion.

As discussed on page 20, control lines that are not on existing roads are usually created with heavy equipment when soils are dry or frozen. Following completion of the burn, rehabilitation of control lines occurs. This may include erosion control in the form of water bar construction and seeding or placement of slash and other debris to deter motorized vehicle access. These actions would generally minimize erosion from control lines.

Burning of slash piles would generally not result in significant levels of erosion. Large, mechanically created piles associated with timber harvest are usually located on slopes of less than 15 percent. After the piles are burned, the sites are scarified and seeded. These rehabilitation efforts generally result in revegetation and prevent significant erosion.

Manually created piles are smaller than machine piles but may be located on steeper slopes. Similar to findings of research conducted in Colorado (Rhoades et al. 2015), sites of small piles in the Black Hills generally revegetate within two years of burning. Based on the burned areas' small size, rapid revegetation, and separation by vegetated areas, plus personal observations, associated erosion would be limited or non-existent.

Effects of Mechanical Site Preparation: As described on page 145, concerns regarding the effects of mechanical site preparation soils have been noted (USDA Forest Service 2008a). Soil disturbance rapid assessment monitoring using Forest Service protocols (USDA Forest Service 2009a) has not been conducted following mechanical site preparation on the BHNF.

Areas where mechanical site preparation may occur include soil map units with at least one dominant soil component that has a moderate to very severe erosion hazard rating. Soil map units are listed in the project analysis file, section 05.12. It is unlikely that mechanical site preparation would actually occur on the soil map units with an erosion hazard rating of very severe. These map units are generally on slopes of 40 to 80 percent, while site preparation would generally occur on slopes of less than 25 percent (page 28). This is also true for soil map units with a rating of severe, where slopes are generally 20 to 60 percent. If mechanical site preparation did occur on steep slopes, the creation of furrows and potential soil damage from heavy equipment operating at its design limits could result in detrimental effects on soils and long-term impacts to site productivity.

In soil map units with at least one dominant component with an erosion hazard rating of moderate, mechanical site preparation would generally result in a short-term loss of effective ground cover in disturbed areas. Because the condition prompting site preparation is competition with grass, and grass recovers from disturbance quickly, these sites would revegetate with two or three years. This conclusion is also based on personal observations and BMP/soil disturbance monitoring that has occurred in the BHNF (USDA Forest Service 2013a, 2015b).

Due to shallow slopes (generally less than 15 percent), limited to no soil erosion would occur on soil map units with a soil erosion hazard rating of low.

Summary: Application of design features and standard measures would generally protect soils from erosion that otherwise could result from implementation of the Proposed Action. Any detrimental erosion would remain within limits specified by the Forest Plan and WCPH. Cable harvest would generally result in less erosion than ground-based harvest. Skid trails, temporary roads, and landings associated with commercial timber harvest would be rehabilitated to control erosion. If mechanical site preparation were to occur on steep slopes, detrimental erosion could result. Site preparation on

gentle slopes would result in minimal erosion when conducted in accordance with resource protection measures. Manually conducted activities would have little to no effect on erosion.

Mass Failure

Effects on mass failure are addressed in the **Geology** section (page 135).

Effects of Other Proposed Activities

Other proposed activities (page 34) include construction of permanent NFS and temporary roads and conversion of unclassified roads to NFS roads. Requirements for protection of soil resources and productivity do not apply to the permanent transportation system (USDA Forest Service 2006b, 2010a). Permanent roads and trails preclude other uses of the land, such as growing trees, and remove most of the productive capacity of directly affected soils. If the permanent transportation system is managed to standard, any indirect effects are expected to be very limited in spatial extent (USDA Forest Service 2010b).

Requirements for protection of soil resources and productivity do apply to temporary roads. The BHRL project proposes temporary roads only to facilitate commercial timber harvest. Temporary roads would be rehabilitated as required under the associated timber sale contract (USDA Forest Service 2006c). Standard rehabilitation actions generally include removing any culverts or temporary bridges, installing erosion control features, ripping or scarifying the template, placing woody material on the template, and/or seeding or planting appropriate vegetation. If post-activity evaluation indicates that rehabilitation using one of these methods has not accomplished resource objectives, additional methods would be used.

Rehabilitation activities would not immediately ameliorate any detrimental soil impacts, but conditions would improve. Establishment of vegetation and additions of organic matter (such as slash) would generally contribute to recovery of site productivity. Recontouring the road to match the adjacent natural landscape would move hydrologic function toward a more natural condition and facilitate revegetation.

Erosion may be associated with NFS road reconstruction and temporary road construction where soil surfaces are exposed to rainfall and overland flow. Short-term increases of erosion may occur. Monitoring indicates that these effects would decrease as disturbed soils revegetate or are rehabilitated following use.

No Action Alternative

The No Action alternative would have no immediate effects. Areas of soil impairment would continue to exist and gradually recover. Over time, fire hazard and suppression difficulty could increase (**Fire and Fuels** section, page 80). Large, high-severity wildfires could result in sheet, rill, and gully erosion networks and a reduction in effective ground cover. A temporary increase in erosion could follow. Large amounts of sediment movement could occur the first year after the fire, decreasing over the next three to five years as vegetation recovers (Keyser et al. 2006).

Cumulative Effects

The cumulative effects analysis area for soil resources is all sites within the BHRL project area where activity may occur (764,188 acres). Activities would occur at various sites within this larger area, not on all acres. It is selected because direct and indirect effects on soils are limited to the specific area of activity. The timespan for cumulative effects analysis is the present through 2031, or five years after

the probable completion of proposed activities. By this time, it is estimated that the project's effects on soils would become difficult to distinguish from those of other activities and events.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Past prescribed burns temporarily reduced ground cover but, due to their low to moderate intensity, sites revegetated quickly with few lasting effects on soil. Unauthorized use of wheeled motorized vehicles off of designated roads and trails has caused exposure of soil in specific areas. Enforcement and rehabilitation efforts are ongoing. Continued use of these unauthorized routes would delay revegetation and soil recovery.

The Proposed Action may add to the above effects of past, current, and foreseeable activities. Proposed commercial timber harvest may occur on sites that were harvested less than 10 years prior. In these and other harvested areas, there is a chance that previous skid trails, landings, and temporary roads caused areas of excessive disturbance and that soil conditions will not have recovered before the new round of harvest occurs. Though considered unlikely due to the documented generally minor effects of these activities, it is possible that the additive effect could exceed acceptable levels of disturbance. Based on the general rapid recovery rate of most Black Hills soils, the additive effect would not persist for more than a few years, but it may occur. For this reason, the BHRL project prescribes soil investigations prior to commercial timber harvest in certain harvested areas (page 40). If these investigations find that proposed harvest would be likely to result in undesirable cumulative effects, harvest would be deferred or conducted in accordance with site-specific measures designed to prevent unwanted effects.

If mechanical site preparation were to occur on previously disturbed steep slopes, additive effects may further exceed guidance levels (see page 150). Other proposed activities would be unlikely to have discernable or lasting effects on soil productivity factors and would therefore not cause additive effects.

With the exception of site preparation on steep slopes, cumulative effects of the Proposed Action would contribute toward achievement of Forest Plan goal 1 (*"Protect basic soil, air, and water resources"*) and comply with applicable laws, standards, and guidelines.

Watershed

Summary

The Proposed Action would not change watershed condition class (page 158). There would be no effects on impaired water bodies.

Road-related activities would result in a slight increase in the potential for sedimentation, mainly at stream crossings. These effects would persist until the site revegetates, which generally occurs within five years. Improvement of existing roads would reduce sedimentation rates below existing levels due to reduction of connected disturbed areas. The Proposed Action would not impair project area streams. Therefore, these streams would continue to meet their beneficial and designated uses.

The Proposed Action would have no more than minor, temporary effects on streamflow. Proposed new road crossings of perennial and intermittent streams would affect associated riparian areas.

Information Sources

The analysis is based primarily on hydrologic survey data collected by Forest Service hydrology professionals and technicians across the project area as part of previous management activities. These surveys recorded location and attribute data for streams, springs, wetlands, and other water features. Where survey has not yet occurred, information on water features was obtained from the National Hydrography and Watershed Boundary Datasets (USGS 2017). Watershed condition class is based on the national Forest Service Watershed Condition Framework process (USDA Forest Service 2011d) and calculated via the Watershed Classification and Assessment Tracking Tool (part of the Forest Service Natural Resource Manager system, https://www.fs.fed.us/nrm/). Analysis also considered BMP evaluation and monitoring results as documented in Forest Plan monitoring reports (USDA Forest Service 2013a, 2015b, etc.).

If the Proposed Action is selected for implementation, field review of areas not previously surveyed and verification of conditions would occur as needed.

Affected Environment

Watershed Condition Class

Watershed condition is the state of physical and biological characteristics and processes that affect soil and hydrologic functions supporting aquatic ecosystems. Watershed condition class reflects a range of variability from natural/pristine (functioning properly) to degraded (severely altered/impaired) (USDA Forest Service 2011c). Watershed condition classification is the process of describing watershed condition in terms of discrete categories that reflect the level of watershed health or integrity (USDA Forest Service 2011c).

In 2011, the BHNF reclassified watershed condition class in response to a national initiative (USDA Forest Service 2011c, 2011d). This replaced the classification detailed in the Forest Plan. Watershed condition is based on a model that considers aquatic and terrestrial indicators. For each Hydrologic Unit Code (HUC) 12 watershed, indicators were individually rated and summed based on a weighting factor to arrive at the ratings displayed in Table 21.

Table 21. Watershed Condition Class Ratings – BHNF

Condition class	Score	Definition	Number of Watersheds
1	1.0-1.6	Functioning Properly	43
2	1.7-2.2	Functioning at Risk	52
3	2.3-3.0	Impaired Function	0

In 2015, the BHNF reassessed four of these watersheds, taking a closer look as compared to the 2011 broad-brush effort. The score remained the same for two watersheds and decreased or improved for the other two (USDA Forest Service 2015b). All remained within the same condition class.

Three watersheds (Newton Fork, Slate Creek, and Victoria Creek-Rapid Creek) have a rating of 2.2, the highest score for a Class 2 watershed before becoming a Class 3. This rating resulted from the condition of aquatic habitat, aquatic biota, riparian/wetland vegetation, roads and trails, and fire regime.

Surface Water

The Black Hills stream network is characterized by geology, climate, and constructed reservoirs that influence stream permanence, volume, temperature, and other factors. The Black Hills region traditionally has some of the best surface water quality in the state. This is due in a large part to the cooler climate, higher precipitation, and less erosive bedrock than the surrounding plains.

Due to geologic features (page 135), there is very little surface water in the western parts of the project area (Figure 27). Limestone formations also create a loss zone along the periphery of the Black Hills, where stream flow enters groundwater aquifers. During periods of base flow, some streams lose their entire volume when crossing these formations.

The project area includes approximately 4,567 miles of streams (Table 22).

Table 22. Stream Miles by Flow Type

Flow Type	NFS Miles	Non-NFS Miles	Total Miles
Perennial	567	461	1,028
Intermittent	1,042	479	1,521
Ephemeral	1,628	390	2,018
Total	*3,237*	*1,330*	*4,567*

There are no natural lakes in the Black Hills (Stewart et al. 1964, SDGFP 2015). All standing waters are impoundments. The largest Black Hills lakes (Pactola, Sheridan, and Deerfield) are in MA 8.2, which is excluded from the project area. Reservoirs in the project area total approximately 400 acres.

Beneficial Uses and Impaired Waters

The Clean Water Act requires states to adopt water quality standards to protect the nation's waters. These standards define how much of a pollutant can be in surface water or groundwater before its condition ceases to meet its designated uses, such as for drinking water, fisheries, swimming, irrigation, or industrial purposes.

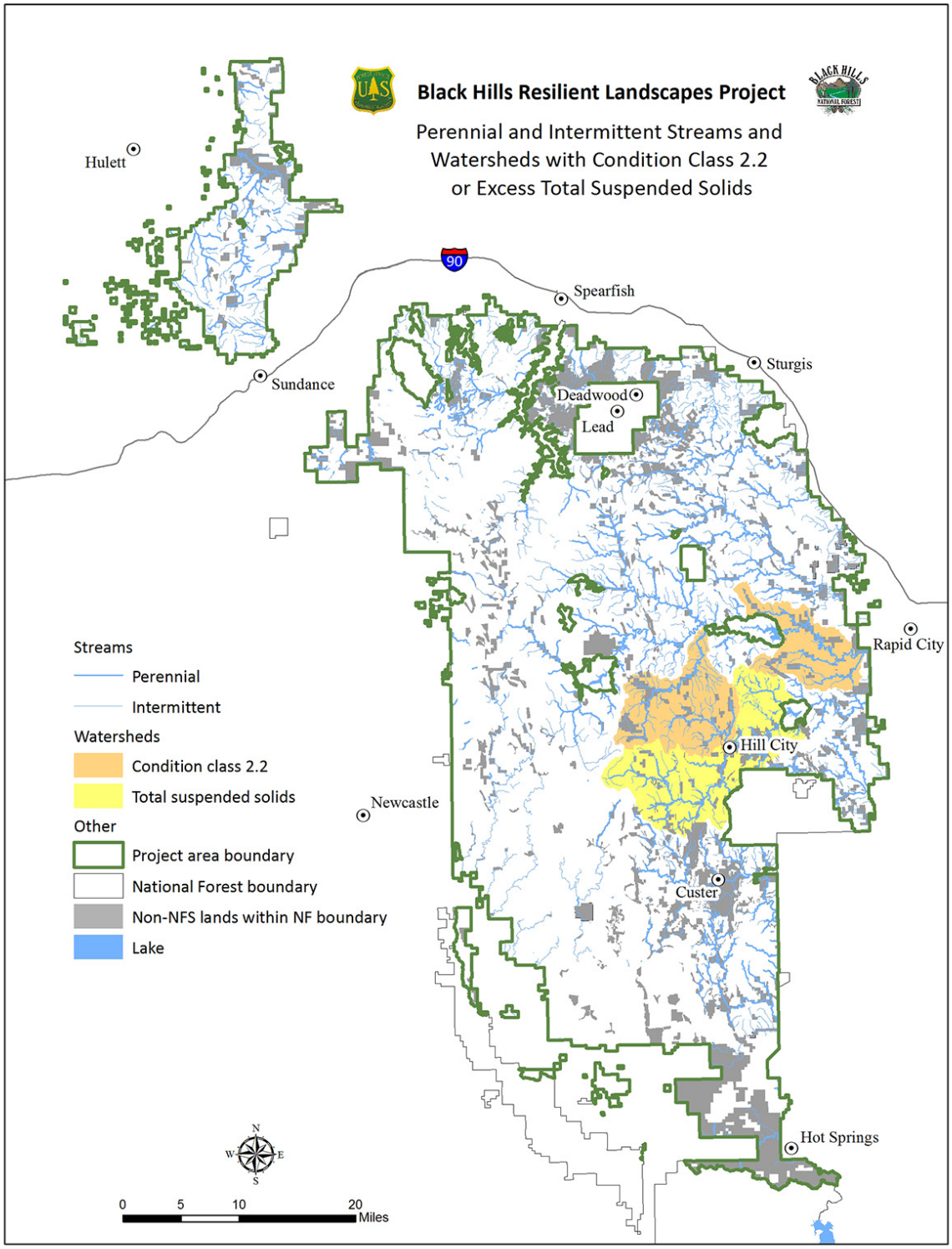


Figure 27. Streams and Design Feature 5(a) Watersheds

Every other year, states must publish an updated list of streams and lakes that are not meeting their designated uses because of excess pollutants (impaired waters). Table 23 displays the 2016 list of impaired Black Hills streams and lakes, all located in South Dakota. Watersheds containing Spring Creek (relevant to design feature 5(a), page 39) are displayed by Figure 27. No impaired waters are identified in the Wyoming part of the BHNF (WYDEQ 2016). Other impaired waters occur near the BHNF, but they are not addressed here; the Proposed Action would be unlikely to affect their water quality because the magnitude or intensity of activities would be negligible in the context of the impairment.

Table 23. Beneficial Uses and Impaired Water Bodies

Water Body	Beneficial Use	Impairment	Source of Impairment
Battle Creek	Limited contact recreation	Escherichia coli, fecal coliform	Unknown
Deerfield Lake	Coldwater permanent fish life	Temperature	Unidentified
Iron Creek Lake	Coldwater permanent fish life	Temperature	Unidentified
Sheridan Lake	Coldwater permanent fish life, fish/wildlife propagation, recreation, stock water	Mercury in fish tissue, dissolved oxygen, temperature	Mercury: Atmospheric deposition* Oxygen: Nutrient loading
Spring Creek	Coldwater permanent fish life, immersion recreation, limited contact recreation	Total suspended solids, E. coli, fecal coliform	Wildlife, urban runoff, storm sewers, septic systems, livestock
Stockade Lake	Coldwater permanent fish life, fish/wildlife propagation, recreation, stock water	Mercury in fish tissue	Atmospheric deposition
Strawberry Creek	Fish/wildlife propagation, recreation, stock water	Cadmium	Acid mine drainage, impacts from abandoned mines
Victoria Creek	Coldwater permanent fish life	Temperature	Unidentified
Whitewood Creek	Immersion recreation	E. coli, fecal coliform	Aging municipal lines, sewer overflows

**The primary source of mercury in South Dakota is global atmospheric deposition (SDDENR 2016).*
Sources: SDDENR (2016) and State of SD (2015)

Stream Connectivity and Connected Disturbed Areas

Dams associated with artificial impoundments affect stream connectivity and aquatic organism passage. Other in-stream structures, such as "perched" culverts at road-stream crossings, also fragment the stream network and block fish and other aquatic organism passage.

Unpaved roads are a long-term source of sediment input into water bodies, resulting in connected disturbed areas (CDAs). The proximity of a road to a water body increases the potential for sediment input. Stream crossings are the road features with the greatest potential for contributing non-point source pollution to water (Edwards et al. 2016). Road-stream crossings are typically CDAs. Current data indicate approximately 2,753 road crossings on perennial and intermittent streams in the project area. Of those crossings, 2,031 are on NFS lands and 722 are on non-NFS lands. These figures include roads under all management jurisdictions (Forest Service, State, county, etc.) regardless of travel management status.

Water Yield

Water yield is a concern for communities in and around the Black Hills. The water provided by streams flowing from the Black Hills is an important resource used for drinking, irrigation, livestock, fisheries, and recreation.

Forested landscapes intercept rain and snow, some of which returns to the atmosphere through evapotranspiration. As a result, forests can decrease the quantity of water that reaches the ground surface. In the Black Hills, over 92 percent of total annual precipitation is lost to evapotranspiration associated with forests (Driscoll et al. 2002). Conversely, forests also help conserve moisture by providing shade and cooler temperatures, reducing evaporation. The transpiration of moisture back to the atmosphere contributes to rain and snow development in the area. Thus, annual water yield depends on the density or coverage of the forest, the type of forest vegetation, as well as many other factors including climate, weather patterns, geology, slope, soils, stream channel conditions, and riparian area conditions.

Floodplains, Riparian Areas, Springs, and Wetlands

Floodplains are natural inundation areas for floods that reduce flood stages and velocities. Every stream has a floodplain. Floodplains store water, serve as natural sponges to moderate the release of high water, and act as filters to trap sediment and pollutants. They are important because the loss of floodplain function can change the timing and peak of stream flows. There are 16,584 acres of mapped floodplains in the BHRL project area.

Riparian areas are those lands that interface between water and drier uplands. Riparian areas are some of the most ecologically diverse habitat types and provide bank stability, sediment filtering, streamside shading, and nutrient input into streams and lakes. The acreage of riparian areas in the BHRL project area is unknown. They are generally located along perennial and intermittent streams, which are displayed in Table 22 (page 154).

Springs are defined as a "place where groundwater flows naturally from a rock or the soil onto the land surface or into a body of surface water" (Wilson and Moore 1998). Springs are managed as a subset of wetlands due to their unique characteristics. Springs are always groundwater-dependent (USDA Forest Service 2012c, 2012d). The Watershed Conservation Practices Handbook states "avoid any loss of rare wetland such as fens and springs" (USDA Forest Service 2006b). Fens are a subset of wetlands. They are groundwater-dependent and accumulate peat or muck (USDA Forest Service 2012c, 2012d). Fens are further discussed in the **Botanical Resources** section, page 90.

There are approximately 4,014 springs and 25 fens on NFS lands in the BHRL project area. Because intensive field surveys have not occurred in all areas, these figures may be low. In this document, springs and fens are discussed with wetlands.

Wetlands control runoff and water quality, recharge ground water, and provide special habitats. Actions that may alter their ground cover, soil structure, water budgets, drainage patterns, and long-term plant composition can impair these values. There are approximately 2,802 wetlands on NFS lands in the BHRL project area.

The wetland classification system identified by the Federal Geographic Data Committee (2013) is the national standard for mapping, monitoring, and reporting on wetlands. Wetlands were initially mapped in 1995 by the U.S. Fish and Wildlife Service for a National Wetland Inventory (USFWS 1995). Table 24 data are based on the National Wetlands Inventory and supplemental mapping by

BHNF personnel. This inventory contains known omissions and inaccuracies. Data improvement is an ongoing process.

Table 24. Wetlands by Type

Wetland Type	Definition	Count	Acres
Palustrine	Marshes, swamps, bogs, fens, and ponds	944	698
Lacustrine	Permanently flooded lakes and reservoirs	3	32
Riverine	Rivers and creeks (flowing water)	6	10
Unclassified	Type has not been verified	1,849	1,932
Total		*2,802*	*2,672*

Municipal Watersheds

According to 36 CFR part 251.9, "The Forest Service shall manage National Forest watersheds that supply municipal water under multiple use prescriptions in forest plans (36 CFR part 219). When a municipality desires protective actions or restrictions of use not specified in the forest plan, within agreements, and/or special use authorizations, the municipality must apply to the Forest Service for consideration of these needs."

The Forest Service has no agreements related to municipal watersheds in the BHNF. Due to the geology of the Black Hills, many watersheds are source areas for public water systems. Most of the larger communities draw their supplies from groundwater and many of their sources are identified as vulnerable to contamination by chemicals because they are generally connected to surface water. The Lead/Deadwood source is surface water and Rapid City uses water from Rapid Creek during peak summer usage.

As a demonstration of how vulnerable some of the municipal supplies are, dye tracing was completed at several stream sink locations in 1971, 1973, 1993, and 1999. Of particular interest were Box Elder Creek and Spring Creek sinks. A focused flow path was observed from the Box Elder Creek sink to the southeast. At City Springs and Rapid City Well #6, dye detection began 30 days after injection and continued until day 261. At Rapid City Well #10, dye detection began less than 50 days after injection and continued until day 198 (Long et al. 2002). The flow path from the Spring Creek sinks was to the northeast and dye was detected in at least one Rapid City well.

Information about public water systems in South Dakota is found on the Department of Environment and Natural Resources website (https://denr.sd.gov/des/dw/sysinfomap.aspx). There are many public water systems in and around the Black Hills. Individual HUC 12 watersheds that are source areas for public water systems have not been identified.

Environmental Consequences

Watershed Condition Class

Of the 95 HUC 12 watersheds in the BHNF, the BHRL project excludes or proposes no activities in 13. Eleven additional watersheds would be minimally affected, with no new road crossings of perennial or intermittent streams and very little commercial timber harvest. This analysis considers the remaining 71 watersheds.

Effects on Class 1 Watersheds

Of the 71 watersheds, 22 are rated as Class 1 (Functioning Properly). Thirteen of the 22 watersheds have a score of 1.6, approaching Class 2 (Functioning at Risk). Proposed commercial timber harvest and road construction vary among these watersheds (Table 25).

Table 25. Activities Proposed in Condition Class 1 Watersheds with Score of 1.6

Watershed Number	Watershed Name	Proposed Commercial Treatment (% of Watershed)	New and Temporary Roads (Miles)	New Crossings of Perennial or Intermittent Streams
101201060401	Fourmile Creek	18%	0.9	0
101201060403	Pleasant Valley-Red Canyon Creek	6%	1.5	0
101201070405	Whoopup Creek	10%	3.6	0
101201070501	Upper Pass Creek	12%	1.9	1
101201070502	Middle Pass Creek	2%	0.2	0
101201070503	Tepee Canyon	4%	4.7	4
101201090102	Lower Cold Brook	4%	0.1	0
101201090906	Rockerville Gulch-Spring Creek	2%	0.0	0
101201110603	Stagebarn Canyon Creek	7%	1.6	1
101201110605	Morris Creek	2%	1.4	0
101202030202	Grand Canyon	27%	22.3	1
101202030205	Bear Gulch	9%	7.7	1
101202030405	North Fork Hay Creek	1%	0.1	0

The Proposed Action would not cause these watersheds to transition from Class 1 to Class 2. This conclusion is based on the proposed activities affecting a small percentage of most of the watersheds; expected improvements in fire regime, forest cover, and forest health factors; and implementation of design features. Grand Canyon watershed is an outlier, with relatively high proposed activity levels. Assuming activities are implemented as proposed, including application of all design features, condition class score would remain unchanged. The same outcome would occur under the No Action alternative.

Effects on Class 2 Watersheds

Forty-nine watersheds are rated as Class 2 (Functioning at Risk). Activities are proposed in the three watersheds with a score of 2.2 (Table 26). This score indicates that the watersheds are approaching Class 3 (Impaired Function).

Table 26. Activities Proposed in Condition Class 2 Watersheds with Score of 2.2

Watershed Number	Watershed Name	Proposed Commercial Treatment (% of Watershed)	New NFS and Temporary Roads (Miles)	New Crossings of Perennial or Intermittent Streams
101201090902	Newton Fork	22%	2.5	0
101201100109	Slate Creek	19%	2.3	2
101201100201	Victoria Creek-Rapid Creek	14%	1.4	0

Assuming activities are implemented as proposed, including application of all design features, condition class score would remain unchanged. The No Action alternative would result in the same outcome.

The Proposed Action may construct new specified and temporary roads and convert unclassified roads to NFS roads. All new specified and converted roads would be closed to motorized vehicles after use. Temporary roads would be permanently closed. The Watershed Condition Framework only considers density of open roads in its roads and trails indicator (USDA Forest Service 2011c). These roads would not change open road density and thus would not affect the roads and trails indicator.

Water Quality

The primary aspects of water quality that National Forest management may affect include sediment, chemistry, and temperature. Other factors affecting water quality in and around the Black Hills include bacteria, mercury in fish, dissolved oxygen, and cadmium (Table 23, page 156).

Project effects on impairments of Battle, Strawberry, and Whitewood Creeks and Stockade Lake are not analyzed further for the following reasons.

- The causes of bacterial impairment for Battle and Whitewood Creeks would not be affected by the Proposed Action.
- The primary cause of mercury occurrence in fish tissue in Sheridan and Stockade Lakes is global atmospheric deposition (SDDENR 2016). Implementation of the Proposed Action would not affect mercury deposition.
- The cause of cadmium impairment in Strawberry Creek is associated with abandoned mines and acid mine drainage (SDDENR 2016). The Proposed Action would not affect these lands or produce cadmium.

The analysis addresses impairments of the following water bodies.

- Sheridan Lake: Temperature (page 163) and dissolved oxygen deficiency (Sediment, below).
- Spring Creek: Total suspended solids (Sediment, below). (Spring Creek is also impaired by bacteria, the causes of which would not be affected by the Proposed Action.)
- Deerfield and Iron Creek Lakes and Victoria Creek: Temperature (page 163).

Water Quality: Sediment

Aquatic Management Zones: The land next to streams is referred to as the Aquatic Management Zone (AMZ). The National Best Management Practices for Water Quality Management on National Forest System Lands (USDA Forest Service 2012b) defines AMZ as an administratively designated zone adjacent to stream channels and other water bodies. Analogous terms used elsewhere include Water Influence Zone (WIZ) and Streamside Management Zone (SMZ).

The width of the AMZ depends on site-specific factors and local requirements. Based on the WCPH and State guidance (SDSU et al. 2003, WSFD and WYDEQ 2006), the BHNF uses an AMZ width of at least 100 feet on either side of streams and 100 feet around springs and wetlands.

Standard design features restrict activities in the AMZ. Landings are prohibited. Skid trails may be placed in the outer half of the AMZ, but only if a hydrologist determines that long-term stream health and riparian ecosystem conditions would not be adversely affected (page 39). With the same limitations, other mechanized equipment can operate in the AMZ. Factors the reviewing hydrologist considers include riparian vegetation, stream shade, and stream banks, as well as potential for sediment transport to the stream.

Roads are considered the primary contributors of sediments to streams in managed watersheds (USDA Forest Service 1996 and EPA 2005). Erosion can occur on cut and fill slopes, on the road surface, and in ditches. The amount of erosion is affected by road surfacing, cross-drainage, and underlying soil (USDA Forest Service 1996). An estimated one-third to half of road erosion occurs during the first year after construction, dropping quickly to near background levels within two to three years if continued use is not allowed (EPA 1976 in USDA Forest Service 1996).

Roads can also impact the ecological integrity of a watershed. If constructed without properly planned drainage, roads can impair water quality in nearby streams (USDA Forest Service 1996, 2006b). Undersized culverts or bridges can wash out, contributing to erosion and sedimentation to levels that can be detrimental to other aquatic resources (USDA Forest Service 1996).

Proposed road construction and improvement activities would occur on soil map units with severe erosion hazard. Forest Plan standards 1105, 1106, 1109, 1112, 1113, and 1114 and guideline 1115 provide measures to prevent or minimize erosion and sedimentation from roads and other disturbances. WCPs, State BMPs, and road design standards provide additional protective measures. Examples of specific measures for protecting highly erosive soils include placement of aggregate on the road bed, reducing the distance between cross-drains, and prompt seeding of cut and fill slopes. Adherence to these measures would reduce concentration of surface runoff, minimizing erosion related to road construction and improvement. Sedimentation would be localized and limited to the time during and soon after road work, decreasing as revegetation occurs.

Commercial timber harvest may occur in AMZs on up to 4,516 acres. The actual figure would likely be closer to 2,800 acres, which is proportional to the actual acres to be harvested out of the total available acreage. Harvest activities would contribute minimal sediment due to protective measures for AMZs (page 39). These measures ensure retention of vegetation that acts as a sediment filter, especially during overland flow conditions. The Environmental Protection Agency (EPA; 2005) showed the effectiveness of an AMZ buffer in reducing harvest-related sediment input to streams. Libohova (2004) found that thinning treatments in ponderosa pine generated minimal to no sediment yield. Because activities would contribute little to no sediment, there would be no effects on Spring Creek or Sheridan Lake (both of which are impaired due to sediment-related issues).

Observations in the Black Hills show that commercial logging generally does not generate sediment (USDA Forest Service 2011e, 2011f). While intense rain events on recently logged areas can cause water to run off the site, the water has been observed to carry away organic particles rather than sediment. This can occur for one to two years after the operations, ending when vegetation becomes reestablished. These events are rare but can occur.

The Proposed Action would result in a slight increase in the potential for sedimentation due to road-related activities, mainly those at stream crossings. These effects would persist until the site revegetates, which generally occurs within five years. Improvement of existing roads would reduce sedimentation rates below existing condition due to reduction of CDAs. The Proposed Action would not impair project area streams. Therefore, these streams would continue to meet their beneficial and designated uses.

Prescribed fire would have minimal impact on sediment. Studies have shown that prescribed fire, if carefully planned and implemented using appropriate BMPs, has no significant effect on water quality (EPA 2005).

Other proposed activities would not result in sedimentation. Most would not involve large mechanized equipment, so soil disturbance would be minimal and surface organic matter would

remain in place to protect soil and absorb precipitation. Mechanical site preparation would disturb the ground but would not occur in AMZs (page 39).

Effects on Impaired Water Bodies: Spring Creek is the only water body in the project area that is listed as impaired due to sediment (SDDENR 2016, WYDEQ 2016). Sheridan Lake is considered impaired due to low dissolved oxygen, which results from phosphorus delivered with sediment.

Spring Creek is in three HUC 12 watersheds, one of which also includes Sheridan Lake. Table 27 displays proposed activities in these watersheds.

Table 27. Activities Proposed in Watersheds with Impaired Water Bodies

Watershed Number	Watershed Name	Acres	Maximum CTA Acres	Max. % of Watershed Treated	Max. AMZ Acres in Potential CTAs	New Road Xings of Perennial and Intermit. Streams
101201090901	Headwaters Spring Creek	23,095	9,003	39	104	4
101201090903	Newton Fork-Spring Creek	24,411	6,449	26	85	2
101201090904	Sheridan Lake-Spring Creek	24,976	5,130	21	169	1

As discussed above, commercial timber harvest in AMZs would not contribute sediment to streams when conducted in accordance with WCPs and other design features. Roads that cross or are adjacent to streams are the main generator of sediment. For this reason, design feature 5(f)(i) would apply (page 40). Adherence to this measure and WCPs, BMPs, and road design standards would minimize sediment contribution to Spring Creek.

A fourth watershed, Newton Fork, also contributes to Spring Creek. The above design feature would not apply to Newton Fork watershed because Major Lake, which is at the mouth of the watershed, captures and stores any sediment before it can reach Spring Creek.

Sediment delivered to the streams would remain at current levels under the No Action alternative. Stream crossings and road-related CDAs contributing sediment into streams would continue to do so.

Though large, high-severity wildfires could occur under either alternative, fire hazard and suppression difficulty would be greater under the No Action alternative (**Fire and Fuels**, page 80). If such a wildfire were to occur, sediment could be delivered to streams. Large amounts of sediment movement could occur the first year after the fire, decreasing over the next three to five years as vegetation recovers. This was observed after the 83,500-acre Jasper wildfire, which occurred in August 2000 (Keyser et al. 2006). At first, a large flush of sediment from roads and hillsides moved downstream. Sediment and ash were deposited along floodplains and within streams. This caused changes in streambed sediment size class. Usually, streams deposit a layer of fine sediment (2 mm or less) along point bars. A large flow event after a severe fire can cause streambank erosion and formation of mid-channel bars. Sediment may choke the system for about three years and then start tapering off, depending on precipitation events.

Under this scenario, increased sediment could affect water quality the first few years after the fire. This would be most apparent during times of high flows, especially after summer thunderstorms. Sand and smaller particles could fill in the gaps between cobbles and boulders, reducing habitat for aquatic organisms. Fire and subsequent high flows may also result in channel cutting or movement of

material from the streambank. During storm events, high-velocity water flow may pick up streambank sediment and move it downstream, increasing stream incision. Such changes to the sediment regime could alter stream morphology. Suspended sediment could be deposited within meanders and create new point and mid-channel bars.

Water Quality: Chemical

"Water purity can be degraded by placing concentrated pollutant sources near water bodies, applying harmful chemicals in or near water bodies, or intercepting hazardous rock strata by roads. Degrading water purity can impair or destroy use of the water by aquatic biota and humans" (USDA Forest Service 1996).

Use of chemicals, pathogens (bacteria, fungi, or viruses), or petroleum products can affect chemical aspects of water quality. The Proposed Action would involve use of herbicides for weed control. Forest Plan standard 1213 and the WCPH require application of chemicals using methods that minimize the risk of entry to surface and ground water. The WCPH requires use of "only aquatic-labeled chemicals" in the AMZ. Adherence to these measures as well as prescribed herbicide application procedures would prevent creation of concentrated pollutant sources and degradation of water quality due to weed spraying.

Equipment refueling and servicing can also threaten water quality. Forest Plan standard 1211 requires that these sites be placed where potential pollutants will not reach surface or ground water. State BMPs and the WCPH also contain measures regarding placement and design of refueling and servicing sites and require preparation of spill prevention plans before project implementation. Adherence to these measures would alleviate the risk of chemicals reaching streams, wetlands, or groundwater.

The No Action alternative would not alter existing chemical aspects of water quality.

Water Quality: Temperature

According to the South Dakota Department of Environment and Natural Resources (DENR; 2016), temperature is the primary cause of impairment for lakes in the Cheyenne River basin. All impairments are due to exceedances of the temperature criterion for coldwater permanent fish life. The source of the temperature impairment has not been identified, but ambient air temperature and solar radiation affect water temperature during the peak summer months.

Deerfield, Iron Creek, and Sheridan Lakes are listed as impaired due to temperature. Achievement of the temperature criterion for these lakes may not be realistic, since they are not natural lakes and ambient air temperature and solar radiation appear to be the cause. Implementation of the Proposed Action would not affect these factors.

Activities and events that reduce stream shading may result in increased water temperature. Victoria Creek is listed as impaired due to temperature. Proposed activities that may occur along Victoria Creek include commercial timber harvest, prescribed fire, other fuel reduction, and removal of pine from oak or grasslands. These activities have the potential to reduce stream shading and contribute to temperature increase. Adherence to the project-specific design feature requiring review by a hydrologist of activities in the AMZ along Victoria Creek (page 40), in addition to design features limiting activities in AMZs, would minimize loss of shade.

Wildfire can also reduce stream shading. Fire can remove riparian vegetation, increasing direct solar radiation to the stream surface and leading to warmer summer water temperatures (Mahlum et al.

2011, Sestrich et al. 2011). Though large, high-severity wildfires could occur under either alternative, fire hazard and suppression difficulty would be greater under the No Action alternative (**Fire and Fuels** section, page 80). If proposed activities were to reduce the size or severity of a potential wildfire, their ultimate effect may be to prevent loss of stream shading and temperature increases. The No Action alternative would otherwise have no effect on stream temperature.

Proposed new road road-stream crossings could disrupt streamside vegetation and potentially affect stream temperature. The effects from the loss of streamside vegetation are discussed in the **Riparian Areas, Springs, and Wetlands** section (page 165).

Flow Regimes

"Flow regimes can be altered by major changes in cover type or ground cover, dense road networks, or water projects. Water temperature and chemistry, sediment transport, aquatic habitats, and aquatic life cycles can be degraded" (USDA Forest Service 1996).

The Forest Plan FEIS contains a detailed discussion of flow regimes (USDA Forest Service 1996). In general, flow regimes in Black Hills watersheds are constantly changing. Precipitation is the main factor in flow regimes. Vegetation is another factor; water that is used by vegetation does not flow out of the watershed. Fire suppression allows vegetation density to increase, which may reduce water yield over time.

Changes to flow regimes in the Black Hills are usually subtle. Most activities and events do not result in major changes to vegetation type or ground cover. The exception is severe wildfire, which can abruptly change vegetation type and ground cover across large areas. This can result in large changes to flow regimes.

Roads in the Black Hills have a minimal effect on flow regime because of the semi-arid climate. Water diversions put in place a century ago still reduce streamflow in East Spearfish, Elk, Tillson, and Spearfish Creeks, while Whitewood Creek gains water. The large dams forming Deerfield, Pactola, and Sheridan Lakes affect downstream flow regime.

The Proposed Action would result in no more than minor, temporary increases in streamflow. Commercial timber harvest would occur in a small percentage of the area of most watersheds. The greatest potential treatment area would be in Grand Canyon watershed, with 27 percent affected. Because this watershed is on limestone formations in which all precipitation infiltrates and there is very little surface water yield, even this amount of treatment would not cause a major change to the vegetation types or ground cover within the watershed. Magnitude and duration of any streamflow increase would be minor.

Proposed new road/stream crossings have the potential to increase streamflow. Adherence to standard construction practices (USDA Forest Service 1991), WCPs, and other design features would largely disconnect these disturbed areas from the stream. These measures would minimize the amount of unfiltered water delivered to the stream.

The No Action alternative would have no discernable effect on streamflow.

Floodplains

Proposed new roads would cross floodplains associated with perennial or intermittent streams in up to 43 locations. Crossings can impact floodplains by adding fill material and concentrating or narrowing flood flows through a culvert or under a bridge. Forest Plan standard 1203 requires that stream crossings be constructed to provide for passage of flow and sediment and withstand expected

flood flows. Application of standard procedures, such as minimizing placement of fill in floodplains, and engineering standards (USDA Forest Service 1991, 1992) to road design and construction would minimize the impact of crossings in accordance with standard 1203 and Executive Order 12988 (Floodplain Management; EPA 2012).

Other proposed activities would not affect floodplains. The No Action alternative would result in no new effects on floodplains.

Riparian Areas, Springs, and Wetlands

Commercial timber harvest and other mechanized vegetation management activities can affect riparian areas, springs, and wetlands by changing composition and structure of vegetation and by altering ground cover, soil structure, water budget, and drainage patterns. Forest Plan standards and guidelines 1301 through 1306, WCPs, and state BMPs are designed to prevent or minimize these effects by keeping mechanized equipment and ground disturbance at a distance. By adhering to these measures, proposed commercial timber harvest, mechanized fuel treatment, and mechanical site preparation would have no effect on riparian areas, springs, and wetlands.

No permanent or temporary roads or mechanically constructed prescribed fire control lines would be constructed in AMZs associated with springs, wetlands, or stream sinks (page 38). Application of this design feature ensures that the project would comply with Executive Order 11990 (Protection of Wetlands) and Clean Water Act sections 401 and 404.

Proposed new road crossings of perennial and intermittent streams would affect associated riparian areas. Up to one new permanent road, 14 new temporary roads, and 28 temporary roads on existing templates would cross streams. For new NFS roads, loss of riparian vegetation and other effects would be permanent. For temporary roads, effects would diminish after the road is removed, but complete recovery could take decades.

Proposed prescribed fire would have little to no effect on riparian areas, springs, or wetlands. These sites are wetter than surrounding areas and unlikely to burn under typical prescribed fire conditions. New mechanically constructed control lines would not be placed in AMZs associated with these ecosystems.

Proposed hardwood and grassland enhancement would not adversely affect riparian areas, springs, or wetlands. These activities may have a positive effect on these ecosystems by removing encroaching conifers.

Manually conducted vegetation management activities would not adversely affect these areas.

The No Action alternative would result in no new, immediate effects on riparian areas, wetlands, or springs. Though large, high-severity wildfires could occur under either alternative, fire hazard and suppression difficulty would be greater under the No Action alternative (**Fire and Fuels** analysis, page 80). A fire of this type would have little effect on riparian areas, wetlands, or springs since they are generally wet. Some of the riparian shrubs may be lost, but rushes and sedges should recover quickly.

Municipal Watersheds

Municipal water supplies can be affected by sediment or chemicals. As discussed above, the Proposed Action would not affect sediment levels in streams or result in chemicals entering streams. Streams would continue to meet their beneficial and designated uses.

Though large, high-severity wildfires could occur under either alternative, fire hazard and suppression difficulty would be greater under the No Action alternative (page 80). A fire of this type occurring in a municipal watershed could result in sediment production. Surface water withdrawals could be affected.

Cumulative Effects

The cumulative effects analysis area for water resources is the total area of the 80 HUC 12 watersheds that are within or partly within the project area (2,455,000 acres). This area is selected because effects of proposed activities would be limited to these watersheds. The timespan for cumulative effects analysis is the present through 2033, or five years after probable completion of proposed activities. By this time, it is estimated that the project's effects on water resources would be difficult to distinguish from those of other activities.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. The Proposed Action may add to the effects of past and ongoing timber sales in affected HUC 12 watersheds. Table 28 and Figure 28 (page 168) display the 18 watersheds in which the Proposed Action would result in a cumulative timber harvest acreage of more than 25 percent of the total watershed acreage between 2007 and 2028. Figures assume that proposed timber harvest would be distributed evenly across the potential CTAs. Percentage of each watershed on Precambrian geology is also displayed and is discussed further below.

Table 28. Cumulative Timber Harvest Area in Analyzed Watersheds, 2007-2028

Watershed Name	Cumulative Proportion of Watershed Acres Treated	Percent of Watershed on Precambrian Geology
Fourmile Creek	41%	86%
Lightning Creek-Red Canyon Creek	47%	20%
Roby Canyon	41%	0%
Ruby Creek-French Creek	35%	91%
Stockade Lakes-French Creek	26%	99%
Headwaters Spring Creek	27%	82%
Newton Fork	37%	99%
Newton Fork-Spring Creek	30%	95%
North Fork Rapid Creek	29%	52%
Slate Creek	26%	97%
North Boxelder Creek-Boxelder Creek	27%	84%
South Boxelder Creek-Boxelder Creek	43%	94%
Estes Creek-Boxelder Creek	38%	52%
Jim Creek-Boxelder Creek	30%	80%
Cold Springs Creek	27%	0%
Grand Canyon	41%	0%
Upper Spearfish Creek	40%	0%
Little Spearfish Creek	29%	0%

Of the remaining 62 watersheds, the cumulative proportion would be 21 to 25 percent in six watersheds; 16 to 20 percent in seven watersheds; 11 to 15 percent in 12 watersheds; six to 10 percent in seven watersheds; and less than six percent in 30 watersheds.
Watershed cumulative effects from sediment are an important concern in managed watersheds (Megahan and Hornbeck 2000). Stream buffers (page 39) have been shown to be very effective in moderating cumulative watershed effects (Reid 1993, SDSU et al. 2003, USDA Forest Service 2006b).

The third column in Table 28 displays the percentage of watershed that is on Precambrian (non-limestone) rocks. Cumulative effects of timber harvest and related activities would be buffered in watersheds that are on limestone geology because water infiltrates rapidly, resulting in very little to no streamflow. The watersheds with higher Precambrian percentages (greater than 60 percent) usually have more surface water. Ten watersheds consisting mainly of Precambrian rock would have a cumulative timber harvest proportion of 26 to 43 percent.

Factors tempering watershed response to these cumulative harvest levels include precipitation regime and vegetation recovery. In the central Rocky Mountains, 70 percent of precipitation falls in the form of snow (Troendle et al. 1998) and is delivered to stream channels in a one- to two-month period of time. In the Black Hills, however, most of the annual precipitation falls as rain and is spread out over a five-month period. Consequently, the Black Hills does not see the cumulative effects of timber harvest and road building that areas of the Rocky Mountains may experience. Additionally, the flush of vegetation growth that happens after timber harvest in the Black Hills moderates watershed response to timber harvest.

The Proposed Action may also add to the effects of past and foreseeable road/stream crossings. Table 29 displays the potential additive effects.

Table 29. Cumulative Road/Stream Crossings in Analyzed Watersheds

Watershed Name	Road/Stream Crossings (Perennial and Intermittent Streams)		
	Existing	Potential (BHRL)	Total
Fourmile Creek	8	0	8
Lightning Creek-Red Canyon Creek	10	0	10
Roby Canyon	74	1	75
Ruby Creek-French Creek	54	1	55
Stockade Lakes-French Creek	53	1	54
Headwaters Spring Creek	68	4	72
Newton Fork	90	0	90
Newton Fork-Spring Creek	81	2	83
North Fork Rapid Creek	49	1	50
Slate Creek	72	2	74
North Boxelder Creek-Boxelder Creek	25	0	25
South Boxelder Creek-Boxelder Creek	49	1	50
Estes Creek-Boxelder Creek	33	0	33
Jim Creek-Boxelder Creek	68	0	68
Cold Springs Creek	20	0	20
Grand Canyon	45	1	46
Upper Spearfish Creek	66	6	72
Little Spearfish Creek	24	0	24

Proposed new road/stream crossings have the potential to increase streamflow. Implementation of project-specific design features, Forest Plan standards and guidelines, WCPs, and standard construction practices (USDA Forest Service 1991) would largely disconnect these disturbed areas from the stream (page 161). These measures would minimize the amount of unfiltered water delivered to the stream. Proposed activities would occur over the course of up to 10 years, further decreasing the potential for additive effects.

With adherence to Forest Plan standards and guidelines, WCPs, and other direction, effects of road and vegetation management activities conducted on NFS lands would remain within acceptable limits. The Proposed Action would not add measurably to effects of past, ongoing, or foreseeable actions. Cumulative effects would contribute toward achievement of Forest Plan goals 1 and 2 by protecting basic water resources and providing habitat for a variety of species associated with aquatic and riparian habitats.

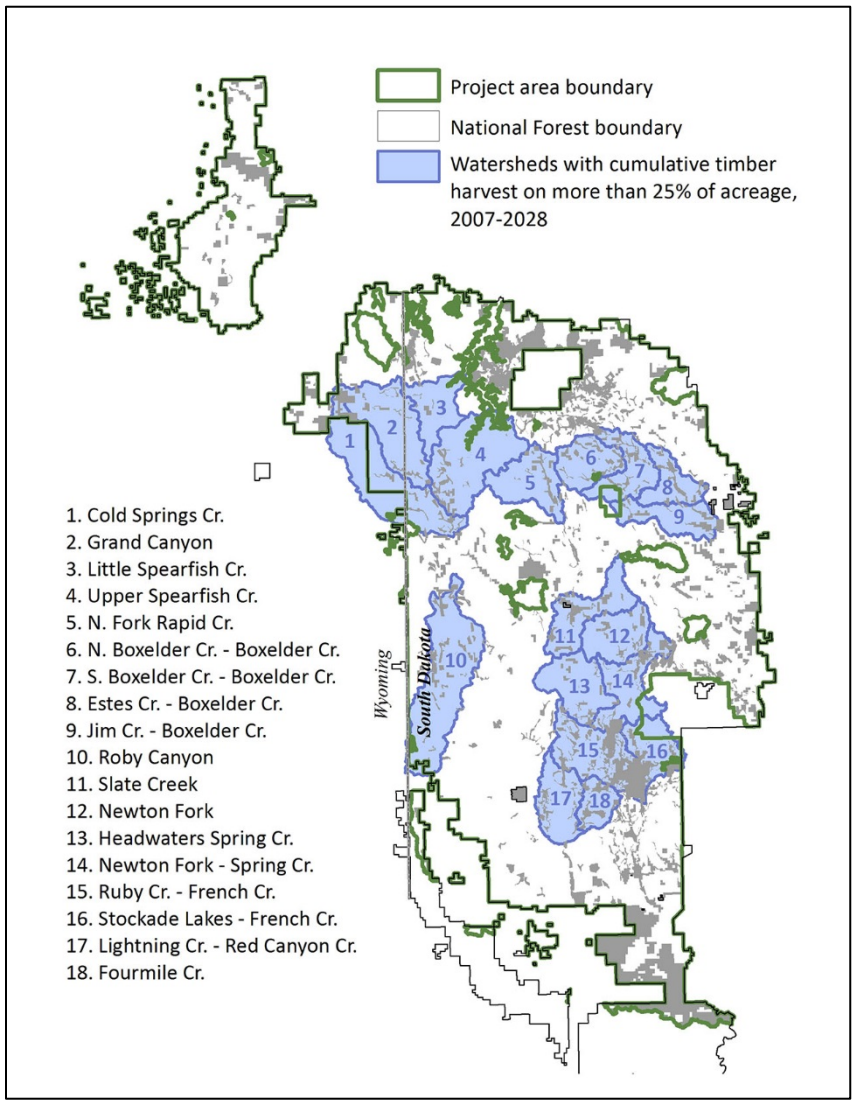


Figure 28. Watersheds with Cumulative Timber Harvest on More Than 25% of Acreage, 2007-2028

Air Quality

Summary

Proposed prescribed burning would affect air quality. Burning would be subject to prescriptive elements as defined in an approved Prescribed Fire Plan. These measures have proven effective in maintaining smoke emissions at acceptable levels. The Proposed Action (including prescribed burning) would not have long-term or significant impacts on air quality or visibility in Class I airsheds.

Information Sources

Air quality data were obtained from EPA's Airtrends website (https://www.epa.gov/air-trends/).

Existing Environment

Air quality in the BHNF is generally very good. Conditions as measured at four air quality monitoring stations downwind of the BHNF comply with National Ambient Air Quality Standards (NAAQS) for all pollutants. These stations are in Custer, Jackson, Meade, and Pennington Counties, South Dakota.

South Dakota contains two Class I airsheds: Wind Cave National Park and Badlands National Park. These airsheds are also those in closest proximity to the project area. Wind Cave is adjacent to the BHNF to the southeast, and Badlands is located approximately 50 miles east/southeast of the BHNF. A 1997 amendment to the Clean Air Act established a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I federal areas where impairments result from human-caused pollution.

The BHNF works closely with the South Dakota Department of Environment and Natural Resources. In the last 10 years, few air quality impacts from prescribed fire have been identified. The only case of known impacts was an event that lasted less than two hours.

In accordance with the Clean Air Act, the EPA has established NAAQS for six "criteria pollutants." NAAQS include primary standards, which were established to protect public health, and secondary standards, which protect public welfare. One of the criteria pollutants, particulate matter less than 2.5 microns in size ($PM_{2.5}$), is a primary component of smoke emissions from wildland fires and prescribed fires. The EPA issued two standards developed for $PM_{2.5}$: An annual standard of 12 micrograms per cubic meter of air ($\mu g/m^3$) and a 24-hour standard of 35 $\mu g/m^3$. This means that the three-year average of the weighted annual mean concentration measured at established monitoring stations must not exceed 12 $\mu g/m^3$, and the 98th percentile of readings, averaged annually over three years, may not exceed 35 $\mu g/m^3$ (78 FR 3086, January 15, 2013). EPA established the secondary standard as equal to the primary standard.

$PM_{2.5}$ data from four monitoring stations in the South Dakota portion of the Black Hills are reported on the Airtrends website. One of these sites meets minimum trends completeness criteria. This site is located in Jackson County, near Badlands National Park. The other three sites record data but do not meet the minimum trends completeness criteria.

South Dakota's ambient air quality monitoring network for $PM_{2.5}$ has continuously demonstrated attainment with the $PM_{2.5}$ standards. Between 2007 and 2016, monitoring stations in Custer, Jackson, and Pennington Counties showed $PM_{2.5}$ concentrations averaging 4.9 $\mu g/m^3$, based on seasonally-

weighted annual averages. These measurements are well below the national average for $PM_{2.5}$ concentrations and are also well below the primary and secondary standards for this criteria pollutant.

Air pollution in the form of PM_{10}, particulate matter smaller than 10 microns in diameter, was at one time a problem in the Rapid City area. The 1996 Forest Plan FEIS (USDA Forest Service 1996) notes that the Rapid City area had been classified as an area not attaining NAAQS for PM_{10} particulates. In September 2005, the South Dakota Department of Environment and Natural Resources petitioned the EPA to redesignate the Rapid City area from unclassifiable to attainment status for the PM_{10} standard. EPA published a proposed rule in the Federal Register on December 9, 2005, soliciting public comment on the proposal (70 FR 73183). On March 6, 2006, the EPA published a final rule approving the request from the State of South Dakota (71 FR 11162). The approval was based on the State's demonstration that the Rapid City area had attained the PM_{10} national standard and was committed to continuation of fugitive dust controls. The Rapid City area was officially redesignated from unclassified to attainment status for PM_{10} effective April 5, 2006.

Areas downwind of the BHNF have not historically been subject to hazardous levels of other air pollutants such as ozone, nitrous oxide, or Hazardous Air Pollutants (benzene, perchloroethylene, etc.). Fourth-maximum values for ozone, the figure used to determine NAAQS attainment, were 63 parts per billion (ppb) or less in 2007 through 2009 and 58 ppb or less in 2013 through 2015 at the three sites downwind of the BHNF (SDDENR 2010).

The project area is designated as a Class II airshed. Higher concentrations of pollutants are allowed compared to Class I airsheds. Smoke generated by wildfire usually exceeds that produced by prescribed fire and cannot be mitigated. Smoke generated under controlled conditions, such as during a prescribed fire, can be mitigated using various means.

Environmental Consequences

Proposed Action

Heavy equipment used during mechanical treatments would impact air quality due to pollutants emitted in exhaust. These impacts would be localized and short-lived.

Prescribed burning, regardless of whether pile burning or broadcast, would affect air quality. The main pollutants that would be emitted include: $PM_{2.5}$, PM_{10}, carbon monoxide, and volatile organic compounds. PM_{10} emissions may result from heavy equipment use associated with logging operations, log hauling, and road construction/improvement. Dust may also be generated through timber harvest activities, adding fine particulate emissions locally.

Smoke from prescribed burning may affect visibility and air quality. It may be noticed by nearby residents, recreational users, and adjacent communities. Users of sensitive areas such as the Class I airsheds in Wind Cave and Badlands National Parks may notice smoke, depending on transport wind direction and mixing heights.

Fire intensity and fuel consumption are expected to be lower during prescribed fire than during high-intensity wildfire. Unlike wildfire, the timing of a prescribed fire can be controlled to minimize smoke effects. Prescribed fire's short-term emissions to the atmosphere are likely to be lower than those of a wildfire, with generally low concentrations of pollutants that dissipate fairly quickly.

Prescribed burning would be subject to prescriptive elements as defined in an approved Prescribed Fire Plan. These prescriptive elements may include smoke mixing height, transport windspeed and

direction, and smoke dispersal conditions. Fuel model along with fuel loading determines the type and concentration of pollutants produced by a prescribed fire. These factors are taken into consideration when identifying prescriptive elements in the Prescribed Fire Plan.

Monitoring of potential smoke impacts may include on-site air monitoring, ozone monitoring, ocular estimation of visual smoke impacts, or referencing of air monitoring sites at Wind Cave or Badlands National Park or the monitoring site in Rapid City, South Dakota. In addition, the prescribed burn planning process would incorporate the Interagency Prescribed Fire Planning and Implementation Procedures Guide (NWCG 2008) and would undergo technical review prior to Line Officer review and approval. Potential short-term effects would be minimized by adhering to smoke permit conditions identified in the appropriate State implementation plan (SDDENR 2011, WYDEQ 2011). The Forest Service coordinates burning with the Wyoming Department of Environmental Quality by preparing a Smoke Management Plan waiver (if smoke dispersal is "fair" or better), notification of implementation, and post-burn reporting. South Dakota does not require notification.

These design features have proven effective in maintaining smoke emissions at acceptable levels, as demonstrated by State monitoring. The public would be notified prior to ignition as specified in the approved Prescribed Fire Plan. Weather forecasts are obtained through the National Weather Service and are one of the primary factors influencing the decision on whether to proceed with ignition.

As a result of the above measures, the Proposed Action (including prescribed burning) would not have long-term or significant impacts on NAAQS or contribute to significant future impairments of visibility in Class I airsheds.

No Action Alternative

The No Action alternative would have no immediate effects on air quality. Continued high fire hazard would increase the likelihood of large wildfires, which may have severe effects on air quality in nearby communities and Class I airsheds.

Cumulative Effects

The cumulative effects analysis area for air quality is all lands within the external project area boundary plus adjacent forested areas. This area includes approximately 1,935,000 acres, including 1,200,000 NFS acres. It is selected because the activities whose effects are most likely to overlap in time and space are prescribed broadcast burning and pile burning, which occur on forested NFS, private, state, and other federal lands in the Black Hills. The timespan for cumulative effects analysis is lifespan of the project, or approximately 2018 through 2028, as the Proposed Action would produce smoke only during this time.

Ongoing and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Proposed burning may add to the air quality effects of planned burning on NFS and other lands; because favorable conditions for burning tend to occur on relatively few days, smoke from more than one source may be present at a given time. Burning is an ongoing activity that has caused few air quality violations (see page 169), and it is likely that the cumulative effect of the Proposed Action on air quality would be minor and short-lived.

Transportation System

Summary

The Proposed Action would impact roads and motorized trails during implementation of proposed activities due to increased truck traffic, construction equipment operations, and additional vehicles using the roads. Effects may include closures and traffic delays. Safety considerations would be included in road design for new and reconstructed roads and during active road work.

Information Sources

Transportation system information was obtained from the National Forest Transportation Atlas, which is updated annually or more frequently if needed. The Atlas contains site-specific information on road location, as well as function and maintenance information from the transportation geodatabase and INFRA database. The Atlas contains Road Management Objectives, which include the specific authorization for and purpose of each road and outline the design parameters and current maintenance level as well as possible future changes to design and maintenance level. Information from national visitor use monitoring conducted in the BHNF was also used.

Existing Transportation System

The existing BHNF transportation system is a result of historic management and use of the forest. The BHNF has been extensively managed for timber production, grazing, mining, big game hunting, wildlife, insect and disease risk, fuels, and recreational uses that include hiking, horseback riding, mountain bike riding, hunting, off-road vehicle use, and snowmobiling (USDA Forest Service 2007b). In addition, there are over 300,000 acres of private land within the BHNF boundary that are accessed by the transportation system.

The BHRL project area includes approximately 5,880 miles of existing roads under the following jurisdictions:

- National Forest: 4,831 miles
- Other federal: 2 miles
- State: 219 miles
- County: 441 miles
- Local: 6 miles
- Private: 381 miles

NFS roads are defined by maintenance level, as documented in each Road Management Objective (RMO). Maintenance level defines the level of service provided by, and maintenance required for, a specific road. RMOs document the intended purpose and standards for an individual road and contain specific design, operation, and maintenance criteria (Table 30; further definitions in the project analysis file, section 5.08).

Table 30. Project Area Roads under National Forest Jurisdiction

Maintenance Level	Miles
1 – Basic custodial care (closed)	1,941
2 – High clearance vehicles	2,297
3 – Suitable for passenger cars	489
4 – Moderate degree of user comfort	104
5 – High degree of user comfort	Less than 1
Total NFS roads	*4,831*

In addition to the roads in Table 31, there are 1,095 miles of unauthorized routes that have been inventoried by the Forest Service within the project area. Unauthorized routes are not part of the system of roads maintained by any jurisdiction. They are not available for any motorized vehicle travel and have not been determined to be necessary for future management of the forest. Unauthorized routes may be user-created or former roads that were not effectively closed.

The transportation system that is intended for public motorized travel was established by the Travel Management Plan Record of Decision (ROD) signed on May 7, 2010 (USDA Forest Service 2010d). The ROD designated certain roads and trails as open to public motorized vehicle traffic on lands administered by the BHNF and also assigned a class of vehicle and season of use to these designated roads or trails in accordance with 36 CFR 212 Subpart B. Implementation began in December 2010 with publication of the first BHNF Motor Vehicle Use Map (MVUM). The current MVUM is dated January 1, 2017, and displays 3,045 miles of roads open to motorized travel by the public. An additional 658 miles of designated motorized trails, some of which are coincident with NFS roads, are open to users with motorized trail permits.

Table 31 displays travel management designations for roads and trails in the BHRL project area and across the BHNF.

Table 31. Travel Management Designations for Motorized Roads and Trails

Designation	Miles Open Seasonally	Miles Open All Year	Total BHRL Miles	Total BHNF Miles
Road open to highway-legal vehicles only	848	1,555	2,403	2,556
Road open to all motor vehicles	115	356	471	489
Trail open to all motor vehicles	93	61	154	154
Trail open only to wheeled motor vehicles 50” or less in width (Wyoming)	72	0	72	72
Trail open only to wheeled motor vehicles 62” or less in width (South Dakota)	144	203	347	347
Trail open to motorcycles only	39	46	85	85
Total	*1,311*	*2,221*	*3,532*	*3,703*

Further details of the existing transportation system can be found in the project analysis file, section 5.08.

Proposed Transportation System

The proposed transportation system for the BHRL project would primarily use the existing transportation system. Where existing roads do not provide access to a proposed treatment area, permanent or temporary roads would be constructed. New NFS roads would be reviewed to determine whether they should be included as part of the minimum road system, informed and documented by a travel analysis (including resource specialist input) as required by 36 CFR 212 Subpart A. The analysis would be documented and would supplement the 2007 Black Hills Travel Analysis Report. The decision to add a new NFS road would be documented in the Forest Transportation Atlas. See **Road Construction and Maintenance** (page 34) for description of road-related activities.

Prior to using the existing road system for any project, it is necessary to review the condition of the road system and determine the amount of maintenance needed as well as any reconstruction required to meet resource protection needs. For the Proposed Action, detailed field reviews by teams of specialists would be performed in preparation for implementing specific actions. Therefore, a projection of needs based on past performance of the road system was used for this analysis. Maintenance and reconstruction activities were estimated based on historical information from timber sale and annual reporting records. The methods used and confidence in the estimate are discussed in Appendix D of the Transportation Report, project analysis file, section 5.08.

New access for areas of the project that cannot be reached using the existing road system may be needed. To identify potential needs for new access, teams of specialists met at each Ranger District during development of the Proposed Action to identify potential commercial treatment areas without existing road access, based on individual knowledge of field conditions. Where it was known that no road access existed, the teams recommended either a new NFS road or a temporary road to access each area. These recommendations were incorporated into the Proposed Action.

The 2007 Black Hills travel analysis report will be incorporated into the project analysis and updated to reflect any new information such as changed conditions and travel management decisions.

Transportation System Effects

Proposed Action

Road Density

The Proposed Action could add up to 38 miles of NFS roads as part of the minimum road system mileage in the BHNF. Although that is a small amount compared to the 4,831 miles existing in the project area today, those 38 miles are short segments of road that would provide access to areas that are not currently accessible from the existing road system. The new roads would not increase open road density because they would be closed to all motorized use after the project. Monitoring and maintaining those closures as well as all of the existing closures would be a factor in assuring illegal access does not occur. The overall road density would not violate Forest Plan direction because the new NFS roads would be scattered in stands with no existing access.

Truck Traffic

Increased truck traffic associated with the Proposed Action would affect the quality of gravel road surfaces and require additional maintenance to repair washboards, potholes, cattleguard approaches, etc. Logging trucks are weighed at the mill, which assures loads are consistent with road design

weight standards. On native-surface roads, maintenance would be required to repair ruts and damage to roadway drainage features like rolling dips, ditches, and outsloping. Mud tracked from native-surface roads onto aggregate surface roads could contaminate and degrade the surfacing. The placement of rock approaches would mitigate this damage. Forest Service road damage guidelines (USDA Forest Service 1991, 1992) would be adhered to in order to limit road damage during hauling activities.

Road Surface Improvements

As the road surface is improved by maintenance and reconstruction, vehicle speeds and dust generation would likely increase. Relocation of roads could improve sight lines, allowing increased speed and associated dust generation.

Sensitive Resources

The potential effects of road maintenance, reconstruction, and construction on sensitive resources would require consideration during design and execution of the work. The specific effects are described elsewhere in this chapter (pages 78, 89, 97, 114, 117, 125, 131, 135, 151, 158).

Motorized Recreation

Table 32 displays road and motorized trail mileages (by current MVUM designation) that may be used for commercial timber harvest associated with the Proposed Action.

The mileages shown below reflect roads and trails that would provide access to all potential commercial treatment areas (300,000 acres). Because the proposal is to harvest approximately 187,000 acres out of the 300,000 acres (62 percent), not all of the possible access routes would be used. Based on the harvest proposal, it is assumed that a similar percentage of the possible road and trail mileage would be used.

Table 32. Road and Motorized Trail Mileage Potentially Used During Implementation of the Proposed Action

Designation	Miles in BHRL Project Area			Percent of Total BHNF Miles
	Open Seasonally	Open Year-round	Total	
Road open to highway-legal vehicles only	649	1,030	1,679	66%
Road open to all motor vehicles	89	296	385	79%
Trail open to all motor vehicles	43	40	83	54%
Trail open only to wheeled motor vehicles 50” or less in width (Wyoming)	47	0	47	65%
Trail open only to wheeled motor vehicles 62” or less in width (South Dakota)	65	81	146	42%
Trail open to motorcycles only	1	3	4	5%
Total	*894*	*1,450*	*2,344*	*63%*

The greatest impact to these roads and motorized trails would occur during timber harvest activities due to increased truck traffic, construction equipment operations, and additional vehicles using the roads. Probable effects on road and trail users include the following.

- Road construction and reconstruction activities may cause traffic delays.
- Roads and motorized trails may be closed to public motorized use during active harvest periods. When open, the disruption to roads and motorized trails caused by the work would generally discourage recreationists from using the areas.
- Roads and motorized trails may also be closed to public motorized use, with only administrative/contract use allowed during fuel treatments or precommercial thinning conducted using fire or mechanized equipment.
- While up to 65 percent of the BHNF motorized road and trail system may be affected, not all of these roads and motorized trails would be affected at the same time. The project work would be distributed across several years and only occur during portions of those years. The effects of proposed activities on public use would be similar, if not identical, to the patterns experienced from similar forest management activities since the implementation of the Travel Management Plan.

BHNF visitor use monitoring was most recently conducted in 2014. Monitored activities directly related to the road and motorized trail system include driving for pleasure, OHV (off-highway vehicle) use, and motorized trail use. Driving for pleasure was the third-most frequently reported primary activity at 10.9 percent of responses. In addition, 32.5 percent of responses reported participating in driving for pleasure as part of other activities. The monitoring was designed to ensure that the respondents who did use portions of the system designated on the MVUM during their visit were included. Of the responses for main activity, eight percent were directly related to the road and trail system for OHV and motorized trail use. OHV use was reported as an activity in 6.7 percent of responses, but only four percent cited it as the primary activity. Motorized trail activity was reported in 11 percent of responses with four percent reporting it was the primary activity. Therefore, a range of eight to 18 percent of users could be affected as motorized recreation enthusiasts, and up to 50 percent of visitors could be affected if their driving for pleasure and OHV use coincided with areas where forest management activities were in progress. Due to the scattered activity of both the recreation and the forest management, a smaller percentage of these visitors may be affected, but this cannot be reliably quantified based on available information.

Physical changes to the trail system would be necessary during timber removal. Many of the trails are coincident with NFS roads that would be used for proposed activities during implementation of the project. Upon completion of the project, the NFS road would be maintained and returned to the pre-project condition. Similarly, if a motorized trail is used for project access, the trail would be returned to the pre-project condition. Additional costs to the recreational trail system may occur if another standard is desired for operating the motorized trail.

Public Safety

During project implementation, traffic associated with the project would use roads of the many jurisdictions within and adjacent to the BHNF. Increased traffic would include pickups, log trucks, equipment hauling trucks, chip trucks, fire trucks, etc. This traffic would mix with residential, commercial, and recreational traffic on the roads. State and county roads are generally designed for user comfort with higher speeds and incorporate regulatory signs and warning signs to assist drivers. Forest roads are generally designed for low-speed traffic and have few warning signs and no posted speed limits. In addition, OHV traffic is allowed on designated forest roads. OHVs have different

characteristics than other vehicles. Safety considerations would be included in road design for new and reconstructed roads. In areas with active road reconstruction and new construction, temporary traffic control devices would be used to notify road users of the activity. Traffic control would comply with the Manual for Uniform Traffic Control Devices (Federal Highway Administration 2012). Safety concerns identified in relation to existing roads could be addressed by the project or by other road improvement program funding. MVUM designated roads and trails could also be closed to public motorized use during implementation of activities that could endanger users, such as timber harvest, precommercial thinning, and prescribed fire.

No Action Alternative

The No Action alternative would result in no new effects on the transportation system. Road surfaces and alignment would remain in their existing condition until other activities or events occur. The potential for modification of motorized trails and interruption of use would remain low. Levels of heavy equipment traffic would not increase in the foreseeable future.

Cumulative Effects

The cumulative effects analysis area for the transportation system is all lands within the project area and access roads leading to the project area. This area is selected because more than one proposed activity may occur in each forest stand and the access roads would experience traffic from multiple stands. The timespan for cumulative effects analysis is the present through 2031, which is three years after the probable completion of proposed activities. By this time, the project's effects on the transportation system likely would not be discernable.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. The Proposed Action could add to the effects of these projects by further increasing truck and equipment traffic. State, county, and Forest Service road projects and related heavy equipment traffic have been occurring simultaneously for decades. The additive effects would therefore be seen by the public as normal conditions.

Climate Change and Carbon Cycle

Information Sources

Information sources include the published scientific literature cited below.

Affected Environment

Human influence on the climate system is clear and growing, with impacts observed across all continents and oceans (IPCC 2015). Many of the observed changes since the 1950s are unprecedented over decades to millennia. Recent anthropogenic emissions of carbon dioxide and other greenhouse gases are the highest in history.

The carbon cycle is the movement of carbon in its many forms between the atmosphere, oceans, earth, and living beings. Forests play a major role in the carbon cycle. The carbon stored in live biomass, dead plant material, and soil represents the balance between carbon dioxide absorbed from the atmosphere and its release through respiration, decomposition, and burning. Forest management actions and natural events change the amount of carbon sequestered in and released by a forest.

Carbon stored in trees killed by recent mountain pine beetle infestation is gradually returning to the soil and the atmosphere. Because more sunlight is reaching the forest floor in these previously infested areas, regenerating pine and other vegetation are establishing, growing, and storing carbon.

Sustainable forest management is one of the most cost-effective options for mitigating carbon emissions and climate change (IPCC 2015). This project focuses on using forest management to increase ecosystem resilience to disturbance. Increased resilience would enhance the forest's ability to sequester carbon and withstand and adapt to a changing climate.

Environmental Consequences

In 2009, the Forest Service offered Climate Change Considerations in Project Level NEPA Analysis (https://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf) as a framework to consider both the implications of a project to climate change and implications of climate change to a project. The discussion that follows qualitatively describes the expected implications of the proposed activities on atmospheric greenhouse gases – largely through both emissions and sequestration. It also describes the nature of how the treatment would enhance resilience, which is a way to better adapt to climate change. More discussion on resilience can be found throughout the analysis.

Proposed commercial timber harvest would temporarily decrease carbon stored in the forest through removal of live trees. There would also be direct emissions associated with harvesting equipment and shipping wood products. Some of the carbon removed from the site would, however, remain fixed in long-lasting manufactured wood products. Some of these wood products may also displace other non-renewable alternatives, such as concrete and steel. In some cases, woody biomass may also be used to generate electricity and could provide an alternative to traditional fossil fuel sources of energy. Some of the sequestered carbon would be transferred into other carbon pools, such as soil carbon or atmospheric carbon (carbon dioxide). Proposed thinning would reduce the forest's carbon stocks in the near term but enhance carbon storage as stands establish and grow over time.

Carbon dioxide and water vapor generally make up over 90 percent of the total emissions from wildland fire (NWCG 2001), releasing approximately 3,000 pounds of carbon dioxide per ton of fuel consumed. Wildfires usually burn at higher intensity and consume fuel more completely than prescribed fires, releasing more carbon dioxide into the atmosphere per acre burned. The purpose of

proposed burning is to reduce fuel loading and increase ease of wildfire suppression. If this allows earlier containment and control of a future wildfire, the net result would be a reduction in emissions. In addition, areas burned with prescribed fire generally remain vegetated and continue to sequester carbon. Severe wildfire, which is more likely to occur across large areas under the No Action alternative (page 80), may damage soil. Subsequent revegetation may be slow and the rate of carbon storage may require decades to return to pre-fire conditions.

At a global, national, or even regional scale, any short-term reduction in carbon stocks and sequestration rates or increase in greenhouse gas emissions due to a single project is imperceptibly small, as are the potential long-term benefits. The proposed 357,000 acres of activities is minor in scale when compared to South Dakota's 49 million acres and Wyoming's 63 million acres. Furthermore, management actions that improve the resilience of forests to climate-induced disturbances could help sustain the current strength of the forest's carbon sequestration ability (Birdsey et al. 2006). When forest management activities are considered together with storage/sequestration activities, the cumulative result at the national level is a net sequestration of carbon dioxide (EPA 2016). This assumes that the proposed activity does not change the land use and the area remains forested, as is the case with this project.

Social Environment

Cultural Resources

Summary

A total of 705 historic properties have been identified within the BHRL Area of Potential Effect (APE) as of March 2017. When known data are used for a proxy calculation, an estimated 112 additional historic properties may ultimately exist within the BHRL APE. Other cultural resources not yet identified unquestionably exist. It has been estimated that 11,000 cultural sites (archaeological and historic) may exist in the BHNF (USDA Forest Service 2005a: III-409), producing a theoretical site density of one site for every 110 acres. If present trends are maintained, roughly 15 to 25 percent of the sites identified in the BHNF may be eligible for the National Register of Historic Places. Any further attempts to quantify effects would be highly speculative. The reader should be aware, however, that it is ordinarily possible to develop and implement protection measures to safeguard historic properties located in project APEs, thereby eliminating the potential for adverse effects.

Introduction

Cultural resources provide information about past human behavior and activities. Cultural resources are non-renewable assets that frequently consist of ephemeral materials susceptible to irreparable destruction or deterioration. They are found in a variety of physical forms that include, but are not limited to, material objects, archaeological sites, historic architecture, traditional cultural properties, and cultural landscapes. Cultural resources may also include American Indian sacred sites, although sacred sites may include non-tangible properties not subject to the authority of the National Historic Preservation Act.

Area of Potential Effect

The National Historic Preservation Act (NHPA) is a primary statute that governs the management of cultural resources on federal lands. Compliance with the implementing regulations of the NHPA are often used to fulfill NEPA requirements. In the regulatory vernacular of the NHPA, the project area is termed the "Area of Potential Effect", or APE. The APE must be identified before an assessment of effects can be completed. An APE is defined as:

> *… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.* (36 CFR §800.16(d))

Although the BHRL analysis area is approximately 746,000 acres (Table 4, page 44), it is not currently possible to identify exact locations where BHRL activities will occur. For each activity that is proposed during implementation, the project-specific APE will define an area within which a specified type and scale of activity would occur. Activities indirectly associated with treatment prescriptions may, however, occur beyond the boundaries of the identified 746,000 acres. For example, it may be necessary to modify access roads in order to access timber stands where treatment is prescribed. Other activities that may occur beyond the polygons identified include, but are not limited to, the development of landings and staging areas. The analysis of potential effects reported in this section is based on the 746,000-acre analysis area cited above, even though the APE may change or be refined as the location of individual BHRL project activities are identified.

Information Sources

Records Review

It is standard practice in this discipline to conduct a review of existing records in the project planning phase, an exercise often referred to as a "Level I" or "Class I" inventory. While existing data are summarized in the Affected Environment section below, complete and up-to-date literature reviews will be conducted prior to implementation of BHRL project activities. All previously recorded cultural resource sites within specific project areas would be identified and site records and project reports referenced from the BHNF's extensive cultural resources files. BHNF Heritage Resources staff would also access the Archaeological Resources Management System (ARMS) database managed by Archaeological Research Center staff, Rapid City, South Dakota, and the Wyoming Cultural Resources Office (WYCRO) database. The data archived in those repositories would then be compared with BHNF data and any necessary updates or corrections completed.

To obtain data for this section of the DEIS, the BHNF Cultural Resources GIS spatial database was referenced. The same geodatabase provided information needed to determine which areas of the project area have previously been surveyed for cultural resources and which have not. The official US Forest Service database for tracking cultural resources is called "Natural Resources Manager" or "NRM". That database is also useful to obtain details regarding site and survey information.

Field Survey

Approximately 87 percent of the BHRL analysis area has been previously surveyed for cultural resources. Without knowing exact locations of treatment activities, field reconnaissance cannot be conducted. Consequently, no new field survey has yet been conducted for this project. Field survey, where needed, will be completed prior to implementation activities and according to stipulations and conditions in programmatic agreements that govern how the BHNF meets its NHPA mandates for the project. In those cases where programmatic agreement stipulations may not apply, applicable cultural resources laws, rules, and directives would be followed.

Traditional Knowledge

Input from Tribal representatives is an important component of this project. Certain types of cultural resources can be difficult to identify by means of standard archaeological survey. Traditional knowledge can provide unique insight into physical features or geographic areas that are of particular spiritual or sacred significance to Native American communities.

Tribal input has been solicited throughout the course of this project. Tribes have been notified and invited to comment through the NEPA process and standard scoping means. In addition, Tribal authorities have been invited to participate in the development of programmatic agreements that will be used to comply with NHPA mandates for this project—most recently on the South Dakota side of the border. The objectives of BHRL projects have also been presented to Tribal representatives at several formal government-to-government meetings (page 15). Tribal officials will have additional opportunities to provide input during the implementation phase.

Affected Environment

The purpose of this section is to summarize existing conditions based on the most current data available. In the vernacular of the cultural resources legal framework, the affected environment is, by definition, located within the APE. It has been established, based on criteria cited above, that the APE

for this project cannot currently be delineated with certainty. Treatment prescriptions may ultimately incorporate any portion of 746,000 acres of NFS lands as exhibited in Chapter 2 maps. The data presented in this section have been calculated on the 746,000 acres of the analysis area.

Site Types

The types of cultural resources that are found in the affected environment include a large variety of both post Euro-American contact and pre-contact cultural resources. A partial list of site types dating to the period prior to Euro-American contact includes rock art (in the form of pictographs and petroglyphs), lithic quarries, artifact scatters, stone circles, and other Native American architectural features such as rock cairns and rock alignments. Equally important are sacred sites identified by Native American communities. The post-contact period materials are dominated by mining-related features such as prospector pits, mine shafts, drifts, and structures. Logging features such as long, linear flumes built to transport water and industrial materials are not uncommon. Other cultural resources identified on BHNF lands attest to the presence of homestead-era settlements and cattle ranching.

Historic Properties

The effects analyses in the Cultural Resources section refer repeatedly to "historic properties". The term, where employed in this section, has a specific meaning under the National Historic Preservation Act:

> *Historic property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.* (36 CFR section §800.16(l)(1))

According to the definition above, not all cultural resources qualify as historic properties; consequently, not all cultural resources are subject to protective treatments or mitigation measures.

A Traditional Cultural Property (TCP) consists of a cultural site that is eligible for inclusion in the National Register of Historic Properties (NRHP) because of its association with cultural practices or beliefs of a living community that are rooted in that community's history and important in maintaining the continuing cultural identity of the community. The entity evaluated for eligibility for inclusion in the NRHP must be a tangible property, meaning a district, site, building, structure, or object as defined in 36 CFR §60.4 and in the National Register Bulletin No. 38 (USDI National Park Service 1994). TCPs are managed under the authority of the NHPA.

Because TCPs are managed under the same authority as historic properties (NHPA), they must also be eligible to the NRHP. The term "historic properties", where employed throughout this document, is inclusive of TCPs, provided they have formally been designated as such through the proper procedures.

The figures reported below in Table 33 were calculated on the roughly 746,000 acres of NFS lands in the analysis area. To date, a total of 4,615 cultural resource sites have been identified within the analysis area. Of that number, 705 historic properties (Listed and Eligible sites combined) have been formally identified. That number includes only those properties 1) listed in the NRHP or 2) determined eligible for the NRHP with State Historic Preservation Officer (SHPO) concurrence (pursuant to 36 CFR §63). The total excludes all isolated finds (not eligible for the NRHP by

definition) and those cultural resources formally determined not eligible for the NRHP with SHPO concurrence (pursuant to 36 CFR §63).

Table 33. National Register Significance of Cultural Sites Identified to Date in APE

Site Significance	Number of Sites
Listed	8
Eligible	697
Not Eligible	3,351
Unevaluated	559
Total	*4,615*

Table 33 demonstrates that the NRHP significance of 559 cultural sites within the APE remains undetermined. Of the known cultural sites in the greater BHNF for which NRHP eligibility has been determined, roughly 20 percent have been determined significant and eligible for the NRHP. Applying that same ratio, an estimated 112 of the currently identified sites within the BHRL project area may ultimately be determined eligible for the NRHP once formal evaluations have been completed.

Table 34 provides a breakdown of historic properties according to the relative ages of cultural materials identified for each site. It is rarely possible—or may be prohibitively expensive—to determine absolute ages of historic properties. For that reason the categories are roughly separated into American Indian (pre-contact) sites and Euro-American (post-contact) sites.

Table 34. Relative Ages of Historic Properties Identified to Date in APE

Relative Age	Number of Sites
Pre-contact	286
Post-contact	322
Multi-component	95
Undetermined	2
Total	*705*

Ultimately, the number of historic properties determined to exist within the APE will be greater than the quantities cited in the above tables. While a relatively large percentage of the BHNF has been surveyed for cultural resources, a number of areas remain un-inventoried. Field surveys have occurred in approximately 87 percent of the analysis area. In some cases, the methods and reporting criteria used during the older field surveys may not be adequate compared with contemporary standards. Consequently, it may be necessary to resurvey certain areas to obtain current and more accurate data.

The disclosure of sensitive data related to the specific location and/or character of a historic property is regulated pursuant to stipulations in 36 CFR §800.11(c) and Section 304 of the NHPA, in addition to 43 CFR §7.18 and Section 9 of the Archaeological Resources Protection Act. Pursuant to these mandates, information regarding the nature and locations of historic properties within the APE is not provided in this section.

Environmental Consequences

Methods

A variety of methods have been employed in this analysis, each of which contributes in unique ways toward the objective of identifying historic properties that may be susceptible to adverse effects as a result of the undertaking. Some of the methods used in this analysis have been identified above in the Information Sources section. Other methods are identified below.

The effects analysis in this section lacks quantitative data regarding the total number of historic properties present and/or potentially affected in the analysis area and, more importantly, the number of properties considered at-risk. This omission is unavoidable due the fact that exact activity areas cannot yet be identified. *By necessity, the analysis that follows provides an assessment of the Proposed Action based on the best available data.*

Implementation of proposed activities, in the context of cultural resources, would be conducted under the authority of Section 106 of the NHPA or either of two separate programmatic agreements (PAs). PAs are legal documents that can provide an alternate means for a federal agency to comply with its NHPA Section 106 mandates (pursuant to 36 CFR §800.14(b)). An executed PA is necessary for BHRL because the effects of the project cannot be fully determined prior to signing a Record of Decision (pursuant to 36 CFR §800.14(b)(1)(ii)).

PAs can result in a number of benefits to the signing parties. A PA may, for example:

- Streamline the consultation process by eliminating the need for case-by-case consultation for routine and/or repetitive activities. This would undoubtedly be beneficial to BHRL projects since similar treatments would be repeatedly prescribed.
- Provide a negotiated list of exempt undertakings, or undertakings that are likely to have minimal or no effects on historic properties.
- Standardize methodologies, treatments, protection, and monitoring measures.
- Save state and federal agencies and tribal governments money by reducing the amount of time and effort needed for consultation and review.

As reported in Chapters 1 and 2, the Forest anticipates implementing BHRL activities on NFS lands in both Wyoming and South Dakota. Since 2009, the BHNF has been a Signatory to a PA (renewed in 2014) that governs undertakings on NFS lands located in the state of Wyoming (USDA Forest Service 2014). Appendix F of that document addresses vegetation management projects. Subsection B of Appendix F specifically addresses landscape-scale projects such as BHRL, for which specific effects cannot be identified prior to the Agency signing a project decision. That stipulation, in addition to others, is cited as the legal authority for this project on NFS lands in the state of Wyoming.

The BHNF and the South Dakota State Historic Preservation Officer will complete a programmatic agreement specifically for this project in order to fulfill the Agency's NHPA Section 106 obligations for this undertaking (USDA Forest Service 2017a). Stipulations in that document would govern how the Forest Service implements projects under the authority of the BHRL Record of Decision, should the Proposed Action be selected.

Assumptions

The following assumptions apply to the assessment of effects:

- Cultural resources would be managed according to existing laws, regulations, agency policies, and programmatic agreements.
- Additional cultural resources not yet identified unquestionably exist.
- All cultural resources identified within the Area of Potential Effect for BHRL projects are considered historic properties unless they have previously been determined not eligible for the NRHP in consultation with the SHPO or through other agreed-on procedures (36 CFR §60.4; 36 CFR §800).

Indicators

The "at risk" category used in this analysis consists of historic properties with *identified* or *potential* direct, indirect, or cumulative adverse effects. The NHPA implementing regulations define an adverse effect:

> *An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. (36 CFR §800.5(a)(1))*

The BHNF has identified one primary indicator to determine the potential for adverse effects to historic properties: the number of at-risk historic properties within the Area of Potential Effect.

Due to the current undelineated geographic scope of individual project APEs, it is not possible to quantify or predict with confidence which specific historic properties may be at risk. Site identification and effects analyses will be completed during the implementation phase. Consultation with the appropriate SHPOs and American Indian Tribes will be conducted as per stipulations in the PAs developed for the project. It may be more practical and expeditious to consult on multiple activities in a single consultation package.

Proposed Action

Direct Effects

Should the Proposed Action be selected, the specific areas targeted for treatment in the implementation phase would be clearly identified and subject to review by the BHNF Heritage Resources staff to determine the potential for adverse effects. Past experience working with similar types of vegetation management projects suggests it would be possible to develop and implement protection measures for the majority of the historic properties located in project APEs, thereby eliminating the potential for adverse effects. Nevertheless, the risk of direct effects to historic properties due to treatment prescriptions does exist.

Stipulations in the two PAs applicable to BHRL undertakings outline options and procedures for protecting historic properties. Where such preventive measures cannot be identified and an imminent

threat to those properties is anticipated, the terms of the PA would no longer apply and the BHNF would follow mandates outlined in 36 CFR §800.6, which are designed to resolve adverse effects.

Indirect Effects

The APE for indirect effects on historic properties considers visual, audible, and atmospheric elements that could diminish the integrity of the properties for which setting, feeling, and/or association are qualifying characteristics of NRHP eligibility. The indirect APE for indirect effects from BHRL projects may extend beyond the direct APE for direct effects, which has been discussed above. The indirect APE for indirect effects may encompass properties that have traditional religious and cultural importance, including traditional cultural properties or other geographically extensive historic properties such as trails, when effects have been determined to extend beyond this distance. In certain cases, an assessment of visual effects may require a viewshed analysis using GIS technology. Indirect effects would be analyzed on a case-by-case basis during the implementation phase as per stipulations in the appropriate PA.

Cumulative Effects

Past, present, and reasonably foreseeable activities within the analysis area include vegetation management projects, recreation, road construction and maintenance, and a host of other projects, each of which are anticipated on NFS lands (page 49). These activities have occurred in the past, are ongoing, and in all likelihood will continue to occur in the foreseeable future.

The geographic scope of the cumulative effects analysis is limited to the BHNF administrative boundary because impacts to cultural resources accumulate at their specific locations, irrespective of actions in surrounding areas.

Cumulative effects are not anticipated under the Proposed Action because the NHPA Section 106 implementing regulations found at 36 CFR §800 outline procedures for protecting historic properties from impacts caused by federal actions (undertakings). Adverse effects can frequently be avoided or minimized through the implementation of appropriate site-specific protection measures through consultation with the Advisory Council on Historic Preservation, the appropriate State Historic Preservation Officers, Tribal governments, and the public, as appropriate.

No Action Alternative

If the No Action alternative is selected, both favorable and unfavorable effects on historic properties may occur. There would be no potential for direct effects on historic properties due to ground-disturbing activities.

The potential for indirect effects to historic properties could be more significant should the proposed activities not occur. Treatments designed to reduce fuel loading or fire hazard would not be prescribed, at least not under the BHRL authority. Taking no action could escalate the threat of large-scale wildfire. The intense heat produced by wildfires sustained by heavy fuel loads can result in adverse effects to historic properties, including the potential for complete obliteration (Ryan et al. 2012; Sturdevant 2009). The latter is particularly true of rock art (Tratebas et al. 2004) and historic structures. Ignition of ground fuels can also create post-fire soil and sediment conditions unfavorable to the preservation of historic properties. When surface vegetation is incinerated, a common byproduct is increased soil erosion (page 148). Hydrologic regimes change, resulting in the exposure and transportation of previously undisturbed soils which can entrain and relocate surface and subsurface cultural artifacts. In addition to artifact assemblages suffering possible physical

deformation or destruction, the stratigraphic context—of critical importance for accurate archaeological interpretations—may be disturbed or destroyed.

Scenic Integrity

Summary

The recent mountain pine beetle epidemic, response actions, and wildfires have altered scenery in parts of the project area. The Proposed Action would add to some of these effects by increasing acreage of young and open forest. With implementation of project-specific design features and adherence to Forest Plan guidelines, proposed activities would meet assigned scenic integrity objectives.

Information Sources

Scenic integrity objectives (SIOs) for each management area were developed during the Forest Plan revision process (USDA Forest Service 1996). Analysis was based on spatial SIO data stored in the corporate database. The analyst also considered results of visitor use monitoring, past vegetation management activities in representative areas of the BHNF, and consultation with specialists in various resource areas.

Affected Environment

Many Black Hills residents and landowners are concerned with management of NFS lands. Much of the project area is wildland-urban interface due to interspersion of NFS and private lands. NFS lands are visible from most homes that are within the project area boundary and many in adjacent communities. The project area also provides the scenic background for a large tourism industry. Millions of visitors travel to the Black Hills each year, and NFS lands in the project area are part of that experience.

Near Custer, South Dakota – 2009, 2011, and 2016

The recent mountain pine beetle epidemic altered scenery in many areas (above). Before the epidemic, typical Black Hills background scenery consisted of a sea of green pine trees. Infestation caused pine needles to turn first yellowish, then red and gray. This occurred on individual trees, in patches of forest, or sometimes across whole hillsides. Over the course of the epidemic, scenery changed from contiguous green forest to varying arrangements of green, red, and gray forest. Changes occurred gradually in some areas; in others, the visual character of entire landscapes

changed over the course of a few months. This caused considerable distress and concern among residents and visitors.

The eye-catching red needles have now fallen from most infested trees. From a distance, effects of the epidemic are much less obvious. The forest appears more patchy and varied. Casual visitors may not notice the background effects. When in the foreground, effects of the epidemic often still dominate scenery. Dead trees in all stages of decay remain standing or have fallen into jackstrawed piles. Some management responses to the epidemic, such as hazard tree removal and fuel reduction, have decreased this evidence. Overall, large areas of forest are now much more open than before the epidemic, and evidence of management response in the form of commercial timber harvest and sanitation cutting is widespread.

Scenic integrity is the degree to which a landscape is visually perceived to be complete. Higher scenic integrity ratings are generally applied to areas with less visual evidence of human activities, but human alterations may not reduce scenic integrity if they have become accepted over time as positive landscape character values.

The Forest Plan sets forth SIOs for each management area. The following SIOs apply to the project area.

- High (12 percent of the project area NFS acres)
- Moderate (44 percent)
- Low (44 percent)
- Very low (less than one percent)

Most of the areas with high SIOs are along major highways (see Figure 29) or in certain management areas, such as 3.32 (backcountry non-motorized recreation emphasis).

According to the Forest Plan, activities in areas with high scenic integrity must result in scenery elements similar to those currently present. For example, placing a large pile of logging slash next to a main forest road would not maintain high scenic integrity because the form, color, and visual texture of the slash pile would be inconsistent with those of the forest. If the slash pile is further from the road, removed in a timely manner, and the site revegetated, the result is likely to be consistent with high scenic integrity and Forest Plan guideline 5606[25].

The Forest Plan also states that human activities should not be "visually evident" in areas with high scenic integrity. Due to the long history of mining, timber harvest, and other actions on NFS lands in the Black Hills, as well as development of private lands within the BHNF, the existing landscape character in many areas includes visual evidence of human activities. The degree to which proposed activities would alter scenic integrity should be interpreted in this context.

[25] "Where the SIO criterion is high or moderate, meet the criterion within one full growing season after completion of a project…"

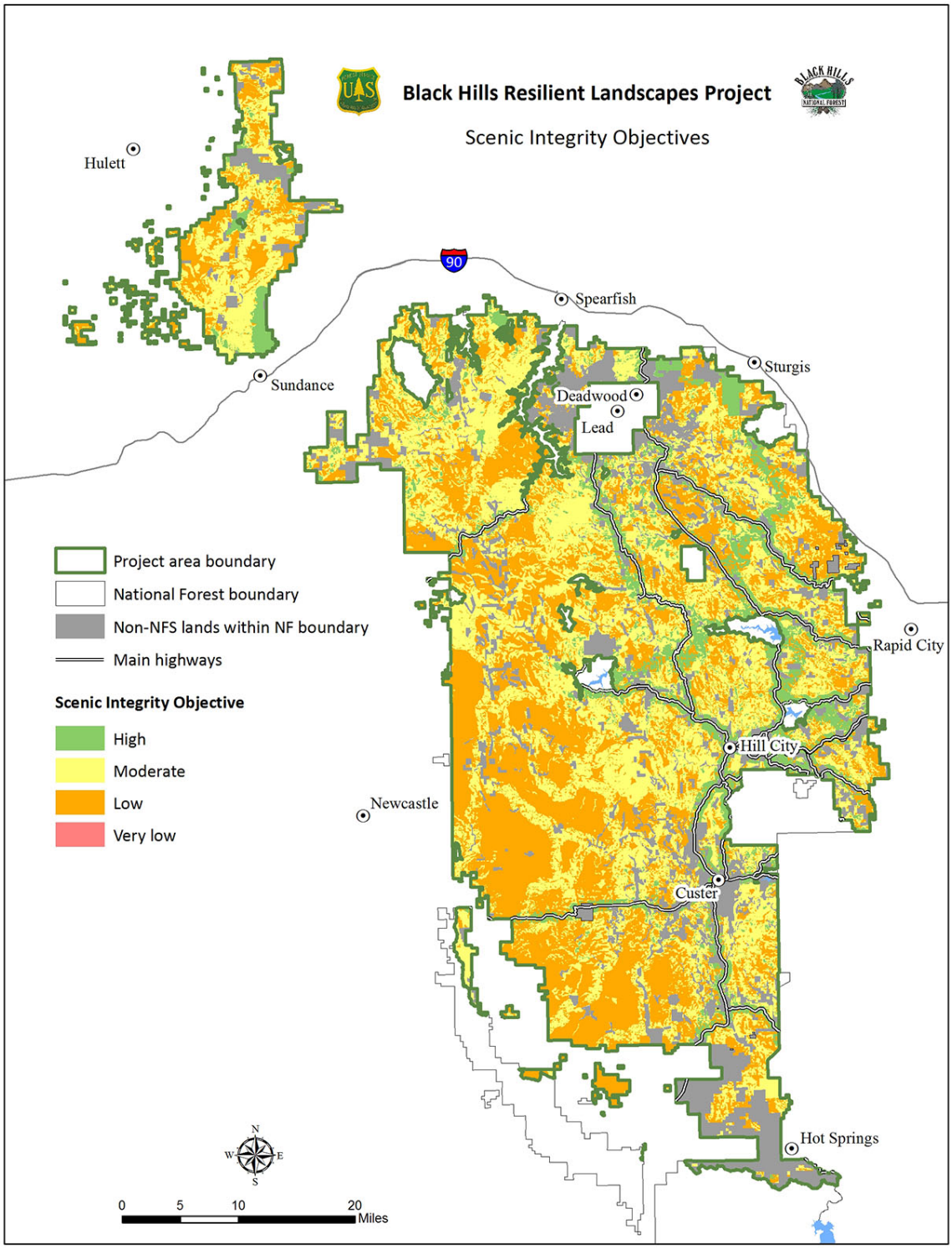


Figure 29. Scenic Integrity Objectives

Environmental Consequences

Proposed Action

Effects of Fuel Treatments and Hazard Tree Removal

Proposed **mechanical fuel treatments** would result in variable quantities of processed woody material on the ground. This material would gradually blend into the foreground landscape as its color changes, snow packs it down, and other vegetation hides it. Shaded fuel breaks are discussed further in the **Commercial Timber Harvest** section, below.

Manual fuel treatments may result in a natural appearance, especially if residual vegetation is unevenly spaced. Fuel piles created manually are much smaller than mechanically created piles; after burning, visual evidence would consist of a small patch of scorched ground that would revegetate within two to three years (see **Soil Productivity**, page 150). Scattering rather than piling fuels would create a negative visual element until vegetation obscures the slash.

Broadcast prescribed fire would mimic natural processes and appearances. Revegetation combined with a mix of fire effects, including scars on trees, fire-killed trees, and charred logs, would result in a natural appearance within one to two years of burning.

Hazard tree removal would affect individual trees or small groups of trees. Effects would be limited to the immediate foreground of the road, trail, or other feature threatened by the hazard tree. The tree stump, bole, and limbs would generally blend in with existing down woody material.

Effects of Hardwood and Grassland Enhancements

Non-commercial **removal of conifers from aspen and oak** stands and inclusions would generally result in conditions similar to those described above for manual fuel treatments, depending on the volume of conifers cut. The exception would be in aspen areas where trees are only partially cut to deter grazing animals (page 41). The resulting unusual appearance (right) would stand out until cut trees decay or are screened by other vegetation. It would not blend in with the surrounding landscape and may draw negative attention. If this method is effective in protecting aspen regeneration, however, the longer-term effect would be revitalization of aspen and diversification of scenery.


SDGFP photo

Aspen and oak activities involving commercial timber harvest are discussed in the **Commercial Timber Harvest** section, below.

Aspen regeneration would result in a dense grove of aspen shoots within five to seven years of cutting. During the first few years, the horizontal trunks of the cut aspen trees would dominate the foreground in comparison to the vertical lines formed by standing trees in the surrounding forest. Within 20 years, the view would be dominated by a thriving aspen stand.

Removal of pine from grasslands would maintain existing openings. Depending on disposal of slash, a natural appearance would dominate the site within three to five years.

Effects of Commercial Timber Harvest and Associated Activities

Proposed commercial timber harvest may be in the form of overstory removal, uneven-age individual tree selection, group selection, patch clearcut, shaded fuel break, or (to a lesser extent) removal of pine from aspen, oak, and grasslands. Table 35 displays estimated commercial timber harvest acres by scenic integrity objective.

Table 35. Proposed Commercial Timber Harvest by Scenic Integrity Objective

SIO	Acres in Project Area	Estimated Acres to be Cut	Estimated Percent of Project Area Acres to be Cut
High	132,382	21,952	16
Moderate	476,746	82,432	17
Low	490,060	82,901	17
Very low	70	3	4

Table 36 displays estimated road construction by scenic integrity objective. Figures assume that all proposed roads would be constructed, though the actual total may be less.

Table 36. Proposed Road Construction by Scenic Integrity Objective

SIO	New Permanent Road Miles	New Temporary Road Miles	Temporary Road Miles on Existing Templates
High	2.5	5.9	13.8
Moderate	8.9	18.9	85.2
Low	6.0	14.0	81.5
Very low	0.0	0.0	0.0

Overstory removal would change the visual character of treated areas by removing most or all of the mature pine trees. These stands currently consist of well-spaced mature pine over pine seedlings and saplings in addition to shrubs, forbs, and grasses. If pine regeneration is dense, overstory removal would generally be followed by precommercial thinning. The resulting stand would consist of small pine, often with scattered patches and groups of large trees. The small pine would present a fine texture, with variety provided by any remaining groups of vertical tree trunks. Harvest units would be located and designed to provide variety in stand size, shape, and arrangement across the management area.

A dense stand next to a completed overstory removal can resemble a wall of trees (right). To avoid creating this type of abrupt visual transition, harvest unit design would include gradual changes in density between the harvested stand and adjacent forest, where possible (page 38). In addition, the rolling nature of Black Hills topography can be an asset in breaking up the appearance of treated areas. Overstory removals designed to take

Completed overstory removal and adjacent untreated stand

advantage of these topographic features and laid out in accordance with Forest Plan guideline 2105[26] and project-specific design features (page 38) would mimic natural forest variability. The resulting appearance would not be out of character for the area and, after disposal of slash and revegetation of disturbed soil, would generally meet assigned SIOs.

Uneven-age individual tree selection would also reduce concentration of mature trees. Because trees of all size classes would remain, a relatively natural appearance would result. Over time, further development of an uneven age structure would provide variety in a landscape otherwise dominated by even-age forest.

Group selection would mimic forest structure created by mountain pine beetle or moderate-intensity fire. Small patches of young forest would be scattered in a matrix of mature forest.

Patch clearcuts would produce the greatest visual change from the existing condition. Initially, stumps and any remaining slash would be obvious at close range. When viewed from a distance, patch clearcuts designed in accordance with Forest Plan guidelines 2105 and 2106[27] would appear similar to natural forest openings. Patch clearcuts would also be designed to regenerate naturally within five years (Forest Plan guideline 2109). As a result, their foreground appearance would blend in with the surrounding landscape within a decade.

Shaded fuel breaks would increase viewing distance into the forest and result in a clean forest floor. A fuel break in dense forest may be an obvious alteration when seen from a distance. To minimize this effect, the change in density at the edge of the fuel break would be gradual, and the width of highly visible fuel breaks would vary (page 38).

Most commercial timber harvest would be accomplished using **ground-based yarding methods**, which use heavy equipment to move logs to landing sites. "Skidding" logs up, down, or across slopes can remove vegetation and displace soil, leaving visible trails. The result is new lines or unusual color contrasts in the landscape. Skid trails would be evident until slash treatment and revegetation are complete. Where advanced regeneration exists, the resulting skid trails could appear as linear features radiating from landings and may remain visible at least until precommercial thinning occurs.

Skidding would normally occur during dry or frozen soil conditions. Under these conditions, skidding on gently rolling terrain would cause little disturbance. On steeper slopes, disturbance may be greater. The degree would depend on the quantity of logs moved along each trail, type of equipment used, and characteristics of soil and existing vegetation. In general, the combination of close oversight of logging operations by Forest Service administrators and the relatively forgiving nature of Black Hills soils and plants minimizes the occurrence of adverse effects. Within two or three years, most areas where ground-based logging occurs would move toward a natural-appearing condition with grasses and shrubs breaking up the skidding routes.

Whole-tree yarding would occur, especially in WUI areas. This method creates large piles of slash along roads. From a scenery standpoint, the benefit of whole-tree yarding is the resulting clean, park-like appearance of the forest floor, which increases viewing distance. The large slash piles, however, can be present for several years while the slash dries prior to burning. The piles would appear as

[26] "*When developing openings in vegetative communities, copy naturally shaped edges.*"

[27] 2105: *"When developing openings in vegetative communities, copy naturally shaped edges."*
2106: *"Avoid altering more than one-third of the edge of a natural opening whenever an artificially created opening is adjacent to a natural opening. Additional edge should not be created until previously treated areas are considered closed, according to Standard 2104. This guideline does not apply to treatments intended to restore meadows to historic conditions."*

forms that contrast with the surrounding landscape and would temporarily dominate the immediate foreground of affected roads. Project design (page 38) would generally keep large piles out of the foreground of main travelways and recreation areas, but topography may limit options in some areas.

Burning of these large concentrations of fuel sterilizes the ground beneath. Post-burn rehabilitation generally includes scarification, dispersal of unburned material, and seeding. Nevertheless, noxious weeds usually appear. Most invasive species are extremely efficient at exploiting the initial decrease in competition that follows a disturbance such as fire, especially one that is hotter than normal due to an increase in fuel load (Hobbs and Huenneke 1992). Even with herbicide treatment, it can take three to five years for grass and other desirable vegetation to overcome weeds and return the site to a natural appearance. After this point, most landing sites appear to be small meadows interspersed with surrounding vegetation.

Byproducts of commercial timber harvest include tree tops, limbs, and stumps. Tops and limbs would be piled as described above or left scattered within the harvest area. This slash may be present in high quantities, creating strong contrasts in color and texture. Stumps would initially be evident throughout treatment areas, especially on steep slopes. The quantity of these byproducts would determine how natural the forest appears after project implementation. Whole-tree yarding or post-activity fuel treatments such as piling and burning would reduce visual impacts of slash within harvest units.

Roads: Proposed use of existing roads would involve removal of any grass, shrubs, or trees that have grown on the road template since it was last used. New construction would create additional horizontal line features. The color of the road surface and cut/fill slopes would contrast with surrounding vegetation. Most new permanent roads would be on slopes of less than 20 percent.

Some would be located near the top of a slope and may be visible from a distance. Up to eight sections of new roads (total of 2.5 miles) may be constructed in high SIO areas. None would be used for cable yarding. If constructed, two of these roads (1.0 mile) may be visible from a major travelway (South Rockerville Road or South Dakota Highway 44; see figures below). Road location and design would be coordinated with a landscape architect to minimize adverse effects on scenic integrity.

Precommercial thinning to an even spacing would be readily apparent and result in a managed appearance. Thinning to an uneven spacing results in a more natural appearance and results in higher scenic integrity.

Tree planting would result in natural-appearing areas of pine seedlings. Trees would not be planted in rows.

Mechanical site preparation would occur in areas with low to moderate SIOs. Initially, treated sites would appear disturbed, with many patches or strips of bare soil. Revegetation would occur within one to two growing seasons, returning the area to its original scenic integrity.

No Action Alternative

The No Action alternative would cause no new, immediate effects on scenic integrity. Over time, conditions that do not currently meet assigned SIOs may move toward them as visible evidence of management activities decreases. If pine continues to encroach on aspen, oak, and grasslands, scenic diversity would eventually decline. Viewing distance into the forest and at scenic overlooks may decrease as closely spaced pine seedlings and saplings increase in height.

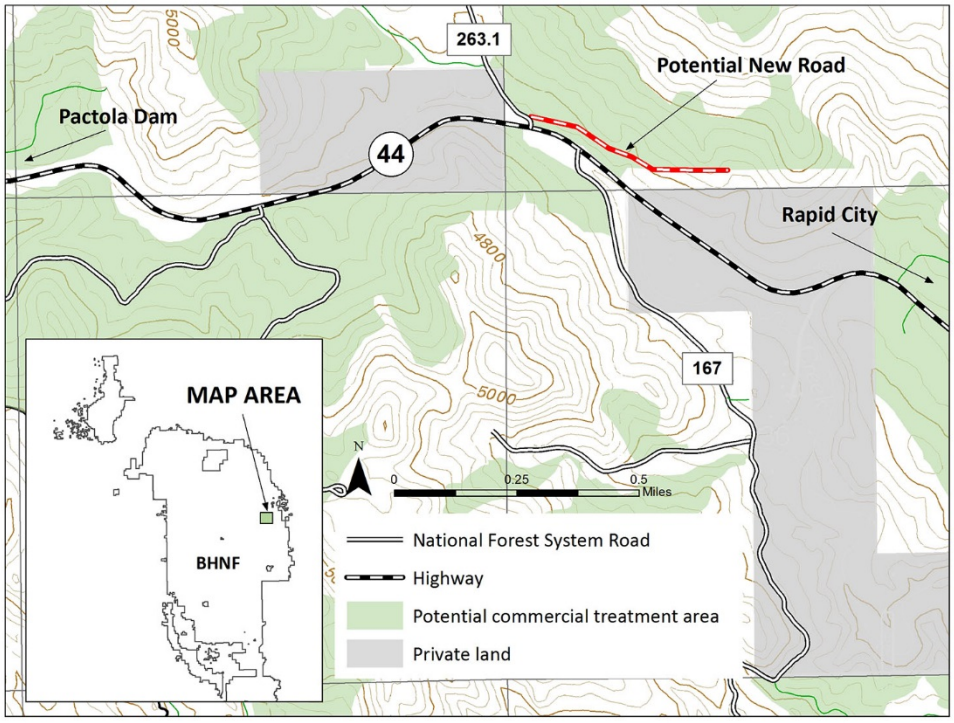


Figure 30. Potential New Road in Area with High SIO (Along SD 44)

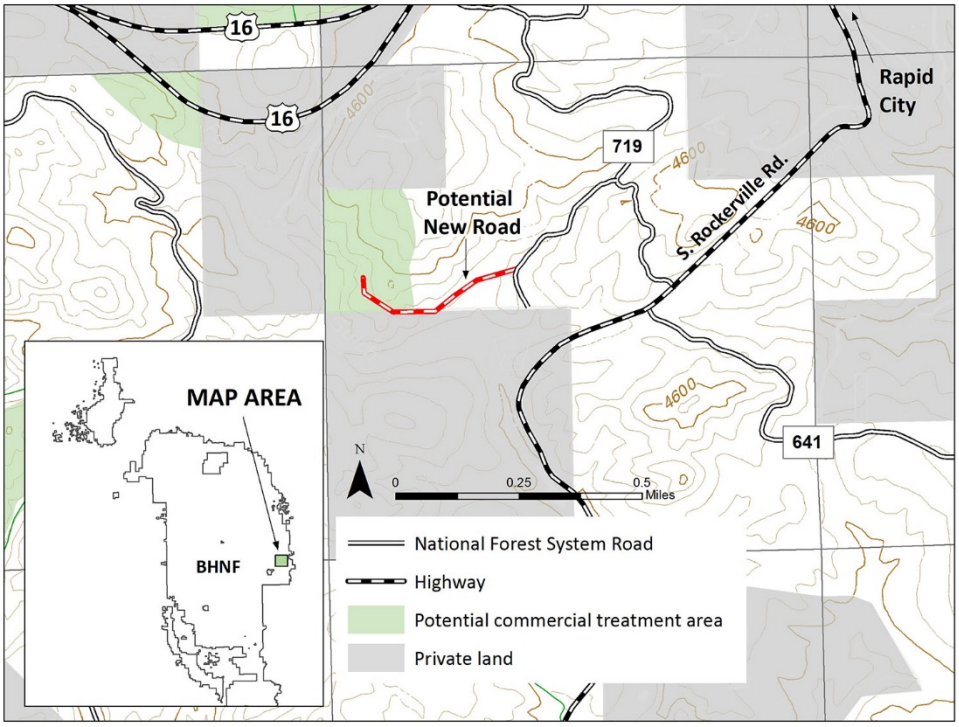


Figure 31. Potential New Road in Area with High SIO (Near S. Rockerville Road)

Cumulative Effects

The cumulative effects analysis area for scenery is the BHRL project area plus a 0.25-mile buffer. This area includes 1,469,700 acres, including 1,142,000 NFS acres. This area is selected because foreground views are contained within this area. While direct and indirect effects of the Proposed Action may be visible from beyond this area, they would not dominate the landscape when seen from a distance. The timespan for cumulative effects analysis is from the present through 2038, or 10 years after the probable completion of proposed activities. By this time, it is estimated that the project's effects on scenic integrity would be difficult to distinguish from those of other activities and events.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. Fire suppression will continue to allow increases in pine stand density and encroachment of pine into other vegetation communities. Timber sales have generally removed mature trees and reduced stand density. They have also added persistent roads and trails to the landscape as well as transitory features such as slash and exposed soil.

The Proposed Action would not add to the effects of fire suppression. It would add to the effects of past, current, and foreseeable vegetation management. With implementation of Forest Plan guidelines and design features, cumulative effects of proposed activities would continue to meet assigned SIOs in accordance with Forest Plan guideline 5602[28].

Recreation

Summary

The project area includes popular recreation destinations. The Proposed Action may cause temporary, localized disruptions of recreational activities but would maintain overall recreation opportunities. Commercial timber harvest and related activities, which have the greatest potential to affect recreation, would occur only in Roaded Natural and Roaded Natural Non-Motorized areas. Advance coordination with recreation special use permit holders and adherence to permit terms would minimize effects on these uses.

Information Sources

Analysis was based on recreation infrastructure data held in the INFRA and BHNF transportation databases, national visitor use monitoring conducted in the BHNF in 2003, 2009, and 2014, and observations by BHNF recreation managers.

Affected Environment

The project area provides settings for recreation in all seasons and is a key regional destination. The area's natural and cultural diversity provides the basis for a wide variety of recreational activities and is vital to the area's recreation and tourism industries. Common recreational activities include driving, riding OHVs, hunting, fishing, horseback riding, viewing scenery, wildlife observation, hiking, biking, snowmobiling, cross-country skiing, and camping. Mount Rushmore National

[28] *"Management activities which are inconsistent with the scenic integrity objectives will be prohibited unless a decision is made to change the scenic integrity objective. Such decisions will be documented in a site-specific decision document."*

Memorial, Wind Cave National Park, Devils Tower and Jewel Cave National Monuments, and Custer State Park are in or adjacent to the project area.

Natural resources in the project area have been managed since before the designation of the National Forest. In the more developed and populated areas it can be difficult to experience a sense of solitude, but these make up a fraction of the project area.

Recreation Opportunity Spectrum

To provide a variety of recreational experiences, the BHNF uses the Recreation Opportunity Spectrum (ROS) system. ROS is a planning and management tool that categorizes recreation opportunities into classes ranging from primitive to urban. The Forest Plan assigned one of the following ROS classes to each MA in the project area.

- Semi-primitive non-motorized (SPNM): Large areas with a mostly natural appearance; interaction between users is low.
- Semi-primitive motorized (SPM): Moderate to large areas with a mostly natural appearance; interaction between users is low, but there may be evidence of other people.
- Roaded natural (RN): Resource use and modification are evident; interaction between users may be moderate to high.
- Roaded natural non-motorized (RNNM): Closed to motorized use but with resource modifications evident.

Table 37 displays ROS assignments in project area MAs.

Table 37. Recreation Opportunity Spectrum by Management Area

MA	Emphasis	ROS Class
3.31	Backcountry motorized recreation	SPM
3.32	Backcountry non-motorized recreation	SPNM
3.7	Late succession landscapes	RNNM
4.1	Limited motorized use and forest products	RNNM
5.1	Resource production	RN
5.1A	Southern Hills forest and grassland	RN
5.2A	Fort Meade VA Hospital watershed	RN/SPNM*
5.4	Big game winter range	RN
5.43	Big game and resource production	RNNM
5.6	Forest products, recreation, and big game	RN

**RN on designated travel routes, SPNM in remainder of area*

Forest Plan guideline 5101 requires that management activities comply with assigned ROS.

Developed Recreation Sites

The following developed recreation sites are located on NFS lands in the project area.

- Campgrounds: 11
- Day-use area: 1
- Picnic sites: 5
- Horse camp: 1
- Lookout cabins: 2

- Trailheads: 47, including 21 specifically for motorized trails

Campgrounds are designed for semi-primitive family camping. Many have ADA-accessible sites. Most BHNF campgrounds and picnic sites are managed during the primary recreation season by a private company under a recreation concession special use permit.

The largest recreation complexes (Pactola, Sheridan, Deerfield, and Cook Lakes) are in MA 8.2, which is excluded from the project area.

Recreation Special Uses

BHNF recreation special uses under active permits include:

- Outfitting and guiding: 46
- Recreation events: 22
- Recreation residences: 157
- Miscellaneous other: 13

Most, but not all, are in the project area.

Dispersed Recreation

The following dispersed recreation features are located on NFS lands in the project area.

- Trails open only to vehicles less than 62 inches wide (South Dakota) or 50 inches wide (Wyoming): 418 miles
- Trails open to all vehicles: 154 miles
- Trails open only to motorcycles: 84 miles
- Snowmobile trails: 363 miles
- Non-motorized trails: 305 miles, including 60 miles of cross-country ski trails
- Dispersed campsites as allowed along open roads and trails (see current-year Motor Vehicle Use Maps)

Generally, corridors along non-motorized trails are managed to maintain a natural appearance. The slow pace of the hiker or horseback rider allows more time to study the environment along the trail. Corridors along motorized trails are managed for a natural to modified appearance because users have limited time to register details during travel unless they are driving slowly or stopped (USDA Forest Service 1973, pp. 62-63.). In addition, due to the number of miles covered on an average daily drive, the motorized user has a greater chance of encountering ongoing management activities.

Vegetation along trails may be altered through a variety of management activities. Along non-motorized trails and near developed recreation sites, alterations should affect small areas so that they do not dominate the recreation setting. The mountain pine beetle epidemic and response actions have, however, created larger openings along trails. Beetle-killed forest may not be considered a desirable recreation setting by some users but is the result of a natural process. For several years following management activities, treated areas may or may not appear “natural”.

Environmental Consequences

Table 38 displays acreage and percent of proposed commercial timber harvest by ROS class.

Table 38. Proposed Commercial Timber Harvest by ROS Class

ROS Class	Acres	Proposed Commercial Timber Harvest Acres	Percent*
SPM	6,870	0	0
SPNM	8,948	0	0
RNNM	69,941	10,520	15
RN	1,009,358	178,490	18
RN/SPNM	3,299	0	0

**Percent of ROS class acres proposed for commercial timber harvest*

The above table addresses commercial timber harvest because this activity, along with associated road work, may affect appearance of and access to treated areas. Timber harvest would occur only in roaded natural non-motorized and roaded natural areas, in which the Forest Plan allows resource use and modification to be evident. Other proposed activities would not affect the degree to which treated areas appear natural and would not require new roads. The Proposed Action would comply with ROS guidelines.

Effects on Developed Recreation Sites

Proposed fuel reduction and removal of hazard trees would improve safety in treated recreation sites. Temporary closures may occur while hazard trees and fuels are being removed. If closure would be required during the period when sites are administered by the concessionaire, coordination with the permit administrator would occur. The public would be informed of the purpose and anticipated duration of the closure. Adverse effects (displacement of use) would be limited to the period of removal operations. Positive effects (reduction of hazards to visitors) would persist until natural events or processes cause development of new hazards. Recreation site improvements would be protected during implementation of proposed activities.

Proposed activities would be designed and implemented to maintain high scenic integrity in and adjacent to these sites (page 38; see also **Scenic Integrity**, page 187).

The Proposed Action would have no direct or indirect effects on large, developed recreation sites (Pactola, Sheridan, Deerfield, and Cook Lake recreation areas), which are excluded from the project area.

Effects on Dispersed Recreation

Dispersed Camping

Many dispersed campsites are adjacent to NFS roads. Those that fall within treatment areas may be unavailable or undesirable while activities are occurring due to noise, traffic, and/or smoke associated with management activities. Sites would again be available after activities are complete.

Motorized Trails

Effects on trails open to motorized, wheeled vehicles are discussed in the **Transportation System** section, page 174.

Non-motorized Trails

Sixty-one miles of non-motorized trails are on roads that are normally closed to motorized vehicles but may be used for access to potential commercial treatment areas. If these roads are used, trail use would be displaced for up to the life of the timber sale. No new permanent or temporary roads are proposed on existing non-motorized trails. New roads may cross existing trails in up to 10 locations. Adherence to design features (page 38) would prevent lasting effects on the trail system.

Up to 48 miles of non-motorized trails may fall within potential commercial treatment areas. During implementation of commercial timber harvest, mechanical fuel treatment, and related activities, affected trails may be temporarily closed or rerouted. Heavy equipment may need to cross non-motorized trails. When this is required, standard practice is to designate crossings in coordination with recreation managers. Users of trails that remain open during activities may experience increased noise and disturbance. These effects would persist only as long as the activity. See also **Scenic Integrity** analysis, page 187.

Proposed prescribed fire may affect up to 111 miles of non-motorized trails. All of these are in the large block of potential burning in the eastern part of the project area (Figure 7, page 21). Burning would occur only in small subsets of the larger area at any one time. Trail use could be displaced during burning, which usually occurs over the course of one to several days. Prescribed fire occurs in early spring and late fall, outside of the main trail use season.

Other proposed activities would have little effect on non-motorized trails. For the above reasons, the magnitude of the project's effects on non-motorized trails would be negligible. Duration of effects, however, could be substantial if trails are closed for several years.

Snowmobile Trails

Up to 108 miles of snowmobile trails may fall within commercial treatment areas. Standard procedures include placement of slash piles away from trails or burning these piles outside the snowmobile season. Adherence to these measures would prevent snowmelt due to fire while trails are being used. Many snowmobile trails are on existing roads that are normally closed to wheeled vehicles in the winter, including 98 miles of roads that provide access to potential commercial treatment areas. Where roads are used for treatment area access, snowmobile trails would need to be closed or rerouted during timber harvest or timber harvest would need to be limited to April through November. If a main trail is closed and an alternate location cannot be found, use of the trail system may be adversely affected. Other proposed activities do not usually involve snowplowing and thus would be unlikely to affect snowmobile trails.

Effects on Recreation Special Uses

The Proposed Action may affect recreational uses of the project area that are allowed under special use permits. Temporary negative effects, such as increased noise or traffic, may occur. Outfitting and guiding and recreation events may be temporarily displaced. Advance coordination with permit holders and adherence to permit terms would minimize effects on these uses.

Effects of No Action Alternative

The No Action alternative would cause no new, immediate effects on developed or dispersed recreation. As described in the **Scenic Integrity** analysis (page 193), viewing distance into the forest from roads and trails could eventually decline as young, dense pine stands increase in height.

Cumulative Effects

The cumulative effects analysis area for recreation resources is NFS lands in the BHNF (1,239,400 acres). This area is selected because proposed activities may displace temporarily recreation from active treatment areas to other parts of the BHNF. The timespan for cumulative effects analysis is the present through 2031, or five years after the probable completion of proposed activities. By this time, it is estimated that direct and indirect effects on recreation resources would have ended.

Past, ongoing, and foreseeable activities that may contribute to cumulative effects are described starting on page 49. These activities are expected to continue to temporarily displace recreation activities and alter the character of parts of the forest.

The Proposed Action would add to the effects of past, current, and foreseeable actions. Regarding displacement of recreation, the effects of other management activities would be ending or diminishing as BHRL effects occur, so there would be little additive effect. Where the effects of past, ongoing, foreseeable, and/or proposed timber harvest overlap along non-motorized trails and in other sensitive areas, changes related to tree cutting, slash piles, temporary roads, and skid trails could accumulate and result in a change from the existing degree of perceived naturalness of the area. Because commercial timber harvest and related activities, which have the greatest potential to affect recreation, would occur only in Roaded Natural and Roaded Natural Non-Motorized areas, effects would be consistent with Forest Plan guideline 5101.

Land Uses

Special use permits authorize a wide range of activities typically involving the use or occupancy of NFS lands. Recreation special uses are discussed on page 197. According to the Forest Service Special Uses Data System (part of the Forest Service Natural Resource Manager system, https://www.fs.fed.us/nrm/), the following non-recreation special use permits are currently active in the BHNF. The majority relate to sites within the project area.

- Road easements or permits: 357
- Water pipelines, wells, etc.: 65
- Utilities: 20
- Communications: 23
- Agricultural: 17
- Other (26 categories): 61

Road easements or permits are active on numerous roads that may be used during proposed activities. Other permitted improvements and facilities are present in proposed activity areas. The potential for the Proposed Action to affect most of these permitted uses is low. Coordination among special use administrators and project implementation personnel and adherence to Forest Plan direction and project design features would prevent adverse effects on permitted land uses.

The No Action alternative would have no effect on existing land uses.

Ecosystem Services and Economics

Summary

The Proposed Action would provide various sectors of the public with multiple values and benefits associated with the maintenance of ecological processes. Perpetuating the resilience of these processes is critical to sustaining multiple use management and providing a broad range of ecosystem services. The project's focus on forest structural diversity at the stand and landscape scales would contribute toward the forest's capacity to resist change or recover following disturbance.

Timber harvest associated with the Proposed Action would also contribute to the local economy during the project implementation period. It is estimated that the Proposed Action would support over 1,300 jobs, $55 million in total labor income, and $64 million in GDP contribution for the local economy on an annual average basis. Note that these may not be new jobs or income, but rather existing jobs and income in the regional economy that are supported or sustained by the estimated harvest volume.

Information Sources

Sources include 2015 data from the US Department of Commerce, Census Bureau, American Community Survey, Department of Labor, and other official data retrieved using the EPS-HDT (2017) software system maintained by Headwaters Economics. Only major trends and benchmark comparisons are presented in this section. Detailed data, with complete county-by-county statistics, are found in the project analysis file.

Affected Environment

Ecosystem Services

Ecosystem services are components of nature that contribute to human well-being. The following discussion of ecosystem services generally applies across the entire project area. Table 39 summarizes existing landscape challenges and identifies the ecosystem services or ecological processes associated with those landscape needs.

Table 39. Project Area Needs and Associated Ecosystem Services

Existing Condition (Landscape Challenges and Needs)	Relevant Ecosystem Services, Processes, Structure, and Function
Uncharacteristically heavy surface fuel loadings and complex fuel arrangements on NFS and non-NFS lands; the need for moving fire regime/condition class (page 71) toward more fire-adapted conditions with which native species evolved.	Regulation of insect infestation and other natural disturbances
Hardwood stands and grasslands losing vigor or disappearing due to pine encroachment or age; the need for maintaining aspen and oak stands for their habitat diversity values and resistance to fire and insects.	Habitat and scenic diversity; ecosystem resilience to disturbance
Mountain pine beetle infestation has changed forest structure and composition; small pine trees must compete for limited resources in dense young stands, stagnation could slow growth and increase potential for damage.	Habitat and scenery diversity; insect and fire regulation

By associating the current needs of the landscape with relevant ecological processes, it is clear that insect and fire regulation as well as diverse habitat and scenery are the overlapping benefits that are critical to this landscape.

Economic Environment

To depict measures of individual prosperity, this section describes per capita income, non-labor income, average earnings per job, and unemployment rate in the BHNF regional economic contribution zone of influence. The regional economic contribution zone of influence includes four counties, based on locations of processing or harvesting firms receiving Black Hills timber in recent years. They include Lawrence, Pennington, and Meade Counties in South Dakota and Crook County in Wyoming. Custer and Fall River Counties in South Dakota are not in the economic model but they are included in the affected environment description to provide context for the social and economic environments surrounding the BHNF. While Weston County, Wyoming contains NFS lands, it is not included in the model because the county's primary industries are less related to the output and products associated with this project.

Per capita income is total personal income (from labor and non-labor sources) divided by total population. Annual per capita income is **$45,183** (2015 data) in the Black Hills area, ranging from $39,148 (Meade County) to $47,085 (Pennington County). South Dakota ($48,503) has a higher overall per capita income than the zone of influence and other counties within the study area (BEA 2016).

Per capita income is considered one of the most important measures of economic well-being, but it can be misleading. Because it is based on total personal income, which includes non-labor income sources (dividends, interest, rent, and transfer payments), it is possible for per capita income to be relatively high due to the presence of retirees and people with investment income. Also, because per capita income is calculated using total population and not the labor force as in average earnings per job, it is possible for per capita income to be relatively low when there is a disproportionate number of children and/or elderly people in the population.

Non-labor income makes up **42.1 percent** of total personal income in the Black Hills area. Figures for individual counties range from 34.9 percent (Meade) to 49.7 percent (Fall River). Non-labor income consists of money earned from investments (dividends, interest, and rent) and transfer payments (government retirement and disability insurance benefits, medical payments such as Medicare and Medicaid, income maintenance benefits, unemployment insurance benefits, etc.). In many counties, non-labor income can be more than a third of all personal income. As the Baby Boom generation retires, this source of income will continue to grow. A high dependence on non-labor income can be an indication of an aging population and/or the attraction of people with investment income. Public lands activities may affect these constituents.

Average earnings per job are total earnings divided by total employment. Employees, sole proprietors, and active partners are included. Average earnings per job is an indicator of the quality of local employment. A higher average earning per job indicates that there are relatively more high-wage occupations. Average earnings per job are **$49,208** for the Black Hills area (2015 data), ranging from $32,226 (Custer County) to $47,115 (Pennington County) (BEA 2016).

Unemployment rate is an important statistic of economic well-being. The annual unemployment rate is the number of people actively seeking but not finding work as a percent of the labor force. The unemployment rates for the state of South Dakota and the study area are at or below the *natural rate* of 4.5 to 5 percent. The natural rate of unemployment, or full employment, is the level of unemployment that predominantly comprises transitional and voluntarily unemployed workers. The

2015 annual unemployment rate in the Black Hills area was **3.3 percent,** ranging from 3.2 percent (Meade and Pennington Counties) to 4.5 percent (Fall River County).

Regional Economic Contribution

Commercial timber harvest on the BHNF contributes to local employment, income, and other economic activities. In fiscal years 2012 through 2016, annual harvest levels ranged from 179,554 CCF in 2014 to 206,530 CCF in 2012 (Table 40).

Table 40. BHNF Recent Timber Harvest Volumes: FY2012-FY2016

	2012	2013	2014	2015	2016	5-Yr Avg
Sawtimber (CCF)	193,848	208,936	171,388	193,427	179,010	189,322
Poles (CCF)	5,258	8,172	1,055	3,362	6,216	4,813
Posts (CCF)	-	1	-	1	115	39
Firewood (CCF)	6,650	5,093	6,100	6,168	5,925	5,987
Misc. and non-sawtimber products (CCF)	774	1,030	1,011	1,508	1,166	1,098
Total	*206,530*	*223,233*	*179,554*	*204,466*	*192,432*	*201,243*

Annual average employment, labor income, and Gross Domestic Product (GDP) contributions from timber harvest are estimated using IMPLAN data and Forest Service modeling tools (see project analysis file) based on the five-year average (Table 41).

Table 41. Annual Average Employment, Labor Income, and GDP Contributions from BHNF Timber Harvest

	Direct	Indirect and Induced	Total
Employment	629	992	1,551
Labor Income (2015 $)	$27,164,538	$36,044,769	$63,209,307
Contribution to GDP (2015 $)	$27,606,347	$46,082,685	$73,689,032

Based on five-year average volume, FY2012-FY2016.
Employment is the total full- and part-time wage, salaried, and self-employed jobs in the region.
Labor income includes the wages, salaries, and benefits of workers who are paid by employers and income paid to proprietors.

Environmental Consequences

Ecosystem Services

Multiple values and benefits are associated with the maintenance of ecological processes that are the focus of this project (insect and disturbance regulation and diverse forest structure and composition). Besides the more apparent, if not immediate, benefits of thinning and fuel reduction (to reduce hazard to public health and safety, infrastructure, and communities), other benefits center on the premise that landscape-level forest diversity will (1) decrease susceptibility to widespread fire and insect infestation in the future and (2) provide varied habitats for wildlife and scenery (recreation values).

The concept of Final Ecosystem Goods and Services (FEGS) is a useful foundation for defining, classifying, and measuring ecosystem services. FEGS focuses less on ecosystem services that regulate or support and more on components of nature that are directly enjoyed, consumed, or used to yield human well-being (Boyd and Banzhaf 2007) and emphasizes linking specific beneficiaries with services. While the objectives of the BHRL project relate more to supporting or regulating services (forest insect and disturbance regulations), it is worthwhile to point out the many values from which people would benefit.

Various end users would receive multiple values and benefits associated with the maintenance of ecological processes that are the focus of this project. This analysis relates the most critical processes (fire and insect regulation) with relevant beneficiaries. Four general groups of beneficiaries are identified:

- General public and their safety resulting from reduced risk of wildfire to landscapes and structures.
- People interested in the provision of timber, including future harvest opportunities (option values).
- People interested in having diverse habitats for scenic/recreational values, in addition to having decreased fire hazard and insect infestation risk.
- People interested in the preservation of wildlife, both for use (hunting, wildlife viewing) and passive values (awareness of the existence of wildlife species supported by diverse pine forest habitats).

Overall, the Proposed Action would directly or indirectly benefit the above groups by achieving various ecological outcomes or intended effects. Table 42 summarizes the intended outcome associated with proposed management actions as well as the ecological challenges these actions aim to address. Some actions would provide commercial timber for processing, generating regional economic contributions.

Table 42. Ecological Outcomes – Proposed Action

Landscape Challenges and Needs	How the Proposed Action would Address the Needs to Increase and Maintain Ecosystem Resilience	Ecological Outcomes or Intended Effects
Uncharacteristically heavy surface fuel loadings and complex fuel arrangements on NFS and non-NFS lands; the need for moving fire regime/condition class (page 71) toward more fire-adapted conditions with which native species evolved.	Mechanical and manual fuel treatments	Reduced potential of dead trees burning intensely, damaging soils and causing problems for firefighters. Some activities would provide timber for processing.
	Precommercial and POL thin	Thinning small pine trees (which are not fire resistant) to reduce density, reducing potential for vertical and horizontal fire spread.
	Prescribed fire	Reduced fuel loading; moving toward fire-adapted landscape conditions
	Hazard tree reduction	Reduced risk of trees falling on open roads or trails, structures, private property, or critical infrastructure.
Hardwood stands and grasslands losing vigor or disappearing due to pine encroachment or age; the need for maintaining aspen and oak stands for their habitat diversity	Aspen maintenance and enhancement (cut or burn encroaching pine, declining aspen)	Maintaining aspen stands and their inherent resistance to fire and pine pathogens; providing habitat and scenery diversity.
	Removal of encroaching pine from oak stands	Maintaining oak stands and their inherent resistance to fire and pine

Landscape Challenges and Needs	How the Proposed Action would Address the Needs to Increase and Maintain Ecosystem Resilience	Ecological Outcomes or Intended Effects
values and resistance to fire and insects.		pathogens; providing habitat and scenic diversity.
	Removal of encroaching pine from grasslands	Maintaining areas of low fuel loading; providing habitat and scenic diversity.
Mountain pine beetle infestation has changed forest structure and composition; small pine trees must compete for limited resources in dense young stands, stagnation could slow growth and increase potential for damage.	Convert some open, mature stands (SS 4A) to young stands by removing some or all of the mature trees	Moving toward Forest Plan objectives for SS 4A and other structural stages.
	Fuel treatments in understory of dense, mature pine stands	Maintain dense, mature pine stands
	In areas where grass/forb (SS 1) is below Plan objective, patch cut to produce more SS 1 In areas where grass/forb is above Plan objective, plant trees or conduct site preparation to facilitate reforestation	Moving toward Forest Plan objectives for SS 1
	Precommercial thinning small trees in young stands	Increase vigor of remaining saplings and prevent stagnation

The No Action alternative would not respond to the needs to increase and maintain ecosystem resilience.

Forest Structural Diversity and Resilient Ecosystems

Resilient ecosystems have greater capacity to survive disturbances and large-scale threats such as wildfire and beetle infestation, especially under changing and uncertain future environmental conditions. Maintaining and perpetuating ecological resilience is critical to achieving sustainable multiple use management and providing a broad range of ecosystem services. When viewed over an appropriate time span, a resilient forest ecosystem is able to maintain its 'identity' in terms of taxonomic composition, structure, ecological functions, and process rates. For similar site types, diverse forests are both more resistant (remaining unaltered in the face of chronic change) and more resilient than those with less diversity (Stone et al. 1996). The available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or recover following disturbance, depends on biodiversity at multiple scales – stand, landscape, ecosystem, bioregional (Thompson et al. 2009). This project primarily focuses on forest structural diversity at the stand and landscape scales.

Forest Structural Diversity and Wildlife Habitat

Diversified structural features provide varied recreational values as well as critical habitat components for forest-dwelling wildlife species. For example, vertebrate habitat diversity is associated with forest structure (Urban and Smith 1989; Hansen et al. 1995). In addition, it may be that structural characteristics, not plant species composition, are the primary determinants of avian community diversity (MacArthur and MacArthur 1961).

Regional Economic Contribution

Economic contributions (jobs, labor income, and GDP) are estimated using input-output analysis. Input-output analysis is a means of examining relationships within an economy, both among businesses and between businesses and final consumers. It captures all monetary market transactions for consumption in a given time period. The resulting mathematical representation allows one to

examine the effect of a change in one or several economic activities on an entire economy, assuming that all else remains constant. This examination is called impact analysis. The IMPLAN modeling system allows the user to build regional economic models of one or more counties for a particular year. The model for this analysis employed 2014 IMPLAN data (the most recent data available at the time of analysis). IMPLAN translates changes in final demand for goods and services into resulting changes in economic effects, such as labor income and employment of the affected area's economy.

Economic effects are measured by estimating the direct jobs and labor income generated by the processing of the timber volume from the project. The direct employment and labor income benefit employees and their families and, therefore, directly affect the local economy. Additional indirect and induced multiplier effects (ripple effects) are generated by the direct activities. Indirect effects are felt by the producers of materials used by the directly affected industries. Induced effects occur when employees of the directly and indirectly affected industries spend the wages they receive. Together the direct and multiplier effects form the total economic contributions to the local economy.

Direct effects were estimated using direct response coefficients developed from a national Timber Mill Survey conducted by the University of Montana's Bureau of Business and Economic Research (BBER) (Table 43). BBER timber response coefficients, also known as Keegan Timber Mill Survey Response Coefficients, are broken into multi-state regions. Data for the region covering South Dakota and Wyoming are used in this analysis. Along with these direct Keegan coefficients, a Forest Service model specifically constructed for the BHNF zone of influence (using county-level IMPLAN data) is then used to model the total economic contribution of timber harvest.

Table 43. Keegan Timber Mill Survey Response Coefficients for South Dakota and Wyoming

Industry Sector	Direct Response Coefficients	
	Employment (jobs per MMCF*)	Income (2014 $ per MMCF)
Forestry and Logging	14	$588,000
Softwood Sawmills	12	$492,000
Other Timber Products	15	$525,000
Facilities Processing Residue From Sawmills	4	$164,000

*Million cubic feet of timber

For the purpose of analyzing the regional economic contributions of the Proposed Action, the total estimated timber volume resulting from the proposal is estimated at 678,000 CCF, to be harvested over four years starting in 2019.

Given these inputs and assumptions, it is estimated that the Proposed Action would support over 1,300 jobs, $55 million in total labor income, and $64 million in GDP contribution for the local economy on an annual average basis. Table 44 displays the direct, indirect and induced, and total estimates for employment (part- and full-time), labor income, and GDP contribution that may be attributed to the Proposed Action. It is important to note that these may not be new jobs or income, but rather existing jobs and income in the regional economy that are supported or sustained by this project.

Table 44. Annual Average Employment, Labor Income, and GDP Contributions from Proposed Action Timber Harvest

	Direct	Indirect and Induced	Total
Employment	549	809	1,358
Labor Income (2015 $)	$23,745,304	$31,684,847	$55,430,151
Contribution to GDP (2015 $)	$24,082,002	$40,343,267	$64,425,269

Based on four-year implementation period starting in 2019.
Employment is the total full- and part-time wage, salaried, and self-employed jobs in the region.
Labor income includes the wages, salaries, and benefits of workers who are paid by employers and income paid to proprietors.

Since the model assumed that harvest of timber volume associated with the Proposed Action would occur over a four-year period (approximately 169,100 CCF per year), estimates of average annual part-time and full-time jobs shown in Table 44 depend heavily on harvest implementation. If the actual implementation period is shorter, more jobs would be supported over a shorter period of time. Conversely, if the implementation period is expanded, fewer jobs would be supported annually but for a longer period of time. Also, within the implementation period of a project, the numbers of jobs supported may or may not be filled by the same personnel or distributed evenly over time, depending on the nature of the project, turnovers, number and type of firms involved, and other factors. Therefore, it would be misleading – or, not meaningful at best – to calculate a "total employment over the life of the project" figure. Due to these issues, readers are further cautioned against multiplying the average annual employment number(s) as presented above with the project implementation timeframe (years) in an attempt to arrive at a "total employment over the life of the project" figure.

These regional economic contribution estimates are associated with the Proposed Action only and do not include jobs or income effects associated with ongoing and planned timber sales, those currently scheduled for sale, or those that have been sold but not yet cut.

It is also important to note that there would be additional jobs, labor income, and GDP contributions associated with other project-related activities (those without product removal components). Personnel and firms carrying out these activities would incur various expenditures (labor costs, fuel, equipment, etc.). The direct project-related employment and labor income would benefit employees and their families, while additional indirect and induced multiplier effects (ripple effects) would be generated by, or associated with, various direct activities, from mechanical and manual fuel treatments to thinning or burning understory vegetation.

The No Action alternative would incur no immediate or direct financial costs and would not produce any revenue from an Agency perspective or further contribute toward GDP, jobs, or income. Employment, income, GDP contributions, and other economic impacts associated with ongoing timber projects (including any planned sales, those currently scheduled for sale, or those that have been sold but not yet cut) will continue to occur in the local economy.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be undone, such as the extinction of a species or the removal of mined ore. Irretrievable commitments occur when resources are lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or roads.

The Proposed Action would not result in any irreversible commitments of resources.

The Proposed Action could result in the following irretrievable commitment of resources.

- Loss or modification of a percentage of habitat for certain wildlife and plant species would be likely to occur. Habitat losses would be temporary and would not result in loss of viability or persistence of any species in the BHNF (pages 82, 99, and 131).
- Production of desirable vegetation may be temporarily lost in areas that become infested with noxious weeds (page 97).
- Soil productivity and timber productivity would be lost where roads are constructed. This loss would last until the road prism revegetates or is removed (page 141).
- Air quality would be temporarily impacted to varying degrees due to smoke generated by broadcast prescribed fire and slash pile burning and due to dust resulting from road use and improvement (page 170).

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). This includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

These relationships between short-term uses and long-term productivity are addressed in the effects section for each resource. Design features incorporated into the Proposed Action would ensure that long-term productivity of the land is not impaired by short-term uses.

Unavoidable Adverse Effects

The Proposed Action may have the following unavoidable adverse effects. Measures to minimize these effects would be implemented where possible. For further details, see the respective resource sections.

- Noxious weed infestation may increase (page 97).
- Individuals of some wildlife and rare plant species may be harmed. Habitat for certain species would be adversely affected to varying degrees. These effects are disclosed on pages 86-92 and 99-130.
- Temporary soil erosion may occur (page 148). Soil compaction may occur where heavy equipment operates or under large piles of logs or slash (page 143).

- Air quality would be adversely affected on a temporary basis by broadcast prescribed fire and slash pile burning and by dust (page 170).
- Heritage resources may be disturbed or destroyed if unknown resources exist in treated areas. Procedures that would be followed if new resources are found would minimize this effect (page 185).
- Various proposed activities would cause scenic integrity to deviate from objectives in some areas for a period of time (page 191).
- Recreation sites may be temporarily unavailable (page 198).

DEIS Preparers

Name	Organization	DEIS Contribution	Education	Yrs Relevant Experience
Anne Davy	U.S. Forest Service Enterprise	Project management	M.B.A.; B.S. Forest Management and Forest Administration	32
Gale Gire	U.S. Forest Service, Black Hills National Forest	Silviculture analysis	B.S. Forest Management	44
Les Gonyer	Action Staffing Solutions, Inc.	Watershed analysis	B.S. Forestry/Hydrology	38
Amy Ham	U.S. Forest Service, Black Hills National Forest	Fire and fuels analysis	B.S. Biology	19
Michael Hilton	U.S. Forest Service, Black Hills National Forest	Heritage resources analysis and tribal relations	Ph.D. Archaeology	22
Steve Hirtzel	U.S. Forest Service, Black Hills National Forest	Wildlife and fisheries analysis	B.S. Wildlife and Fisheries Science	30
Stephen Keegan	U.S. Forest Service, Black Hills National Forest	Landscape architecture and recreation analyses	B.S. Landscape Architecture and Environmental Studies	35
Craig Kjar		Transportation system analysis	B.S. Civil Engineering	38
Elizabeth Krueger	U.S. Forest Service, Black Hills National Forest	Team leader	B.S. Forest Resources	28
Justin McConkey	U.S. Forest Service, Black Hills National Forest	Rangeland and noxious weeds analyses	B.S. Rangeland Management/Wildlife	16
Kawa Ng	U.S. Forest Service, Rocky Mountain Regional Office	Ecosystem services and economic analyses	Ph.D. Ecology; M.S. Resource Economics; B.S. Natural Resource Management	7
Rhonda O'Byrne	U.S. Forest Service, Black Hills National Forest	Project management	B.S Environmental Resources, Rangeland Ecology	26
Deanna Reyher	U.S. Forest Service, Black Hills National Forest	Soils analysis	B.S. Agronomy	33
Rylan Sprague	U.S. Forest Service, Black Hills National Forest	Botany analysis	M.S. Sustainability; B.S. Biology/Botany	8
Deanna Stever	U.S. Forest Service, Black Hills National Forest	Geology analysis	M.S. Geology	10
Ryan Tallmadge	U.S. Forest Service, Black Hills National Forest	Mapping and database management	B.S. Ecology and Natural Resources with Environmental Geomatics	7

DEIS Recipients

The following parties will receive a copy of the DEIS (hard copy or compact disc):

US Environmental Protection Agency
USDA National Agricultural Library
USDI Office of Environmental Policy and Compliance
Wyoming State Forestry Division
Cheyenne River Sioux Tribe
Cheyenne/Arapaho Tribes of Oklahoma
Crow Creek Sioux Tribe
Eastern Shoshone Tribe
Flandreau Santee Sioux Tribe
Kiowa Ethnographic Endeavor for Preservation
Lower Brule Sioux Tribe
Mandan, Hidatsa, and Arikara Nation
Northern Arapaho Tribe
Northern Cheyenne Tribe
Oglala Lakota Nation
Rosebud Sioux Tribe
Santee Sioux Nation
Sisseton-Wahpeton Sioux Tribe
Spirit Lake Sioux Tribe
Standing Rock Sioux Tribe
Yankton Sioux Tribe

An additional 45 parties will be notified of DEIS availability.

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