

Black Hills

Resilient Landscapes Project



Transportation

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Transportation Report
Black Hills Resilient Landscapes Project

USDA-Forest Service
Black Hills National Forest

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Contents

Introduction.....	1
Project Area Description.....	1
Purpose and Need	1
Relevant Issues.....	2
Proposed Action Summary	2
1. Fuel Reduction and Prescribed Fire.....	2
2. Enhancement of Non-pine Vegetation and Within-stand Diversity.....	2
3. Pine Structural Stage (SS) Modification	3
4. Summary of Proposed Activities	3
Design Features.....	5
Regulatory Framework	11
1. Authority.....	11
2. Regulations	11
3. Other Authorities	11
Information Sources.....	12
Existing Transportation System.....	12
Proposed Transportation System	15
1. Road Activity and Cost.....	16
2. Management and Maintenance	18
3. Desired Conditions	19
Analysis Methodology	20
Analysis Assumptions.....	21
Forest Plan Compliance	22
Effects	24
1. Project effects to the road system	24
2. Motorized Recreation Effects	25
3. Public Safety.....	27
Cumulative Effects.....	27
Monitoring	29
Bibliography	30

List of Figures

Figure 1. Potential New and Temporary Roads..... 17

List of Tables

Table 1. Management Areas and Acres 1

Table 2. Summary of Proposed Activities 4

Table 3. Miles of Road by Jurisdiction..... 13

Table 4. Miles of National Forest System Road by Maintenance Level in BHRL 13

Table 5. Miles of Road and Trail by MVUM Designation..... 14

Table 6. New Road Construction..... 18

Table 7. Cost Estimate for Project Roads 18

Table 8. Project compliance with Forest Plan 22

Table 9. Roads and Motorized Trails Open to the Public in BHRL..... 26

Table 10. Monitoring 29

Appendix A – Road Definitions and Descriptions

Appendix B – Effects Analysis

Appendix C – Road Cost Estimate

Introduction

This report presents information about an analysis of the portions of Black Hills National Forest transportation system affected by the Black Hills Resilient Landscapes Project (BHRL). The report supports the Environmental Impact Statement.

Project Area Description

The project area includes National Forest System lands that are managed by the Black Hills National Forest within the areas designated by the Secretary of Agriculture under the amended Healthy Forests Restoration Act (HFRA, 16 U.S.C. 6591), excluding Inventoried Roadless Areas and certain management areas. The project area includes approximately 1,098,000 acres of National Forest System lands.

The project area includes the following management areas (MAs).

Table 1. Management Areas and Acres

MA	Emphasis	Acres*	Proposed activities
3.31	Backcountry motorized recreation	6,870	Fuels/hazard trees
3.32	Backcountry non-motorized recreation	8,948	Fuels/hazard trees
3.7	Late succession landscapes	18,484	Fuels/hazard trees
4.1	Limited motorized use and forest products	41,374	All
5.1	Resource production	558,520	All
5.1A	Southern Hills forest and grassland	27,845	Fuels/hazard trees
5.2A	Fort Meade VA Hospital watershed	3,299	Fuels/hazard trees
5.4	Big game winter range	388,950	All
5.43	Big game and resource production	10,083	All
5.6	Forest products, recreation, and big game	34,043	All
*MA acres in project area		Total	1,098,425

Purpose and Need

The Black Hills National Forest 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.

Relevant Issues

Public comments resulted in 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 wide 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 time frame.

Proposed Action Summary

The Forest Service is proposing to conduct the following land management activities in the project area, starting in approximately 2018 and continuing for about 10 years.

1. Fuel Reduction and Prescribed Fire

To increase ecosystem resilience and reduce wildfire hazard to landscapes and communities, the proposal includes mechanical fuel treatments (up to 7,000 acres per year), prescribed fire (up to 10,000 acres a year), and hazard tree removal. Total acres implemented annually would depend on budget constraints and, for prescribed burning, weather conditions. Priority criteria for treatment include wildland-urban interface (specifically, within one-half mile of at-risk communities and within 300 feet of other private property) and areas adjacent to egress roads and critical infrastructure.

Activities described in the following sections (precommercial thinning, removing encroaching pine, etc.) also would contribute toward fuel reduction goals.

2. Enhancement of Non-pine Vegetation and Within-stand Diversity

The project would cut encroaching pine from areas of hardwoods and grasslands. Pine and spruce removal from aspen stands would take place on up to 6,000 acres. On up to 30,900 acres of pine stands, pine and spruce would be removed from aspen inclusions. Regeneration of declining aspen stands would occur on up to 4,000 acres. Pine removal from oak stands would take place on up to 5,400 acres. Pine would be cut from encroached grasslands on up to 14,200 acres. Uneven-age management would occur on up to 10,000 acres of SS 4A stands.

3. Pine Structural Stage (SS) Modification

These activities would occur in MAs 4.1, 5.1, 5.4, 5.43, and 5.6.

Overstory removal would occur on up to 185,210 acres of SS 4A stands. This treatment would decrease 4A and increase younger structural stages, which are generally below Forest Plan objectives. Precommercial and/or POL thin would occur on up to 25,000 acres per year to increase SS 3A and 3B and to promote growth toward 4B.

Patch cuts would occur on up to 1,300 acres in MA 4.1 and 600 acres in MA 5.6. This treatment would produce SS 1, which is below Forest Plan objectives in these MAs. Tree planting would occur on up to 5,000 acres per year in large burned areas in the southern Black Hills. Without planting, reforestation of these areas may require decades.

Mechanical site preparation would occur in open, mature pine stands on up to 4,000 acres in the western Black Hills where thick sod hinders establishment of pine seedlings. This action would expose soil, creating conditions favorable for establishment of pine.

4. Summary of Proposed Activities

Maximum activity acres and road miles are displayed in Table 2. The amount implemented may be less.

Table 2. Summary of Proposed Activities

Fuel and hazard tree treatments	
Mechanical and manual fuel treatments (<i>shaded fuel break construction; thin, pile, and burn fuels; scatter, shred, or chip fuels; cut, lop, and scatter fuels</i>); includes up to 4,000 acres of shaded fuel breaks with commercial removal	70,000 acres (7,000 acres per year)
Prescribed fire	100,000 acres (10,000 acres per year)
Hazard tree treatments	As needed and funded
Hardwood and grassland enhancement	
Removal of pine/spruce from aspen stands	2,400 acres
Regeneration of aspen stands	4,000 acres
Removal of pine/spruce from aspen inclusions (possibly commercial)	22,500 acres
Removal of pine/spruce from aspen inclusions (non-commercial)	8,400 acres
Removal of encroaching pine from oak stands	5,400 acres
Removal of encroaching pine from grasslands	14,200 acres
Uneven-age individual tree selection or group selection	As stand conditions allow (max.10,000 acres, out of the 185,210 acres below)
Pine structural stage modification	
Overstory removal <i>By management area:</i> 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
Precommercial and/or POL thin	250,000 acres (25,000 acres per year)
Patch cut <i>By management area:</i> MA 4.1: 1,300 acres MA 5.6: 600 acres	1,900 acres
Tree planting (MAs 5.1, 5.4, and 5.43)	5,000 acres
Mechanical site preparation	4,000 acres
Connected actions	
Road construction – New NFSR	18 miles
Road construction – Temporary	39 miles
Temporary roads on unauthorized routes	182 miles
Road conversion (unauthorized to system)	20 miles (part of 182 miles above)
Road maintenance	2,500 miles (estimated)
Road reconstruction	375 miles (estimated)

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.
 - e. In MAs 5.4 and 5.43, no open, mature pine stands (SS 4A) with an average tree size of “very large” 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.
- 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. 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. 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 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.

12. To meet Standard 1203 regarding aquatic organism passage, structures installed at road-stream crossings would: a) maintain a stream channel which is equal to or greater than the bankfull width of the adjacent upstream and downstream reaches, b) contain natural stream substrate throughout the length of the structure, and c) in the case of culverts, avoid perched outlets.

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Regulatory Framework

The forest roads are subject to a system of laws, regulations and technical directives. Only a few of those are applicable to this report.

1. Authority

These two laws provide the basic authorities for the roads discussed in this report:

The National Forest Roads and Trails Act of October 13, 1964, as amended (16 U.S.C 522-538) authorizes road and trail systems for the National Forests. The act authorizes construction and financing of roads including imposition of requirements on road users for maintaining and reconstructing roads including cooperative deposits for that work.

The National Forest Management Act of 1976 (16 U.S.C. 1608) directs that roads be designed to standards appropriate for their intended uses and requires revegetation of temporary roads authorized under a contract, permit, lease, or other written authorization within 10 years of termination of the written authorization. The written authorization can specify a shorter time.

2. Regulations

The following sections of the Code of Federal Regulations apply to roads for the purpose of this report.

Sale and Disposal of National Forest System Timber (36 CFR Part 223). These regulations govern road construction related to Forest Service timber sale appraisals and contracts.

Travel Management (36 CFR Part 212, Subparts A, B, and C). Subpart A of these regulations establishes requirements for administration of the Forest transportation system, including roads, trails, and airfields, and contains provisions for acquisition of rights-of-way. Subpart A also requires identification of the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands and use of a science-based roads analysis at the appropriate scale in determining the minimum road system. Subpart B describes the requirements for designating roads, trails, and areas for motor vehicle use and for identifying designated roads, trails, and areas on a motor vehicle use map (MVUM). Subpart C describes the requirements for designating roads, trails, and areas for over-snow vehicle (OSV) use and for identifying designated roads, trails, and areas on an OSV use map (OSVUM).

3. Other Authorities

Various sections of the Forest Service Manuals (FSM) and Handbooks (FSH) apply to road construction and management. These sections include FSM 7700 and FSH 7709 and FSH 2409.

Construction specifications are developed using Federal Highway Administration standards and Forest Service Supplemental Specifications. The construction specifications contain detailed requirements for the construction of each road.

Information Sources

The following information was used in this analysis:

- Black Hills Forest-Wide Travel Analysis Report September 2007
- Black Hills Travel Management Plan Record of Decision May 7, 2010
- Black Hills Geodatabase Road Feature Class September 6, 2016
- Infra Roads Database September 6, 2016
- Black Hills National Forest Cost Estimating Guides for Construction and Maintenance
- Bureau of Labor Statistics Consumer Price Index – All Urban Consumers
- See the Bibliography for publications

Existing Transportation System

The existing transportation system of National Forest System Roads (NFSR) is a result of historic management and utilization of the forest. The forest 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. In addition, there are over 300,000 acres of non-federal land within the forest boundary that are accessed by the transportation system.

The transportation system is subject to legal requirements for land ownership and right-of-way (ROW). The roads across the National Forest under the jurisdiction of others are issued permits or ROW to cross federal land under authorizations by Congress. Where the NFSR cross private land or land owned by other public entities, ROW must be obtained by the Forest Service prior to road construction. No road improvements can be made by the Forest Service on private land without a ROW. This restriction can limit access to portions of the forest if a ROW cannot be obtained.

Table 3 shows the categories of the road systems both inside and outside the forest boundary that provide a seamless transportation network for the surrounding area. Each system maintains roads for public purposes, but not all roads are open to use by the public. State road systems are the major highways. The county road systems provide public access to private land and to the adjacent National Forest land. Local and private roads are managed by individuals or groups of individuals to provide access to private land and often exclude public use.

Table 3. Miles of Road by Jurisdiction

Jurisdiction	Total Miles	Miles in BHRL
National Forest System	5,226	4,831
Other Federal	2	2
State	755	219
County	746	441
Local	9	6
Private	594	381
Total	7,332	5,880

The NFSR provide long-term access for management activities including public use of the forest. There are five maintenance levels for NFSR commensurate with their design and function. The maintenance levels range from two-lane paved roads to single-lane native surface roads as defined in Appendix A.

In addition to the roads in Table 3, there are 1,420 miles (1,095 miles in BHRL) of unauthorized routes that have been inventoried by the Forest Service. The unauthorized routes are not part of the system of roads maintained by any jurisdiction. The routes were traveled by vehicles at some time, but are not included in the minimum road system. The routes are not available for motorized use and have not been determined to be necessary for future management of the forest. Three possible reasons for these routes are:

- The routes are a result of many vehicles driving in the same place.
- The routes were roads at one time, but were closed in a way that allowed people to continue to drive on them.
- The routes were temporary roads constructed for removal of timber and never effectively rehabilitated and people continued to drive on them.

The NFSR are further categorized by maintenance level (ML). ML 1 roads are in storage until needed for future management and are closed to all motorized use. The ML 2, ML 3, ML 4, and ML 5 roads are currently in use for management of the forest including public access.

Table 4. Miles of National Forest System Road by Maintenance Level in BHRL

Maintenance Level	Miles	Percent
ML 5	0	0
ML 4	104	2
ML 3	489	10
ML 2	2297	48
ML 1	1941	40
NFSR Total	4831	---

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. The ROD designated certain roads and trails as open to public motorized vehicle traffic on lands administered by the Forest and also assigns a class of vehicle and season of use to these designated roads or trails in accordance with Travel Management Regulation 36 CFR 212 Subpart B. Motorized trail designations in the ROD were the result of either changing an existing NFSR to a Forest System Trail, or converting an unauthorized route to a system trail. Some NFSR were also changed from the status of “highway legal only” to “mixed use” (also referred to as roads open to all motorized uses). Implementation began in December 2010 with publication of the first Motorized Vehicle Use Map (MVUM). The current MVUM is dated January 1, 2017, and displays 3,045 miles of NFSR open to motorized travel by the public. An additional 658 miles of designated motorized trail, some of which is coincident with NFSR, are open to users with trail permits. Table 5 displays the current road and trail designations.

Table 5. Miles of Road and Trail by MVUM Designation

Designation	BHRL Yearlong	BHRL Seasonal	BHRL Total	BHNF Total
Roads Open to Highway Legal Vehicles Only	1555	848	2,403	2,556
Roads Open to All Vehicles	356	115	471	489
Trails Open to All Vehicles	61	93	154	154
Trails Open to Vehicles 50” or Less in Width (Wyoming)	0	72	72	72
Trails Open to Vehicles 62” or Less in Width (South Dakota)	203	144	347	347
Trails Open to Motorcycles Only	46	39	85	85
Total	2,221	1,311	3,532	3,703

Road conditions vary throughout the project area. In areas of active and recent timber sales, the roads meet maintenance standards due to the ongoing or recent maintenance activities by the timber purchaser. The Forest Service also performs or contracts road maintenance for ML-3 and ML-4 roads on an annual basis and on a portion of ML-1 and ML-2 roads on a five-year rotation. Any road may not meet maintenance standards if it has not received maintenance recently or there has been damage since the last maintenance. Segments of roads may be damaged easily because they are located in or across drainage bottoms or other wet areas. These road segments may not drain properly and may be contributing to sediment movement due to lack of recent maintenance of drainage features. Some road sections that cross drainages may not have a hardened surface or a proper design through the crossing and portions may have steep grades which will show evidence of road rutting and surface material loss. Numerous roads may have small-diameter trees growing within the roadway clearing limits which restrict sight distance and road width. Roads that do not meet standards are identified by reports from forest employees, reports from the public, scheduled reviews,

or other means and scheduled for maintenance or proposed for reconstruction in a future project.

Proposed Transportation System

The proposed transportation system for the Black Hills Resilient Landscapes Project would primarily use the existing transportation system. Where additional access is needed to proposed treatment areas there will be a choice to construct temporary roads or new NFSR. Any proposed NFSR would be reviewed to determine whether they should be included as part of the minimum road system informed by a travel analysis as required by Travel Management 36 CFR 212 Subpart A. Information used to determine the minimum road system will consider 1) support the proposed management activities and future transportation needs and 2) meet requirements for protection of resources as discussed in other specialist reports for this project. There are five activities proposed to provide the roads and improvements needed to access treatment areas:

- Maintenance of existing roads to continue their function as designed.
- Reconstruction of existing roads where necessary to meet design standards and resource protection requirements.
- Construction of new roads which become part of the minimum road system.
- Construction of temporary roads which are obliterated, and the area rehabilitated after use.
- Construction for conversion of unauthorized routes to the minimum road system.

Maintenance of the existing road system would be performed before, during, and after commercial treatments to assure the road system is functioning as designed. This assures the road would be safe for vehicle traffic, and the features that protect resources (such as drainage systems) are functioning properly. Road maintenance would be the responsibility of the purchaser and would be monitored by the Forest Service.

Reconstruction of some roads may be necessary to improve them to a standard that would accommodate logging trucks and protect resources along the road corridor. Reconstruction can include work along the existing road prism such as surface improvements, road and curve widening, turnouts, drainage structures, or other features to improve safety. Reconstruction can also involve relocation of the road. Some reasons to relocate roads include: 1) protect resources (usually riparian) or 2) improve alignment or 3) correct trespass issues, or 4) slope stability. The relocations would be identified by specialists as the routes for each treatment area are determined. Road designs would take into account the individual resource needs.

Construction of new NFSR may be necessary to access some areas. Reasons to construct a new NFSR would include need for technical construction methods to protect resources, large volume of timber to be hauled, resource protection requirements, or need to access the area for future management after removal of timber. When a new NFSR is proposed, a travel analysis is required using all specialist input to inform the decision regarding whether a new NFSR is needed for the minimum road system. The analysis will be documented and will

supplement the 2007 Black Hills Travel Analysis Report. The decision to add new NFSR will be documented in the Forest Transportation Atlas Infra Database.

Temporary roads may be constructed to access areas where the terrain is flat or gently rolling on stable soils where resource concerns are minimal. Temporary roads are only for the project's use and must be rehabilitated prior to closure of the project. Temporary roads provide economical access to areas that require treatment, but do not require long-term access. Temporary roads would be obliterated and revegetated after use, including temporary roads built on unauthorized routes. Impact to resources would be minimized and mitigated in accordance with requirements of specialists as discussed in other Black Hills Resilient Landscapes Project specialist reports.

Unauthorized routes within the treatment areas would be reviewed during analysis of road needs for the area. An unauthorized route alignment may be used when constructing a new NFSR or a temporary road. Unauthorized routes not used for this project would not be closed or obliterated as part of this project, but ground disturbing activity may obliterate the unused unauthorized routes or make them more difficult to locate after project completion.

1. Road Activity and Cost

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 this project, detailed field reviews by teams of specialists would be performed in preparation for implementing specific actions. Therefore, this analysis uses a projection of needs based on past performance of the road system. 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 C.

The project anticipates about 200 miles of new access for areas of the project that cannot be reached using the existing road system. To identify potential needs for new access, teams of specialists met at each District Office to identify areas without existing road access based on their knowledge of field conditions. Where it was known that no road access existed, the teams recommended either a new NFSR or a temporary road to access each area as displayed in Figure 1. The discussion favored use of temporary roads to minimize allocation of land to roads and to minimize the future maintenance costs of the road system.

The initial recommendation to consider a NFSR versus the preferred temporary road included discussion of the transportation system most likely needed to accomplish long-term management objectives. The discussion included topics such as resource needs; location and construction requirements; long-term maintenance responsibilities; and obliteration needs, as well as continued reliance on Forest Road Program funding for maintenance costs. Table 6 displays the miles of proposed new access as well as the numbers and range of lengths of the roads. The 18 miles of new NFSR includes 14 roads (6 miles) constructed in steep terrain to be used for cable logging. The teams recognized that the discussions were weighted toward constructing temporary roads and the miles of unauthorized routes converted to NFSR may be greater after all specialists have completed on-site investigations and a travel analysis is completed.

Figure 1. Potential New and Temporary Roads

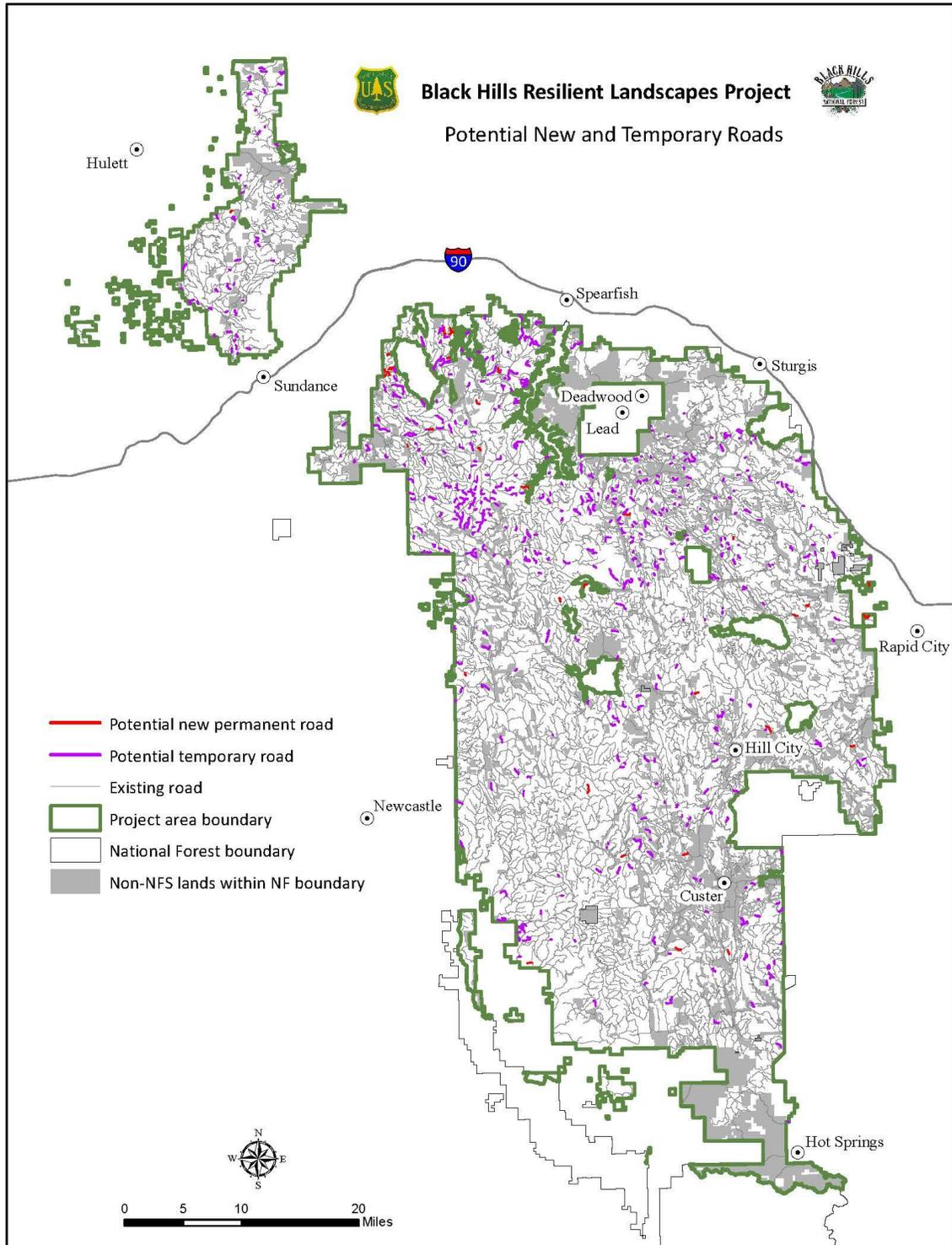


Table 6. New Road Construction

Road Type	Length Miles	Number	Average Length *	Median Length	Minimum Length	Maximum Length*
New NFSR	12	23	0.51	0.44	0.10	0.91
New NFSR Cable	6	14	0.40	0.36	0.18	0.82
Temporary on Unauthorized Route **	182	444	0.41	0.35	0.04	1.70
Temporary	39	139	0.28	0.26	0.02	1.18

*Of the 620 new roads, only 95 are longer than 0.6 mile and 15 of those are 1.0 mile or longer.

**Of the 182 miles, it is anticipated that up to 20 miles could be converted to new NFSR after field reviews and Travel Analysis are completed.

Field reviews of the road system during implementation may indicate the need for reductions or additions to the estimated mileages for new road construction. The notation in Table 6 for 20 miles of conversion of unauthorized routes to new NFSR anticipates some unauthorized route locations may be determined to be necessary for long-term access to manage the forest. In those cases, the unauthorized route may be constructed as a NFSR if it meets the Black Hills Travel Analysis Report criteria for long-term access and would be cost effective for this project. As discussed above, the recommendation to construct a new NFSR requires additional travel analysis using all specialists input to inform the decision that a new NFSR is required for the minimum road system. There would be changes in allocation of actual project costs based on variations in the miles of NFSR required. This cost estimate anticipates 20 miles of new NFSR on unauthorized routes will be constructed to produce the worst-case cost estimate. See Appendix C for details of the road cost estimate summarized in Table 7.

Table 7. Cost Estimate for Project Roads

Activity	Miles	Cost*
Maintenance	2,500	\$3,000,000
Reconstruct	350	\$2,100,000
New NFSR	38	\$680,000
Temporary	39	\$230,000
Temporary on unauthorized	162	\$490,000
Total Cost		\$6,500,000

2. Management and Maintenance

The new NFSR would be used for long-term management activities in the project area, but would not be necessary for public access. Therefore, all the new NFSR for this project could be categorized as Maintenance Level 1 and closed to all motorized use after the project. The closure method used could be a ditch and berm, rock barrier, gate, or other method that discourages access. Generally, the least costly closure method would be selected unless user interest indicates more robust measures would be necessary.

Maintenance on system roads used for timber harvest would be the responsibility of the Purchaser/Contractor for the life of the Timber Sale Contract. Maintenance would include cleaning out silt from sediment collecting ponds and depositing it in upland locations; keeping erosion control measures functioning by cleaning out any sediment collected in the structure and depositing it in upland locations; keeping all drainage structures and ditches clear and functional; eliminating erosion of cut and fill slope and roadway soils; removing roadway vegetation; and blading road surfaces.

Maintenance of the roads after conclusion of the proposed activity would be the responsibility of the Forest Service and would be performed on a five year rotation or sooner if a critical need to protect resources is identified.

3. Desired Conditions

The desired condition is to provide and maintain a safe, efficient, and economical transportation system that meets the purpose and need of the Project and future management activities.

Forest Plan (Phase II Amendment) desired future conditions, as applicable to the transportation system, are:

- Management Area 3.31 – Backcountry Motorized Recreation Emphasis. Generally, few signs of people away from roads or trails are evident. There is little or no evidence of recent human activity or development. Overall, the landscapes of these areas are scenic and natural. Management provides for a variety of uncrowded, motorized recreational activities in areas that appear natural. Challenging off-highway motorized opportunities exist on area trails. This management area also may be suitable for non-motorized uses, such as hiking and photography.
- Management Area 3.32 – Backcountry Non-Motorized Recreation Emphasis. This management area provides a backcountry setting with a high likelihood of solitude; at times, however, large groups of people may be present. A variety of uncrowded, non-motorized recreational opportunities are provided. Old road beds may be evident, though rehabilitation efforts are probably underway to change their appearance. Old road beds may be used as part of a trail system. Roads currently maintained at level 3, 4, and 5 will be downgraded to level 2 for administrative use.
- Management Area 4.1 – Limited Motorized Use & Forest Product Emphasis. An extensive road system is present, which is usually closed to motorized vehicles. Some main Forest Development Roads may be open most of the time for vegetation management activities. Most roads have native surfacing, which often includes grasses or other vegetation, unless they have been recently used by logging traffic. In such a case, the vegetation is likely worn down, and there may be disturbed areas due to maintaining drainage structures. 4.1-9102 Guideline: Motorized road travel is limited to designated routes. Designated routes will vary over time based on the need to do vegetative management. Generally, the road system will be closed to motorized travel.

- Management Area 5.1 – Resource Production Emphasis. Activities such as hunting, hiking, and biking occur along roads closed to vehicle traffic. Some roads and nearby areas are available for year-round motorized vehicle use. Some motorized vehicle use may be restricted for management area purposes. Logging traffic may be encountered throughout the year. 5.1-9102 Guideline: Motorized road travel is allowed where designated by a project decision.
- Management Area 5.1A – Southern Hills Forest & Grassland Area. Motorized travel, hunting, hiking, timber harvests, mining, and livestock grazing will be evident. 5.1A-9102 Guideline: Motorized road travel is allowed where designated by a project decision. 5.1A-9104 Standard: Do not construct any new System roads in the Pilger Mountain area shown on page C-27 of the FEIS Appendix C.
- Management Area 5.2A – Fort Meade VA Hospital Watershed. Roads open for public travel in the Fort Meade Watershed are Forest Highway 26 and portions of the Forest Development Road 171 system. Non-motorized activities, like hiking and wildlife viewing, are provided.
- Management Area 5.4 – Big Game Winter Range Emphasis. Vehicle traffic is limited to only a portion of the total road network. Low standard roads are visible, but may be physically closed by barriers or seasonally closed by gates. Motorized road closures may be implemented, especially during winter months, particularly to minimize stress to wildlife, especially deer and elk. 5.4-207 Objective: Manage for an open road density of 1 mile of road per square mile or less for general-public travel between December 15 through May 15.
- Management Area 5.43 – Big Game and Resource Production. An extensive road system is present, but, except for the major routes, is usually closed to motorized vehicles. Most roads have native surfaces. Most of the local road surfaces are covered with grasses or other vegetation, unless they have been recently used to haul logs. In such a case, the vegetation may be worn down. Non-motorized recreational opportunities are provided, such as hiking, mountain biking, horseback riding, hunting, and cross-country skiing. 5.43-205 Objective: Manage for an open road density of 1 mile of road per square mile or less from December 1 to May 15.
- Management Area 5.6 – Forest Product, Recreation, and Big Game Emphasis. An extensive road system is present; except for major routes, motorized travel is restricted. Most roads have native surfaces. Most of the local road surfaces are covered with grasses or other vegetation, unless they have been recently used to haul logs. In such a case, the vegetation may be worn down. Snowmobiles use some routes. Non-motorized recreational opportunities are provided, such as hiking, mountain biking, horseback riding, hunting, and cross-country skiing.

Analysis Methodology

The actions associated with road activities were identified and a list of possible effects for each category developed. Road activities for this project would be maintenance,

reconstruction, new construction, conversion of unauthorized routes, and temporary road construction. The result will be a revised minimum road system. The effects were divided into direct and indirect categories and are shown in Appendix B.

In addition to the project's effects to the forest road system, there are other jurisdictions (state, county, local, private) managing other portions of the road system within the Black Hills National Forest. Since this project analysis encompasses most of the forest, the activities of each of those other jurisdictions would be affected by the project and would affect the project. A review of the activities that would be likely to occur on all portions of the road system revealed the likelihood of the project contributing to cumulative effects of activities by the Forest Service and other road jurisdictions.

Analysis Assumptions

The following assumptions apply to this analysis:

- The majority of the road system would be adequate for this project. A few new roads may be needed for areas which have not been accessed previously.
- New NFSR would be subject to the Black Hills Forest-Wide Travel Analysis Report and any decision to add a road to the minimum road system would be informed by travel analysis.
- Road construction costs would tend to follow historic trends on the forest with costs subject to adjustment for inflation. The costs are estimated based on the Black Hills cost guides developed for appraisal of timber sales and adjusted using the Consumer Price Index for all urban consumers.
- Road maintenance needs would likely be similar to those encountered historically.
- Road reconstruction needs are likely to be similar to those encountered historically.
- Temporary bridges or other structures may be needed to cross drainages. Site review by specialists would be necessary for design of adequate crossing structures.
- Road construction contracts use Federal Highway Administration Standard Specifications and supplemental specifications developed by the Forest Service. Use of these specifications would continue established procedures for complying with resource protection and public safety requirements.
- Travel management designated roads would remain unchanged by the project, but would be subject to MVUM updates in a separate decision process.
- Temporary roads would be obliterated to standard timber sale contract requirements and recommendations of resource specialists where unique conditions require specific treatments.
- During implementation, there would be an opportunity to secure existing closure devices to protect the resource. Benefits of this action would eliminate motor vehicles from closed roads and areas of high quality winter habitat for wildlife.

Forest Plan Compliance

Table 8 displays the road activity compliance with the Forest Plan.

Table 8. Project compliance with Forest Plan

Proposed Road Activities	Forest Plan (Phase II Amendment)
Secure existing road closures	Goal 1: Protect Basic Soil, Air, Water and Cave Resources, Objective 105: Prohibit motorized vehicle use in wetlands, wet meadows, and riparian areas, except at specified locations and times of year
Construct new system roads to access proposed commercial treatment for conventional and cable logging	Goal 3 – Provide for sustained commodity uses in an environmentally acceptable manner. The Forest System Roads would be maintained to facilitate both commodity and amenity uses of the forest, as well as administration and protection. Lands identified as suitable for timber production would require construction of some new local National Forest System Roads. Road density range would be between 2 and 5 miles per square mile
Closure and/or obliteration of unauthorized routes used for temporary access	Goal 3: Provide for sustained commodity uses in an environmentally acceptable manner, Objective 309: Provide the following changes to the National Forest System roads and two-track roads in support of long-term sustainable production of commodities: Road Construction – 280 miles/decade Road Reconstruction – 870 miles/decade Road Obliteration – 140 miles per decade Two-track Obliteration – 270 miles/decade
Maintain and reconstruct roads	Goal 3: Provide for sustained commodity uses in an environmentally acceptable manner, Objective 310: Maintain the National Forest System Roads (NFSR) and prioritize capital improvements in accordance with Forest Plan direction and road management objectives
Relocation would move roads sufficiently far from streams or wetlands to minimize sediment discharge and use vegetative buffer strips or barriers to reduce sediment	STANDARD 1304 states: as opportunities arise, relocate, or implement mitigation measures for roads, trails, watering tanks, and similar facilities currently located within the Water Influence Zone
Proper location and design of crossings would prevent restriction of expected flood flows and minimize sediment movement	STANDARD 1203 states: Design and construct all stream crossings and other in-stream structures to provide for passage of flow and sediment, withstand expected flood flows, and allow free movement of resident aquatic life
Reconstruct/realign existing roads to add and improve drainage structures, improve alignment, and stabilize the roadbed	STANDARD 1113 states: Construct roads and other disturbed sites to minimize sediment discharge into streams, lakes, and wetlands

Proposed Road Activities	Forest Plan (Phase II Amendment)
Construction of temporary roads for one-time use and closure of such roads	STANDARD 9105 states: Construct temporary roads when there is a one-time need for a transportation facility. Return the road to vegetative production when the one-time need is fulfilled
Seed all disturbed areas immediately after road work is complete	STANDARD 1106 states: Stabilize and maintain roads and other disturbed sites during and after construction to control erosion. STANDARD 1110 states: Initiate re-vegetation as soon as possible, not to exceed 6 months after termination of ground disturbing activities. STANDARD 4306 states: Use certified noxious-weed-free seed, feed, and mulch.
Obtain Rights-of-Way to access areas restricted by steep terrain or private property	Goal 5 In cooperation with other land owners, strive for improved landownership and access that benefit both public and private landowners. Objective 503: Acquire approximately 25 rights of ways each year to improve Forest access GUIDELINE 8101 states: Classify lands or interest in lands for acquisition where lands are valuable for National Forest System purposes based on the following: Section b states, Where lands or rights-of-ways are needed to meet resource management goals and objectives.
Unauthorized routes used as temporary roads would be obliterated and revegetated after use.	STANDARD 1109 states: Reclaim roads and other disturbed sites when use ends, as needed to prevent resource damage. STANDARD 1105 states: 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.
New constructed roads and relocated roads would be located on flatter side slopes so the cuts and fills are not seen from major highways, recreational areas and facilities, and trails, local communities, and other high use areas.	GUIDELINE 5609 states: Highest priority for protection of scenic quality are those areas of heavy public use, such as scenic by-ways, major roads or trails, developed recreation sites, administrative sites, and backdrops for cities and towns.

Effects

Under the No Action alternative, there would be no direct effects to the existing transportation system.

1. Project effects to the road system

Expanding the Road System. The project could add up to 38 miles to the NFSR minimum road system on the forest. Although that is a small amount compared to the 5,226 miles existing 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 roads would be closed to the public after the project, but 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 additional NFSR miles would not increase open road density because all new NFSR would be closed after use to be stored for future management activities. Overall road density would not violate forest plan direction because the new NFSR would be scattered in stands with no existing access.

Work on the Road System. Work on the roads (maintenance, reconstruction, construction) would have resource effects that would require consideration during design and execution of the work. The specific effects are described in other specialists reports such as soils, hydrology, archaeology, botany, invasive species, wildlife, and recreation (motorized recreation is discussed here). Effects of dust, noise, and increased traffic including large trucks would occur during the progress of the work.

Cable Logging Roads. Some of the new NFSR would be constructed for cable logging to access timber in steep terrain. These roads would be susceptible to mass movement and slope erosion. As noted, site investigation and coordination of design with geologists and hydrologists would be critical in choosing location, alignment, and construction techniques to minimize potential problems. In addition, coordination with the Landscape Architect would be necessary to minimize visual impacts of these roads.

Truck Traffic. The project would generate increased truck traffic on the road systems within the forest that would affect the quality of the gravel road surfaces and require additional maintenance, such as repairing washboards, potholes, and cattleguard approaches. 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 (FSH 2409.15 and Black Hills Supplement 7700-91-1) 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 on the roads. Relocation of roads could improve sight distance which may result in increased speed and dust.

2. Motorized Recreation Effects

Public use of the transportation system is guided by the Travel Management Plan. The plan was developed in a public process and has a Record of Decision signed on May 7, 2010. Implementation of the plan requires publication of a Motor Vehicle Use Map (MVUM) valid for a specific period. The latest map was effective January 1, 2017. The MVUM displays designated roads and trails that are open to vehicle traffic including the class of vehicle and season of use. A permit system is used for trails open to motorized vehicles.

Table 9 shows the current MVUM designations of road and motorized trail miles within the 300,000-acre proposed BHRL treatment area (3,532 miles) and the miles that potentially will be used at various times during the project (2,344 miles). The most impact to these roads and motorized trails would be during timber harvest activities when there would be increased truck traffic, construction equipment operations, and additional vehicles using the roads. Road reconstruction and new construction activities may cause traffic delays. The roads and motorized trails may be closed to public use during active harvest periods, and even if not closed, the disruption to roads and motorized trails caused by the work would generally discourage recreationists from using the areas. The roads and motorized trails may also be closed to public use during periods of fuels treatments or precommercial thinning that use fire or mechanized equipment. While the potentially affected roads and motorized trails would be a significant percentage of the forest-wide system, 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 the project activities to public use would be similar, if not identical, to the patterns experienced from these forest management activities since the implementation of the Travel Management Plan. Motorized trails would be restored to pre-project condition when work in that area is completed.

Table 9. Roads and Motorized Trails Open to the Public in BHRL

Designation	BHRL Area	Potentially Used	Percent Used
Yearlong			
Road Open to Highway Legal Vehicles Only	1,555	1,030	66
Road Open to All Vehicles	356	296	83
Trail Open to All Vehicles	61	40	66
Trail Open to Vehicles 50" or Less in Width	0	0	0
Trail Open to Vehicles 62" or Less in Width	203	81	40
Trail Open to Motorcycles Only	46	3	7
Total	2,221	1,450	65
Seasonal			
Road Open to Highway Legal Vehicles Only	848	649	77
Road Open to All Vehicles	115	89	77
Trail Open to All Vehicles	93	43	46
Trail Open to Vehicles 50" or Less in Width	72	47	65
Trail Open to Vehicles 62" or Less in Width	144	65	45
Trail Open to Motorcycles Only	39	1	3
Total	1,311	894	68

The latest visitor use monitoring for the Black Hills National Forest was conducted in 2014. Monitored activities directly related to the road and motorized trail system are driving for pleasure, OHV (off-highway vehicle), 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 assure the respondents that did use portions of the system designated on the MVUM during their visit were included. It appears 8 percent of responses for main activity were directly related to the road and trail system for OHV (off-highway vehicle) and motorized trail use. OHV use was reported as an activity in 6.7 percent of responses, but only 4 percent cited it as the primary activity. Motorized trail activity was reported in 11 percent of responses with 4 percent reporting it was the primary activity. Therefore, a range of 8 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 MVUM 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 it cannot be reliably quantified from the information available.

Physical changes to the trail system would be necessary during the project. Many of the trails are on converted NFSR that would be used temporarily during the project. Upon completion of the project, the NFSR would be returned to the pre-project trail condition. If a motorized trail is used for project access, the trail will be returned to the pre-project condition. There may be additional cost to the recreational trail system if different trail standard than the pre-project condition is desired.

3. Public Safety

During the project, traffic associated with the project would use roads of the many jurisdictions within the forest. The increased traffic from the project would include pickups, construction equipment, log trucks, equipment hauling trucks, water trucks, chip trucks, fire trucks, and road graders. 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 would be designed for low speed traffic, have few warning signs, and no posted speed limits. In addition, designated forest roads would allow OHV traffic which has different characteristics than all of the other vehicles. Safety considerations would be required to be included in road design for new and reconstructed roads. In areas with active road reconstruction and new construction, the use of 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. Safety concerns identified in 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 the public during periods of project activities that could endanger the public such as timber harvest, precommercial thinning, and prescribed fire.

Cumulative Effects

Cumulative effects analysis includes the NFSR transportation system on all lands within the project area and access roads outside the project area. The access roads outside the project area would be the transportation system for equipment taken to the project and products removed by the project, and would be a mix of NFSR, County, and State roads. The effects of the project will be spread across the transportation system over a 10-year period of operations which includes a series of activities within selected portions of the project area. Effects on roads within each portion of the project area would conclude as the project work ends for each activity. The access roads outside the project area may experience simultaneous use by several activities accessing different portions of the project area. These access roads are higher speed, higher volume roads because they are routinely used for several forest projects, public access to the forest, and access to multiple parcels of private land. The access roads may be scheduled for rehabilitation or repairs due to the cumulative effects of project and non-project use for periods up to 3 years after the project is completed about 2028.

Road construction and reconstruction is an activity that occurs annually on the Black Hills National Forest and will occur within the project area annually. The effects of increased truck and equipment traffic of the proposed project could impact these other road activities.

- Routine Forest Service construction and maintenance projects would be needed to manage the road system for public safety and resource management. These projects would include road surface replacement, road surface grading, bridge and culvert replacements, road relocation, and maintenance to culverts, cattleguards, drainage, and other structures. The effects of these activities would be noticed by the public as traffic delays, short-term road closures, increased truck traffic, equipment on the roadway, etc. It is possible that multiple projects would be in progress in the same area.
- County road projects could also occur annually. Bridge and culvert replacements, road realignment, road widening, resurfacing, maintenance grading, clearing trees in the right-of-way, intersection improvements, and other projects have all occurred in recent years in many of the counties. Projects in progress and planned for the next couple years indicate this activity would likely continue.
- Both Wyoming and South Dakota publish a Statewide Transportation Improvement Program (STIP) outlining proposed projects for a 3- to 5-year period. The STIP is updated annually. The current plan extends through 2020 for work within the project area such as crack repair and chip seal; joint and spall repair; pavement replacement or improvement; striping and signing; bridge and culvert replacement; bridge rehabilitation; landslide repair; milling and asphalt concrete repair; grading and asphalt replacement; spot erosion repair; guardrail upgrades; shoulder repair; approach grading; and turn lanes. This work would be scattered throughout the project area and would affect public use of the roads managed by the States which are also routes that would be used for activities related to the Black Hills Resilient Landscapes Project.

Each year landowners within the Black Hills National Forest make requests for initial construction and maintenance of access roads to private land. The requests are reviewed by resource specialists to determine appropriate routes, resource protection requirements, and road design. Because over 300,000 acres of private land are within the forest boundary several requests are received annually. If access exists on NFSR routes, those routes would usually be chosen. Construction of a new private road or a new NFSR with a right-of-way across the private land could also be possible.

Numerous large parcels of private land exist within the boundaries of the Black Hills National Forest. This land is attractive for residential subdivisions which support significant construction activity for road construction and structure construction as they are developed and increase traffic, dust, and noise in the area. Project road activities adjacent to private developments would expand the area where traffic, dust, and noise would be generated.

The project proposed activities could add truck and equipment traffic and road construction. Forest management projects similar to the proposal have been occurring for decades. The proposed activities would be similar to historical activity in type and volume.

Monitoring

Implementation monitoring of road maintenance, reconstruction, and new construction activities would be accomplished through site inspections conducted by certified engineering and timber sale personnel to ensure contract specifications and road designs would be implemented as described in the road and timber contracts. Measured and visual monitoring would determine physical effects, success of natural and enhanced revegetation, and to ensure traffic safety and compliance with state and federal laws.

Table 10. Monitoring

Resource	Objective	Timing	Methodology	Responsibility
Transportation system	Ensure adherence to contract and road design specifications during road construction, reconstruction, and maintenance	Daily to weekly while operations are active	Site inspections	Transportation engineer
Temporary road system	Ensure temporary roads are obliterated temporary bridges removed and sites rehabilitated as required in contract documents	After timber sale implementation	Site inspections	Sale Administrator or Engineering representative
Road Closure	Assure road closure devices are installed where required	After all operations are completed	Site inspections	Sale Administrator or Engineering representative

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APPENDIX A

ROAD DEFINITIONS AND DESCRIPTIONS

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Grid Maintenance ~ The condition of maintenance level 1 and 2 roads evaluated on a 5-year rotational grid pattern within the forest. Each grid is reviewed by a team of engineers and specialists the year prior to maintenance activities to determine the extent of road maintenance necessary. Maintenance work is specified and can be performed by force account or contractors.

Motorized Mixed-use road ~ Segments of National Forest System roads that are identified and signed as open to state licensed and unlicensed vehicles; generally more than 50 inches in width and usually, but not always, low maintenance roads with no high-speed traffic.

Motor vehicle ~ Any vehicle which is self-propelled, other than: (a) a vehicle operated on rails; and (b) any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area (36 CFR 212.1).

Motor Vehicle Use Map (MVUM) ~ A map reflecting designated roads, trails, and areas on an administrative unit or a ranger district of the National Forest System (36 CFR 212.1).

Motorized mixed use ~ Designation of a National Forest System road for use by both highway-legal and non-highway-legal motor vehicles (FSM 7700).

Motorized trail ~ A travel way usually, but not always, less than 50 inches in width usually, but not always, available for use by all-terrain vehicles (ATV) and/or motorcycles. These travel ways may also be made available to high-clearance four-wheel drive vehicles, and may also be used by bicycles, horses, and hikers.

Off Highway Vehicle ~ Any motor vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain (36 CFR 212.1)

Regulatory Signs ~ A sign that informs road users of selected traffic laws or regulations and indicate the applicability of the legal requirements. The signs are installed where the regulations apply and clearly indicate the requirements imposed. Compliance is required.

Warning signs ~ A sign that calls attention to unexpected conditions on or adjacent to a highway, street, or private road open to public travel, and to situations that might not be readily apparent to road users. Warning signs alert road users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operation.

Road Types

National Forest System road (NFSR) ~ A forest road other than a road which has been authorized by a legally documented right-of-way held by a state, county, or local public road authority (36 CFR 212.1).

Unauthorized route ~ A road or trail that is not included in a forest transportation atlas and is not a temporary road or trail.

Temporary Road ~ A road or trail authorized by contract, permit, lease, or other written authorization, or emergency operation that is not intended to be part of the forest transportation system and is not necessary for long-term resource management. Temporary roads are rehabilitated after use by removing any culverts or temporary bridges, installing erosion control features, ripping or scarifying the template, placing woody material on the template, and seeding or planting appropriate vegetation.

Obliteration ~ The act of eliminating the functionality of a road or route and returning it to resource production. Work typically includes a combination of removal of drainage structures, roadbed scarification, moving material from fill to cut sections, erosion control, seeding, and planting of vegetation consistent with the surrounding area.

Road Classification

Arterial road ~ A National Forest System road that provides service to large land areas and usually connects with other arterial roads or public highways.

Collector road ~ A National Forest System road that services smaller areas than an arterial road and that usually connects arterial roads to local roads or terminal facilities.

Local road ~ A National Forest System road that connects a terminal facility with collector roads, arterial roads, or public highways, and that usually serves a single purpose involving intermittent use.

Road Maintenance and Construction

Maintenance ~ No additional investment is expected for planned resource management activities. Identified maintenance would be performed.

Reconstruction ~ Work would be done to provide a usable facility for expected traffic and protect resources which are usually riparian areas, but could also be heritage, botanical, or any other resource. Relocation of some portions of roads is also expected. Expected costs range from \$1,000 to \$15,000 per mile.

Construction ~ New construction of roads may take place. Costs range from \$10,000 to \$20,000 per mile. Costs range for construction/conversion of unauthorized route to forest system road from \$1,000 to \$15,000 per mile.

Road Damage Guidelines ~ USDA-FSH, 2409.15 – Timber Sale Administration Handbook, Chapter 50, Specified Transportation Facilities, Black Hills Supplement No. 2409.15-92-1.

Road Maintenance Level

Maintenance level (ML) ~ Defined in FSH 7709.58, 10, 12. 3 as the level of service provided by and maintenance required for a specific road. Maintenance levels must be consistent with road management objectives and maintenance criteria. Roads may be maintained at one level and planned to be maintained at a different level at some future date. The operational maintenance level is the maintenance level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns. The maintenance level defines the standard to which the road is currently being maintained. The objective maintenance level is the maintenance level to be assigned at a future date considering future road management objectives, traffic needs, budget constraints, and environmental concerns.

Maintenance level 1 road ~ Defined in FSH 7709.58, 10, 12. 3 as intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed one year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are "prohibit" and "eliminate." Roads receiving level 1 maintenance may be of any type, class, or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are closed to vehicular traffic, but may be open and suitable for nonmotorized uses. These roads have the following attributes: (1) vehicular traffic is eliminated, including administrative traffic; (2) physically blocked or entrance is Final Environmental Impact Statement 395 disguised; (3) not subject to the requirements of the Highway Safety Act; (4) maintenance is done only to minimize resource impacts; and (5) no maintenance other than a condition survey may be required so long as no potential exists for resource damage.

Maintenance level 2 road ~ Defined in FSH 7709.58, 10, 12.3 as roads open for use by high-clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either (1) discourage or prohibit passenger cars or (2) accept or discourage high-clearance vehicles. These roads have the following attributes: (1) low traffic volume and low speed; (2) typically local roads; (3) typically connect collectors and other local roads; (4) dips are the preferred drainage treatment; (5) not subject to the requirements of the Highway Safety Act; (6) surface smoothness is not a consideration; and (7) not suitable for passenger cars.

Maintenance level 3 road ~ Defined in FSH 7709.58, 10, 12.3 as roads open and maintained for travel by prudent drivers in a standard passenger car. User comfort and convenience are low priorities. Roads in this maintenance level are typically low speed, single lane with turnouts, and spot surfacing. Some roads may be fully surfaced with either native or processed material. Appropriate traffic management strategies are either Encourage or Accept. Discourage or Prohibit strategies may be employed for certain classes of vehicles or users. These roads have the following attributes: (1) subject to the requirements of the Highway Safety Act and Manual of Uniform Traffic Control Devices (MUTCD); (2) roads have low to moderate traffic volume; (3) typically connect arterial and collector roads; (4) a combination of dips and culverts provide drainage; (5) may include some dispersed recreation roads; and (6) potholing or washboarding may occur.

Maintenance level 4 road ~ Defined in FSH 7709.58, 10, 12.3 as roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated. The most appropriate traffic management strategy is Encourage. However, the Prohibit strategy may apply to specific classes of vehicles or users at certain times. These roads have the following attributes: (1) subject to requirements of the Highway Safety Act and MUTCD; (2) roads have moderate traffic volume and speeds; (3) may connect to county roads; (4) culverts provide drainage; (5) usually a collector; and (6) may include some developed recreation roads.

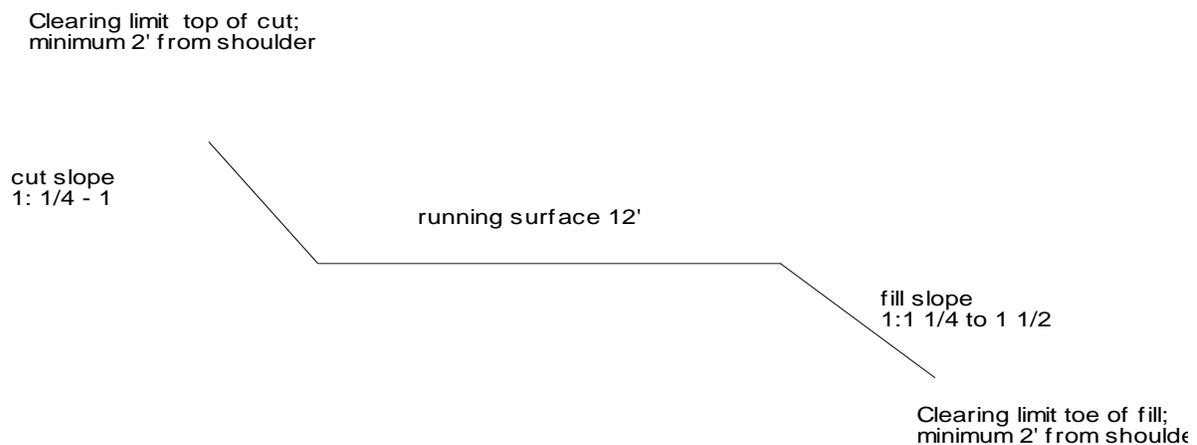
Maintenance level 5 road ~ Defined in FSH 7709.58, 10, 12.3 as roads that provide a high degree of user comfort and convenience. These roads are normally double-lane, paved facilities. Some may be aggregate surfaced and dust abated. The appropriate traffic management strategy is Encourage. These roads have the following attributes: (1) subject to the requirements of the Highway Safety Act and MUTCD; (2) highest traffic volume and speeds; (3) typically connect State and county roads; (4) culverts provide drainage; (5) usually arterial and collector; (6) may include some developed recreation roads; and (7) usually paved or chip-sealed.

Road Standards

Road standards were determined by anticipated traffic, maintenance and traffic management implementation. Aggregate surfacing would be utilized on road sections to protect soils and provide a more stable surface on roads serving large areas of the Forest. Figure through Figure show typical road profiles for ML 1, ML 2, ML 3, & ML 4 roads.

ML 5 roads meet the design standard of roads under the State of South Dakota or county jurisdiction. Reconstruction activities would be evaluated as proposals are received from these agencies. Anticipated traffic, safety and land management needs would be considered.

Figure 1. Road Standard 1

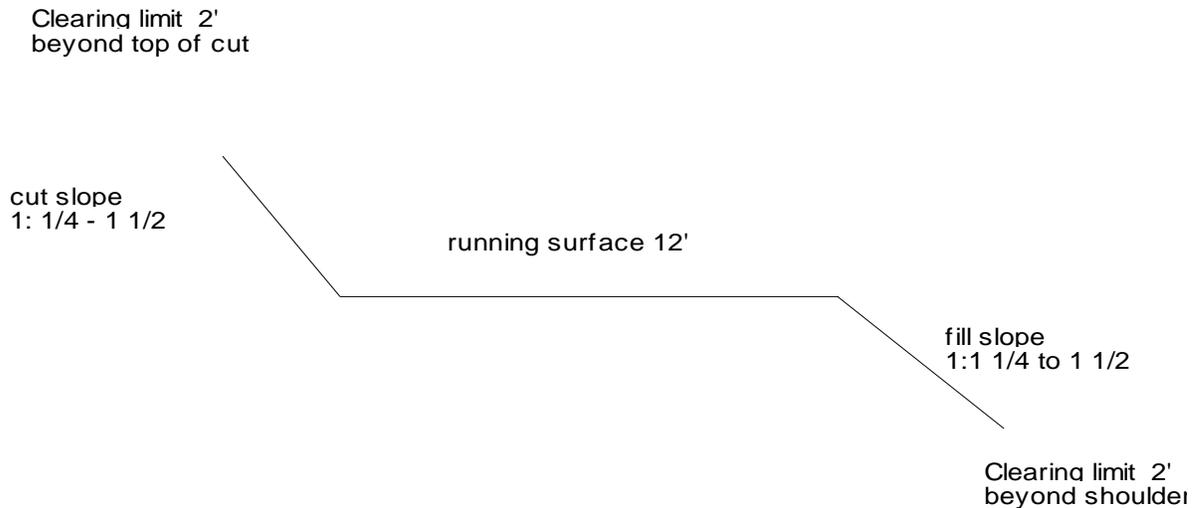


These are minimum standard timber access roads and are usually closed after use (ML 1). Season of use would be curtailed due to soil stability and drainage problems, which are expected seasonally. Generally used on short (less than 1/2-mile) roads or roads with traffic restrictions or where timber haul is expected to be less than 1.0 MMBF per entry.

Features:

- ◆ Surface: native
- ◆ Turnouts: none
- ◆ Grades: sustained 10 percent; pitches 500 feet to 16 percent
- ◆ Curve widening: 400/R, maximum 4 feet
- ◆ Curve radius: 50 feet
- ◆ Drainage: rolling dips, low water crossings. Metal pipes and cut slope ditches are rarely used

Figure 2. Road Standard 2



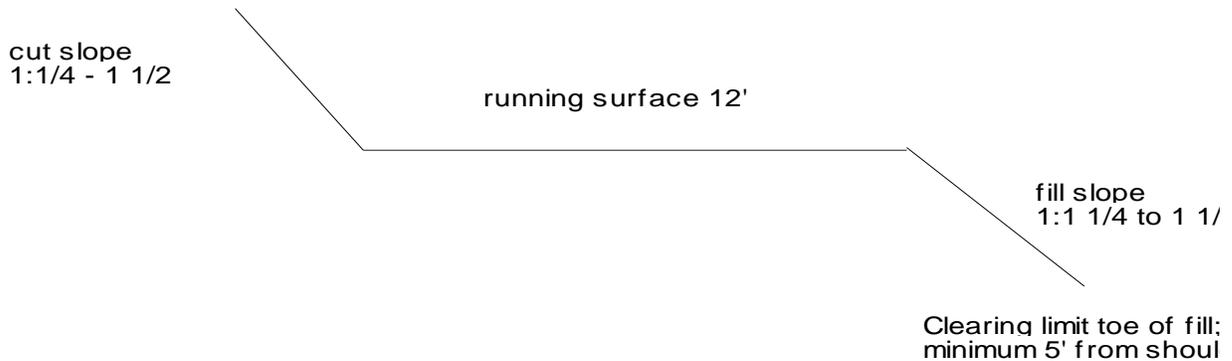
Timber access road where soil stability problems are anticipated with expected timber volumes. Road may or may not have travel restrictions (ML 1 or ML 2). Used for roads expected to carry 0.5 to 1.5 MMBF per entry.

Features:

- ◆ Surface: native, spot surfacing in deep unstable soils
- ◆ Turnouts: at critical safety features (crests of grades)
- ◆ Grades: sustained 10 percent, pitches 400 feet to 16 percent
- ◆ Curve widening: 400/R
- ◆ Curve radius: 50 feet
- ◆ Drainage: rolling dips, low water crossings, metal pipes at drainages, metal pipes with cut slope ditch may be used,

Figure 3. Road Standard 3

Clearing limit 2' beyond top of cut,
minimum 3' from shoulder



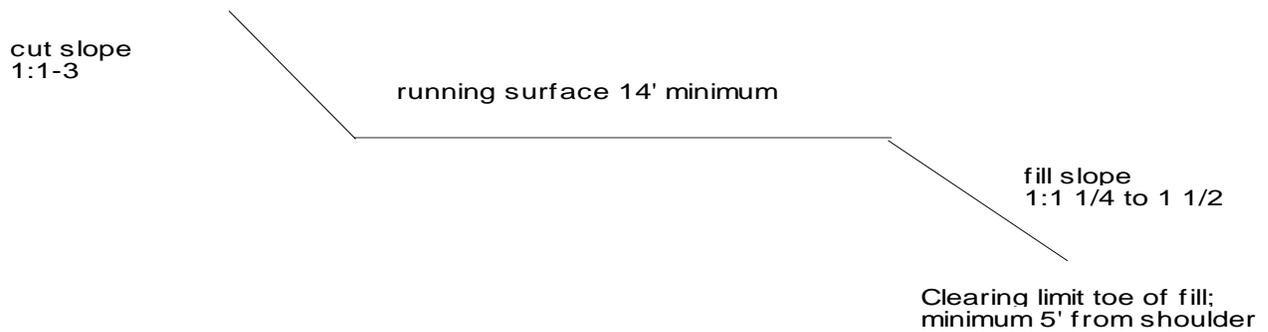
This level of road standard is applied to roads where extensive timber haul is expected and where use may be important to maintaining logging continuity in the area or recreation roads where timber traffic is strictly regulated. Added safety features are needed for potential conflicts with mixed traffic. These are generally ML 3 roads that are designated open to travel (at least seasonally).

Features:

- ◆ Surface: aggregate where timber haul exceeds 3 MMBF reinforce deep unstable soils aggregate for user comfort of recreation access
- ◆ Turnouts: 1,500 feet maximum spacing
- ◆ Grades: sustained 8 percent, pitches 400 feet to 15 percent
- ◆ Curve widening: 400/R
- ◆ Curve radius: 75 feet
- ◆ Drainage: rolling dips, low water crossings, metal pipes at drainages, ditch at toe of cut slope where necessary to direct water to metal pipes

Figure 4. Road Standard 4

Clearing limit 3' beyond top of cut,
minimum 5' from shoulder



These are usually ML 4 roads with high or medium traffic levels expected and user safety and comfort are the primary concerns.

Features:

- ◆ Surface: aggregate or asphalt
- ◆ Turnouts: inter-visible
- ◆ Grades: sustained 8 percent, pitches 300 feet to 12 percent
- ◆ Curve widening: 800/R
- ◆ Curve radius: minimum 100 feet
- ◆ Drainage: metal or concrete pipe or bridges

APPENDIX B

EFFECTS ANALYSIS

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APPENDIX B – EFFECTS ANALYSIS
Black Hills Resilient Landscapes Project

MAINTENANCE		
Actions	Direct Effects	Indirect Effects
blading road cleaning ditches reshaping drainage structures repair cattleguards and gates repair signs, if any	noise dust smooth travel way	lower maintenance costs increased user comfort increase speed and dust
RECONSTRUCTION		
Actions	Direct Effects	Indirect Effects
clearing and grubbing slash disposal bury stumps excavation install drainage structures place embankment place and compact roadbed haul materials realign road culvert installation place concrete mat place aggregate construct sediment basins	dust visual changes cost of implementation increased traffic increased noise visual impacts contaminate gravel roads with mud smooth travel way improve sight distances	lower maintenance costs increase speed and dust increase user comfort
CONSTRUCTION		
Actions	Direct Effects	Indirect Effects
Clearing and grubbing slash disposal bury stumps deck logs and haul offsite excavation install drainage structures place embankment place and compact roadbed haul materials plate roadbed Erosion control Construct sediment basins	noise dust visual changes introduce new traffic drainage changes harden road surface	establish new traffic pattern remove vegetation dust from users new source of noise ease of access, more people
TEMPORARY ROAD		
clearing slash and stump scattering deck logs and haul offsite surface disturbance install drainage structures provisions for sediment close road scarify and reshape to natural terrain reseed install access deterrent measure	visual changes noise dust drainage changes to NFSR compacting and scarifying soil	unauthorized use vegetationless corridor erosion patterns change direct drainage to NFSR

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APPENDIX C

ROAD COST ESTIMATE

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Road Cost Estimate

This appendix discusses the methods, assumptions, and unit costs used to develop the road cost estimate for this project.

Road costs include maintenance of the portion of the road system that is used for the project; reconstruction of roads that are in poor locations or are causing resource damage; and construction of new roads (both NFSR and temporary) needed to access the project area. The majority of these activities would be done to support the transportation of timber because the log truck traffic would produce the most wear and tear on the road system and would be the reason new roads are needed for this project. Other project activities such as fuels treatments and products other than logs (POL) and precommercial thinning could also require some road maintenance during the life of the project, but that maintenance would not be as extensive as required for the timber harvest traffic.

Methods

The reconstruction and maintenance needs were estimated using the average of two methods. The estimate identifies a magnitude for the reconstruction and maintenance needs, but is not intended to be an upper limit. Resource needs and funds available will be major factors determining the actual miles of reconstruction and maintenance.

- The first method reviewed 24 timber sale contracts for acres treated and road miles constructed and maintained as part of the timber sale contract. The miles per acre for each activity was developed as shown in Table 1. The timber contracts were awarded prior to 2012.
- The second method reviewed four years of annual reports for timber sale harvest and road construction and reconstruction. The result was a 4-year average miles per acre for each activity in Table 2.

Table 1. Summary of 24 Timber Sales.

Sale Name	Acres	Reconstruction		Maintenance	
	Treated	(Miles)	Miles/Acre	(Miles)	Miles/Acre
Gooseberry	3,722	2.70	0.0007	38.1	0.0102
Four Mile	4,015	0.81	0.0002	25.8	0.0064
Bullseye	285	0.14	0.0005	3.3	0.0116
Corral	1,714	5.83	0.0034	29.2	0.0170
Minnesota Box	2,482	8.69	0.0035	27.8	0.0112
Jewel	1,642	4.57	0.0028	23.1	0.0141
Elk Hay	1,495	2.44	0.0016	13.7	0.0092
Austin Spring	740	3.70	0.0050	22.1	0.0299
Wabash Resale	1,181	-		13.8	0.0117
Stovehole	250	-		1.4	0.0056
Palmer Gulch	1,822	2.42	0.0013	2.7	0.0015
Baldy	1,305	2.15	0.0016	20.6	0.0158
Seth	159	-		2.3	0.0145
Rockerville	120	-		0.6	0.0050
Hoo Doo	1,706	1.14	0.0007	15.9	0.0093
Pony	531	2.79	0.0053	10.3	0.0194
Woodchuck	568	1.15	0.0020	17.4	0.0306
Outlier	909	2.90	0.0032	21.8	0.0240
Felis	374	-		9.8	0.0262
West Rim	1,719	2.90	0.0017	42.2	0.0245
Raddick	1,636	4.80	0.0029	19.1	0.0117
Squid	1,375	3.90	0.0028	21.4	0.0156
Hip	613	-		18.4	0.0300
Short Draw	1,347	3.88	0.0029	35.8	0.0266
SUM	31,710	56.91		436.6	
Miles/Acre		0.001795		0.013769	

Table 2. Annual Road Accomplishment Report and Total Acres Treated.

Year	Timber Harvested		Reconstruction		Maintenance	
	CCF	Acres	Miles	Miles/Acre	Miles	Mi/Acre
2011	200,479	19,936	32	0.001605	327	0.016402
2012	240,251	27,175	62	0.002282	335	0.012328
2013	203,083	25,127	40	0.001592	321	0.012775
2015	206,157	20,920	46	0.002199	191	0.009130
Average	212,493	23,290	45	0.001932	294	0.012602

2014 Road data is not available.

The two methods resulted in miles per acre that were within 10 percent of each other which is probably due to the consistent volume of timber and extent of the existing road system (Table 3). The miles per acre used for the estimate was an average of the two methods.

Table 3. Average Timber Sale and Annual Methods.

Method	Miles/Acre	Reconstruction		Maintenance		
		Average	Variation	Miles/Acre	Average	Variation
Sales	0.001795	0.001864	7.09%	0.013769	0.013186	9.26%
Annual	0.001932			0.012602		

As shown in Table 4, the proposed 187,000 acres of commercial logging treatment was multiplied by the average miles per acre for each activity. The resulting distance was rounded and multiplied by the estimated cost per mile for that activity.

Table 4. BHRL Project Estimate – Road Reconstruction and Maintenance.

Activity	Acres	Miles/Acre	Miles	Round Miles	\$/Mile	Cost
Reconstruction	187,000	0.001864	348	350	\$6,000	\$2,100,000
Maintenance	187,000	0.013186	2,466	2,500	\$1,200	\$3,000,000

Reconstruction Estimate

Reconstruction costs were estimated to be about two-thirds of the construction costs for a new NFSR per mile. Reconstruction costs can vary widely depending on the reason for reconstruction. A high reconstructed cost per mile can occur when a road must be moved to avoid and restore wetlands and the relocation alignment requires extensive rock excavation. A low reconstruction cost per mile can occur if a road is rerouted to avoid an archaeological site and the new alignment is in gently rolling terrain on well drained, rocky soils. The reconstruction cost per mile used in this analysis was \$6,000 per mile.

Maintenance Estimate

Maintenance costs for timber sales are estimated using the Black Hills Timber Sale Appraisal Worksheet. The results of the sale appraisal are then used in the preparation of the timber sale advertisement and contract. The worksheet is designed to estimate the purchaser's road maintenance costs for a specific timber sale where many variables about the road system are known in detail. The worksheet is not intended for use in feasibility level estimates like this one. There are three primary components of the timber sale road maintenance estimate:

1. Pre-use maintenance is a contract requirement to return all system roads used for the sale to the maintenance standard for each road. The standard depends on the maintenance level assigned to the road. The pre-use maintenance would be the most general estimate of the three and is easily computed using a few basic facts (or in this case, assumptions) about the conditions the roads. Cost for maintenance per mile ranges from \$234 for light maintenance to \$584 for medium maintenance to \$1,098 for heavy maintenance. For this estimate, it was assumed that the costs averaged \$600 per mile.
2. During-use maintenance is a contract requirement to keep the road system in condition to support the traffic required to remove the timber. Heavy trucks and equipment could cause extensive damage to a road if maintenance to preserve the designed features of the road were not conducted. For example, damaged drainage features could leave the road wet and result in loss of surfacing, rutting, and damage to the subgrade which would be expensive to repair. Maintenance of the drainage features designed into the road would prevent that damage at a lower cost than a repair. This cost is normally estimated using the volume of timber being transported on the road, the maintenance level of the road, and length of the road used. None of these factors is known for this estimate. Therefore, an assumption must be made.
3. Post-use maintenance is a contract requirement to assure the road system used for the timber sale is left in a condition that preserves the design features that protect the road and surrounding resources. The cost is normally estimated in a similar manner as during-use maintenance. Once again none of the factors is known for this estimate so an assumption is necessary.
4. To address the unknowns in during-use and post-use maintenance with any degree of accuracy was not possible here. Historical total costs for these two components showed that they could be less than or greater than pre-use maintenance depending on the characteristics of the road system. Therefore, the estimate for the total of during-use and post-use maintenance for the purpose of this report was assumed to be equal to the pre-use maintenance of \$600 per mile.

The maintenance portion of the road cost estimate uses \$1,200 per mile for the cost of all maintenance.

New Road – NFSR Construction

Construction cost for new National Forest System Roads (NFSR) was estimated using the Black Hills National Forest Cost Estimating Guide. The latest version was for the 2014

construction season so estimates were indexed to January 2017. The Consumer Price Index (All Urban Consumers) adjustment was 3.04 percent.

Cable logging roads are constructed with additional road width and curve widening to accommodate equipment and log decks. The cable road costs were estimated using a 14-foot road on slopes of 40 and 50+ percent. Using the 212 Linear Grading alternative method for new construction of 12-foot roads and adjusting for the wider roads, costs per mile were \$24,750 and \$38,530 for slopes of 40 and 50+ percent respectively (Table 5). The percentage of road for each slope was estimate to derive a weighted cost per mile for the 6 miles of cable road.

Table 5. NFSR Cable Roads, 14-Foot Road, 4-Foot Minimum Clearing, Blade Finish.

Ave % side slope	\$/Mile 2014	CPI Adjust	\$/Mile 2017	% of road	Cost/Mile
40 Cable	\$24,020	3.04%	\$24,750	25	\$35,085
50+ Cable	\$37,390	3.04%	\$38,530	75	

The remaining 12 miles plus the 20 miles of unauthorized routes that may be needed as NFSR were estimated as 12-foot roads and assumed to be on ground with 30 percent slope or less (Table 6). Using the 212 Linear Grading alternative method for new construction of 12-foot roads, costs per mile were \$9,890, \$12,350, and \$17,510 for slopes of 10, 20 and 30 percent respectively. The percentage of road in each slope category was estimated to derive a weighted cost per mile used for the remaining 32 miles of anticipated NFSR construction. The areas have not been accessed previously due in part to the steep slopes so a higher percentage is assigned to the steeper slopes. The total cost was rounded in the final step of Table 7.

Table 6. 12-Foot Road, 4-Foot Minimum Clearing, Blade Finish.

Ave % side slope	\$/Mile 2014	CPI Adjust	\$/Mile 2017	% of road	Cost/Mile
10	\$9,600	3.04%	\$9,890	20	\$14,438
20	\$11,990	3.04%	\$12,350	30	
30	\$16,990	3.04%	\$17,510	50	

Table 7. NFSR Construction Cost.

Road Type	Miles	\$/Mile	Cost	Total Cost	Rounded
NFSR	32 *	\$14,438	\$462,016	\$672,526	\$680,000
NFSR (Cable)	6	\$35,085	\$210,510		

*Includes 20 miles of unauthorized routes converted to NFSR and 12 miles of new NFSR

New Road – Temporary Road Construction

Construction cost for temporary roads was estimated by adjusting the cost estimates for new NFSR construction. Temporary roads are used to access landings with the least impact on natural resources. Temporary roads would be stabilized, drained and seeded after purchaser use to return the area to a more natural condition. Therefore, temporary roads would be used in relatively flat ground and could have fewer drainage structures and other features of NFSR. The cost was estimated to be \$6,000 per mile which is about half of the cost of a NFSR in terrain with 20 percent side slope. Temporary roads that are constructed on unauthorized routes would cost less to construct because the unauthorized routes tend to be in favorable locations. The cost of construction of a temporary road on unauthorized route was estimated to be \$3,000 per mile which is half of the cost of temporary road on new alignment. The total cost was rounded in the final step of Table 8.

Table 8. Temporary Road Construction.

Type	Miles	\$/Mile	Cost	Rounded
New Temporary	39	\$6,000	\$234,000	\$230,000
Temporary on Unauthorized Route	162	\$3,000	\$486,000	\$490,000