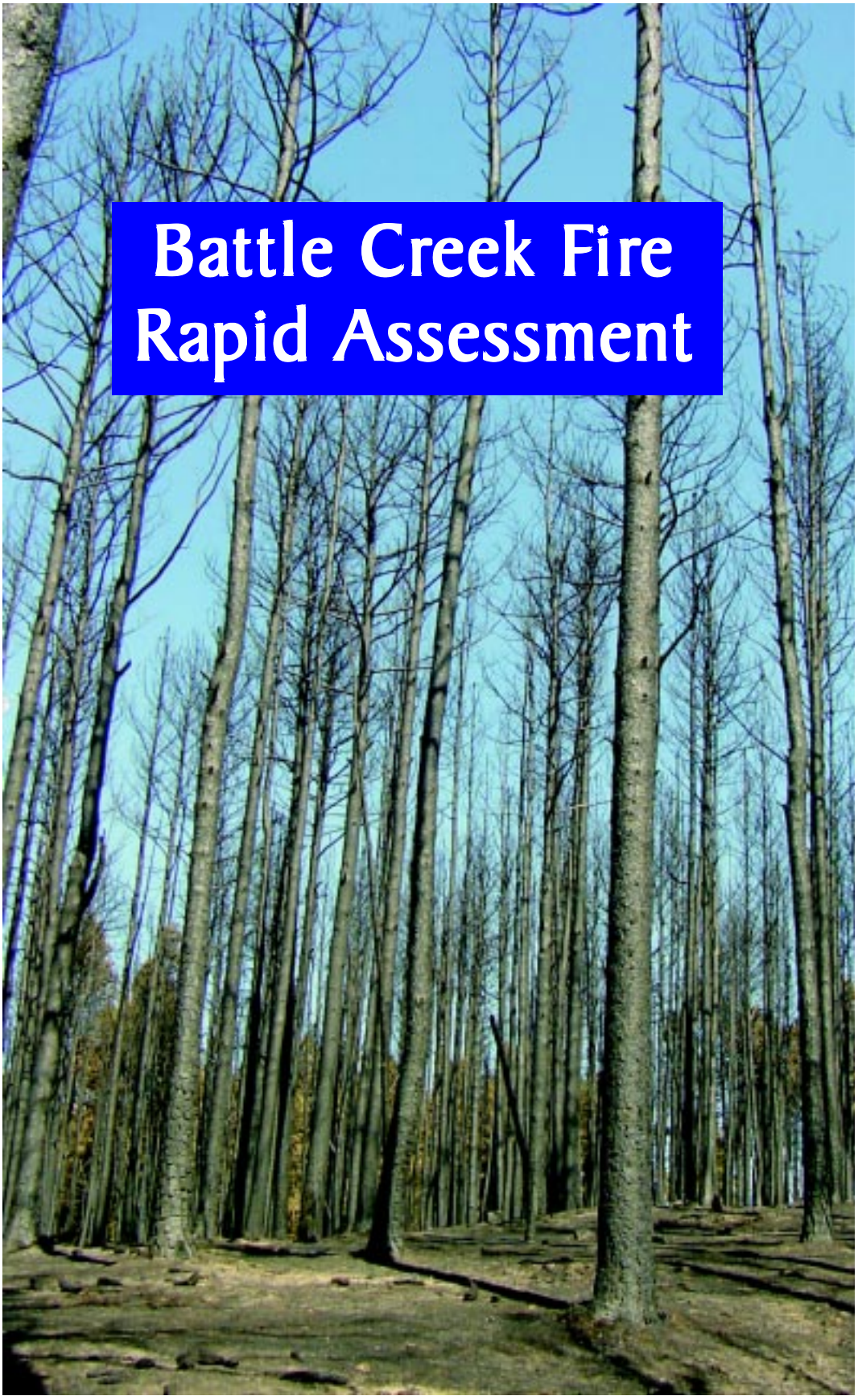
Battle Creek Fire Rapid Assessment



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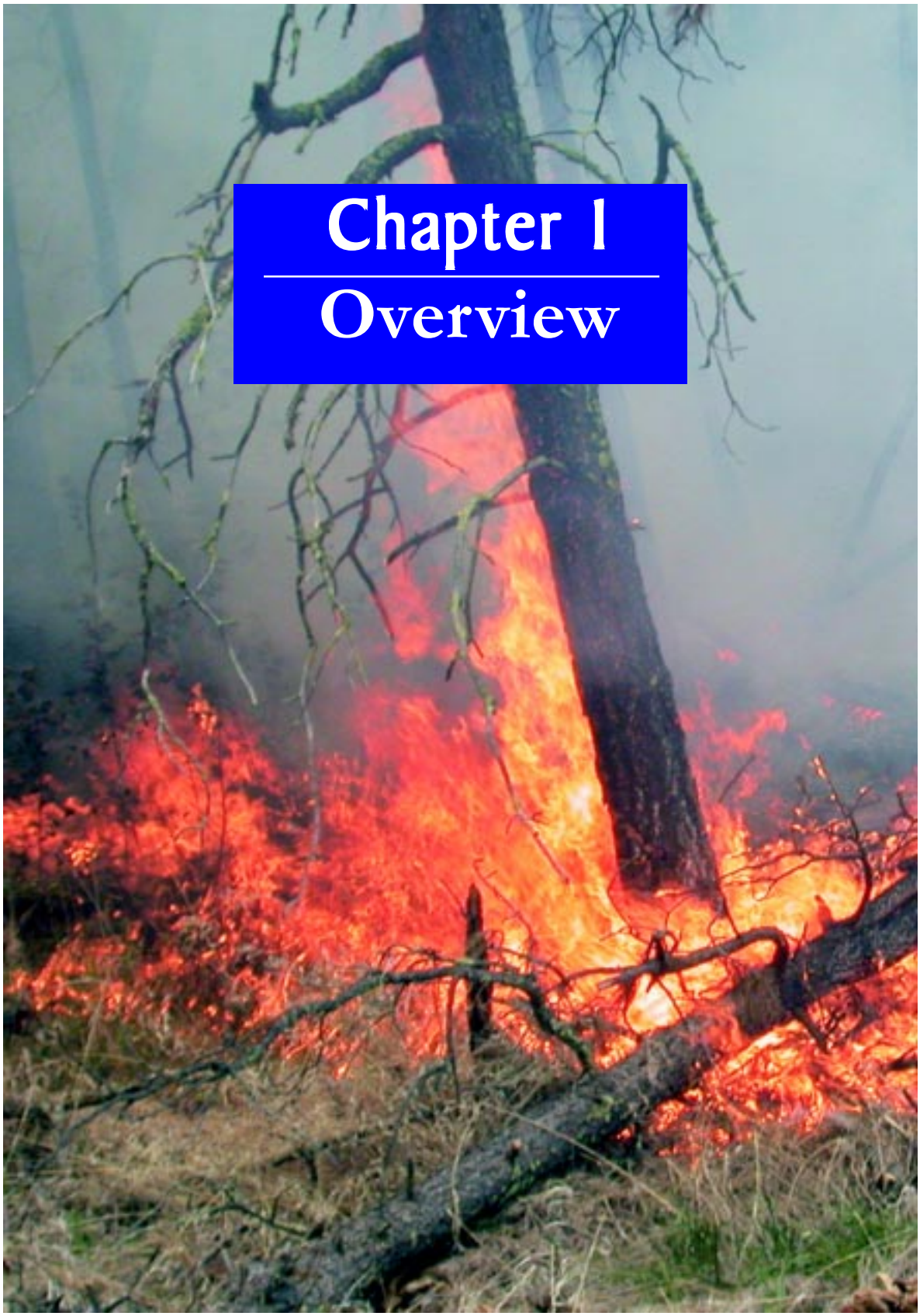


Chapter 1
Overview

OVERVIEW

Fire Background

The Battle Creek Fire ignited on August 16, 2002, off the South Rockerville Road on private land near of Keystone, South Dakota. High temperatures, low relative humidities and strong winds created conditions that resulted in intense fire behavior with long range spotting. The fire burned actively for four days, spotting across Highway 40, South Rockerville Road, and Highway 16. Before it was contained on August 25, the fire had burned 12,450 acres.

Tanker dropping retardant on the fire

During the first day, the fire spread rapidly and burned 2,400 acres. The two other major burning periods occurred on August 17th (3,300 acres) and 19th (4,200 acres).

Over 600 structures were threatened, in addition to the town of Keystone. Firefighter efforts were able to limit losses to three residences near the community of Hayward.

The area affected is administered primarily by the Black Hills National Forest. Of the 12,450 acres burned, 9,120 acres are national forest system lands, and 3,330 acres are private lands. Suppression costs are estimated at $7,000,000.

Area Setting

The fire lies approximately 10 miles southwest of Rapid City with the small communities of Rockerville, Keystone and Hayward flanking its boundaries.

Most of the burned area is characterized by the mountainous topography of the Black Hills, with many areas containing steep slopes and narrow canyon bottoms. The eastern third of the fire area is located in sedimentary limestones and sandstones that flank the Black Hills. The western two-thirds are situated in the central metamorphic crystalline area. Precipitation averages around 19 inches per year, most of which falls as rain from high-intensity storms in early spring and summer. Vegetation consists of extensive stands of ponderosa pine with

inclusions of bur oak and aspen. The area supports a variety of wildlife species. Human uses include hunting, driving for pleasure, firewood cutting, cattle grazing, and logging. Residences are located within and around the burn area.

Post Fire Activities

This Rapid Assessment is part of the overall process to rehabilitate and recover from the fire's effects. Two other processes are also involved. this includes the Fire Suppression Rehabilitation activities and the Burned Area Emergency Rehabilitation process.

The Fire Suppression Rehabilitation Activities

The fire suppression command team has the responsibility to rehabilitate all damages caused by suppression activities. The funds for this rehabilitation comes from the same source as the funds used to fight the fire. Fire suppression rehabilitation for the Battle Creek Fire is currently in progress. It includes rehabilitation of dozer and hand fire lines, and repaving roads.

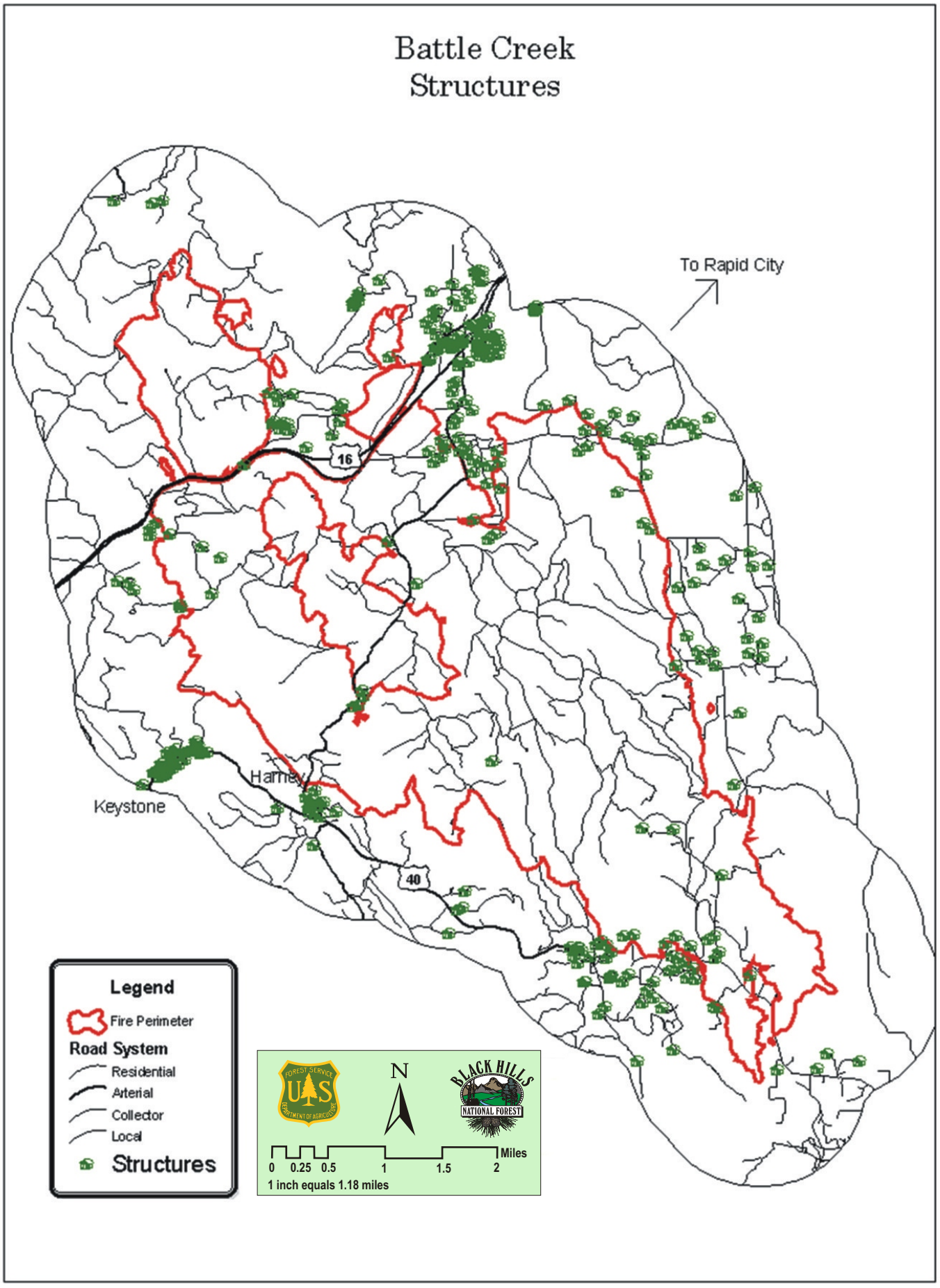
The Burned Area Emergency Rehabilitation (BAER) Process

Immediately following the Battle Creek Fire, a Burned Area Emergency Rehabilitation team met and evaluated threats to human life, property, and critical cultural and natural resources. BAER funding can used for treatments on National Forest System lands to reduce the post-fire emergency to these "values at risk".

Field reviews within the burned area and downstream of the burned area confirmed that threats to life are unlikely except for ash flows and rock on Highway 16. Threats to homes and outbuildings that are located in or near the floodplain or at the mouth of drainages exist in and downstream of the burned area. The impact will be wet foundations and ash and sediment deposits. There are numerous culverts on state highway, private, county roads and Forest Service roads that could be damaged.

The BAER Team conducted intensive field surveys after the fire to identify impacts and compiled the following recommendations for stabilization and rehabilitation of affected lands:

- Treat previously weed-free areas adjacent to known populations for next 3 years
- Install automated rain gage and Data Collection Platform (DCP) with GOES telemetry within burned area
- Install four straw bale check dams above the Highway 16 culvert near Rockerville
- Clean all ditches, outlets and drainage structures on 56 miles of system roads and 20 miles of unclassified roads


Battle Creek
Structures
To Rapid City
16
Keystone
Harney
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Legend
Fire Perimeter
Road System
Residential
Arterial
Collector
Local
Structures
N
BLACK HILLS
NATIONAL FOREST
Miles
0 0.25 0.5 1 1.5 2
1 inch equals 1.18 miles

- Complete numerous road and trail specifications, including grade dip construction, template restoration, drop inlet installation, and trail protection (Flume Trail)
- Complete hazard tree removal and analysis along some roads and trails
- Assess unclassified roads

Rapid Assessment Process

A team of interdisciplinary specialists developed this assessment. The team considered lands administered by the Black Hills National Forest, along with private lands.

The purpose of this document is to:

- Provide an assessment of the fire's effects on the landscape
- Provide a context for future actions that may be taken to address the fire's effects and reach desired conditions
- Facilitate program and budget development by recommending priorities for needed management actions
- Suggest general guidelines to protect and maintain physical and biological resources
- Recommend monitoring strategies and research opportunities
- Recommend possible actions/treatments on private land

This assessment was prepared using tabular and spatial databases, environmental analyses, and other information previously collected by the Black Hills National Forest. It includes information from the Battle Creek Burned Area Emergency Rehabilitation (BAER) Report and supporting specialist reports. The assessment team, along with support specialists from the Forest Service and other State and Federal agencies, conducted field observations and analyses for this assessment.

Satellite imagery of the fire area on August 27th

Of particular value was a burn area image provided by Quickbird® high resolution, satellite imagery. This satellite imagery, collected on August 27th, 2002, allowed the team to rapidly map fire intensity throughout the fire area. The satellite image was in the form of spectral data. Differing fire intensities were classified by their reflectance. Ground measurement

plots were used to refine this spectral image classification. No statistical estimate of accuracy for the fire intensity classification is available at this time, but field verification indicates it is accurate for the purpose of providing an overall assessment of the fire area.

This fire intensity mapping was the most critical data needed for this assessment. Models were developed from field observations to predict the fire's effect on these resources. These models utilized existing Geographic Information System (GIS) and other databases as a baseline data source. Field observations and site sampling were used to estimate effects of different fire intensities. Site locations were determined using global positioning system (GPS) electronic survey equipment, where precise location data was desired. GIS was then used to overlay the fire intensity mapping on various resource coverages to determine effects. Using the models and state-of-the-art technology, the assessment team could rapidly gather information and estimate resource and other effects.

Management Direction

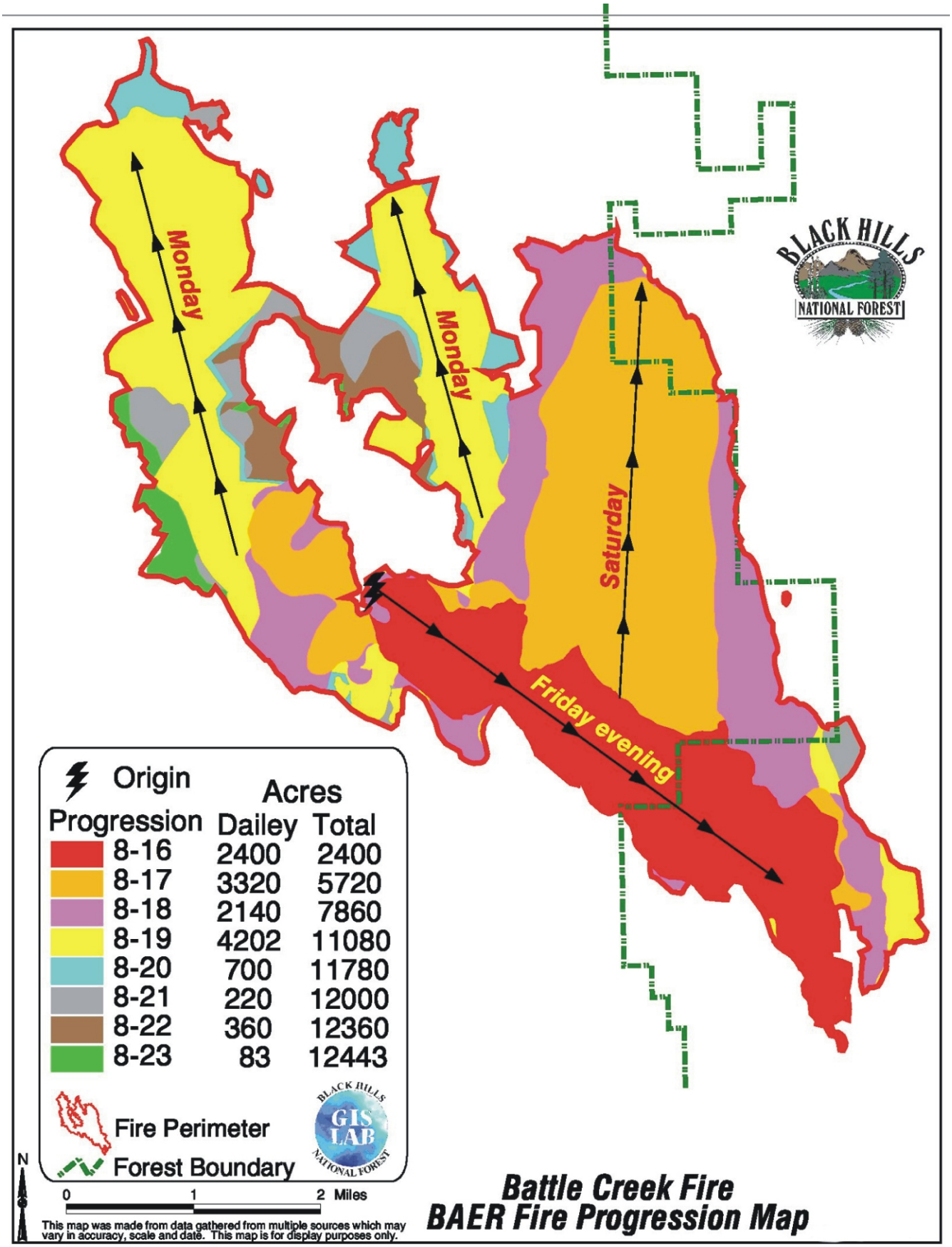
The Black Hills National Forest Land and Resource Management Plan, revised in 1997 and amended in 2001, provides guidance for all resource management activities on the forest. Known as the Forest Plan, it establishes goals, objectives, standards, and guidelines, and specifies management emphasis for each area of the forest. The Battle Creek Fire affects Management Areas 5.4 – big game winter range emphasis, 3.7 – late successional forest landscapes, and 5.1 – resource production emphasis.

BATTLE CREEK FIRE OVERVIEW

The Battle Creek Fire started at about 6:30 p.m. on August 16, 2002, on private land near Keystone, South Dakota. High temperatures, low relative humidities and very strong winds created conditions that resulted in intense fire behavior with long range spotting. The fire burned actively for four days spotting across Highway 40, South Rockerville Road and Highway 16. Before it was contained on August 25, 2002, the fire burned 12,450 acres of land and threatened over 600 structures, and the town of Keystone. Many people were evacuated from their homes during the fire. Effective firefighting was able to limit losses to 3 residences near the community of Hayward, and there were no serious injuries or deaths.

Weather conditions the day of the fire saw maximum temperatures in the high 90's with relative humidities as low as 8%. This coupled with wind speeds of 17-20 and gusts to 60 mph created explosive conditions. The fire was reported at 6:45 p.m. Even though the first initial attack forces arrived at the scene within 15 minutes, the fire was already crowning and out of control. Strong northwest winds pushed the fire 5 miles to the southeast threatening the community of Hayward. It was a rapidly running crown fire with blowing embers starting spot fires up to one-half mile ahead of the main fire. By the next morning the fire had burned 3,562 acres and destroyed 3 residences. Saturday afternoon (August 17) the winds shifted the fire toward the north burning an additional 2,665 acres and threatened several homes near Rockerville. Another flank of the fire crossed the south Rockerville road and was poised to threaten the town of Keystone. Strong southerly winds pushed the fire in a northwest direction on Monday, August 19. The fire burned additional 2,305 acres and crossed highway 16 at Silver Mountain and at Rockerville. Tuesday, August 20, was calm with cloudy skies. This moderated fire behavior and allowed firefighters to contain the head of the fire. Wetter conditions later in the week helped contain the fire at 12,450 acres.

The Battle Creek Fire was fought both on the ground using dozers, handcrews and engines, and from the air using fire retardant tankers and water dropping helicopters. Firefighting in the Black Hills is a group effort. There were many agencies and groups involved in fighting the Battle Creek Fire. Among them were the many Volunteer Fire Departments, U.S. Forest Service, South Dakota State Division of Wildland Fire Suppression, National Guard, Pennington County Sheriff's Office, South Dakota Highway Patrol, South Dakota Department of Corrections and many others that came from across the country to support the effort.


Monday
Monday
Saturday
Friday evening
BLACK HILLS NATIONAL FOREST
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Progression
Acres
Dailey
Total
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8-17 3320 5720
8-18 2140 7860
8-19 4202 11080
8-20 700 11780
8-21 220 12000
8-22 360 12360
8-23 83 12443
Fire Perimeter
Forest Boundary
BLACK HILLS GIS LAB NATIONAL FOREST
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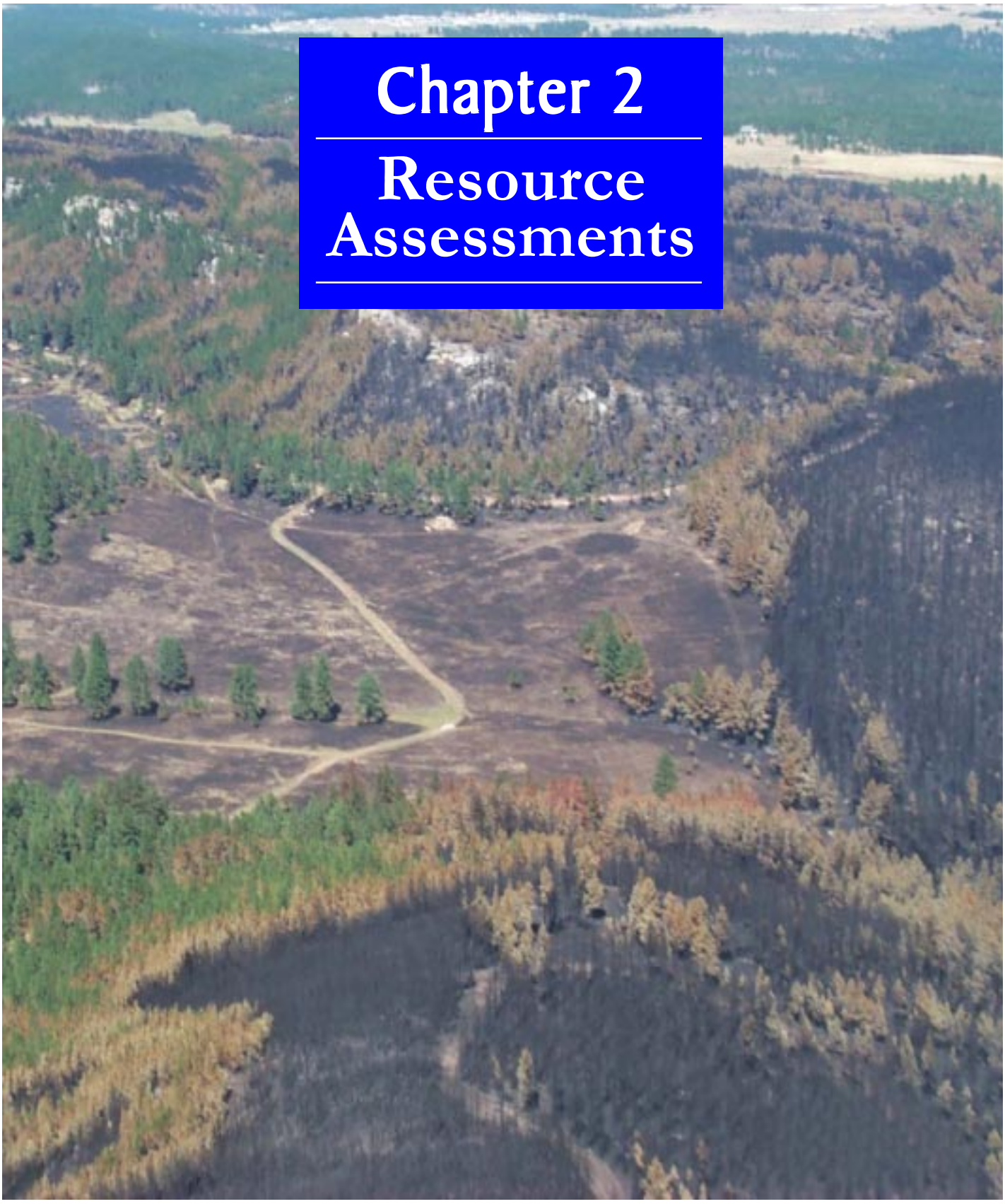
This map was made from data gathered from multiple sources which may vary in accuracy, scale and date. This map is for display purposes only.
Battle Creek Fire
BAER Fire Progression Map



Chapter 2

Resource Assessments

WATERSHED

Pre-fire Conditions

Precipitation and Climate

Battle Creek Fire area elevations range from 3,800 feet near Hayward to over 5,400 feet on Silver Mountain. The Battle Creek Fire area has a semi-arid climate with low humidity throughout the year. Temperatures range from 100° F during summer months to well below 0° F in winter. Average annual precipitation for the area is 19 inches and generally decreases from west to east. Approximately 50% of the annual precipitation occurs May through July and approximately 75% of the annual precipitation occurs April through August. Localized intense thunder cells associated with the monsoons can produce much greater rain than surrounding areas within one storm event. The largest recorded storm in the Black Hills occurred on June 9, 1972. About 10 to 15 inches of rain fell on the central Hills, resulting in the devastating flood of Rapid City that killed over 200 people.

The Battle Creek Fire area is surrounded by weather stations. In the table below are the stations in the area with their averages. The table displays the 30-year average from 1961 to 1990. Rapid City is located 11 miles northeast, Hermosa is 12 miles southeast, Mt. Rushmore is 4 miles southwest and Hill City is 10 miles east.

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Annual
Rapid City	0.33	0.49	0.95	2.08	3.18	3.30	2.58	2.01	1.23	1.10	0.48	0.42	18.15
Hermosa	0.27	0.40	0.81	1.78	2.97	3.07	2.63	1.47	1.25	0.94	0.44	0.39	16.42
Mt. Rushmore	0.33	0.52	1.03	2.09	3.68	4.08	3.36	1.88	1.61	0.98	0.55	0.50	20.61
Hill City	0.28	0.54	0.92	2.13	3.30	3.73	3.49	2.05	1.51	0.98	0.58	0.47	19.98
Average	0.30	0.49	0.93	2.02	3.29	3.54	3.01	1.85	1.40	1.00	0.52	0.44	18.79

Streamflow

Streamflow within the Battle Creek Area is different from the east side to the west side of the fire, due to differences in geology. The east side generally does not see flows in the channels except from an intense precipitation event. The channels are generally ephemeral. The west side streams are more intermittent and perennial channels and see more frequent and persistent flows.

Water Quantity and Peak Flow

In reviewing the USGS data along Battle Creek at stations near Keystone and Hermosa, peak flows have occurred in any month from March through October. Most of the peaks occur during the months May, June or July with the most occurring in June. These peaks fall right in line with the precipitation averages and are related to precipitation events.

Water Quality

Battle Creek near Hayward is designated as an impaired water body in the 1998 State of South Dakota 305(b) report. The pollutants of concern are pH, temperature, and ammonia and the priority for development of a Total Maximum Daily Load is high. The sources of these pollutants are not listed, but municipal and residential developments in the canyon bottoms are likely candidates.

Wetlands

Mapped wetlands are scattered throughout the Battle Creek Fire area. They are primarily linear wetlands along stream channels or associated with seeps and springs.

Floodplains

Mapped FEMA floodplains within the Battle Creek Fire are along Battle Creek. None of the other streams within the fire area are mapped. Mapped floodplains downstream from the fire area include Deadman Gulch and Battle Creek in the Battle Creek Watershed and Rockerville Gulch and Spring Creek in the Spring Creek Watershed.

Watersheds

The Battle Creek Fire is within three HUC 6 watersheds, Upper Battle Creek, Lower Battle Creek and Lower Spring Creek. HUC 6 watersheds are generally 10,000 to 50,000 acres in size. Within those HUC 6 watersheds, the fire affected six HUC 7 watersheds. HUC 7 watersheds are generally 5,000 to 10,000 acres in size. All watersheds are tributaries to the Cheyenne River.

Post-fire Conditions

Streamflow

Changes to the streamflow and stream channels are expected to occur. The east side of the fire stream channels will more than likely see a change from ephemeral to intermittent channels and see more frequent flows until the ground cover over the area recovers. The west side will see more persistent flows as a result of more water available for stream flow. Due to the decrease in vegetation, there may be an increase of water in the caves.

Water Quantity and Peak Flow

The table below illustrates what increase in peak flow can be expected as a result of the Battle Creek Fire. Two year return interval storms are illustrated here and data for other return interval storms are available in the BAER report and analysis.

Watershed Name	Acres	Pre-Fire 2-Year Return Interval Flood cfs	Post-Fire 2-Year Return Interval Flood cfs
Battle Creek	25184	275	2196
Tepee Gulch	3738	41	448
Bobtail Gulch	1120	53	582
Keystone Dump	198	2	7
Horsely Gulch	262	3	20
Foster Gulch	4282	47	1121
Johnson Gulch	2758	30	120
Rockerville Gulch	800	9	87
Cabin Creek	1024	11	56
North Deadman Tributary in section 32	627	8	191
South Deadman Tributary in section 32	1331	15	378
Deadman Tributary in section 5	422	5	202
Deadman Tributary near Jackson Spring	589	6	275
Lost Cave & Dog House Gulch	1146	13	350

Water Quality

There is potential for post-fire stormflow to contribute ash and eroded soil to the stream channel, which could increase pH and ammonia. However, the remaining and newly establishing vegetation will quickly capture most nutrients made available as a result of the fire. Temperature should not be impacted given that the fire only affected intermittent and ephemeral channels in Battle Creek drainage.

Wetlands

Wetlands will be impacted by the increased flows as a result of the fire. Ash and sediment will be deposited in these areas. The impact will be short term and should be beneficial as this is a process that has occurred long before the area was settled and developed.

Floodplains

The mapped FEMA floodplains should not see a significant increase in flows from the Battle Creek Fire area. There will be increased flows in these areas but the drainage area and floodplains are such that it should be able to absorb the flows with out much of an increase in flood elevations.

The significant increases are going to occur on the unmapped floodplains. Any drainage in the fire area and immediately downstream will carry water and the increases are projected to be significant. See the section on Water Quantity and Peak Flows for more details.

Watersheds

The Battle Creek fire covered a significant area. It included parts of three HUC 6 watershed, as shown below.

HUC 6 Watershed Name	HUC 6 Watershed Number	Watershed Acres	Acres of Watershed within Fire	% Of Watershed within Fire
Upper Battle Creek	101201090501	37,321	2,903	8%
Lower Battle Creek	101201090502	29,546	8,193	38%
Lower Spring Creek	101201090604	27,195	1,355	5%

Upper Battle Creek and Lower Spring Creek watersheds had only a small portion of the Battle Creek Fire within them. Lower Battle Creek had a large portion of the watershed within the fire perimeter. Each HUC 6 watershed will be discussed separately below and will also be broken down into HUC 7 watersheds.

Upper Battle Creek HUC 6 – This is a headwaters watershed. A headwaters watershed is the beginning of a watershed and does not have any water flowing into it other than rainfall or spring flow and all of the water flowing out of the watershed was generated within the watershed. The portion of the Upper Battle Creek watershed within the fire perimeter is small, 8%, is in the northeastern part of the watershed.

This watershed is broken down into six HUC 7 watersheds, as shown in the table below.

HUC 7 Watershed Name	HUC 7 Watershed Number	Watershed Acres	Acres of Watershed within Fire	% Of Watershed within Fire
Upper Battle Creek	10120109050101	9,238	0	0%
Grizzly Bear Creek	10120109050102	6,641	0	0%
Tepee Gulch	10120109050103	4,977	2,082	42%
Middle Battle Creek	10120109050104	4,319	821	19%
Upper Iron Creek	10120109050105	5,733	0	0%
Lower Iron Creek	10120109050106	6,413	0	0%

The Battle Creek Fire affected two of the HUC 7 watersheds. The fire intensity is indicated in the table below.

HUC 7 Watershed Name	Fire Intensity							
	High		Moderate		Low or Unburned		Outside Fire Perimeter	
	Acres	%	Acres	%	Acres	%	Acres	%
Tepee Gulch	499	10%	377	8%	1,207	24%	2,895	58%
Middle Battle Creek	81	2%	147	3%	593	14%	3,498	81%

Lower Battle Creek HUC 6 – This watershed is a mid basin watershed. A mid basin watershed is a watershed that has water from another watershed flowing into this watershed and flowing out with the water generated by this watershed. Upper Battle Creek HUC 6 watershed flows into this watershed. A large percentage of this watershed is within the fire perimeter, 38%, and is the most impacted of the three HUC 6 watersheds.

This watershed is broken down into four HUC 7 watersheds. See table below.

HUC 7 Watershed Name	HUC 7 Watershed Number	Watershed Acres	Acres of Watershed within Fire	% Of Watershed within Fire
Foster Gulch	10120109050201	7,809	4,393	56%
Lakota Peak	10120109050202	6,544	2	0%
Deadman Gulch	10120109050203	6,357	3,798	60%
Lower Battle Creek	10120109050204	8,836	13	0%

The Battle Creek Fire affected two of the HUC 7 watersheds. See table below for fire intensities within the HUC 7 watersheds.

HUC 7 Watershed Name	Fire Intensity							
	High		Moderate		Low or Unburned		Outside Fire Perimeter	
	Acres	%	Acres	%	Acres	%	Acres	%
Foster Gulch	1,117	14%	1,279	16%	1,997	26%	3,416	44%
Deadman Gulch	1,062	17%	1,222	19%	1,514	24%	2,559	40%

Lower Spring Creek HUC 6 – This watershed is a mid basin watershed. Above this watershed are Upper Spring Creek, Newton Fork, and Sheridan Lake HUC 6 watersheds, which flow into this watershed. A small portion of the Lower Spring Creek watershed is included in the fire perimeter, 5%. It is the southern portion where of the watershed.

This watershed is broken down into four HUC 7 watersheds. See table below.

HUC 7 Watershed Name	HUC 7 Watershed Number	Watershed Acres	Acres of Watershed within Fire	% Of Watershed within Fire
Bitter Creek	10120109060401	7,627	542	7%
Deadman Creek	10120109060402	5,157	36	1%
Lower Spring Creek	10120109060403	6,484	0	0%
Rockerville Gulch	10120109060404	7,926	777	10%

The Battle Creek Fire affected two of the HUC 7 watersheds. See table below for fire intensity within the HUC7 watersheds.

HUC 7 Watershed Name	Fire Intensity							
	High		Moderate		Low or Unburned		Outside Fire Perimeter	
	Acres	%	Acres	%	Acres	%	Acres	%
Bitter Creek	38	1%	176	2%	328	4%	7,086	93%
Rockerville Gulch	58	1%	109	1%	609	8%	7,150	90%

Of the HUC 6 watersheds, Lower Battle Creek is the one most affected by the fire. Almost 40% of the area is within the fire perimeter. The other two HUC 6 watersheds, Upper Battle Creek and Lower Spring Creek, had small areas of their watersheds affected, less than 10%.

HUC 7 watersheds affected by the fire include Foster Gulch and Deadman Gulch, which have greater than 50% of their area within the fire perimeter. Tepee Gulch and Middle Battle Creek had 20 to 40% of their area within the fire perimeter. Bitter Creek and Rockerville Gulch had less than 10% within the fire.

Recommendations

Vegetative Treatment

Concerns

- Potential to increase the watershed emergency.
- Potential to retard the speed of watershed recovery.

Goals

- Not to increase the watershed emergency.
- Not to retard the speed of watershed recovery.
- Strategically improve the watershed condition.
- Strive for 60% ground cover.
- Minimize disturbance of ground cover that remained after the fire.
- Minimize concentration of runnoff.

Recommendations applicable to all areas of the fire.

- Design skid trails to minimize the concentration of runoff.
- Avoid storage or deposition of slash, log decks, and other materials within drainages.
- Avoid extensive disturbance of residual duff and litter.
- When falling trees that are to be retained on-site, fall on the contour.

High Intensity Areas

There is an opportunity to increase the ground cover by putting limbs and tops of trees on the ground.

Moderate Intensity Areas

These are the most sensitive areas within the fire area. Post-fire activities within these areas have the highest potential to change the character of these sites and move them to flood source areas.

- In moderate areas, remaining tree needles will fall this winter and be compacted by snow and rain. This will help decrease flooding potential. Disturbing these areas or removing the needle source could put the area back into a flood source area.
- Leave enough trees to achieve 60% or more ground cover after treatment is completed. A torturous water path during high-intensity storms is desired to slow the water getting to a stream channel.

Low Intensity Areas

It is recommend that enough trees be left to achieve 60% ground cover after treatment is completed if the litter and duff layer was consumed.

Range Management

Grazing should not occur until there is at least 60% ground cover on the area to be grazed. Grazing too soon will remove vegetation that would have been available for ground cover.

Road 366.1/Lower Tepee Gulch

These roads should be closed and obliterated.

- This road is in a bad location. The road follows Tepee Gulch and crosses the stream eight times. Significant sediment from the road has been deposited in Tepee Gulch at each road crossing. The stream substrate is different below the crossing from above. Below there is nothing but fines and above there is a good rocky substrate. This problem will be aggravated and made worse because of the fire.
- If the road is closed, it should be obliterated at the sections where it crosses and is near the stream. The stream banks will need to be rebuilt. The stream channel will need to be cleaned out below several crossings.
- If the road remains open, stream crossings should be improved with concrete mats. This will not be cheap as the stream and road do not cross at right angles and more mats will be needed to stabilize the stream and the banks. Gravel will also be needed on the approaches. The stream channel will need to be cleaned out below several crossings.

Road 366.2/Upper Tepee Gulch

Road crossings should be improved.

- This is a good gravel road with three road and stream crossings. The crossings were improved by placing gravel at the crossing. This works for a short period of time, but does not hold up to the continual traffic. The crossings widen with time, sediment is transported down stream, and the gravel also migrates downstream. Also, there are no drainage structures to keep the water from running down the road to the stream at the crossing.
- These crossings should be improved with concrete mats and rolling dips which will mitigate the road impacts to the stream.

60% Ground Cover Discussion

Howard K. Orr did a study following the 1959 Deadwood Fire. His conclusion is that 60% ground-cover density (live vegetation plus litter) is postulated as the minimum necessary for soil stabilization. Overland runoff and soil erosion showed a progressive deceleration as total

ground cover increased to 60%. Further increase in ground cover over 60%, runoff and sediment production declined at a slower rate.

Evaluation & Monitoring

- Develop contracts with provisions that address the concerns, goals and actions of this report.
- The District Hydrologist should be consulted as needed when questions arise.
- Normal BMP monitoring will take place.
- Rain gages will be located across the fire area to gather data for the smaller isolated storms.

References

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SOILS

Pre-fire Conditions

Geology/Physiography

Most of the burned area within the Battle Creek Fire is characterized by the mountainous topography of the Black Hills, with many areas containing steep slopes and narrow canyon bottoms (See Figure 1). The eastern third of the fire area is located in the steeply dipping plateau lands of the Deadwood, Minnelusa, and Madison Limestone and Englewood Formations. The western two-thirds are situated in the central crystalline area, comprised primarily of greywacke with lesser amounts of metamorphosed sedimentary rock outcroppings. Slopes range from nearly flat on the plateau-like ridge tops and grassy meadows to greater than 80% on the steep eastern slopes and canyon walls. Elevations of the burned area range from approximately 3650 feet in the southernmost tip of the fire to 5400 feet at the summit of Silver Mountain in the northwestern portion of the fire.

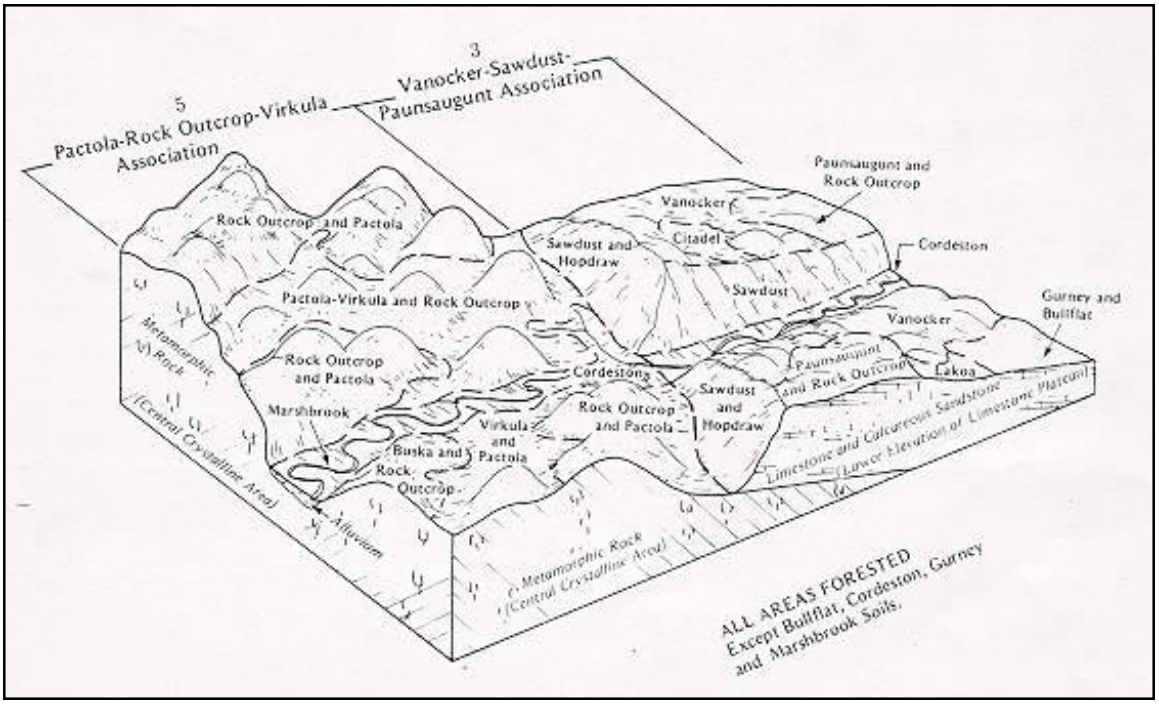


Figure 1. Cross-Section of Geology, Physiography, and Soils

Soils

The dominant soils within the fire perimeter are comprised of various complexes in combinations of the following soil types: Pactola, Virkula, Vanocker, Citadel, Sawdust, Buska, Paunsaugunt, Gurney, Hopdraw, Lakoa and rock outcroppings. These generally fall within two major associations – the Vanocker-Sawdust-Paunsaugunt and the Pactola-Rock Outcrop-Virkula. Small units of Barnum, Bullflat, Cordeston, Columbo, Marshbrook, Winetti, Heeley, and Hilger soils are also found within the burned area. These lesser soil types are generally managed as grazing areas.

The Vanocker-Sawdust-Paunsaugunt association consists of deep and shallow, well drained, gently sloping to very steep, loamy soils formed from weathered limestone and calcareous sandstone. It is located on mountains at the lower elevations of the Limestone Plateau. It is characterized by broad ridges and canyons, and is highly dissected by drainage ways and major streams. Some canyons are deeply entrenched and have very steep side slopes and rimrock ledges. Minor soil types in this association include Bullflat, Citadel, Cordeston, Gurney, Hopdraw and Lakoa, as well as areas of Rock outcrop. The deep Bullflat, Citadel, Cordeston, and Lakoa soils have fewer coarse fragments than the major soils. Bullflat, Citadel, Gurney, and Lakoa soils are on the less sloping parts of the landscape, with Cordeston soils found along drainage ways. The deep, sandy Hopdraw soils occur in scattered areas throughout the association. Gurney soils have bedrock at a depth of about 28 inches. The rock outcroppings occur as ledges and ridges of limestone and sandstone. Nearly all of this association is managed for Ponderosa Pine production, with most areas also used for livestock grazing.

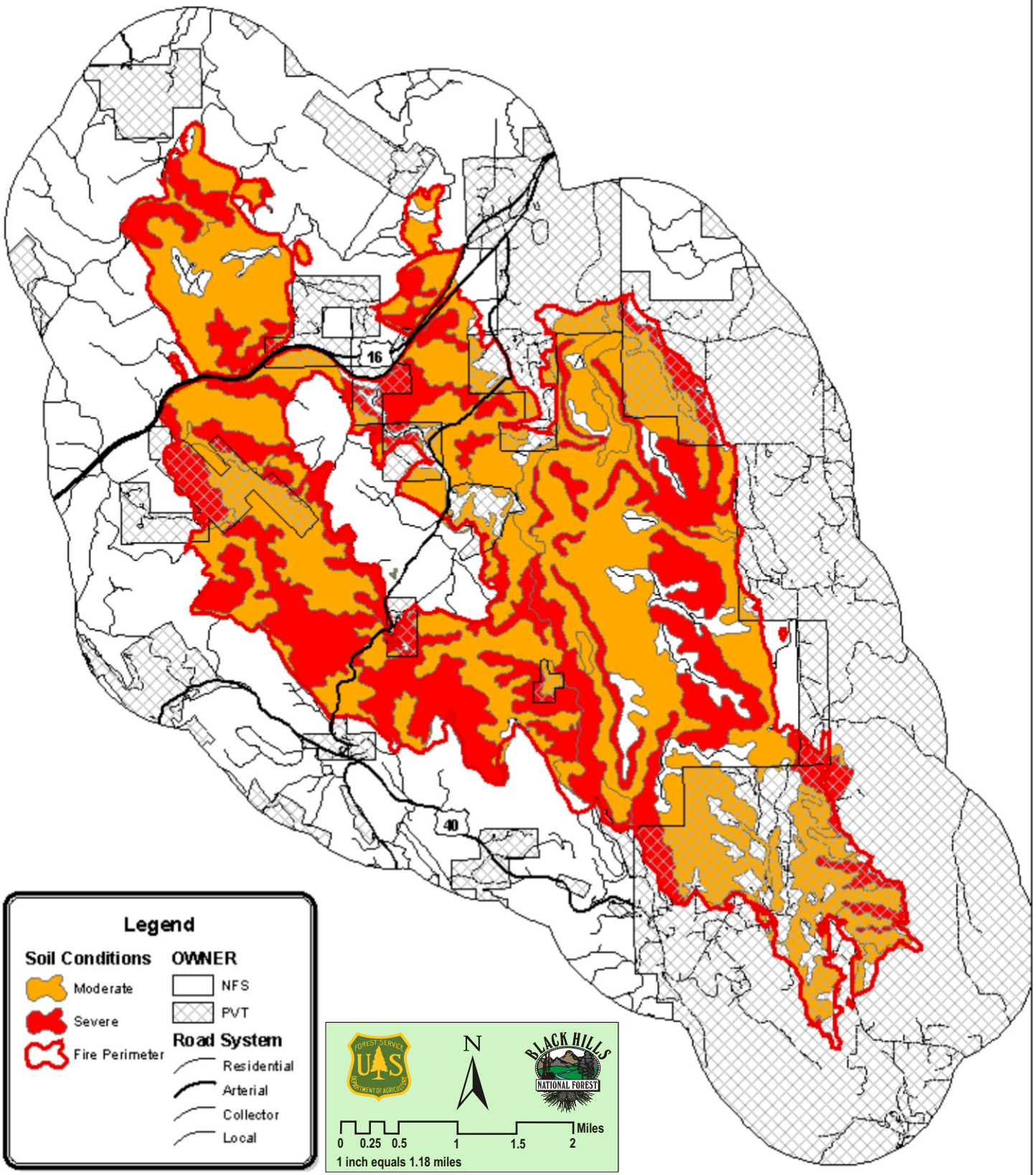
Soil in a high severity burn area

The Pactola-Rock Outcrop-Virkula Association consists of Rock outcrop and deep, well drained, gently sloping to very steep, loamy soils formed in material weathered from steeply tilted metamorphic rock. It is located on mountains in the Central Crystalline area. Ridges, peaks, and canyons characterize this association. It is highly dissected by drainage ways and major streams, which are deeply entrenched. The Rock outcrop consists of peaks, ledges, and dikes of extremely hard, highly fractured, steeply tilted metamorphic rock. The Virkula soils are on the slightly concave, mid and low side slopes. Minor soils in this association are the Buska and Cordeston soils and the poorly drained Marshbrook soils. Buska soils formed in material weathered from micaceous schist. They are in landscape positions similar to those of the Pactola soils. Cordeston and Marshbrook soils formed in alluvium and are along drainage ways. Nearly all of this association is forested, with small areas used for range.

Within the fire, 4,149 acres (33% of the fire area) consist of the Hopdraw-Sawdust-Rock Outcrop (HtG), Rock Outcrop-Buska (RgG), Rock Outcrop-Pactola (RlG), and Rock Outcrop-Sawdust (RnG) complexes. These soils are naturally susceptible to mass movement and have a severe erosion hazard because they rapidly shed rainfall. An additional 6,995 acres or 56% of the area are comprised of soils with a moderate erosion hazard. Of these moderate erosion soils, soil units BuE, PaE, VcE, and VkE, comprising 5,919 acres, also have the potential for mass movement on steep and disturbed areas. (*See map on next page*)

Testing soil hydrophobicity

Soils with Moderate or Severe Erosion Hazards



Legend

Soil Conditions
- Moderate
- Severe
- Fire Perimeter

OWNER
- NFS
- PVT

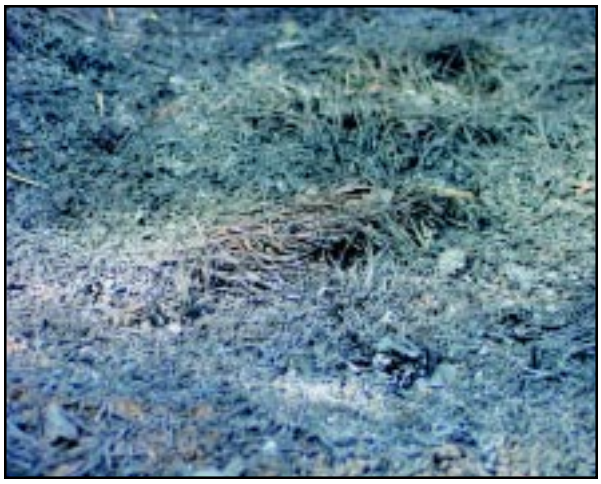
Road System
- Residential
- Arterial
- Collector
- Local

N

0 0.25 0.5 1 1.5 2 Miles

1 inch equals 1.18 miles

Post-fire Conditions



Duff layer in moderate severity burn

Soil Productivity

Soil productivity is the inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Following the Battle Creek Fire, a Burned Area Emergency Rehabilitation (BAER) team determined that the fire did not result in an emergency regarding potential loss of soil productivity. Viable plant roots were found at relatively shallow depths throughout most of the burned area. In addition, most of the duff layer and litter cover was retained in low severity areas, which comprises 6,825 acres or 55% of the fire. These areas are expected to recover quickly and should begin to revegetate during the next growing season following the fire, and as such the BAER team did not identify a need for soil productivity rehabilitation (i.e. reseeding).

Soil Cover

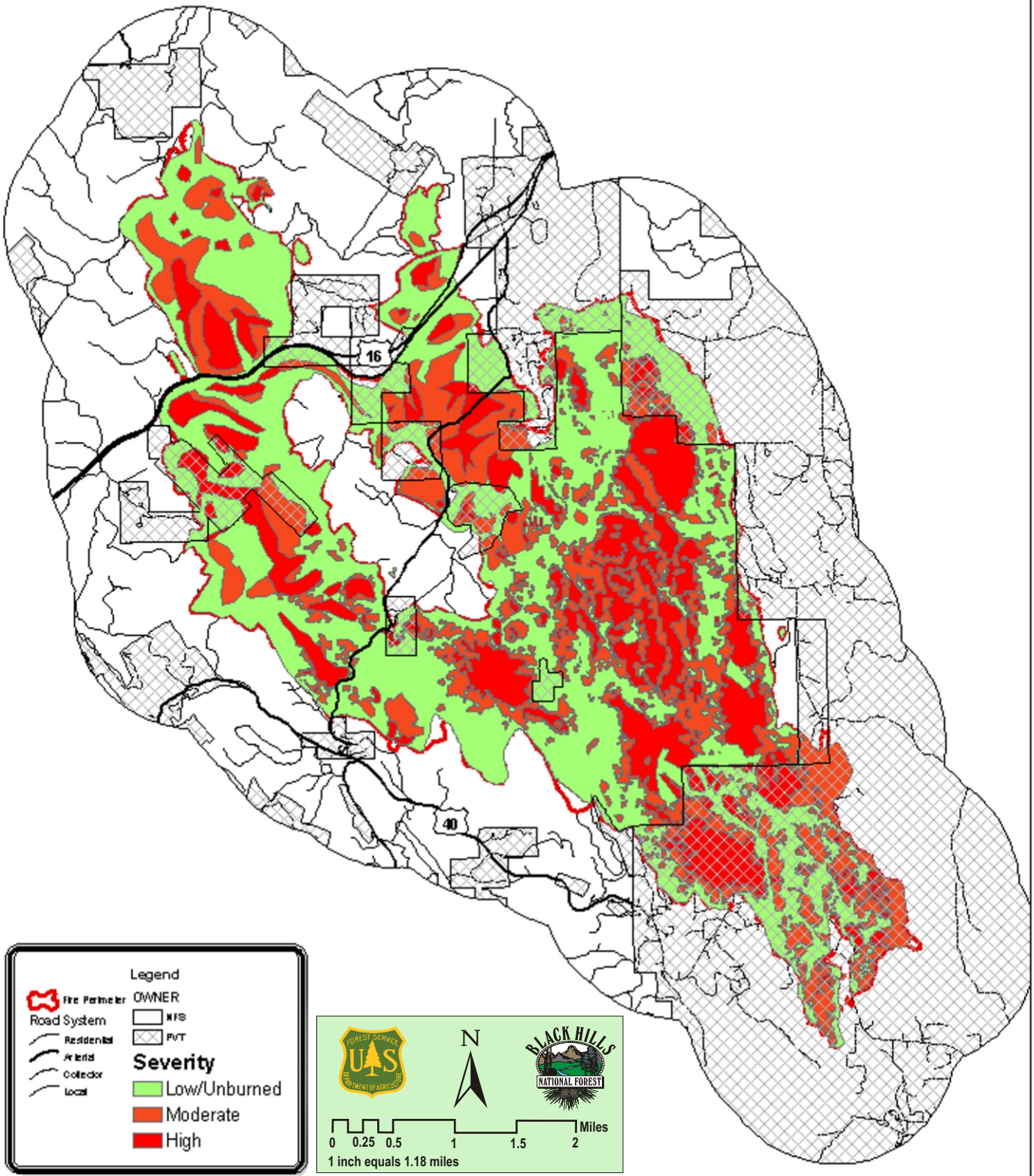
Field analyses conducted during the BAER assessment indicated that soil cover was affected. Sites classified as high severity on average had 92% bare soil conditions (surface rock, bare mineral soil, and litter with no remaining duff); under moderate severity, 65% of the site exhibited bare ground; and low and unburned severity, had 22% bare ground (*See Burn Severity Map*).

Following a wildfire, one of the most important variables in reducing overland flow is the duff layer. Duff acts as a natural sponge, temporarily storing rainfall, allowing it to infiltrate slowly, and thus reducing erosion. Sod-like duff layers also serve as a soil stabilizing mechanism. In areas classified as low severity, most of the duff layer and litter cover were retained. In moderate severity areas, a duff layer was present, however it was found in thin, discontinuous patches. Generally, in the high severity areas, pre-fire litter cover and duff were entirely consumed, leaving 2-3" thick ash layers where the litter and duff once were. Where a duff layer is still present, it is typically not more than ¼" thick.

In light of these conditions, measures will need to be taken before ground-disturbing activities resume, in order to:

- Retain the existing productivity of burned sites, and
- Retard soil loss due to erosion by removal of stabilizing root systems associated with dead-standing timber or disturbance of remaining litter and duff.

Battle Creek
Fire Severity



Legend

Fire Perimeter

OWNER

Road System

NFS

PVT

Residential

Arterial

Collector

Local

Severity

Low/Unburned

Moderate

High

N

0 0.25 0.5 1 1.5 2 Miles

1 inch equals 1.18 miles

Erosion Hazard

Erosion is a natural process occurring on the landscape. The rate and scale of erosion in the Black Hills depends on local geology, topography, vegetation, and climate. Fires and fire management activities also have the potential to increase the amount of material transported offsite, as well as accelerate the rate at which it is removed. Removal of topsoil, along with the associated organic matter, through the forces of erosion or by mechanical disturbance, can result in a decrease in site productivity.

Each soil is assigned an erosion hazard rating based on soil characteristics and slope (*See Erosion Hazard Map*). Erosion hazard is the soil's relative susceptibility to sheet and rill erosion when the surface vegetative cover is completely removed from the site. Ground cover requirements to prevent soil erosion from exceeding tolerance limits were calculated with the Universal Soil Loss Equation (USLE) for soil types within the fire perimeter and can be found in the Custer and Pennington County Soil Inventory Notebook (prepared by Darwin Hoeft, Black Hills NF Soil Scientist, retired).

Dozer line

Orr (1970) examined plant cover and erosion for 3 years following the 1959 Deadwood Fire in the northern Black Hills. Extensive areas of the 4,500-acre burn experienced complete consumption of humus down to mineral soil. The area was seeded with a mixture of grasses and legumes. Results indicated that storm runoff was 50 percent less on plots with high plant and litter cover than on those with sparse cover. Analysis showed a decrease in runoff and sediment production with increasing ground cover up to 60 percent cover. It was postulated that total ground cover must equal or exceed about 60 percent density for minimum tolerable runoff control and soil stability.

Fire suppression dozer lines are another area of erosion concern, especially on steeper slopes. Teams are already working to rehabilitate dozer lines by constructing water bars, pulling soil berms and slash back into place, and reseeding the firelines. However, vegetative crowns are usually removed during the construction of dozer lines. It will be important that these areas be given enough time for vegetation to develop adequate root masses and above ground biomass to protect against disturbances that could result in further erosion. Examples of such disturbances include cattle grazing and trampling before a litter layer has developed, and motorized traffic due to increased accessibility. Potential accessibility in the overall fire area has increased greatly. The fire removed trees and shrubs that protected soils from motorized

Mass Movement Potential map

vehicle traffic. If this type of use now occurs on burned, unvegetated slopes, increased erosion could result. Roads that before the fire may have been impassible or closed, may now be used in the condition that they are in, increasing erosion and watershed problems.

Nutrient Removal

Trees, ground vegetation, litter, and duff were mostly or entirely consumed in areas of moderate and high severity, respectively. This resulted in a "quick release" of nutrients into the soil (Graham et al 1994). Fallen dead trees and root masses will continue to release a constant nutrient supply as they decay. This decaying woody debris provides nutrients necessary for new plant growth and hosts ectomycorrhizae, micro-organisms which play an important role in the uptake of nutrients and water by woody plants (Graham et al 1994). Soil surface layers contain the highest amount of nutrients in a form most readily available for plant uptake. In particular, Nitrogen is the one nutrient that is in the most demand by vegetation and is only found in the soil's surface layers. Increased erosion will result in the removal of nitrogen and other vital nutrients needed for successful establishment of vegetation.

Mass Movement Potential

A significant portion of the burned area is naturally susceptible to mass movement, prior to fire disturbance, due to the large amount of surface rock and unsuitability to timber production. The potential for mass movement in these areas has now increased due to the consumption of trees, which provided slope-stabilizing root masses. Intense rainfall associated with summer thunderstorms and post-fire, ground-disturbing activities may further augment the mass movement potential. Mass movement exposes extensive areas of bare soil on hill slopes and can result in debris flows, transporting large boulders, dead trees, and sediment, effectively pulverizing anything in its path. Areas of most concern are those soil units identified as having a mass movement potential that intersect hill slopes of 25% or greater (*See Mass Movement Potential Map*).

Soil Compaction

Soil compaction is caused when excess weight is placed on the soil, as by vehicles or large animals. Compaction associated with vehicles is often accompanied by the formation of ruts, which collect and concentrate runoff, thus increasing erosion. Compaction impairs infiltration, root growth, and soil biota, increasing runoff and the associated effects of increased erosion. Soil map units BvC, HoD, PaE, VcE, VkE, and VpC within the Battle Creek fire perimeter are composed of soils that are susceptible to compaction when wet (*See Soil Compaction Potential Map*).

Soil Compaction Map

Reforestation Potential

Foresters consider soil interpretations when determining land suitability. These interpretations are used to predict soil response to various activities. The ratings assume the soils are in their natural condition and do not consider current uses, accessibility, or other factors related to forest land use. The assessment team used soil interpretations to estimate the potential for successful natural tree regeneration on soil types in the fire area.

Natural tree regeneration could be impeded on some sites by seedling mortality, plant competition, and other factors. In the Black Hills, competition with other vegetation is one of the major factors that can prevent successful restocking. Some of the soil types in the Battle Creek Fire area are rated "moderate" for vegetative competition with ponderosa pine, and natural regeneration in the burned area may be hindered by this competition. Other problems include the lack of nearby seed trees in the more heavily burned areas, and the possibility of low seed production years and drought conditions. Successful regeneration will also depend on moisture retention. Soils will dry faster where the canopy, litter, and down woody debris were consumed by the fire. This increases the potential for seedling mortality. Leaving down woody debris on site would help retain soil moisture and encourage vegetation re-establishment.

Seedling mortality ratings are probably the best available prediction of hand tree planting success. Seedling mortality refers to the probability of survival of naturally occurring or planted tree seedlings, as influenced by soil type and topographic conditions. The primary causes of seedling mortality are too much water (soil wetness) or too little water (soil droughtiness). Excessive soil wetness is caused by a seasonally high water table or flooding during a substantial part of the growing season. Soil droughtiness can be caused by available water holding capacity, shallow rooting depth, or high evaporation rates. Within the fire area, the soil map units with the lowest potential for seedling mortality are include BuE, BvC, PaE, VcE, VkE, VnC, VoG, and VpC. (*See Seedling Mortality Map*) These soil units total 7,755 acres, or 62% of the fire area. VpC soils have a high available water capacity, which benefits competing vegetation as well as tree seedlings and may affect seedling establishment. The remaining soil types have low to moderate available water capacities. Planting can occur on other soil map units, but measures such as using special planting stock, bedding, planting on north-facing slopes, etc., may be needed to offset the seedling mortality hazard.

Regeneration of areas of moderate fire intensity and high fire intensity will require the retention of a certain amount of burned trees falling on the site for moisture retention and soil stabilization. Between the fire consumption of tree canopies, litter and downed woody debris, these soils will have the potential to dry faster and there is a higher potential for seedling mortality.

Seedling Mortality Map

Recommendations

Objectives of all recommendations are to:

- ❒ Retain soil productivity
- ❒ Minimize retarding vegetative recovery
- ❒ Minimize retarding formation of duff and litter layers
- ❒ Minimize increasing sediment transport off site (directly related to all the above and avoiding increasing overland flow)

- All potential activities should be focused on minimizing or eliminating ground disturbance on soils with mass wasting potential, steep slopes, and moderate and high burn severities.

- Soil map units BvC, HoD, PaE, VcE, VkE, and VpC within the Battle Creek fire perimeter are composed of soils that are susceptible to compaction when wet. Logging activities such as skidding and hauling can cause surface compaction and rutting, which concentrate runoff and increase erosion. These activities as well as other forms of mechanical disturbance should be restricted to periods when the soil is dry or frozen, or avoided altogether.

- In moderate and high burn severity areas, as well as areas identified as mass wasting soils (BuE, HtG, PaE, RgG, RlG, RnG, VcE, VkE, and VpC) harvesting and thinning methods that do not isolate the remaining trees or leave them widely spaced will help to overcome windthrow hazard of dead and live trees, thus providing slope stabilization. Retaining live trees, stumps, and root masses on site will also stabilize slopes and reduce sediment transport. The additional canopy cover provided by live trees, as well as the litter cover provided by needle cast from dying trees, will help to protect the ground from raindrop splash and increased erosion.

- In moderate and high severity areas, seeding, mulching, and installing water bars on skid trails and dozer lines will help stabilize and protect soils from runoff and increased erosion. Skid trails should be designed to avoid concentrating overland flow and connecting disturbed areas to existing channels.

- Installing and/or maintaining culverts and rolling dips on roads will help alleviate concentrated runoff, thus reducing erosion.

- Grazing should not occur until adequate duff and litter layers are formed and vegetation has recovered. The duff and litter should combine to provide at least 60% groundcover.

Evaluation And Monitoring

- Monitor watershed recovery and formation of ground cover to plan and adjust management activities using the quantitative grid method developed in thesis study of Post-fire Hydrologic Effects of the Jasper Fire, Gould, to be published 12/2002.

- Road crossings within and downstream of the fire will need to be identified and monitored for plugging associated with transport of ash, sediment, and debris during and after rain events.

- Monitor recovery of dozer lines.

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Battle Creek Fire Burned Area Emergency Rehabilitation Team, 9/2002.

VEGETATION, INSECTS, AND DISEASE

Pre-fire Conditions

Tree Species Composition

The majority of the burn area is forested with ponderosa pine Approximately 6% of the area is also forested with bur oak, aspen and some minor amounts of other low elevation species such as hop hornbeam.

Age Class Distribution

Approximately 20% of the area has stands of ponderosa pine over 100 years of age. Seventy percent of the pine acres are within the 60 to 100 year range with the remaining 10% less than 60 years of age.

Stocking Levels

Generally, 50% of the pine area had high stocking levels of pine; 40% had moderate stocking levels and 10% were in low or a non-stocked condition.

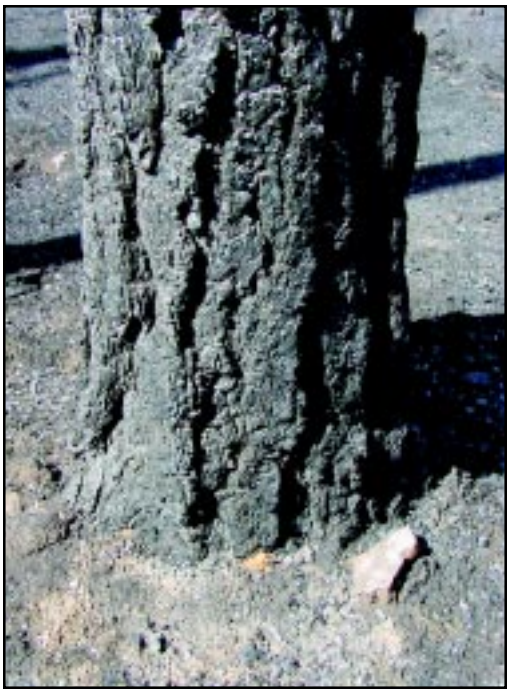
Regeneration

Pine regeneration within both the crystalline area (western portions of the burn), and limestone area (east) was very abundant. The most common plant association in the area is ponderosa pine/snowberry, which is associated with good pine regeneration potential. Past treatments and small burns (i.e. Jackson Springs burn) within this area has resulted in fully stocked pine stands. Older large burns such as the previous Battle Creek burn have also regenerated well with a ponderosa pine/bur oak mix.

Suitable Land Base

Within the burn area there are three major management areas; 3.7 – Late Successional Forest Landscape; 5.4 – Big Game Winter Range; and 5.1 – Resource Production Emphasis. The 3.7 – Late Successional Forest Landscape is within the unsuitable timber base as well as other designated old growth stands scattered through out the burn area. In addition, other portions of the burn area are unsuitable for timber production due to steep slopes, low productivity, low value tree species, and meadows. Approximately 35% of the area is unsuitable for timber production.

Post-Fire Conditions



Wood borer residue

Insects and Diseases

The insects that will most likely be infesting trees in the Battle Creek area can be broken into two classes, bark beetles and woodborers. Both have different feeding habits and will behave differently depending on the amount of fire damage on trees. In general, the probability that one or both of these insect groups will infest a fire-damaged tree increases with the amount of damage. It is also worthy of noting that populations of all of these beetles, red turpentine beetles, *Ips* beetles, which are both considered bark beetles, and wood borers, are at extremely elevated levels at this time. Storm breakage from 2 years ago led to population increases in these beetles and the other fire events the Black Hills has suffered over the past 2 years have caused beetle populations to increase even more. Insect infestations can play a big part in deciding whether the wood will be merchantable and whether salvage operations are warranted and how much time is available before infestations make the wood unusable.

Bark beetles

The most important bark beetle infesting ponderosa pine is the mountain pine beetle, *Dendroctonus ponderosae*. Mountain pine beetle has one generation per year, with its main flight and new attack period being early August. When populations of mountain pine beetle are high enough, they can attack and kill green, healthy trees. At low populations, mountain pine beetle typically attacks stressed or damaged trees, such as lightening struck trees. While it is true that mountain pine beetle does use stressed trees during low populations, it does not preferentially attacked fire damaged trees. This is in contrast to some of its close relatives such as Douglas-fir beetle. This does not mean that mountain pine beetle will not attack trees that are moderately scorched and have suitable phloem resources remaining. Generally speaking, fire damaged trees will NOT cause the start of a mountain pine beetle outbreak; however, mountain pine beetle could very well attack fire damaged trees if beetles are already present in the area.

The second most important bark beetle in the Black Hills are *Ips* species. There are a number of *Ips* species in the Black Hills that attack both pine and spruce. Fire scorched trees that still

have some suitable phloem remaining are frequently attacked by *Ips*. Of all the insects that may be factors following the fire, *Ips* has the potential to build populations to a point where they can attack nearby stands of green timber. There is a very good chance that *Ips* will infest trees that are highly stressed from fire scorch. There is also a chance that surrounding green stands that did not receive any fire damage could have tree mortality caused by *Ips* if they build enough of a population in nearby fire damaged trees.

The third bark beetle that could be of importance is red turpentine beetle, *Dendroctonus valens*. Red turpentine beetle is found throughout the Black Hills attacking pine and occasionally spruce. Trees with fire damage may be attacked by red turpentine beetle. It is unlikely that red turpentine beetle will build to "epidemic" proportions that would be of concern to nearby standing green trees.

All three of the bark beetles introduce blue stain and other general fungi when the successfully attack trees. The blue stain fungi cause discoloration and other fungi that enter the beetle holes can start deterioration of the wood.

Woodborers

The other group of insects that typically follows fire events are woodborers. Woodborers are common residents of the Black Hills where they typically live in fire scorched, injured, dying and dead, and recently felled trees. Woodborers typically do not build up in fire-damaged trees and attack standing green trees, although there have been accounts of woodborers attacking highly stressed green trees. Generally they only attack heavily damaged or dead trees. The greatest concern with woodborers would be in areas that have been killed or heavily damaged by the fire where salvage logging is under consideration. Woodborers cause a much greater level of defect in lumber than do the bark beetles because they spend the bulk of their life tunneling through the heartwood of their host. Wood borers are plentiful in the Black Hills and will locate suitable material rapidly, so to minimize defect and degrade in fire damaged or killed areas, salvage operations should begin to take place as soon as possible following the fire to minimize defects caused by wood borers.

Effects

At this time we found all three of the major fire infesting beetles, red turpentine beetle, *Ips*, and woodborers, were infesting trees in the fire. In all cases, the attacks were very fresh and were in the stage of laying eggs under the bark. At this time, we did not find any larvae of any of the beetles that had hatched yet. Infestation levels were high in pockets, but in some places were fairly low and scattered.

The most often attacked trees were those that had been subject to the highest amount of fire scorch, either the all black or black with some brown needles remaining. At this time there is

very little beetle activity in trees that had any unscorched, green crown remaining. Much of the findings in Battle Creek are opposite what has been observed in the Grizzly Gulch area, where beetle infestations were heavy on almost any fire-scorched tree, regardless of scorch level. This is largely due to the timing of the Battle Creek fire, in mid August as opposed to early July for Grizzly Gulch, which occurred when most of the significant flights were over or almost over.

This fire has provided another large amount of highly productive breeding material for all these beetles, which were already at elevated populations. Any of the fire damaged trees that remain next spring and summer will likely be subject to attack. Although trees that have only partial crown scorch will be the most resistant to attack, large existing beetle populations will increase their risk also.

Although beetles are just getting started in this area, any salvage operations should still occur very soon as beetles will be attracted to them this fall while they are still flying and in the spring again when beetle flight starts.

Vegetation Effects

The fire burned in a mosaic pattern with burn intensities of high, moderate, low, and unburned. Overall, within national forest lands, 2,496 acres (27%) of the Battle Creek Fire burned at high intensity, 4,742 acres (52%) at moderate intensity, 1,599 acres (18%) at low intensity, and 239 acres (3%) was unburned. High burn intensity areas in the ponderosa pine type killed nearly all of the pine in all size classes. Ninety to one hundred percent of the other species of trees, shrubs, forbs, and graminoids were killed as well as 70-90% of the loose litter layer. These areas experienced a stand-replacement fire, which set them back in their successional pathway to an early-seral stage.

Low burn intensity sites experienced relatively low tree mortality (0-20% for the pine vegetation type and less than 1% for other tree species). The bur oak and aspen within these areas were not affected and very little change in species composition and structure will be noticed. There may be a slight increase of growth in tree species, grasses and forbs due to the release of nutrients from the ground fire and reduction of litter and the competing duff layer.

Moderate burn intensity sites are highly variable. Tree mortality ranged from 10% up to 100%. The degree to which shrubs, herbaceous vegetation, and litter was killed or impacted on moderate intensity sites for all the vegetation types is highly variable and directly related to the fire intensity from individual tree torching, short duration crown runs, and the intense heat from the ground fuels consumed. Most of the moderate burn intensity stands experienced enough changes in structure to change their successional status to a grass-forb stage.

Throughout the fire area, even on sites that burned at high intensity, fine roots of trees, shrubs, forbs, and graminoids appeared to be intact (not burned) in the upper inch of mineral soil. This may be an indication that seeds in the mineral soil survived the fire and are available to germinate, grow, and establish cover on burn sites. Rhizomes of grass species also appear to have survived the fire and are expected to regenerate readily after fire.

Pine mortality will continue to occur in areas where greater than 60% of the crown was scorched. The cause of this mortality is insufficient crown mass to sustain biological tree functions; continued drought depriving trees of water; and insects.

Acres burned by vegetation type and burn intensity class

Vegetation Recovery

Bur oak and aspen are species that regenerate from root suckers following disturbance such as fire. Since these species are common on many sites throughout the burn area they will readily sprout and increase in numbers after being released from the pine overstory mortality. Overall, adequate natural vegetation recovery will occur in areas where either oak or aspen were present before the fire. In stands of pine where remnants of oak and/or aspen were scattered through out, mixed pine/oak and pine/aspen stands will appear. Over time the pine should crowd out the oak/aspen and predominantly pine stands will dominate the burn area.

Ponderosa pine is more limited in its response to fire. Unlike many deciduous trees and shrubs (aspen, oak), the root systems of conifers do not regenerate from root suckers. In order for a conifer to survive the fire, some of the roots, the cambium of the main trunk, the buds, and the live crown must survive. The best predictor of survival for the pine will be the amount of live foliage on the trees. In general, if at least one-third of the foliage is still green, and the cambium is alive, the tree should survive if drought and/or insects do not intervene.

Generally ponderosa pine seed can be expected to fall within 40 to 80 feet of the source. In large areas where the overstory pine was killed regeneration from adjacent pine will not be

available. Ponderosa pine seed is viable for many years however, and within areas where the duff was not severely burned, residual pine seed may be available to regenerate some of the areas to pine. One of the greatest deterrents to successful regeneration and the establishment of ponderosa pine in the Black Hills is the presence of grass, especially sod forming grass. Grasses crowd out the pine seedlings restricting their growth due to competition for water and nutrients. Seeding for soil stabilization can also retard and in some cases prevent the natural regeneration process of ponderosa pine. Successful regeneration will also depend on moisture retention. Soils will dry faster where the canopy, litter, and down woody debris were consumed by the fire. This increases the potential for seedling mortality. Leaving down woody debris and slash on site will help retain soil moisture, reduce competition from grasses, and reduce soil temperatures by shading.

The success of naturally regenerating ponderosa pine is high. Past burns within the area indicate that while regeneration by natural means may be slow, regeneration does occur with an abundance of pine. Over a large area this can pose a future fire risk as "doghair" thickets of ponderosa pine are established and crown closure occurs.

Recovery of Commercial Timber

Timber Volume affected by the fire was calculated using satellite imagery and interpretation to establish the burn intensity within the various stands affected and calculating mortality volume and recoverable volume based on pre-burn forest inventory data. In some cases field observations and sale prescriptions were used to adjust predicted volume. Recovery of commercial volume both inside of timber sale areas and outside of sale areas is recommended.

Burn Intensity Class	Mortality Acres	Mortality Volume[1]	
		Sawtimber MBF	POL CCF
None	239	272	341
Low	1,599	3,084	3,641
Moderate	4,742	9,028	17,510
High	2,496	4,483	11,226

[1] *Mortality Volume is the total volume estimated killed within the Battle Creek Fire Perimeter on Black Hills National Forest Lands.*

Recovery within existing and planned sales

Timber Recovery should be considered throughout the fire area. For discussion purposes recovery has been divided as follows:

- Outside of planned and existing sale areas
- Within the cutting unit boundaries of the Beagle Timber Sale
- Within the sale area boundary of the Beagle Timber Sale and outside of cutting units
- Within the Bitter Sale and Hollow Sale boundaries (planned but not sold)

One timber sale is currently under contract and partially harvested. Two sales currently being prepared lie partially within the fire area. These are the Beagle (under contract), Hollow and Bitter Sales. The fire affected timber, both designated for removal and/or leave, harvest unit boundaries, and individually marked trees. Generally, trees within the areas of high intensity fire could be characterized as blackened from top to bottom. These areas sustained 100 percent mortality. Timber harvest unit boundaries and timber designation markings are non-existent within these areas.

Burned marked tree in existing timber sale

Trees within areas of moderate fire intensity have scorched (brown) foliage and blackened boles of varying heights. These areas sustained between 10 and 100 percent mortality. Timber harvest unit boundaries and timber designation marking are random and difficult to consistently locate. Some designation marks may only be visible on a small portion of the tree boles.

Trees within areas of low fire intensity have scorched (brown) foliage on less than 50 percent of the tree crowns and blackened boles generally less than six feet. Seedlings and saplings tended to sustain varying degrees of damage. Timber harvest unit boundaries and timber designation markings under areas of low intensity fire were generally retained. It appears that

about 80 percent of the tree designations were retained. Marking designations most affected by the low intensity fire were stump marks.

Much of the burned area contains pine stands that consist of saplings, poles, and small sawtimber. The saplings and poles are likely to have no economic value in terms of timber recovery. Burned trees are generally not suitable for chip products. Areas of suitable recovery are spread out throughout the burn perimeter and may require additional transportation systems.

Timber value as a result of this fire has been reduced. The demand for fire killed timber is less than for green standing timber. Available time for harvesting these cutting units is limited if quality timber is to be recovered. Blue stain and insects will generally degrade the wood beyond use in less than one year. Insects of concern are longhorn beetles, red turpentine beetles, mountain pine beetle, and Ipps.

The following table summarizes the estimated recoverable volume affected by the fire within existing and planned timber sales:

Sale		Recovery Acres	Recovery Volume Sawtimber MBF	POL CCF
Beagle Existing	Inside CU's Not cut	140	600	900
	Inside CU's Cut	100	400	450
	Outside CU's	540	2,100	2,700
Bitter Planned		280	1,300	700
Hollow Planned		350	1,600	1,800

Recommendations

- Contract modifications should be made to recover value in commercial timber killed within the Beagle Timber Sale, both within existing cutting units and outside cutting units within the sale area boundary.
- The Hollow and Bitter sales should include areas burned within the planned sale areas and adjustments made to ensure regeneration and other resource needs are met.

- If not included in the Hollow and Bitter sales, recovery of commercial volume should be accomplished in a separate sale.
- Additional salvage sales should recover value in commercial timber outside of existing and planned green sales.
- Pine seed should be gathered to ensure quantities are available if future planting is necessary.
- Monitor seed cast from pine within the burn area.
- Retain green seed source trees within and adjacent to the burn area.
- Re-evaluate prescriptions for green units within the burn area.
- Monitor burned-over areas for natural regeneration.
- Some areas may need additional non-commercial trees felled to provide additional ground cover for seedling germination and protection from solarization.

Evaluation and Monitoring

The following monitoring should occur over the next 5-10 years within the burn area:

- Monitor seed cast and evaluate germination potential of pine seeds.
- Evaluate regeneration and stocking levels in the suitable land base.
- Plantability surveys to determine suitability and potential success of planting.
- Evaluate regeneration of aspen, bur oak, and pine stands.
- Continue evaluating pre-burn and post-burn stand conditions to determine future silvicultural treatments that would reduce the potential for large fire occurrence in this and other areas.
- Re-type the burn area and update the existing vegetation database to reflect changes created by the fire.
- Evaluate the suitability of sites within the burn area to determine whether they should be taken out of the suitable base and managed for other resources (i.e. wildlife or range).

Grass regrowth in the burn area

FIRE AND FUELS

Pre-fire Conditions

Weather, topography and fuels are the three primary factors that influence fire behavior. The Black Hills and surrounding areas are currently in a drought condition, as is much of the Western U.S. Two major fires had already occurred in the Black Hills earlier in the fire season, and overall conditions were exceptionally dry. Fortunately, some rain had fallen in the area prior to the Battle Creek Fire and this helped moderate the fire's effects somewhat. Temperatures were in the upper 80's and 90's three days prior to the fire with relative humidities in the teens. These conditions lowered the fuel moistures significantly and increased the Energy Release Component to the high level of 66. Weather conditions the day of the fire saw maximum temperatures in the high 90's with relative humidities as low as 8%. This coupled with wind speeds of 17-20 with gusts to 60 mph created explosive conditions.

Area topography added to the weather conditions. Steep sided canyons served to funnel strong winds and exposed ridgetops provided an avenue for rapidly advancing fire. Steep slopes along Silver Mountain and Boulder Hill provided conditions for the fire to move rapidly uphill.

The majority of the fire area consisted of dense stands of flammable ponderosa pine 60 years of age or older, with lesser amounts of more fire resistant aspen and oak. The timber canopy was largely continuous over most of the fire area, except for the eastern edge where the vegetation was more broken, consisting of open meadows intermixed with pine. This pattern of dense, unbroken stands of ponderosa pine is largely the result of past fire exclusion and timber management practices dating back 60 or more years. Storm damage from a snowstorm in the spring of 2000 contributed to the fire's intensities. Storm damage increased fuel loadings to 20-40 tons/acres in scattered patches throughout the area. These areas often provided the initial heat pulse that would move the fire from the ground to the crowns of the trees.

Post-fire Conditions

The fire burned in a mosaic pattern that was similar to that of a typical wind driven fire. A large percentage of the fire was intense enough to kill either the majority of trees in the stand or the entire stand. Most of the mortality occurred when the fire made runs on August 16th, 17th and 19th. Most of these runs were centered on ridge tops and steep slopes. Fire behavior was very intense with flame lengths over 100 feet and spotting up to one-half mile. The

Crown fire running

burning that occurred outside of the wind events usually consisted of a low to moderate intensity ground fire that killed only a small amount of the larger trees.

Preliminary reconnaissance indicates that the fire did not act as a thinning agent. The fire tended to kill the majority of the trees in the overstory or a small percentage of the trees. There were not many areas where the fire actually thinned out the stand other than killing some of the smaller regeneration. The fire tended to kill most of the trees in the dense stands of small pole timber that were precommercially thinned and the fuels scattered. Here, sufficient fuels remained on site to ignite and sustain a crown fire. Fire intensities were significantly lower in the meadows and hardwood stands. Even when hit with a crown fire, these areas either did not burn or they burned with a low intensity ground fire. In fact most the successful control efforts that were made in the Hayward and Neck Yoke areas occurred when the fire left the conifers and entered the larger openings.

The fire will have both short and long lasting effects upon the fuels in the fire area. In areas that experience high intensity fires, most the area will not have sufficient ground fuel to carry a fire in the short term. In areas with significant crown scorch there will be enough needle cast to carry a fire but fire intensities will be low because very low fuel loadings. Within 5 years there should be sufficient grasses and forbs established to carry a fire with estimated fuel

loadings of 3 tons/acre and a fuel bed depth of 1-2 feet. The fire season will be split and will be susceptible to fires in the spring and fall when the grasses are cured. High live fuel moistures should limit fire activity in the summer unless there is not sufficient rainfall to support the vegetation. Fires in this fuel type are likely to spread quickly with rates of spread over 50 chains/hour and moderate fire intensities. Fuel conditions will improve in areas on the Battle Creek fire where the forest was under burned without killing the overstory. Here, the fire removed most of the downed woody debris and ladder fuels. There will not be enough fuel on the ground to carry a fire except in isolated patches for 1-2 years. Fuel loadings will gradually increase with the yearly needle cast. Fire intensities should be a reduced level for at least 15-20 years.

Fuel loadings in moderate and high intensity fire areas will begin to increase significantly in 5 to 10 years when the standing dead timber in the area begins to fall. Once this happens dead fuel loadings will increase to 20-60 tons/acre. Most of this will be material greater than 3 inches in diameter and generally will not contribute to rapid spread rates. Over time, however, as new dense stands of young pine trees begin the grow among the heavy fuel loads, new fire risks will emerge. At that time, in 15 to 20 years, a fire in this area will have the right mix of fuels—young pine and heavy fuel loading from dead trees—to both carry a rapidly moving and long duration fire. Such an event would significantly affect the area ecology by cooking and sterilizing the soil. Further, the increase in fuel loading from dead trees may have an impact on our ability to suppress wildfires. Large amounts of downed woody debris may limit our ability to access areas with engines and will significantly decrease line construction rates.

Most of the large runs occurred in areas with continuous tracts of forested lands. When the fire reached the larger openings, forces were often more successful in their control efforts. This fire has provided us with an opportunity to help break up the continuity of the forest by maintaining larger openings on strategic portions of the landscape. These areas will help provide natural fuelbreaks that will help reduce the potential of another large fire occurring in this area. Prescribed fire and/or mechanical treatments will be needed in 15-20 years in order to help maintain these openings.

Recommendations

- If roads and trails are obliterated or blocked by fallen timber, access for fire suppression equipment and personnel may be a significant factor in meeting containment efforts. Efforts to keep fires from spreading from the forest onto private lands or to contain fires originating on private lands may be compromised.

- There are potential fire hazards within the area that need to be addressed, especially adjacent to access roads and private property. As dead trees fall to the ground, fuel loadings will increase to 20-60 tons/acre. These large fuels will not increase rates of spread but they could increase the fire's intensity and duration. They could also impede access to the fire and impede fireline construction. Dead trees should be removed to reduce fuel loadings adjacent to the access roads and private property.

- Some of the openings created by the fire should be retained in order to break up the continuity of the forest and to provide future fuelbreaks. An evaluation needs to be conducted and a long term plan developed to determine if these fuelbreaks are desirable, their location, and how to maintain them.

- The fire effectively removed most of the ground fuels and the fire should act as an effective firebreak for 10-15 years. Fuels will gradually begin to accumulate in the stands that were underburned. Prescribed burning should be used at 15-20 year intervals to help prevent future build-up of fuel loadings.

Monitoring

An opportunity exists to monitor how rapidly fuels begin to accumulate in areas that were underburned. By monitoring the fuels we will have a better idea what the most effective interval would be for using prescribed fire for maintenance.

We need to monitor the pine encroachment into the openings created by the fire. This will provide us with the information that is needed to determine what kind of management will be needed to maintain these openings.

Threatened structure

Monitor the oak and other hardwoods to see how effective the fire was in expanding their range. Fire killing large numbers of the larger stems would be undesirable but expansion of these species would help provide natural fire breaks.

RANGE

Pre-fire Conditions

The suitable rangeland on both the Rockerville and Bitter Creek Allotments was slowly moving toward unsatisfactory condition due to the pine encroachment. Ponderosa pine seedlings were encroaching upon meadows and parks. Many young, dense pine stands existed along the ridges and north/east slopes. Timber sale activity was not adequate to maintain openings. Springs and ponds were drying up because of water consumption by increasing numbers of pine trees. The forage trend was moving away from the plant community desired by range management. The visual effect was a solid canopy of pine interspersed with some aspen, oak and rock outcrops.

There are no live streams currently on the allotments within the fire perimeter (with the exception of a small stretch of Battle Creek not used by permitted cattle). Teepee Creek had been modified with low head dams in the 1980's to improve it to a perennial flow. Mudboggers and ATVs reduced it back to intermittent flows in the 1990's.

Maintenance of private land fences has been a continuing problem as ranches and homesteads became subdivided and new homeowners moved in.

Post-fire Conditions

Within the fire, some meadows burned, others did not. Rangeland forage in general within the fire perimeter is reduced to stubble and regrowth. Burned meadows were low to moderate burn intensity except when dense dog hair stands existed. These meadows evolved under fire conditions and the forage plants will re-establish very easily under normal moisture conditions. The allotments are stocked to maintain or improve the range condition. In instances where a downward trend is occurring, management of livestock is being adjusted either through an allotment management plan or the annual operating instructions.

Since most permitted cattle were removed during the fire, there will be no effect from continued grazing on meadows and other rangeland inside the burn this year. The remainder of the cattle were removed after the fire passed. None have been intentionally returned to pastures located inside the burn. Permittees have accounted for all but approximately six head, which they speculate are spread out in the black or have moved to private land due to

destroyed fences and open gates. When those cattle are located and identified, the permittees are asked to remove them immediately.

Continued forage utilization by cattle within the burned area would not be sufficient to provide even a maintenance diet.

Over time the result of this fire will be an increase of forage available to livestock because of the reduction of pine encroachment and timber canopy. Portions of this forage will be transitory in nature. This means that eventually the area will be replaced by pine overstory and lose its forage value to livestock. Also the availability of the forage to livestock is dependent on location of water.

From field observations it is apparent that damage to barbwire fences has occurred. In areas of high fire intensity the wire and all posts are damaged and will need to be replaced. Wooden posts were damaged even in areas of low intensity. Corners and gate braces will need to be replaced. Field observations have shown that green treated posts received the most damage. The metal posts become brittle with heat and will break during stress such as snowfall or high winds.

Field observations have also shown that spring developments received various amounts of damage. Pre-existing exclosures of water sources were destroyed, stock tanks damaged by heat, and posts and barriers around tanks burned up. Damage to pipelines from springs to tanks has occurred due to dozer activity. There is the possibility of dugouts and small dams silting in more rapidly than usual.

Allotments	No. Of Permits Affected	Total No. Permitted Livestock	Total Head Months	HM Lost to fire	Total Acres in Allotment	Acres inside Fire Perimeter by Pasture	Affected Pastures	Grazing System
Bitter Creek	1	50c/c	250	0	12,875	1190 288	Boulder Hill Middle	4-Pasture Deferred
Rockerville	3	89 c/c 10 c/c 12 c/c	556	167 30%	10,944	1787 1500 1208 2919	Foster Upper Deadman Lower Deadman Teepee	4-Pasture Deferred
Rockerville	1	26	130	0	2117	1109	Koopman	Season-long

Range fence damaged by fire

Bitter Creek: 11% of the allotment was within the fire perimeter. There is approximately five miles of fence affected by the fire within the allotment. There is one damaged water improvement located with in the fire perimeter

Rockerville (north): 68% of the allotment was within the fire perimeter. The burned area of three pastures was greater than 90%. The allotment's four pastures are under a deferred rotation grazing system. There are 4 damaged water improvements located within the fire perimeter. There are 8.25 miles of fence that have been affected by the fire. This does not include the private land fencing.

Recommendations

- Reconstruct pre-fire range improvements damaged by the fire or fire suppression . Remove hazardous trees as appropriate where the potential exists to fall on fences.

- New fences may need to be built in areas that were not fenced, but used natural topography or trees (barriers) to deter livestock. Dense stands of timber are now open and may allow the movement of livestock into areas they have not been historically used.

- Rest for Boulder Hill and Middle units of Bitter Creek for one year and then re-evaluate condition and vegetative response. This will take into account hydrology and soil recommendations for ground cover. Reconstruct fences and spring developments.

- Rest Rockerville (north of Highway 40) one year to allow vegetation to become reestablished. Monitor vegetation response, reevaluate for possible entry in 2004. Take that time to reconstruct the fences. Reconstruct the damaged water developments including stock tanks.

Monitoring

This is an excellent opportunity to document post-fire ecosystem changes. With the shortage of personnel and time, permanent photo points are the most efficient type of monitoring. Selection of key areas is the most critical element for this type of monitoring. Photo points should be selected in representative sites in each pasture. The primary method for photo plots should follow the Region 2 Range Analysis guide. Baseline photos should be taken yet this year.

Map of Range Allotments and Pastures

NOXIOUS AND INVASIVE WEEDS

Pre-fire Conditions

Known noxious weed sites within the fire perimeter are approximately 1,100 acres. National forest system lands and private lands adjacent to the burned areas had established noxious weed populations including, but not limited to: Canada thistle, leafy spurge, houndstongue, yellow toadflax, musk thistle, bull thistle, scotch thistle, whitetop, chicory, St. Johnswort, common tansy, burdock, common mullein, and perennial sow thistle. Treatment within this area has been done on a yearly basis due to the Leafy spurge infestations. County and private lands surrounding and interior of the fire area have established noxious weed populations that have been identified through mapping and coordination with the Pennington County Weed and Pest Supervisor.

Biological control sites were established in two or more areas within the burn area with an Aphthona Flea beetle mix for leafy spurge control. Aggressive biocontrol methods were maintained in this area to help establish insect colonies, thus controlling the spread of leafy spurge.

Post-fire Conditions

The Battle Creek Fire has created a favorable seedbed to establish noxious weed populations, especially in severely burned areas. Noxious weeds will establish quickly in areas that take native vegetation much longer to establish, taking advantage of the resources (soil nutrients, soil moisture) with little competition.

County and private lands surrounding and interior to the fire have already established noxious weed populations that have been identified through mapping and coordination with the Pennington County Weed and Pest Supervisor.

During the suppression efforts, vehicles and heavy equipment moved onto public from the weed infested private and county lands. Many vehicles and heavy equipment from all over the country potentially carried noxious weed seed and increasing the potential for noxious weed infestations by at least 30-40 percent. Dozer lines and hand lines created during the suppression efforts are expected to further increase the potential for noxious and invasive weed infestations. Forest Service roads, county roads and the Flume Trail are expected to continue to contribute to the spread of noxious weeds.

Dozer and hand lines built during the suppression efforts have been recorded with GPS units as well as hand lines to monitor for new weed invasions. Forest Service roads, the Flume Trail and county roads within the fire perimeter have been mapped to facilitate monitoring of their spread into or within the burned areas.

Noxious weeds growing after the fire

Biological control sites within the fire permiter were burned over. However, the severity of the damage to flea beetle larva for leafy spurge will not be known until next summer. Grasses are starting to come up, as are leafy spurge.

In the spring, a check of the root systems for the Aphthona larva needs to occur. The biological control measures within the burn cannot be assessed fully until such time, if and when the adult Aphthona beetles emerge.

Recommendations

- National forest system lands need to be treated for noxious and invasive weeds in close coordination with private landowners, due to the amount of traffic and ground disturbance in and out of the fire area. The fire camp (private land) should also be treated.

- Close coordination is needed between the Black Hills NF and Pennington County Weed and Pest Department. In particular, chemical application needs to be a coordinated effort to prevent road rights-of ways from being sprayed by both organizations. Roads going into and out of the fire area need to be treated to help prevent the spread of noxious and invasive weeds.

- Severely burned areas should be seeded with noninvasive annual grasses and perennial native grasses to reduce the potential for noxious and invasive weeds establishment. Weed free seed needs to be checked prior to actual seeding. Seeding has started on dozer and hand lines, and with the proper moisture should help in suppressing weed growth.

- A check of the root systems for the Aphthona larva needs to take place. The biological control measures within the burn cannot be assessed fully until late spring if and when the adult Aphthona beetles emerge.

- Use integrated weed management practices, in accordance with the Environmental Assessment for the Management of Control of Noxious Plants on the Black Hills NF, to provide timely treatments of noxious and invasive weeds.

- Identify and treat species with the highest potential to cause substantial and persistent long-term degradation of ecosystem function. These species include, but are not limited to: Canada thistle, leafy spurge and common mullein. The time frame should be 3 to 5 years due to the characteristics of the noxious weed base.

- Use weed free mulch and erosion materials.

- Select natives or non-invasive introduced species. Provide for testing of seed to verify the absence of noxious weed seed. Monitor and treat areas within the perimeter of the fire adjacent to known private land weed infestations.

- Provide for the use of an Aphthona flea beetle insect mix in the Leafy spurge areas as a means of integrated noxious weed control for 3 to 5 years.

- Provide to Pennington County and the South Dakota Department of Transportation a list of natives and non-invasive seed species for restoration of rights-of-ways and hill sides along all state and county road systems.

Evaluation And Monitoring

- Identify and monitor areas of concentrated human or animal activity prior to the fire where new weed infestations are likely to occur.

    - Private land area is approximately 3,500 acres.
    - Private land infested is approximately 1,000 acres.
    - Miles of road is approximately 60 miles.

- Identify and monitor severe ground disturbance due to fire suppression activities, such as dozer lines, hand lines, safety zones, staging areas, heliports, etc.

    - Dozed lines - 50 miles/1,212 acres
    - Hand lines - 2 miles/48.48 acres
    - Helispots/Safety Zones - 25 acres private and 100 acres national forest

- Fire camp – 18 acres private
- Flume Trail - 1 mile/24.24 acres
- Roads - 60 miles/1,454.4 acres

3. Identify and monitor private and county lands that had weed populations prior to the fire to detect density and spatial growth of populations.

4. Monitor areas for three to five years for presence and persistence of invasive species and treat as required.

Noxious weeds growing in the burn area

WILDLIFE

PRE-FIRE

Elk

Vegetation Structure

For wildlife species, the vegetation structure, both vertically and horizontally provides resources such as food, shelter, water and security.

Prior to the fire, much of the area consisted of dense ponderosa pine stands with lesser amounts of hardwoods and meadows. The extent and density of pine trees was much greater than that which existed historically in the area; hardwoods and meadows were at much lower amounts than the historic norm. The pine also tended to be smaller than under historic conditions, a result of overcrowding due in large part by years of wildfire suppression and also from timber management practices dating back 60 years or more. These vegetative conditions had a significant effect on wildlife habitat in the area.

Pre-fire, various seral stages were present such as openings, seedling/sapling stands, sapling/pole stands dense hiding/thermal cover stands and late-successional habitat that would create a mosaic of forested stands, meadows and hardwoods. See Table 1 for pre-fire ponderosa pine forest structure.

Snags, Down Wood and Water

Snags are dead trees and are used by 23 wildlife species in the Black Hills. Their effectiveness to provide habitat may be reduced by the surrounding habitat. Many cavity excavators require broken topped snags because it is easier to excavate partially decayed trees. Some cavity excavators require large newly created snags due to the size of the cavity needed for nesting. Some excavators and secondary cavity nesters prefer clumps of snags to individual snags, so spatial arrangement of snags along with arrangement of foraging substrates (other dead material) is important to the usefulness to wildlife. Some species such as bats and some birds require snags that have bark somewhat intact to make them useful for nesting and roosting habitat.

Recent surveys on the Black Hills National Forest generally indicate a lack of snags across the landscape to provide optimum habitat for certain wildlife species. This condition has been changing in recent years due to insect infestations and wildfires. Before the fire, the Battle Creek area did not have many snags of the size and distribution desirable for some species.

Dead wood on the ground is important habitat for many birds, small mammals, insects, and even large mammals. Large dead logs provide food, cover and shelter for small mammals. Dead woody debris also is habitat for amphibians, ants and invertebrates along with fungi. Dead wood associated with grass/forbs is used as cover for natal areas by big game and cover for small game. Before the fire, large down woody debris probably ranged from 2 to 5 tons per acre over much of the fire area, and up to 10 tons per acre in thinned pole sized stands.

Water is a limiting factor affecting the distribution of wildlife within the burn area. The underlying limestone soils and bedrock are very absorbent thus little overland flow occurs. There are a few intermittent streams, such as Foster Gulch, Battle Creek, and Teepee Creek. Most of these drainages are dry by the late summer especially during a drought.

Natural water sources had been augmented by construction of water catchments for wildlife use, referred to as "guzzlers". Nine guzzlers had been constructed within the burn area.

Big Game Cover, Forage and Security

There are two types of cover used by big game wildlife; hiding cover, which is cover that will hide 90 percent of an adult deer or elk from view of a human at a distance of 200 feet or less, and thermal cover, which provides escape from temperature extremes. Optimally, thermal cover stands are greater than 30 acres in size and have a canopy cover of greater than 70 percent.

There are currently 3,642 National Forest acres within the Battle Creek Fire area with a big game winter range emphasis. This Management Area (5.4) includes an objective of providing big game thermal cover on 20 percent of the forested area. Prior to the fire, there were approximately 1482 acres of thermal cover or 16 percent of the forested portion of the management area. Thermal cover is more important in the Black Hills to help reduce heat stress on big game in the summer but does provide areas where snow depths, cold temperature, and winter winds are lower.

Due to recent harvesting activities, forage was increasing in the under-story of forested communities. Meadows and other grasslands were being affected by pine regeneration, which was decreasing the amount of forage in those areas. Post harvest activities were scheduled to remove this regeneration prior to the fire.

Roads and trails used by motorized vehicles provide access into and throughout the burned area. Prior to the fire, gates and/or earthen barriers had been used to limit motorized access into some areas in order to provide security of big game and other species, in addition to other purposes. Travel management plans as part of vegetative treatment projects were to be implemented post harvest activities.

Other Wildlife Species

There was one active or historic goshawk nest stands within the fire perimeter. In addition, there may have been two additional goshawk territories within the fire area based on territory size of this species.

Eight species of bats that require caves or deep mine adits for part of their life cycle are found in the Black Hills. Caves and mines in the Black Hills that are suitable bat habitat are rare. Caves are usually indicative of a karst landscape, which is found in the eastern portion of the fire perimeter. Although the geology of the area is conducive for caves and mines, there has been no survey of National Forest lands for potential bat habitat within the Battle Creek fire perimeter. Since the Sitting Bull Cave and the Rushmore Cave are adjacent to the fire area, it is possible that caves/mines will be located later on. Based on the report Land Snail Survey of the Black Hills National Forest, South Dakota and Wyoming (Frest and Johannes Final Report August 7, 2002), there is one survey location in the Battle Creek Fire. However, no sensitive snails were found at this location. There have not been any other snail surveys completed on National Forest land. Habitat (limestone outcrops) does exist in the fire area.

There are two sensitive butterfly species that inhabit the Black Hills area. These two species are the tawny crescent and the regal fritillary butterflies. The tawny crescent butterfly, which has been found adjacent to the fire area, is primarily associated riparian areas, and mesic sites. Regal fritillary butterflies, which have been found adjacent to the burn, are associated with open prairie habitats. These species lay their eggs on vegetation. The tawny crescent prefers asters and the regal fritillary prefers to lay eggs near violets. Prior to the fire, a monitoring point was established during the summer of 2002, near Jackson Springs. None of these species were identified at the time of this survey.

In addition to the above mentioned species, there are several species of reptiles and amphibians, which occur in the Black Hills. Reptiles include several species of snakes, which use rocks, logs, burrows and vegetation for cover. They feed on insects and small mammals. Amphibians are generally associated with aquatic or riparian habitats, which are very limited in the burn area.

POST-FIRE

General Effects

Once the fire passed, many of these animals moved back into the burned areas. Deer, elk, turkeys and other birds that returned to find much of their home ranges burned over likely moved on in search of food, water and cover outside the burned areas, big game species having home range territories that lie within and outside of the fire line continue to travel in and out of the burned areas depending on their needs.

Small burrowing mammals likely retreated to underground dens and tunnels where many survived. During field reconnaissance of the fire area, several squirrels were seen restocking their winter cashes and foraging on cones, still attached to the tops of burnt and scorched trees. A few voles or mice were seen outside their tunnels indicating at least some survival of these species.

Birds likely flew outside burned areas to escape the heat and smoke associated with this wildfire. Given the time of year, it is believed that most birds had fledged their young and many may have begun to migrate to wintering territories. Songbirds seemed to be concentrated in the low intensity burned areas and in areas with available water.

As the Battle Creek Fire area recovers from the fire, species, habitats and wildlife use patterns will change substantially. In general, there will be a shift from forest dwelling species and use to early succession, and edge dependent species and wildlife use patterns.

The fire has caused an abundance of new snags within the fire perimeter. Many of the existing snags were consumed by the fire and will not be available to secondary cavity nesting birds this spring. The increase in snag densities will directly benefit not only primary cavity nesting species, but will also benefit other insect eating birds, due to the increase of beetles and other insect species that utilize burnt and decaying wood. Nesting habitat for ground and shrub-nesting birds has been greatly reduced for at least a one-year period. Secondary cavity nesters will begin using the area after the second year.

Species that will inhabit the Battle Creek Fire area in the coming years will include; sparrows, mountain bluebird, American kestrel, Lewis' woodpecker, red-headed woodpecker, northern flicker, white-tailed deer, mule deer, elk, pronghorn, ruffed grouse, sharp-tailed grouse, and rodents, such as mice, gophers and wood rats.

The fire consumed deer and elk parturition habitat. The loss of this habitat will likely increase predation of deer fawns and elk calves in the spring of 2003. As grasses, forbs, shrubs and hardwood trees regenerate and fire killed trees fall, there will likely be an increase in the quantity and quality of this habitat within 3 to 5 years.

Where the Battle Creek Fire burned as a mosaic, prime brood rearing habitat for Merriam's turkeys was created. Merriam's wild turkeys prefer small grassy openings with abundant downed wood and adjacent cover to rear broods. Roosting habitat for the turkeys has been reduced in the short term.

Elk populations will likely increase in the area, as they did in the Galena and Cicero Peak fire areas. These increases, primarily due to the increased forage availability, may be tempered by increased access and decrease in available cover. Private lands within and around the fire area will likely experience an increased use by animals seeking cover and forage until these habitats become available within the burned area. Initially the private lands will experience an increase in animals seeking forage in the winter of 2002 and possibly 2003. Future impacts to private lands will depend on the population densities, which in turn are dependant upon availability of forage, water and security within the burned area. Big game population densities will also be dependant upon harvest levels that are set by the South Dakota Game, Fish and Parks Department.

Vegetation Structure

Ponderosa pine areas killed by fire or scorch will become structural stage 1 (grass/forbs seral stage) and will remain in this structure for at least 20 years. Oak and aspen clones that were killed by fire or scorch will most likely re-sprout next spring (depending on moisture availability) and expand in size but will revert to earlier seral stages over the landscape. Some root sprouting may occur. Meadows and grasslands will increase in size and return to pre-fire conditions (grass/shrub) in three years.

In areas of the fire where the mixed severity fire (moderate to low intensity burn), most under story structure was removed, thus creating more open park-like conifer stands. In some stands, torching of small groups of trees, creating a mosaic of stand structure, created small openings. These areas now have a more open crown canopy that will provide sunlight to the forest floor.

Shrubs are an important under story component for wildlife in forested landscapes. They provide browse for deer, hiding cover for nesting turkeys, elk calves and deer fawns, berries and nest sites for songbirds, and dens sites for small mammals. Common shrub species in the Battle Creek fire area are snowberry, juniper, buffalo berry, raspberry, currant, chokecherry, and serviceberry. Many of these species are early seral species that were suppressed by pine over-story prior to the fire. Based on monitoring of shrub regeneration in the Cicero Peak and Shirttail burn areas, the following species are expected to increase: raspberry, chokecherry, wild rose, skunk brush, snowberry, gooseberry, currant, buffalo berry, serviceberry, and kinnikinnick. These species are expected to re-sprout within 1-2 years. They will persist for many years until sapling ponderosa pine begin to compete for water, sunlight, and nutrients.

In addition to shrubs, a flush of grasses and forbs will begin to grow as soon as adequate moisture is available. In the Cicero Peak and Shirttail burn areas, from 53 to 90 species of grasses and forbs were identified within 2 years after the fires. These species provide forage and seed for a wide variety of mammals and birds. Noxious weeds are also expected to invade the burn from the existing seed bank or from adjacent infestations.

This change in stand structure and under story structure will benefit the insect gleaners, browsers, grazers and seed foraging wildlife but will reduce the habitat for wildlife that require closed canopy conifer stands and dense under story that provides security and rearing of young.

Turkey in the Battle Creek burned area

Map of Pre-fire Structural Stage

Map of Post-fire Structural Stage

Table 1. Pre-Fire and Post-Fire Structural Stage Estimates based on fire intensity Estimate from Land Sat data**.**

Battle Creek Fire Cover Types	Pre-Fire Structural Stage[1]		Post-Fire Structural Stage[2]	
	Acres	Percent	Acres	Percent
Grasslands	896	10%	896	10%
Scrublands	13	0%	13	0%
Aspen		0%		0%
Regeneration		0%	50	1%
Pole – low density	47	1%	12	0%
Pole- high density	12	0%	11	0%
Mature – low density	78	1%	85	1%
Mature – moderate density	25	0%	18	0%
Mature – high density	14	0%	0	0%
Bur Oak		0%		0%
Regeneration		0%	128	1%
Pole – low density	178	2%	173	2%
Pole – moderate density	129	1%	81	1%
Mature – low density	94	1%	163	2%
Mature – moderate density	144	2%	0	0%
Riparian Mixed Species		0%		0%
Wet meadow	53	1%	72	1%
Pole – low density	96	1%	73	1%
Mature – low density	45	0%	78	1%
Mature – moderate density	143	2%	115	1%
Mature – High density	6	0%	5	0%
Ponderosa Pine		0%		0%
regeneration	105	1%	4164	45%
pole- low density	1618	18%	1209	13%
pole – moderate density	1650	18%	182	2%
pole – high density	672	7%	10	0%
mature – low density	460	5%	1446	16%
mature – moderate density	1882	21%	143	2%
mature – high density	810	9%	43	0%

[1]*Assumptions made to determine prefire structural stage: All stands that were proposed treated in the Beagle, Hollow and Bitter EA/DN are post treatment structural stages prior to burn.*

[2]*Assumptions made to determine post fire structural stage. High intensity areas decreased to regeneration stage. For moderate and low intensity area: >30 % mortality decrease in stand density and >80% decreased to regeneration stag*e

Big Game Cover, Forage and Security

Both hiding and thermal cover were reduced as the result of the Battle Creek Fire. Approximately 79 percent of the burn area experienced fire intensities (high or moderate intensities) that were enough to kill a large amount of the vegetation providing one or both types of cover. Approximately 21 percent of the area within the fire perimeter burned with low intensity fires or no fire at all. These areas are distributed throughout the fire area. Within the low intensity burn areas; there are some remaining stands with enough standing vegetation to provide limited hiding or thermal cover. As a result of the fire, all of the thermal and hiding cover was lost mostly in 5.4 Management Area within the Battle Creek Fire. Thermal cover is more important in the Black Hills to help reduce heat stress on big game in the summer, but does provide areas where snow depths, cold temperature, and winter winds are lower which helps thermal regulation of big game during climate extremes.

The Battle Creek Fire consumed a majority of the forage used by big game animals throughout the fire area. Grasses as well as forbs and woody plants were consumed on approximately 75 percent of the area. Some of the more mesic sites, such as riparian areas and aspen stands and large meadows throughout the burned area maintained some residual forage. Depending on the moisture received in the next two years, there may be a slow response of grasses, forbs and shrubs to regenerate the high and moderate intensity burned areas.

Management Area 5.4 emphasizes providing adequate forage and cover for over wintering big game populations. Deer will be less likely to move from their home range due to the fire and tend to utilize shrub and hardwood species for cover. Elk will move in and out of the fire area but population numbers will increase due to the increase in forage caused by the burn.

Road/trail yearlong and seasonal closures are no longer effective due to the fire. Screening cover adjacent to roads is no longer providing escape cover for deer and elk in the area as the fire has consumed much of that vegetation. Since the fire, the potential for big game disturbance from motorized vehicles increases due to lack of cover and the number of roads open to motorized use. During hard winters, when summer fat reserves are already stressed, the added expenditure of energy to escape from disturbance has been shown to be the key variable in winter mortality rates in big game.

A portion of the Battle Creek fire was in the South Dakota State Fish and Game Department's hunting unit 9. Unit 9 was created by the department to help alleviate depredation problems on adjacent private lands from big game but with special emphasis on elk populations. The fire has now created more forage for big game, which will ultimately increase elk populations in the future. Immediate effects of the burn (loss of forage/cover), may cause more problems on adjacent lands this fall such as depredation of hay meadows. Long term effects could be alleviated by harvest regulations.

Snags, Down Wood and Water

The Battle Creek fire created numerous snags (dead trees). It is difficult to overestimate the importance of large diameter trees, snags, and dead, downed wood to many species of wildlife in the Black Hills. Fire and snags have a complex relationship, where fire converts live trees to snags, but they also burn into the already decayed snags and cause them to fall. Fires may "case harden" trees killed by fire causing the outer wood to decay slower thus also reduces the availability of these snags for nest excavation but slows the rate of decay after they fall to the ground. Fire may facilitate decay of surviving trees by providing an entry point for insect and diseases that cause decay. It is also difficult to determine the longevity of fire-injured trees to provide nesting habitat (cavities) before they fall. For trees that experienced under burned and moderate crown scorch, they may remain alive to two years but eventually succumb to decay processes. Longevity for ponderosa pine snags is positively related to tree age and size at death.

Fire both destroys and creates woody debris. However, most large downed logs are not abundant immediately post-fire. This process takes up to 20 years when the trees killed by the fire eventually fall. Downed wood created by fire decays more slowly due to case hardening from the fire. During field reconnaissance, very little downed wood was observed that survived the fire. Most stumps are now burned out holes. Species that had previously used down wood and vegetation are now exposed to predators. These species use of the area will decline in the short term but will return over time as snags fall to the forest floor.

The fire did not affect three of the guzzlers, two were damaged, and the remaining four were destroyed or damaged beyond repair.

Guzzler burned in the Battle Creek Fire

Other Species

The only known active goshawk nest stand was destroyed by the fire, but some of the area around the nest stand was only partially burned by the fire. Goshawks are expected to continue to use this territory but find another nesting stand. In addition, there may have been two additional goshawk territories affected by the fire based on territory size of this species. Since the nest locations for these territories had not been determined pre-fire, it is difficult to assess the effects of the fire.

Before and after shots of a goshawk nesting area

Caves and karst landscapes are especially vulnerable to changes that occur above this formation. The integrity of any karst system is dependent upon the relationships between water, land, vegetation and soils. Any disturbance in the hydrologic system will threaten the karst and those caves that have a continuing relationship to the water levels or water quality. Changes in soil cover, salutation of waterways, changes in water flow, and changes in vegetation cover can have major impacts. The Battle Creek Fire is a disturbance in the karst landscape and may have impacts to caves that provide habitat for bats, recreational value and cultural value.

It is possible that caves/mines will be located later on that will need protection and monitoring. The Battle Creek fire can potentially impact the use of caves for bat populations below the fire such as Rushmore Cave by increasing water levels and moisture regimes that could cause changes in maternity and hibernacula use. However, Jewel Cave has yet to notice any changes in the cave's microclimate of the Jasper re.

nsitive snail species located by Frest and Johannes (2002) were not affected by the fire. abitat (limestone outcrops) does exist in the fire area. Most of these areas, especially estern and north facing slopes were only slightly impacted by the fire (underburn).

he Battle Creek Fire burned to a lesser extent in riparian areas, and meadows. The fire was ely responsible for the destruction of sensitive butterfly species egg masses located within e burn area. The Battle Creek Fire, however, will likely increase the vegetative diversity in e area, thus increasing the potential habitat for each of these butterfly species, especially the gal Fritillary.

hile some reptiles may have escaped the fire in underground burrows and rock crevices, hers may have perished as down logs and snags burned. In high and moderately burned areas of the fire little or no cover remains for these species making them susceptible to predation by raptors. Additionally most of their normal prey base has been lost. Populations of reptiles are likely to decline for a couple of years until vegetation and down wood accumulate again. Re-colonization will likely occur from adjacent unburned or lightly burned areas.

Amphibians are generally associated with aquatic or riparian habitats, which are very limited in the burn area. Most riparian and aquatic areas were lightly burned or were not affected directly

by the fire. However, loss of vegetation above these habitats may cause degradation of water quality and water quantity short term. Since amphibians are impacted by changes in water pH and more importantly loss of moist wet sites caused by loss of over story vegetation, the fire will have direct impact to amphibians that are utilizing these areas. In addition, rehabilitation efforts, salvage recovery efforts and other management activities that cause soil loss and erosion would continue to affect these habitats for at least 5 years. High precipitation events would likely scour these areas and add ash and debris to the streams and low-lying water catchments. However, as with most burn areas, the lack of ponderosa pine cover will likely expand the hardwoods along these riparian habitats and increased water flow resulting from the loss of trees. Additional springs may appear.

RECOMMENDATIONS

- Do not remove any live trees (>33% live canopy) within the moderate and high intensity burn areas including the timber sale areas unless stand conditions warrant management (e.g. thinning). Whenever possible, negotiate to substitute standing dead for live volume.

- Do not vegetatively treat Management Area 3.7 (Late Successional Landscapes).

- In or adjacent to all salvage areas, leave some of the largest diameter dead trees for snags (<14" DBH and <10' in height). Snags of various sizes include these large snags should be left in clumps of 5-10 acres and should be spatially dispersed across the landscape.

- Leave salvage logging slash on-site to provide ground cover small mammals, provide protection for browse species and where it will prevent soil movement.

- Actively work with adjacent landowners, SD Game Fish and Parks Department and other organizations to reduce depredation problems on private lands due to big game.

- Maintain green tree cover areas within management area 5.4 and consider treating adjacent stands to promote development of thermal cover.

- Discourage livestock grazing and wild ungulate grazing in hardwood stands that experienced moderate to high fire intensity during the next 5 years to allow regeneration of these stands.

- Defer livestock grazing in high and moderate intensity burn areas, especially in Management Areas 5.4 and 3.7, until vegetation/ground cover is determined through

monitoring data to be adequate to provide forage for big game and livestock use concurrently.

- Review goshawk structural stages in goshawk Post Fledgling Areas prior to harvesting of green trees. Adjust silvicultural prescriptions to meet the Forest Plan standards and guidelines for Goshawk management.

- Do not salvage log around openings of caves and mines following Forest Plan standards and guidelines.

- Implement the existing travel management plans for the Beagle, Hollow and Bitter Project areas. Maintain administrative access where needed for fire protection.

- Consider area closures (seasonal or yearlong) for motorized vehicles with designated open roads, especially in Management Areas 5.4 and 3.7.

- Remove hazard trees only along roads that will be maintained for access (administrative and public).

- Repair or replace water developments such as wildlife guzzlers, spring development and water catchments. In stock tanks and guzzlers, provide wildlife escape ramps to prevent accidental drowning of wildlife species.

OPPORTUNITIES

- Consider use of prescribed fire for maintenance of early seral stage areas in long-term project design.

- If planting ponderosa pine, consider interspersion of cover and forage areas for big game.

- In areas of bare mineral soil, consider lightly seeding in fall of 2002 with a mix of winter wheat, oats, and triticale.

- Consider working with SD Game Fish and Parks Department and other organizations to provide information to adjacent landowners that will prevent depredation problems.

- Consider revising allotment management plans along with re-aligning livestock pastures to provide for adequate forage for both livestock and wildlife species. Incorporate direction for fires and drought conditions within management plan. Avoid riparian

areas, which may develop from increased water flow. When replacing enclosures fences around riparian areas, consider the likely expansion of the area due to increased water flow. Fence new spring areas from livestock to protect spring source.

- Consider surveying the burn area for additional cave resources (bat habitat).

- Consider providing a recreational area specifically designed for 4x4-motorized vehicles that would protect sensitive areas while providing an exceptional recreational experience of this type near Rapid City. Work with 4X4 driving groups to help in the design, management and prevention of overuse of the area.

- Consider using snag falling to close roads that have been determined to cause resource damage.

- Consider closing the road in lower portion of Teepee Gulch (FSR 366) to motorized travel to protect riparian and stream habitat from soil erosion that has decrease water quality. Work with four-wheeled drive groups to provide another area for 4X4 use that will not impact sensitive areas. Improve and gravel the upper portion of road in Teepee gulch to provide safe access to private landowners and protect waterways from soil sedimentation due to road drainage problems.

- Consider a Travel Area Closure for Management Area 3.7 (Battle Creek and Bobtail Gulch), Foster Gulch and Teepee Gulch Area, where streams are severely impacted by poor location of roads (in the stream) and recreational use of those roads.

MONITORING AND RESEARCH

- Study and Monitor the effects of motorized travel on roads on big game populations on the forest, especially in the Battle Creek fire area . The study should incorporate other burn areas and other studies of big game in the Black Hills. Study would help with future Forest Plan management decisions and post fire recomendations regarding travel management and road use effects to big game.

- Monitor response of grasses, shrubs and hardwoods using various techniques (e.g. robell pole method) to provide empirical data of post fire response of these species in the Black Hills. Incorporate data into allotment management plans and annual operating plans for the Battle Creek fire area.

- Monitor fall rates of fire-caused snags.

- Monitor post-fire bird diversity in various burn intensity areas.

- Monitor use of known springs and riparian areas by amphibians and reptiles.
- Monitor new springs and seeps for colonization by snails, amphibians and reptiles.
- Monitor use of fire-caused snags by forest bats, woodpeckers, and other snag dependent species.
- Monitor small mammal response to fire conditions and changes in downed wood and structural stages.

HERITAGE RESOURCES

Pre-fire Conditions

Sites represented in the Battle Creek Fire area are variations of the historic themes in the Black Hills Region, including railroad beds, stage routes, mining, logging, camps, and many examples of Civilian Conservation Corps works. One of the most significant sites is the Rockerville flume, located at the northern boundary of the fire. The flume was constructed in 1880 to facilitate gold mining in Rockerville Gulch. The old timbers and rock retaining walls used by the miners can be seen along the trail. Currently used as a recreational hiking trail, it is an interesting trail because it is nearly level and passes through two very narrow tunnels carved out by the flume makers more than 100 years ago.

In total, three eligible prehistoric sites, one unevaluated historic site, and one eligible historic property are located within the Battle Creek fire boundary. In addition, 25 historic properties and six prehistoric properties located within the fire perimeter have been recorded and evaluated as not eligible for nomination to the National Register of Historic Places.

File searches conducted for cultural resources revealed that 73 percent of the area within the Area of Potential Effect (APE) for the Battle Creek Fire had been intensively surveyed. Approximately 1,345 acres were surveyed during suppression reconnaissance. This leaves approximately 1,500 acres of national forest lands to be surveyed.

Post-fire Conditions

Each of the known eligible or unevaluated properties was inspected. One historic site, (Rockerville Flume, 39PN0377) was impacted through construction of fire line by bulldozers. The impact was to a portion of the flume bed and a ditch channel. Hand and mechanical rehabilitation of the fire line was recommended as a suppression rehab taks, and is being carried out under the supervision of the Resource Advisor and District Archeologist.

A total of eight sites were exposed to high levels of fire intensity. Historic properties containing wood features were severely impacted. Open surface scatters of lithic material were also altered in these high fire intensity areas. A total of 16 sites were exposed to moderate levels of fire intensity, while seven sites were exposed to low levels of fire intensity. The Rockerville flume received varying degrees of fire intensity along approximately four miles that were within the fire perimeter. The fire did not impact three previously recorded properties, located in unburned areas.

Currently no Traditional Cultural Properties (TCPs) have been formally identified within the Battle Creek Fire perimeter. An area located in the northern portion of the fire area, reportedly contained locations of spiritual use. Prayer bundles and tobacco ties were noted. The fire impacted two of these locations; however, none were damaged by suppression activities. The sites represent small, probably family oriented use, and the area should be noted for such use, during any current and future activities.

Three new heritage resource properties were recorded through an inventory of suppression activities. All three are historic. None of these sites required any rehabilitation efforts.

Damage in the burned area

Recommendations

- The Forest would recommend to the South Dakota State Historic Preservation Office (SD-SHPO) that only one of these newly discovered sites exhibit high potential for research and public benefit. There is a potential for additional significant unrecorded sites to be located within the Battle Creek Fire area. These sites will be evaluated and consulted upon in the Suppression Rehabilitation Heritage Resource Report (FSID 2002020300107).

- Eligible properties should be managed for research and long-term public benefit. Benefits could include on-site field schools such as Passport In Time projects or off-site programs and interpretive products.

- Sites located during surveys need to be evaluated due to risk of loss from the fire's effects. The need for additional site evaluations and damage assessments may be identified as a result of the file search currently being conducted.

Monitoring and Evaluation

- Eligible properties at risk due to post-fire erosion should be monitored. Monitoring of a sample of previously determined ineligible sites should be carried out to determine if additional information is available due to fire effects.

- The Battle Creek Fire area could be used as an analysis area for the study of fire effects on heritage resources. Data concerning the effects of fire is a critical element in the development of heritage compliance strategies for prescribed and wild fire events. The mosaic character of the Battle Creek Fire and the presence of a variety of heritage resources would provide a unique opportunity to compare and contrast impacts to a variety of site types by different levels of fire intensity.

RECREATION

Pre-fire Conditions

Prior to the Battle Creek Fire, the majority of recreation activities in the burn area were dispersed recreation. These included hiking, dispersed camping, hunting, berry picking, off road motorized travel, and driving for pleasure.

The Flume Trail National Historic Trail is the only designated trail in the burn area. Trail use is by foot only; horses, mountain bikes, and ATVs are prohibited. The trail is extremely popular, particularly with people from Rapid City. The trail was in good condition prior to the fire.

Post-fire Conditions

As a result of the fire, dispersed recreation activities are currently not allowed due to the safety hazards created by dead and unstable trees within the burned area. Directional and informational signing in the burned areas has been destroyed

Portion of the Flume Trail damaged during the fire

The Flume Trail has been damaged as a result of fire suppression efforts. Two segments of the trail have had ground disturbance to the point of the trail surface being removed. An estimated 100 trees along the burned area of the trail have been destroyed or damaged. The trail was closed following the fire. Rehabilitation work has started on the trail to repair the surface and drainage back to standard. Additional work will be need beyond the suppression rehab efforts.

Recommendations

1. The priority is the reconstruction and reshaping of the Flume Trail (currently in progress) to allow the public to use the trail prior to the winter months. Directional signing for the trail should be ordered immediately to be in place prior to the trail reopening, expected to occur in November 2002.

2. Remove an estimated 100 hazard trees within the trail corridor in concurrence with the Flume Trail reconstruction.

3. Informational/interpretative signing does not need to be in place prior to reopening of the trail. Ordering of the signs can be accomplished during the winter and available to install in May 2003.

4. Once hazard trees are removed from the main access routes into the burn area, the public can be allowed access for dispersed recreation.

Evaluation And Monitoring

1. On an annual basis, prior to summer recreation activities, the district trail crew should determine the status of the Flume Trail for the safety and resource problems.

2. The public's enjoyment of the dispersed recreation activities within the burn area will be evaluated through either direct contact with the users and/or through contacts with the districts frontliners and recreation staff.

VISUALS

Pre-fire Condition

The Battle Creek Fire burned into the viewshed of US Highway 16, State Highway 40, County Roads: 330 (South Rockerville Rd), 235 (Neck Yoke Rd), 233 (Silver Mt. Rd), and 228 (Sheridan Lake Road). The fire burned near the communities of Harney, Hayward, Keystone, and Rockerville, as well as north and south into the forest. Meadows and forested lands burned in a combination of low, medium, and high fire intensities, creating a mosaic pattern across the landscape.

The Valued Landscape Character Unit across this landscape is: Gently Rolling Terrain/ Ponderosa Pine/Prairie Grass, which includes ridges and valleys, timberlands and grasslands. The forest appears much denser today than that evident in the photographs taken during the U.S. Military Expedition through the Black Hills in 1874. Few, if any, dead trees are evident on the landscape today, where as, in the photos taken during the Expedition, large portions of the landscape display the effects of insect, disease, or fire activity, in the form of standing dead trees. The landscape evident in those photos is diverse in that there are a variety of tree sizes and densities, natural openings, and the rock formations the Black Hills are noted for, are readily evident. The area, before the fire, is densely covered with a carpet of pine trees. Meadows are small and generally not evident, as pine trees have encroached into them. Few meadow or non-forested areas are evident after leaving the prairie. The vegetative patterns that were once dominant are no longer visually evident. The rock formations, screened by the trees, are hidden as well. Generally the forest on private and national forest lands have been managed in a similar manner so you cannot tell where one starts and the other ends – it is a continuous carpet of vegetation.

The topography south of Highway 16 is in the transition zone between the plains and the foothills of the Harney Mountain Range. Relief is limited, and thus visibility from all roads is generally limited to Foreground (1/4 mile and less) views. The topography north of Highway 16 increases significantly and could be considered the start of the foothills of the Harney Mountain. Range. Silver Mountain is prominent from both east and westbound traffic along Highway 16.
US Highway 16, State Highway 40, Sheridan Lake Rd (County Rd 228) are routes through the national forest with a high level of public concern for scenery (Sensitivity Level 1). Management activities within four miles of the highway (Foreground & Middleground) blend in with the surrounding landscape so completely that they are not evident along these three routes (they meet a High level of Scenic Integrity).

Other main roads through the area that have a moderate level of public concern for scenery (Sensitivity Level 2) include the Silver Mountain Road (County Road 233), and South Rockerville Road (County Road 330). Management activities within 1/2 mile of these highways (Foreground) blend in with the surrounding landscape so completely that they are not evident along these three routes(they meet a High level of Scenic Integrity) .

Highway 16 is a divided high-speed route that receives more than 4 million vehicles annually (*Regional Office – Rapid City, South Dakota Dept of Transportation*), many of them traveling to and from Mt. Rushmore National Memorial. The topography along Highway 16 is rolling with views into the Foreground and distant views into the Middleground.

Along State Highway 40, through the towns of Harney and Haywood, the road is a low-speed scenic route that winds through the rolling foothills and narrow valleys. The topography is such that there are limited views beyond the Foreground.

Sheridan Lake Road (County Road 228) is a low-speed scenic route that winds through the rolling hills and parallels a portion of Spring Creek. The topography and vegetation limit views to the Immediate Foreground. However there are locations along the route where the North side of Boulder Hill and Silver Mountain are evident.

Post-fire Condition

Post-fire: Silver Mountain landscape, west side.

The fire has drastically changed the vegetation across this landscape (see Fire Intensity Map).

		Acres of Fire Intensity		
Scenic Integrity Objective	SIO Total Acres	High	Moderate	Low
High	1360	340	300	720
Moderate	3880	895	1010	1975
Low	3835	1045	963	1827
Totals by Intensity		2280	2273	4522
USFS Lands w/in Fire Area	9,120			
Other Lands w/in Fire Perimeter	3,330			
Total Fire Area	12,450			

Half of the fire area on national forest lands (approximately 4,553 acres) are in the "Moderate" or "High" Fire Intensity classification. Approximately 100% of the vegetation is killed in the High Intensity areas and an estimated 80% in the Moderate Intensity areas.

Those areas with a High and Moderate Scenic Integrity Objective (approximately 5,240 acres) are generally visible from the highways where there are public concerns about the scenic beauty. Approximately half of this area, 2,545 acres, is in a Moderate or High Fire Intensity classification. These areas are generally visible on the upper 1/3 of the foothills. In most cases, there are areas of live vegetation between the viewer on the highway and these severely burned areas. In addition, these burned areas are visible as only a portion of the viewed landform.

The exception to this is Silver Mountain along Highway 16. Approximately 90% of the vegetation across this landform is in the Moderate-High Fire Intensity.

Highway 16, and the other roads traveled by the public, will continue to receive the same level traffic. Severely burned ridge top vegetation throughout the fire area will be visible for short durations along all these main roads of concern. Rock formations along the ridgelines will become more evident as the fire-killed vegetation decays and falls over. A vegetation pattern

is now evolving on the landscape that may be similar in scale to that which is evident in the 1874 Expedition photos.

Recommendations

- Consider trying to maintain portions of the existing pattern that has been created – a transition zone – between the prairie and the forest.

- Minimize visual impacts of roads.

- Consider removing small trees within the immediate foreground, along main travel routes.

- Coordinate management activities with private landowners, utility companies, and others, to limit negative visual effects and create naturally appearing boundaries and vegetative to openings – patterns in the landscape. Coordinate efforts to enhance meadow and hardwood restoration efforts.

- Consider an interpretive site near the fire, in a scenic setting, along a major highway to interpret the Battle Creek Fire event and an aspect of the fire ecology.

- The photos on the following page show the existing condition, and a rough estimate of the vegetative pattern that has been created by the fire. Management activities need to consider preserving, and where possible, enhancing, the overall natural appearance on all sides of this mountain. Consider activities that will maintain the natural vegetative pattern, diversity, and seasonal color. Consider avoiding activities that would create un-natural appearing lines on this landscape. Consider activities that would stabilize the soil on steep slopes that could erode and create soil color contrasts, such as along the south slope of the mountain. Consider planting native grasses and wildflowers to compete with the natural regenerating pine in areas where we want to maintain the existing pattern of openings.

Post-fire: Silver Mountain landscape, east side, viewed from Highway 16.

Potential Summer View: Silver Mountain landscape, east side.

Potential Winter View: Silver Mountain landscape, east side.

Evaluation and Monitoring

The forest should conduct a forest-wide monitoring effort, at 5-year intervals for 10 and possibly 15 years, to determine the effectiveness of management activities on visuals in burn areas:

- To maintain and enhance natural appearing vegetative patterns
- To create natural appearance of managed land boundaries with private land
- To limit creation of soil contrast and erosion control
- To encourage hardwood and meadow restoration in fire areas

RESOURCES ON PRIVATE LANDS

Pre-fire Conditions

Pre-fire conditions on private lands were much like those found on national forest land. If forested, the vegetation consisted mostly of ponderosa pine, intermixed with patches of bur oak, quaking aspen and paper birch. If non-forested, the vegetation consisted of various shrubs, grasses and forbs.

Some properties had been actively managed. Stands within the fire consisted of a variation of pre-commercial, post or poles, and commercial size trees.

Post-fire Conditions

The Battle Creek Fire affected 3,301 acres of private lands. There is no known State land affected. According to county 911 mapping, fifty known structures were in the burn area and possibly 20 more structures were unmapped. Three residences and several outbuildings were burned in the fire. Numerous other residences were threatened by the fire, but not directly affected.

Impacts on private lands will be similar to those on National Forest System lands. These include amount and timing of water flow, sediment loading changes, weed infestations, fence damage, wildlife use patterns, and impacts to stock tanks.

Burn intensity varied from low to high across private properties.

- Low-intensity: many tree crowns are all, or partially, green
- Moderate intensity: many tree crowns are entirely or almost entirely scorched
- High intensity: trees are devoid of needles.

Recommendations

- It is recommended that trees with 2/3 or more of the crown scorched or devoid of needles be removed as soon as possible due to the chance of infestation by wood borers and/or bark beetles. Wood borers decrease the value of the wood by tunneling through the heartwood of pine. They can also introduce blue stain fungi to trees, causing discoloration and an entrance for other fungi to degrade the wood. Bark beetles also allow blue stain fungi to invade the wood. The populations of these insects have increased in the Black Hills over the past 3-4 years due to storm damage and other fire events.

- According to reports from the Forest Service entomologist, red turpentine beetles, Ips and woodborers were found in the fire area. These attacks were on heavily burned or scorched trees. Due to the late infestation of these insects, larvae are not expected to mature much more this fall unless temperatures remain warm throughout the early fall months. High value landscape pines should be sprayed as a preventative measure against insects.

  SD RC&F has cost-share assistance money available through the Bark Beetle Program for removing and disposing of trees infested with mountain pine beetle or Ips, but the beetles must be active in the tree. Details of this program can be obtained through your local SD RC&F office.

- Moderately burned trees with 50% or more green foliage remaining have good chances of surviving fire damage but are highly stressed and may be more susceptible to insect attack next spring. Assistance can be requested from the SD Division of Resource Conservation and Forestry (SD RC&F) to determine which fire-damaged trees should be removed. No cost-share is available for salvaging burned timber.

- Natural regeneration of ponderosa pine is expected in areas of low to moderate burn intensity and in areas near living seed sources. Cost sharing through the SD RC&F may be available in the future, for replanting areas of high intensity burn.

- It is also recommended that where salvage operations are done slash be left in areas with little or no ground cover in order to disperse precipitation and decrease erosion. The State Slash Law (21-10-26) must be followed, which states that "all logging slash must be lopped and scattered so that it will not exceed 18 inches in depth on any part of the logged area… or it must be chipped."

- Private landowners need to be aware that they may experience depredation problems caused by wildlife. Concerned landwoners may contact the South Dakota Department of Game, Fish and Parks for advise and/or technical assistance.

- Landowners should be aware that many private fences were damaged as a result of the fire. Fences adjacent to Forest Service grazing leases should be repaired prior to the 2004 grazing season.

- Soil erosion, sedimentation, and flooding may occur in the area now that much of the vegetation has been removed. Wet areas may also develop in places that were previously dry. this could affect private lands in many ways. the U.S. Natural Resource and conservation Service (NRCS) is available to work with landowners on these issues.

- Landowners should evaluate their property, making their homesites more fire-safe. Specific recommendations can be acquired from the local fire department or the South Dakota Division of Wildland Fire Suppression.

- Landowners should consider overall management of their forest lands. Cost share is available for thinning projects and forest management plans. Contact South Dakota Department of Resource Conservation and Forestry.

- Recommend all South Dakota Best Management Practices (BMPs) be followed during all salvage and/or cleanup operations.

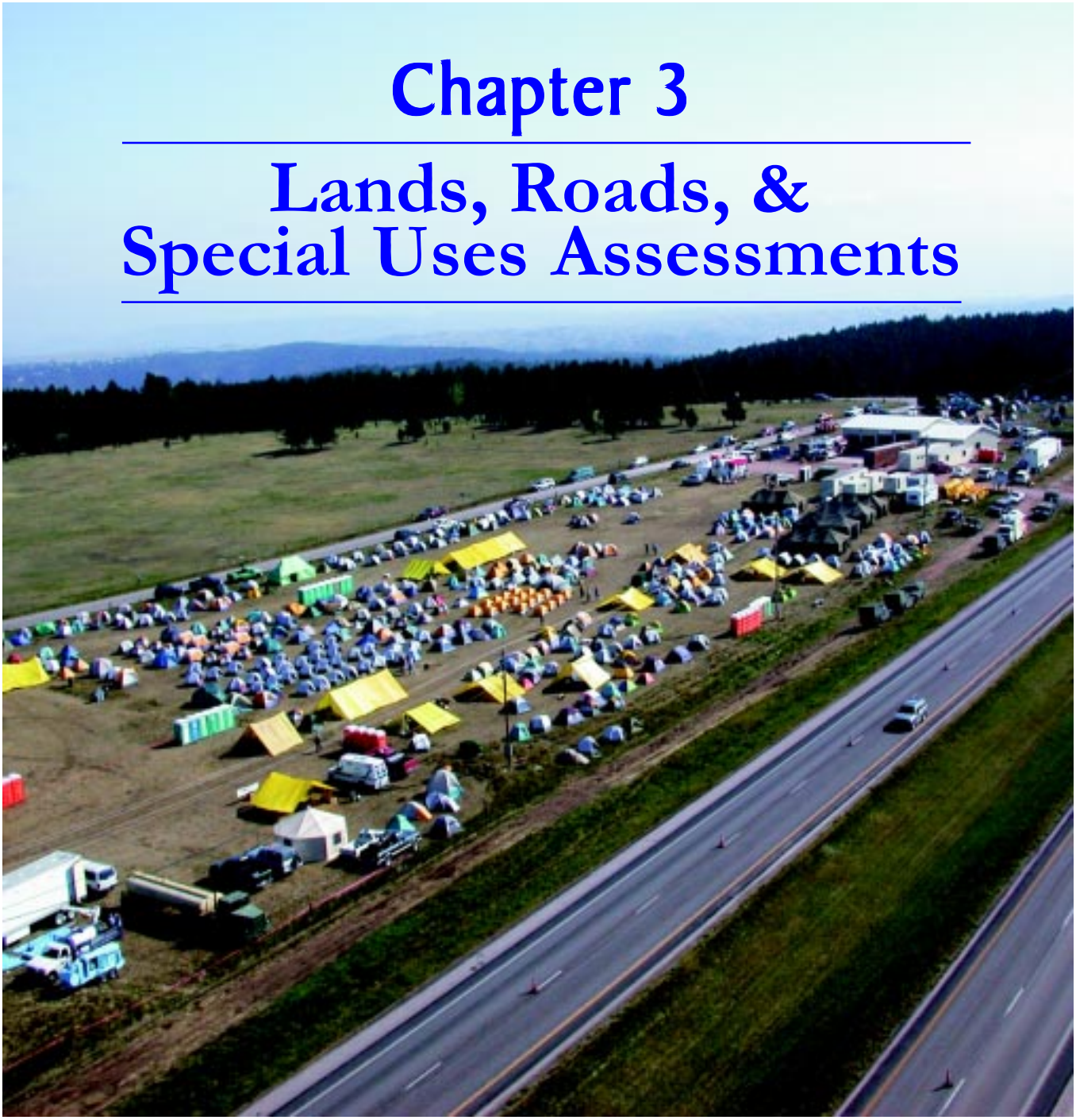
Evaluation and Monitoring

Scorched ponderosa pine that have a good chance of surviving should be monitored through September of 2002 and beginning again in April of 2003 through the summer of 2003 for insect infestation. All beetles will continue to fly throughout the month of September (depending on the weather) and Ips beetles may start flying again in the month of April. Symptoms to look for include sawdust in bark crevices or around the trunk of the tree, coin-sized sap globs (pitch tubes) on the trunk of the tree, BB-size holes (Ips) and ¼" lip-shaped holes (wood borers). SD RC&F will provide assistance to landowners in determining infestations by request.

Fire retardant on structure

Chapter 3

Lands, Roads, & Special Uses Assessments



ROADS

Pre-fire conditions

There are approximately 56 miles of classified national forest system road within the perimeter of the fire and an estimated 45 miles of "non-system roads" (unclassified) or other roads that had been closed or otherwise considered unnecessary for the management and use of the National Forest. Many of the unclassified roads had been closed or grown shut.

Post-fire conditions

Many of the unclassified roads were reopened during fire suppression efforts as fire breaks (dozer lines) and for equipment access. An estimated 28 miles of roads are within moderate and high severity burn areas (16 miles of classified and 12 miles of unclassified).

The Burned Area Emergency Rehabilitation (BAER) report covered those roads that are at risk within moderate and high severity. BAER also identified the need to clean and maintain the drainage structures on all of the Forest Service roads (both classified and unclassified) in all areas within the fire perimeter, with the exception of those unclassified roads that may be re-contoured. Drainage cleaning specified in the BAER report should also include cattle guard cleaning.

Hydrologic analysis has been completed on a number of culverts on Forest Service, County, and State roads.

Recommendations

Begin work as soon as possible to implement the described work activities. Since other rehab work is in progress, it's important to accomplish as much as possible this field season.

Work not covered by BAER includes the following:

- Blade, shape, and define road templates for all system roads within the fire perimeter (56 miles).
- Replace surfacing lost on Beretta Road.
- Remove debris within defined channels upslope from drainage structures.

HAZARD TREES

Pre-fire conditions

Hazard trees along the roads and trails were treated on a case-by-case basis as the hazard was found along trails and open roads. Hazard trees were not treated along closed roads. Trees were generally sound, interspersed with limited numbers of diseased or dead.

Post-fire conditions

Many trees along the classified roads (16 miles) and unclassified roads (12 miles) within the moderate and high severity burned areas are dead and hazardous. Any road that had been closed by vegetation is now open. Hazards from falling trees now exist along 28 miles of road.

Recommendations

- The BAER request identified the need to treat 1,400 trees along roads within moderate and high severity, treat 100 trees along the burned portion of the Flume Trail, and complete further hazard tree assessment. Specifically hazard trees greater than 6-inch dbh should be directionally felled along contours to prevent jackstrawing.

- Further treatments are recommended along all roads that are open to use. Those roads that will be re-contoured will not need to be treated.

Evaluation and Monitoring

Annual monitoring to be conpleted by district timber and Recreation Resource Personnel.

TRAVEL MANAGEMENT

Pre-fire conditions

Prior to implementation of current travel management decisions, there are 56 miles of national forest system roads and 45 miles of non-system roads within the perimeter of the fire, bringing the total to 101 miles.

Travel Management decisions are currently covered under three separate resource decisions. The entire burned area had been included in the Hollow, Lakes, and Beagle NEPA decisions. Road decommissioning and implementation of the travel management decisions had not been completed since timber sale activity was ongoing or yet to be started.

The travel management analysis process was made using public input. All roads were identified in the analysis and decisions were made. Roads fall under the categories of:

1. open to motorized vehicles (66 miles open year long)
2. closed to motorized vehicles seasonally or yearlong (8 miles closed seasonally and 17 miles closed year long) and
3. roads to be decommissioned through obliteration or some other means (10 miles) for a total of 101 miles. See the Travel Management map.

Post-fire Conditions

An estimated 28 miles of all road mileage (16 miles of classified and 12 miles of unclassified) are within moderate and high severity burn areas.

All opportunities for road screening and use of vegetative natural barriers were eliminated within moderate and high severity burned areas.

Fire suppression rehab continues on 52 miles of dozer and 2 miles of hand line. Approximately 7 miles of system roads and 7 miles of non-system roads were used for control lines.

Since a large portion of the area is burned, affects implementing travel management decisions (from the Hollow Lakes and Beagle NEPA decisions) at this time will be minimized.

Travel Management Map

Recommendations

- Implement existing Travel Management decisions immediately in those areas that are not affected by resource projects such as current timber sales and fire salvage projects.

- Apply effective road decommissioning methods.

    - Recontour roads to original slope
    - Use natural materials such as stumps, rocks and slash
    - Discourage "challenge barriers" such as tank traps and other unnatural barriers

- Apply effective road restriction methods for limiting use.

- Issue new orders regarding temporary post-burn resource needs such as soil and water protection, weed prevention, wildlife habitat needs and public safety.

    - Area closures to all off road motorized use in burned areas.
    - Restrict all motorized traffic to roads identified with a route marker within the burned area.
- Request additional law enforcement assistance to enforce road and area closures.

- Inform and involve user groups in implementation of these decisions.

Evaluation and Monitoring

- All methods used to implement travel management decisions must be regularly field checked to determine their effectiveness.

- Ask adjacent private landowners and the general public using the burn area if barriers are working or if changes are needed.

- Annual monitoring to be completed by engineering personnel.

LANDLINES

Pre-fire Conditions

Prior to the start of the Battle Creek Fire, all landline survey work had been completed designating the boundary between the Black Hills NF and private landowners. This represented approximately 24 miles of posted line.

Post-fire Conditions

The fire impacted approximately 18 miles of posted landline by burning the boundary signs and posts, witness trees and other designations of the legal boundary line.

Recommendations

- The remarking and resurveying of witness trees and corner markers should be accomplished immediately where the private property lines are within existing or proposed timber sale boundaries.

- Landlines to be reposted outside of existing timber activity, but adjacent to known encroachment cases should also be completed as soon as possible, to assist adjoining landowners in constructing new fences and/or remove personal property from the national forest.

- Any other remaining landlines should be reposted, following the completion of those in categories listed, above.

Evaluation And Monitoring

- Routine landline monitoring and maintenance of area is recommended.

SPECIAL USES

Pre-fire Conditions

Prior to the start of the Battle Creek Fire, Special Use authorization within the burn area consisted of utility lines, private road easements and snowplowing and road maintenance permits.

Post-fire Conditions

As a result of the fire, segments of the Black Hills Electric Coop and Quest Telephone Company utility lines have been damaged. In addition to the actual line damage, trees along the utility right-of-ways that have been killed or damaged by the fire will need to be removed to prevent them from falling onto undamaged lines.

Private road easements are undamaged by the fire suppression efforts of dozer and handline construction.

Snowplowing and light road maintenance permits issued to private landowners or road districts apply to Forest system roads. Many of these roads were used in the fire suppression effort as dozer lines, and were widened with the ditches removed or buried.

Utility companies are repairing their power and telephone lines that were damaged by the fire. These companies will require access to the lines through both private and national forest road systems. A preliminary review of the travel management restrictions in the burned area indicates that roads leading to the damaged lines will be left opened. Work on the lines will begin immediately. Removal of damaged or dead trees adjacent to the right-of-ways will be the responsibility of the utility companies. Access to these areas will have to be by existing roads or driving along the existing utility right-of-ways.

Progress on the system roads damaged by fire suppression efforts has already started. Rehab work currently being completed on roads where snowplowing and light maintenance permits have been issued should be completed by early October 2002. No additional work is anticipated these roads.

Recommendations

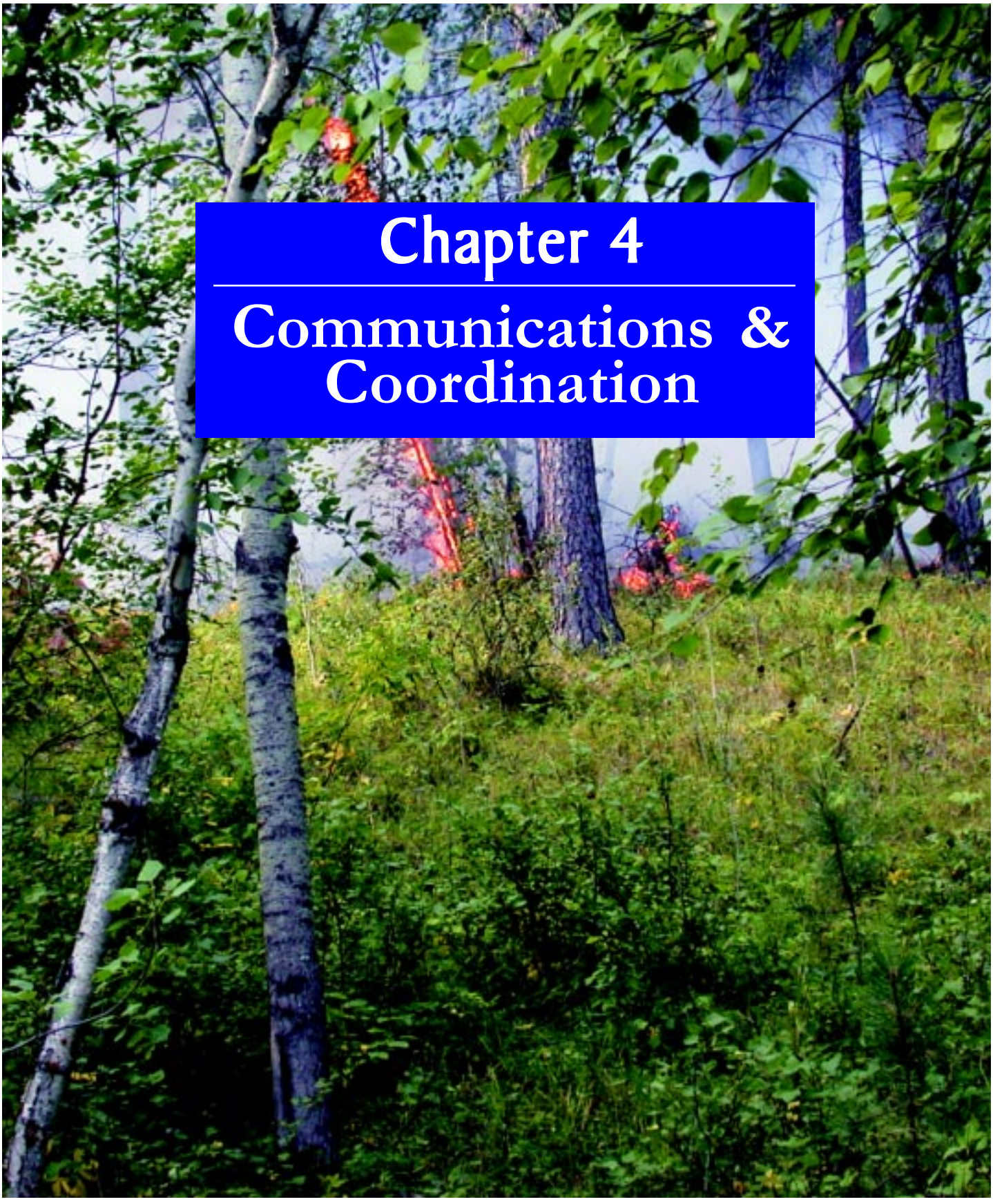
There are no actions recommended at this time. However, the following points should be noted:

- District staff will oversee the removal of merchantable trees within and adjacent to the right-of-way. Any removal of trees with timber value will be cruised or scaled to determine a price for the utility companies to purchase.

- Replacement of utility lines and/or poles will require complete removal of damaged items from the National Forest.

Evaluation And Monitoring

As requests for access are received by the utility companies to access both their damaged lines and dead tree removal areas, the district will evaluate the needs of these roads and any possible resource damage that may result.



Chapter 4

Communications & Coordination

COMMUNICATION STRATEGY

The Battle Creek Rapid Assessment involves scientific, technical, and social elements. While science and technical analysis may lead us to the correct decisions from a resource perspective, the effectiveness of, and support for the decisions (or lack thereof) is what will make or break the success of our efforts. This communication strategy aims to increase public confidence that the Battle Creek Fire recovery issues are being handled responsibly, therefore increasing our chances for successful implementation.

Regrowth inside the fire perimeter has begun

Objectives of the strategy are:

- People will understand what is being done, why it is being done, where it is being done, who is doing it, and how long it will take.
- People will know how they can get involved.
- Messages will be clear and consistent across agency boundaries
- Messages will be timely and easily accessed.
- A communication infrastructure will be further developed within the community that will continue to be useful beyond the recovery effort.
- The Strategy will provide a mechanism for feedback to the implementation team and other land managers regarding the effectiveness of recovery efforts and public information.

Problem and Opportunity Statements

The recovery efforts of the Battle Creek Fire present both problems and opportunities in terms of communicating with the affected and interested public.

Problems include:

- Lack of understanding about the role that the various agencies will play in the recovery (who's responsible for what, and who's going to pay).
- Misconceptions about what forest "recovery" means, and how quickly the forest will "recover."

- A sentiment among some that land managers should be doing more to prevent future crises (flooding, mudslides, debris flows, etc.), or to repair past ones (the burned forest).
- A short time frame in which to make and communicate decisions regarding impact mitigation, travel management, safety, and hunting season.

Opportunities include:

- A community audience that is receptive to fire-related messages, including fire behavior and ecology, fire impacts mitigation, fire prevention, and landowner responsibilities for developing fire-safe property.
- Unprecedented opportunities to work with other land manager partners, community partners, media, and individuals to further develop both short and long-term community fire information resources.
- An enthusiastic volunteer workforce that can be developed into long-term forest stewards and agency partners.

Recommendations

- Implement the "Beyond the Burn – Battle Creek Rapid Assessment Communication Strategy" for both short and long-term priorities. The strategy includes key messages and talking points for all communication-related projects, public meetings, and media events. It also describes tasks such as the development of a traveling exhibit, presentations to groups and businesses, media relations, and other items.

- Develop a set of volunteer projects for interested parties that would like to contribute to the recovery of national forest lands. Coordinate closely with other agencies and landowners.

COORDINATION WITH OTHER AGENCIES

The Battle Creek Fire Recovery provides a tremendous opportunity to further develop an interagency structure for current and future multi-agency fire recovery efforts. Because of this opportunity, the Black Hills NF supports the creation of a Recovery Assistance Center (RAC) that will help communities, individuals, and agencies work together in the recovery efforts of the Battle Creek Fire. The RAC could also provide assistance to those affected by the Grizzly Gulch and Little Elk fires of 2002. Most importantly, the RAC could be poised to provide immediate assistance to those impacted by future fires in the Black Hills.

The RAC will need to be interagency, to address recovery issues such as:

- Wildlife habitat and use issues
- Weed infestations
- Soil erosion, and protection
- Salvage of fire killed trees
- Revegetation of burned land
- Tourism associated with outdoor recreation
- Protection of property from post fire floods
- Insect and disease outbreaks
- Road and trail damage
- Disaster preparedness
- Defensible space

Assistance can be provided through the following agencies:

Resource Conservation and Development (RC&D)

RC&D can assist in the recovery of human and natural resources following wildfires. Staff can provide guidance to the local sponsors in the delivery of technical assistance to landowners within their District.

Natural Resources Conservation Service (NRCS)

The NRCS and Pennington Conservation District located in the Rapid City Field Office can provide conservation technical assistance to private land owners affected by the Battle Creek Fire. Information and assistance can be provided on seeding recommendations, erosion and sediment control practices, and other vegetative and/or structural practices such as dikes and diversions.

A number of sites have been identified by the BAER team as being as risk as a result of the increased flows associated with the Battle Creek Fire. If a request is received from a local sponsor, these sites will be evaluated for potential assistance through the Emergency Watershed Protection(EWP) program.

NRCS is responsible for the EWP program. The overall objective of this program is to assist sponsors in implementing emergency recovery measures to relieve imminent hazards to life and improved property created by a natural disaster that causes a sudden impairment of a watersheds function. NRCS provides assistance to prevent damage from flooding, runoff and erosion, and reducing the threat to life and/or property.

If funding is available, NRCS can provide financial assistance covering up to 75 percent of the construction costs of eligible emergency treatments. Local sponsors such as state, county or Conservation Districts may apply for assistance. Local sponsors of EWP projects are responsible for formally requesting assistance, obtaining necessary permits and land rights, providing 25 percent cost-share, and providing for the operation and maintenance of completed measures.

There also may be funding available through various state sources as the implementation unfolds.

SD Division of Conservation and Forestry (SD DC&F)

SD DC&F can provide assistance to private landowners to determine what fire-damaged trees should be removed from private land. No cost-share monies are currently available for salvaging burned timber.

Cost sharing through the SD RC&F may be available in the future for replanting areas of high intensity burn.

Cost-sharing assistance is also available through the Bark Beetle Program for removing and disposing of trees infested with mountain pine beetle or Ips (the beetles must be active in the tree).

Pennington County Fire Administrator, Volunteer Fire Departments, South Dakota Division of Wildland Fire Suppression

These groups are available to provide information and technical assistance for landowners interested in developing defensible space around their homes.

Pennington County Weed and Pest Supervisor

The Pennington County Weed and Pest Supervisor can provide technical assistance regarding the treatment of noxious weeds.

South Dakota Department of Game, Fish, and Parks

SDGF&P should be contacted regarding wildlife depredation issues.

TEAM MEMBERS

Battle Creek Rapid Assessment Team Members

Robert Thompson ..... District Ranger - USFS
Neil Bosworth ..... Team Leader - USFS

Core Team Members and Team Positions

Gene Bolka ..... Noxious Weeds - USFS
Juanita Garcia ..... Archeologist - USFS
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Jessica Gould ..... Hydrologist - USFS
Henry Goehle ..... Fire and Fuels - USFS
Les Gonyer ..... Hydrologist - USFS
Jerry Hepler ..... GIS Specialist - USFS
Steve Keegan ..... Landscape Architect - USFS
Patti Lynch ..... Wildlife Biologist - USFS
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