SECTION 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Section 3 contains the detailed scientific basis for establishing baselines and measuring the potential environmental consequences of each of the alternatives.

A. PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIVITIES

Past, present, and reasonably foreseeable future activities listed in this section are activities known to have already occurred, are currently occurring, or are likely to occur in the vicinity of the proposed Benchmark Fuels Reduction project and may contribute to cumulative effects. These activities and events are primarily located within the Benchmark project area. Immediately proximate fires and prescribed fires were also included in the analysis, as were activities occurring on immediately adjacent private lands. Past harvests, prescribed fire, and human-caused fire damage were considered for the largest area of analysis for the project (the largest area of analysis used for the project was for Grizzly Bear Habitat—see Map A-10).

Natural processes and past and present management activities have contributed to creating the current condition, as described in the Existing Condition portion of this Section. These activities, as well as reasonably foreseeable actions, may produce environmental effects on issues or resources relevant to the proposal. Therefore, the past, present, and reasonably foreseeable activities have been considered in the cumulative effects for each resource area.

The catalog of past projects, to our knowledge, is comprehensive based on information available to the Forest Service. However, there may be some unintended omissions due to lack of current records or knowledge. Information on past activities was gathered from Timber Stand Management Record System database (TSMRS), historic timber sale maps, completed road design packages, District files, aerial photographs, and collective knowledge of local Forest Service employees.

Because cumulative effects vary in time and space, each resource area has defined a specific cumulative effects analysis area in their effects discussion that is pertinent to their specific resource and the issues addressed.

It is important to note that in June 2005, the Council on Environmental Quality (CEQ) issued a memorandum that provides guidance on the extent to which agencies of the Federal government are required to analyze the environmental effects of past actions when they describe the cumulative environmental effect of a proposed action. CEQ interprets NEPA and CEQs NEPA regulations on cumulative effects as requiring analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonable foreseeable effects of agency proposal for action and its alternatives may have a continuing additive and significant relationship to those effects. In determining what information is necessary for a cumulative effects analysis, agencies should use scoping to focus on the extent to which information is

"relevant to reasonably foreseeable significant adverse impacts," is "essential to a reasoned choice among alternatives," and can be obtained without exorbitant cost. The CEQ regulations do not require agencies to catalog or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision-making (CEQ 2005).

However, in response to the 9th Circuit Court ruling in The Lands Council vs. Powell on August 13, 2004, which stated that the Forest Service should have provided adequate data of time, type, place and scale of past timber harvests and should have explained in sufficient detail how different project plans and harvest methods affected the environment, this section contains a thorough catalog of activities that have occurred or will occur within the project area.

1. Past Activities

Fire History

There are three recent historic wildland fires that are within, or extend into, the project area, and two significant wildfires that burned within close proximity to the project area. These fires are listed below and their perimeters displayed on Map A-5. In addition, four prescribed fires that were implemented are listed below. The perimeters of these fires are in close proximity to the boundary (see Maps A-4 and A-5).

Table 3-1. Fire History

Name of Wildfire	Date of Occurrence	Acreage of Perimeter	Cause	Location in relation to project area
Canyon Creek	1988	247,000	Lightning	To south of project area with minor perimeter incursion into project area
Glade Creek	1996	43	Human ignition	Entirely in project area
Cigarette Rock	2006	2271	Lightning	½ mile west of project area
Ford Creek	2006	323	Lightning	<40 acres within project area
Ahorn	2007	52,205	Lightning	Perimeter touches project's northwest boundary

Table 3-2. Prescribed Fire History

Name of Prescribed Fire	Date of Occurrence	Acreage of Perimeter	Method of Implementation	Purpose of Project	Location in relation to project area
Ford/Fairview	1988	608	Broadcast burn, using aerial ignition	Range and wildlife benefits	In proximity to northeast boundary
Ford Basin	1991	200	Broadcast burn, using hand ignition	Range and wildlife benefits	In proximity to northeast boundary
Ford/Fairview	1999	2232	Broadcast burn, using hand ignition	Range and wildlife benefits	In proximity to northeast boundary
South Fork Sun	2003	4300	Broadcast burn, using hand and aerial ignition	Fuels reduction	In proximity to northwest boundary

Past Harvest

The past timber/silviculture and prescribed fire related activities for the Benchmark project are summarized in the following table, according to total acreages treated in each decade. The area of analysis for the Benchmark Fuels Reduction Project varied depending on the resource potentially being affected by proposed activities. For example, the visual quality analysis focused on the area surrounding the Benchmark Road and the proposed treatments. In contrast, analysis for wildlife was based on much broader areas of analysis. The largest area of analysis for the project was based on Grizzly Bear Habitat (see Map A-10). The following table displays past activities--and acreage involved--occurring in this analysis area since 1980, thus encompassing all lands analyzed for this project. The FACTS database was the source of information for the following summary.

Table 3-3. Acres of activity in each decade based on FACTS database.

Management Activity	1980-1989	1990-1999	2000-2008	Total
Hand-piling of activity fuels	99	76	0	175
Dozer-piling of activity fuels	48	22	0	70
Burning of activity fuels (hand piles)	155	120	1	276
Burning of activity fuels (dozer piles)	20	28	6	54
Burning of activity fuels (landing piles)	0	1	3	4
Burning of natural fuels (piles)	0	0	1	1
Natural fuels prescribed burn (shrub/grass)	0	1160	0	1160
Activity fuels prescribed burn (range improvement)	398	300	0	698
Burning site preparation for natural regeneration	8	0	0	8
Construction of fuel break in activity fuels	0	1590	0	1590
Activity fuels jackpot burn	20	0	0	20
Firewood removal in activity fuels	41	0	0	41
Single tree selection cut	13	0	0	13
Sanitation (salvage)	9	0	0	9
Commercial thinning	1	0	0	1
Precommercial thinning (individual or selected trees)	44	28	0	72
Man-caused fire damage	0	27	0	27
Certification of	0	18	0	18

Management Activity	1980-1989	1990-1999	2000-2008	Total
natural regeneration without site prep.				
Certification of natural regeneration with site prep	0	64	24	88
TSI Certification—Thinning	26	28	0	54
Slashing (pre-site preparation	0	89	6	95
Compacting/crushing of activity fuel—trampling	0	20	0	20
Stand Clearcutting (EA/RH/FH)	0	24	0	24
Watershed Resource (non-structurual improvements erosion control)	0	4	0	4

Past/proposed harvest on private land

John Cobb--Cobb Ranch owner bounding Benchmark Project Area on the east-- reported logging 50 acres of conifer stand adjacent to the Forest boundary in 1998. An additional treatment of less than 100 acres was accomplished in 2007. These treatments thinned predominately mature Douglas fir on the ranches boundary with National Forest. The intent was to disrupt the continuity of fuels along the boundary, and reduce the intensity of fire burning from the National Forest onto the Cobb Ranch. At present, additional treatments for the area are not planned.

Past/proposed wildlife activities

Westslope cutthroat trout, a sensitive species, were introduced into the North Fork of Ford Creek in 2005.

2. Present Activities

Range Management

The following cattle allotments include grazing within, or near, the project area boundary: Ford Basin, Ford Creek, and Willow Creek. In addition, there are horse allotments for administrative use and the use of a private outfitter in the project area. Currently, Ford Basin Cattle Allotment provides for 425 AUMs to be utilized by 134 cow/calf pairs and three horse/mules. The Ford Creek Allotment supports 985 AUMs to be utilized by 320 cow/calf pairs, while the Willow Creek Allotment supports 801 AUMs to be utilized by 260 cow/calf pairs. Benchmark supports a horse allotment for a local outfitter of 74 AUMs to be utilized by 31 horses/mules. In addition, the Forest Service is allotted 10 mules/horses in two administrative pastures in the Benchmark area. The administrative pastures are to be utilized on an alternating basis—twenty days of use is allowed on the Lower pasture on alternating years, and thirteen days of use is allowed in the Upper pasture on the years that the Lower pasture is not utilized.

A number of noxious weed infestations occur in the project area designated for the Benchmark Fuels Reduction Project. Identified infestations occur in areas of impact associated with vehicle traffic, trails, camping, and livestock grazing. The Rocky Mountain District has identified these areas and has an active weed-control program that includes the annual application of herbicides, hand-pulling, and monitoring.

Recreation

The Recreation Opportunity Spectrum (ROS) setting in the Benchmark Project Area is Roaded Natural for Management Area E, Semi-Primitive for Management Area G, Roaded Natural and Rural for Management Areas H and O. A corridor of non-roadless area is identified along the Benchmark Road, extending approximately ¼ mile on both sides of the road prism (see Map A-4). Forested lands beyond this corridor are designated as Inventoried Roadless.

The Benchmark Fuels Reduction Project Area is the setting for significant recreation use. The South Fork Sun trailhead is the single most popular access point to the Bob Marshall Wilderness and serves as an important recreation destination in its own right. In addition, this area supports 48 permitted recreation residences, two permitted commercial lodges/resorts, three campgrounds, a historic rental cabin, an administrative site with historic significance, as well as numerous dispersed campsites. Recreation residence permits were re-issued in January of 2008, for a period of twenty years. Several projects have also been completed—or are nearing completion—to maintain and improve recreation opportunities and facilities in the project area. Recent improvements and maintenance to recreation facilities in the project area include the following: South Fork Sun Campground and Trailhead reconstruction (1993); Janikula Trailhead reconstruction (1995); Benchmark Packer Corral construction (1994); Wood Lake Campground reconstruction (scheduled to re-open in summer of 2009). In addition, routine trail maintenance and construction occurs in the project area.

Travel Plan

In October 2007, a decision was made by the Lewis and Clark National Forest Supervisor designating roads, trails, and airfields that would be managed as system routes and comprise the Forest Transportation System. The Decision covered 262,180 acres of National Forest System lands south of Birch Creek (Record of Decision Birch Creek South). The Forest Supervisor selected a modified version of Alternative 4 in his decision. This decision covers the entire project area identified for the Benchmark Fuels Reduction Project.

*Copies of the Record of Decision for Birch Creek South may be obtained at the Rocky Mountain Ranger District Office in Choteau, MT, or from the Lewis and Clark National Forest headquarters in Great Falls, MT.

3. Reasonably Foreseeable Activities

Planned but Unaccomplished Activities within the Project Area

- South Fork of the Sun River Prescribed Burn—this prescribed burn project lies to the west of the Benchmark Fuels Reduction Project Area, but is included in the analysis because it, potentially, carries effects to the Benchmark Project Area. The South Fork

of the Sun River Project was initiated to protect life and property in the Benchmark area from a fire igniting to the west of the Benchmark Road, in the Bob Marshall and/or Scapegoat Wilderness Areas. The stated objective of the project was "to allow lightning caused fires to play a more natural or historical role in the wilderness than what is currently occurring and to make the wilderness boundary more defensible against the risk of a wildland fire escaping the wilderness." A Finding of No Significant Impact (FONSI) was signed by the Lewis and Clark National Forest Supervisor on February 21, 2001. The project area covered an area of 16,500 acres. Of this project area, fire would have been introduced on 10,000 acres. The project was to be implemented in three phases. The first phase would treat approximately 4,300 acres, phase 2 would treat 1048 acres, and phase 3 would treat 4,665 acres. The first phase of the project was completed in the fall of 2003. Phases 2 and 3 have not been implemented to date due to unfavorable weather and/or fuel conditions (see map A-5 for perimeter of Phase 1, South Fork of the Sun River Prescribed Burn).

- Continued road and trail maintenance will occur, in accordance with the current travel plan, in the project area.

B. FIRE, VEGETATION, AND AIR QUALITY

1. INTRODUCTION

It is estimated that 190 million acres of forest and rangeland in the lower forty-eight states face a high risk of experiencing catastrophic wildfires. Though a number of factors influence the potential for catastrophic fires on these lands, the most significant factors are an unnatural accumulation of fuels across the landscape and the increased exposure of humans to the wildfire threat. Increases in fire intensities and perimeters are primarily the result of fire management practices that, over the past 100 years, have emphasized the suppression of fires in ecosystems that have adapted to fire over a period of thousands of years (HFI Field Guide 2004). The practice of suppressing fires has directly resulted in unnatural fuels accumulations in America's forests and rangelands. Where these increasing fuels combine with homes, businesses, and improvements in the Wildland Urban Interface (WUI), the threat of wildfires to human lives and property can reach an unacceptable level.

2. PROJECT AREA

The Benchmark Fuels Reduction Project is located in the immediate vicinity of the Benchmark Road (Forest Road #235), 15 miles west of Augusta, MT. Primary creeks that are included in the project area are Benchmark, Fairview, Wood, Straight, and Ford Creeks. Ford Creek exits the Forest to the east, and flows into Smith Creek on the plains. Benchmark, Fairview, Wood and Straight Creek flow to the West and join the South Fork of the Sun River after exiting the project area's northwest boundary. Project area boundaries are defined on an attached map. The project area is included entirely on National Forest Lands, although its boundary abuts private land on the east (Map 1-1).

3. PROJECT DEVELOPMENT

In recent years, national fire policy and plans have focused on the growing threat of catastrophic fire to lives and property. District Fire Managers defined the Benchmark Fuels Reduction project through collaboration to address the threat of catastrophic fire to the Wildland Urban Interface in the vicinity of the Benchmark Road on the Rocky Mountain Ranger District. The project adheres to site specific direction found in the Lewis and Clark Forest's Land Management Plan.

National Policy Direction

The Benchmark Fuels Reduction Project was identified through collaboration, and it adheres to agency policy and Land Management Direction (these subjects are treated in more detail in the following paragraphs). Additionally, the project is located entirely outside of wilderness areas and outside wilderness study areas. The project will neither entail the use of pesticides or herbicides, nor will it entail the construction of new permanent roads or permanent infrastructure.

The National Fire Plan's 10-Year Comprehensive Strategy emphasizes a collaborative approach in the identification, development, and implementation of projects directed at reducing the risks wildfires pose to communities and environments. To date, identification

and development of the Benchmark Fuels Reduction Project has been accomplished through a collaborative framework that has elicited input from agency specialists and input from interested agencies, local and state governments, tribal organizations, special interest groups, and members of the public through mailings, press releases, public meetings, and field trips.

The project area was developed through collaboration at a series of meetings held in local communities. District managers presented members of the public with information and maps identifying the Condition Classes, Fire Regimes, Fire History, and Fuel Models represented on the Rocky Mountain Ranger District (Maps A-5, A-6, A-7, A-8). Participating members of the public assisted District managers in identifying Benchmark as an area where fuels and topography align to pose a significant threat to private and public values.

Collaboration continued to involve diverse members of the public and agency specialists in the development of the project. Project boundaries and treatment types were adjusted in response to comments and concerns voiced by members of the public and in response to advice offered by agency specialists. Some of this public input was elicited through scoping, with additional input provided during a field trip to the project area. The project continues to elicit input from agency specialists. This assessment will analyze the effects of two alternatives: A "No-Action Alternative," and an "Action Alternative." The public will be offered a formal 30 day period to respond to the Environmental Assessment. Following the release of a Decision, the public will have a 45 day period in which to file appeals. This project was first listed in the quarterly Schedule of Proposed Actions (SOPA) in July 2004. It will continue to be published in the SOPA until the project is through the decision stage.

Forest Plan Guidance

The Project Area Boundary for the Benchmark Fuels Reduction Project proposal encompasses Forest land within Management Areas E, G, H, and O. It should be noted, however, that activities are only planned to occur within management areas E, H, and O. The management Goals for all Management Areas represented in the project area are provided below:

Management Area E: "Provide sustained high level of forage for livestock and big game animals."

Management Area G: "Maintain and protect Forest resources with minimal investments."

Management Area H: "Provide winter recreation opportunities supported by public and private developments while maintaining other resource values."

Management Area O: "Protect, maintain, and improve resource quality while providing timber at a low intensity level to meet local needs. Manage forage for livestock at a moderate intensity level."

This proposal includes the removal of forest products through thinning and group-select treatments. Prescribed fire will be utilized in conjunction with these activities. Some portions of the project area will receive prescribed fire treatment, without the removal of forest products. The Lewis and Clark Fire Management Plan provides direction for the removal of forest products and direction for prescribed fire utilization in Management Areas E, G, H, and O.

Management Area E:

- (ET2)—"Harvest unprogrammed amounts of forest products including Christmas trees, firewood, ornamentals, and miscellaneous wood products through administrative use, free use permits, salvage and sanitation cutting."
- (PS12A)—"Prescribed fire with planned ignitions will be used in this management area for the enhancement and maintenance of resources."

Management Area G:

- (ET2)—"Harvest unprogrammed amount of products including Christmas trees, firewood, ornamentals and miscellaneous wood products through administrative use, free use, permits, salvage, and sanitation cutting.
- (PS12A)—"Prescribed fire with planned ignitions will be used in this management area for the enhancement and maintenance of resources."

Management Area H:

- (ET2)—"Harvest unprogrammed amounts of forest products including Christmas trees, firewood, ornamentals, and miscellaneous wood products through administrative use, free use, permits, salvage, and sanitation cutting, while maintaining or enhancing other resource values."
- (PS12a)—"Prescribed fire with planned ignitions will be used in this management area for the enhancement and maintenance of resources."

Management Area O:

- (unprogrammed Timber)—"Harvest unprogrammed amounts of forest products including Christmas trees, firewood, ornamentals, and miscellaneous wood products, through administrative use, free use, permits, salvage, and sanitation cutting."
- (Programmed Clearcutting, EP3d; Shelterwood Cutting, EP3e; and Selection Cutting; EP3f)—"Both even-aged and uneven-aged systems will be used within the area, consisting of individual tree and group selection methods, shelterwood harvest, small clearcuts (1-5 acres) and commercial thinnings."
- Prescribed fire with planned ignitions will be used in this management area for the enhancement and maintenance of resources."

4. HISTORIC CONDITION

The area encompassed by the Benchmark Fuels Reduction Project was included in a large scale land survey completed by H.B. Ayres in 1899. Though his focus was directed toward natural resources, with an emphasis on mills and wood production, his survey provides a snapshot of vegetation covering the Reserve at the turn of the century. Ayres report of the survey included detailed descriptions, often accompanied by photographs, of landscapes and the impact of fire on those landscapes. It is evident from Ayres report that fire played a significant role over the entire Reserve. For example, he noted that roughly one-third of the forests and grasslands surveyed had recently experienced fire. One of the areas he described as having recently been impacted by fire was the Ford Creek drainage—an area included in the Benchmark Fuels Reduction Project. In addition, Ayres described the effects of fires

among different conifer stands—this included fires of low-intensity and high frequency that often visited Ponderosa Pine stands, as well as the mosaic pattern created by fires of higher intensity and lower frequency in denser stands of lodgepole pine and Douglas fir (Ayres 1900).

5. EXISTING CONDITION

Since H.B. Ayres survey of the Lewis and Clark Forest Reserve in 1899, the area that is now included in the Benchmark Fuels Reduction Project has been subject to historical processes common to lands throughout the West. Following the fires of 1910, the Forest Service adopted a policy that emphasized aggressive fire suppression (Pyne 1982). Over time, this policy of fire suppression has led to unnatural accumulations of fuels across western landscapes in general—a phenomena that is evident along the Wood and Ford Creek drainages on the Rocky Mountain Ranger District. These comparatively heavy fuel loadings along Wood and Ford Creeks occur in an area that stands as one of the single most popular access points to the Bob Marshall Wilderness and serves as an important recreation destination in its own right. In addition, this area supports 48 permitted recreation residences, two permitted commercial lodges/resorts, three campgrounds, a historic rental cabin, and an administrative site with historic significance. Private lands and ranch buildings lie immediately to the east of the project area.

The condition of fuels located within the boundaries of the Benchmark Fuels Reduction Project is well illustrated on maps of Fire Regime and Condition Class (Maps A-7 and A-8). One way of understanding an area's fuel condition is through Fire Regime Condition Class (FRCC). A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Fire Regime 2007). Condition Class refers to the degree of departure from this natural fire regime, and is separated into high, low, and moderate departure from representative conditions. Representative conditions for the project area are displayed in the following table.

Table 3-4. Project Area Representative Conditions

Structural Class	Representative Conditions (%) for Low Elevation Lodgepole mixed species forest	Representative Conditions (%) for Low elevation Douglas-fir
Early Seral	10	10
Mid-Seral Open	15	25-30
Mid-Seral Closed	50	5-15
Late-Seral Open	5	30-50
Late-Seral Closed	20	10-15

Areas of high departure are of chief concern in identifying potentially dangerous fuels conditions and possess the following attributes:

> Fire regimes [of high departure] have been substantially altered from their natural (historical) range. The risk of losing key ecosystem components are high. Fire frequencies have departed from natural frequencies by multiple intervals. Dramatic changes occur to one or more of the following: fire size,

> intensity, severity, and landscape patterns. Vegetation attributes have been substantially altered from their natural (historical) range (Fire Regime 2007).

Fire Regime and Condition Class have been utilized, in conjunction with other resources, to define boundaries and treatments for the Benchmark Fuels Reduction Project. Along the Wood Creek and Ford Creek drainages, extensive areas of densely stocked stands lead to high departure from the representative conditions. Generally, early seral, mid-seral open and late-seral open stand structures are poorly represented with a corresponding increase in closed canopy stands. Almost all buildings and improvements in the Benchmark Fuels Reduction Project area are located in or near ground that has been classified as having a high departure in Condition Class (Map A-7).

Fuel modeling is another method of assessing the condition of fuels across a given landscape and has been utilized in defining the Benchmark Fuels Reduction Project. Specifically, fire managers utilized maps of the District's landscape, with vegetation represented by its corresponding Fire Behavior Fuel Models, to identify areas of concern. This data was gathered and displayed utilizing remote-sensing technology (Map A-6).

Vegetation along Wood and Ford Creeks is categorized as fitting into Fire Behavior Fuel Models 1, 2, 5, 8, and 10. Of these models, fuel model 8 and 10 are important to any assessment of fire danger in the vicinity of structures, improvements, and centers of human activity. On the Rocky Mountain Ranger District, vegetation in these fuel models includes conifer species and forest structure that can support crown fires of high intensity. Active crown fires in these fuel types are extremely resistant to all methods of fire control. In particular, fuel model 10 can present characteristics that render fire control very difficult even under moderate environmental conditions (e.g. relatively low wind speeds). The following are some fire characteristics of fuel model 10.

> [In fuel model 10] The fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch (7.6-cm) or larger limbwood resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, wind-thrown stands, overmature situations with deadfall, and aged light thinning or partial-cut slash (Anderson, 1982).

Extensive areas along the Benchmark Road are categorized as Fuel Model 10. Moreover, almost all improvements along the road—campgrounds, cabins, trailheads and lodges—are located in vegetation represented as Fuel Model 10, or immediately adjacent to such vegetation (Map A-6).

In assessing the existing fuel conditions in the vicinity of the Benchmark Road, two indirect considerations also deserve recognition. The first of these is the alignment of drainages along the Benchmark Road. Wood Creek and Ford Creek are well-aligned to support fire-spread from west to east—the general direction of predominant winds in the area. Coupled with relatively continuous fuels, the corridor formed by these drainages could promote rapid

fire spread from west to east. Such a fire could threaten buildings and improvements along the Benchmark road and could exit the Forest Boundary and threaten private land, buildings, livestock, and improvements to the east.

Another indirect consideration in assessing fuel conditions in the vicinity of the Benchmark Road is the likelihood of a fire start. Fire history for the area provides the basis for analyzing the potential for such a start (Map A-5). Since H.B. Ayres completed his survey of the Lewis and Clark Forest Reserves, fires have been aggressively suppressed in the Benchmark area. Both lightning and humans have been the source of unwanted fire ignitions in the Benchmark area. Most of these ignitions have been suppressed at relatively small acreages. Exceptions include the Benchmark fire of 1945, and the Ford Creek Fire of 2006. In addition, three large fires have made minor incursions into the project area boundary: the Canyon Creek Fire of 1988, the Ford Creek Fire of 2006, and the Ahorn Fire of 2007 (Map A-5). The Lewis and Clark Forest's Fire Management Plan directs a "A Complete Fire Suppression Strategy" for all fire starts in the vicinity of the Benchmark Road (LCF Fire Management Plan 2007).

6. EFFECTS BY ALTERNATIVE

a. Alternative 1- No Action

1. Direct and Indirect Effects

The project area lies within the Lewis and Clark National Forest's Fire Management Unit 1 (FMU 1). This FMU "includes wildland/urban interface (WUI) as defined by the Western Foresters & Western Governors Association, and it also includes all Forest Service administrative sites on the Forest." Wildland Fire Management Strategies for this FMU are limited to a Complete Fire Suppression Strategy. All wildland fires in this FMU are considered unwanted events and are subject to an aggressive initial attack strategy.

As a result of the public and private values existing along the Benchmark drainage, the options for managing vegetation are limited. Managing vegetation through wildland fire use is not authorized in FMU 1. The opportunity for mechanical treatment of fuels is limited to a corridor near the road because the majority of land in the Wood, Straight, and Benchmark drainages is classified as Inventoried Roadless. Prescribed fire is a tool managers may consider for fuels reduction, habitat enhancement, or restoration. However, the use of prescribed fire is also limited due to the presence of structures and improvements along the Benchmark Road. As stated above, 48 recreation residents, two permitted lodges, three campgrounds, private corrals, and Forest Service cabins are located along the length of Benchmark Road. The Lewis and Clark's Fire Management Plan makes the following observation concerning the management of fuels in this Fire Management Unit: "Prescribed fire is an option for reducing hazardous fuel conditions or meeting other resource management objectives. Mechanical fuels treatments are recommended in areas adjacent to interface areas or administrative structures prior to prescribed burning."

Following the logic of the Forest's Fire Management Plan, failing to manage fuels in areas adjacent to interface areas or administrative structures will have the direct effect of reducing the defensibility of these structures, and will perpetuate conditions hazardous to firefighters and the public. Indirectly, taking no action will compromise the use of prescribed fire in Fire

Management Unit #1 (any prescribed fire application in the Wood and Benchmark drainages would have to forego the Fire Management Plan's recommendation that areas adjacent to the interface be treated mechanically prior to prescribed burning).

Based on the area's fire history, it is expected that human and lightning caused ignitions will continue to occur in the vicinity of the project area. Fire suppression efforts will continue to be aggressive due to the high number of values at risk that are located in the vicinity of the Benchmark Road. In addition, fuel conditions in the area will continue to deteriorate in a close association with stand age and increased insect mortality. This deterioration in forest health, in turn, will continue to erode the effectiveness of fire suppression activities, while increasing the risks posed by catastrophic fire to firefighter and public safety, as well as public and private property (Keane 2002).

b. Alternative 2-Proposed Action—

1. Direct and Indirect Effects

The proposed action for the Benchmark Fuels Reduction Project focuses on public and firefighter safety, buildings and improvements along the Benchmark Road, and to values on private land to the east of the National Forest Boundary. This alternative proposes to mechanically treat fuels in areas adjacent to interface areas and administrative structures. This mechanical treatment would be followed by prescribed burning. This project includes fuel reduction actions with two distinct objectives. First, fuels reduction actions are planned to create Community Protection Zones. These actions would include mechanical and prescribed fire treatments to increase canopy spacing and reduce surface fuels in an envelope around recreational residence tracts, campgrounds, administrative sites, and lodges. Secondly, fuel reduction activities are planned to provide strategic fuelbreaks. These proposed fuelbreaks are located in the vicinity of Benchmark Creek, Fairview Creek, and near the juncture of Ford Creek and the Forest Boundary.

Three types of treatment will be used to create Community Protection Zones and fuelbreaks. The Direct and Indirect Effects of each type of treatment will be described in the following paragraphs.

1. **Commercial thinning with 20 to 30 foot crown spacing.** This treatment would be applied to the following units of the Benchmark Project: Double Falls Unit #1, Double Falls Unit #2, Aspen Unit #2, Green Timber Unit #1, Lick Creek Unit #1, Lick Creek Unit #2, Mule Creek Unit #2, Fairmule Unit #4, Benchmark Unit #3, Benchmark Unit #4, Glade Creek Unit #1, Glade Creek Unit #2.
   Total Acres: 157

Direct Effects: The direct effects of this treatment would be to create 20 to 30 foot spacing between the over-story crowns of groups or clusters of conifers. Trees will be retained in groups containing 5-20 mature trees, as well as additional understory conifers. Crown spacing of approximately 20 to 30 feet will occur between the crowns of a given group of trees and those of another, adjacent, cluster of trees. Over a treatment unit, Crown Bulk Density (CBD) of stands in the treated areas would be reduced to .10 kg/m³ or less, where possible.

Besides increasing crown spacing, this treatment will reduce surface fuel loadings in some, or all, portions of the treatment units. In general, the goal of these treatments will be to reduce total fuel loads to levels typically found in stands characterized by Fire Behavior Fuel Model 8. This fuel loading is modeled at 5 tons per acre for all dead and live fuel under 3 inches in diameter. Stands characterized as Fuel Model 10—occurring widely in the project area—typically exhibit fuel loadings of 12 tons per acre for 3 inch diameter material (Anderson 1982). The desired fuel loadings will be accomplished by removing or treating activity fuels created by the project. This could include removal of material to another site followed by burning, or piling and burning fuels on site. In some cases this activity will include removing, or reducing, surface fuels occurring on the site prior to treatment.

Indirect Effects: The treatment units identified above are intended to act as Community Protection Zones (CPZs) in the vicinity of recreation residence tracts and National Forest Campgrounds. Community Protection Zones are designed to provide an area where firefighters can accomplish structure protection work in comparative safety. Under certain environmental conditions, CPZs can provide a safety zone for firefighters or reduce the exposure of members of the public to intense fire. Treatments in the CPZ can also enhance the safety of firefighters entering a residential tract to extinguish persistent fire or to remove hazardous trees following the passage of a fire front. In addition, these zones may reduce the threat to structures posed by lofted firebrands (Scott, 2003).

The effectiveness of Community Protection Zones may be evaluated by considering whether treatments cover a sufficient area, adequately reduce aerial fuels, and satisfactorily lower surface fuel loadings.

The overriding intent in the Community Protection Zone is to reduce the potential for crown fire or high intensity surface fire in the immediate vicinity of Recreation Residence Tracts and public campgrounds. Recent literature suggests that Community Protection Zones in conifer forests should be approximately 1300 feet (1/4 mile) wide (Nowicki, 2002). In delineating the perimeters of CPZs for the Benchmark Fuels Reduction Project, Nowicki's guidelines were referenced and adjusted to local conditions. For example, in calculating the suggested size of a CPZ, Nowicki uses a "worst possible case" tree height of 165 feet. This figure does not closely represent tree heights in the project area and a worse possible case scenario of 100 feet offers a more accurate reflection of site-specific conditions. Adjusting Nowicki's calculations accordingly, a CPZ should be approximately 800 feet wide. In laying out treatment areas, this distance was met or exceeded where possible; however, topography often dictated the exact size and shape of a CPZ (see attachments—Project Area Map and Treatment Unit Maps). In addition, esthetic concerns and the preservation of wildlife habitat influenced the shape and width of CPZs. In some cases, satisfying this guideline will be dependant on fuels reduction work being accomplished by recreation residence owners. In other cases, adjoining natural openings are linked to the treatment areas to provide adequate Community Protection Zones.

The effectiveness of Community Protection Zones also depends on the post-treatment condition of aerial fuels. Aerial fuels consist of all live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush (Glossary 2007). Aerial fuels play an important role in the initiation and perpetuation of crown fire and can produce fire behavior that is resistant to control and may

threaten human life or property. Two components of aerial fuel are important to consider in designing CPZs. These are Crown Base Height (CBH) and Crown Bulk Density (CBD).

Crown Base Height is the distance between surface fuels and the occurrence of lateral fuels in the canopy. Crown Base Height can play a crucial role in the initiation of crown fire because CBH can represent the point-of-contact between surface and aerial fuels. Those aerial fuels first occurring at the Crown Base Height can provide a ladder for surface fire to climb into the canopy of conifer stands. Due to this role in the initiation of crown fire, researchers often suggest the limbing of trees, or the cutting of understory trees, to raise the Crown Base Height in a treatment unit (Nowicki, 2001).

The proposed treatment for the Benchmark Community Protection Zones does not include a prescription for limbing trees or cutting understory trees in the retained groups of conifers. The retention of lower limbs and trees in these groups is a concession to esthetics. Clumps of trees that include younger conifers and lower branches will afford screening between recreation residence tracts and the Benchmark Road. In addition, the retention of young conifers in these groups will provide a source of recruitment in the event of severe windthrow of the retained overstory canopy. Both recreation residence owners and the general public have identified the project's impact on esthetics and screening as chief concerns during scoping for the Benchmark Fuels Reduction Project. While the retention of this screening may increase the potential for individual and group torching of trees within Community Protection Zones, managers feel that the potential for a running crown fire will be significantly reduced through the establishment of 20 to 30 foot spacing between groups of trees and, more significantly, through the corresponding reduction in Crown Bulk Density in the treated stands.[1]

The initiation of crown fire, or torching, is dependant on surface fire intensity, flame length, crown base height, and moisture content of the live foliage. However, the sustained spread of a crown fire is determined by rate of spread and Crown Bulk Density (Alexander 1988, Van Wagner 1977). The intent of the proposed treatments will be to reduce the potential for a running crown fire to occur in the proposed Community Protection Zones. Perhaps the most important consideration in treating aerial fuels is the reduction of Crown Bulk Density (CBD). Crown Bulk Density is a measurement of the mass of organic material in the crowns of conifer stands and is an important measurement used to assess and model the potential for crown fire. Agee reports that Crown Bulk Densities of .20 kg/m^3 are common in boreal forests and that crown fire is unlikely to occur at levels below .10 kg/m^3 (Agee 2000). Reducing Crown Bulk Density in the treatment areas to levels at, or below, .10 kg/m^3 will be the primary goal of treating aerial fuels in the identified Community Protection Zones.

Treatments in these units will reduce the total basal area by approximately fifty percent. Several Nexus runs were utilized to evaluate the effect of this treatment on conifer stands found in the Benchmark area. Nexus is a computer program that predicts both surface fire and crown fire behavior. It requires weather, fuels, and topography inputs provided by the user. The output from Nexus is not spatial in nature; rather it is for a specific set of input values. Two sets of weather values were utilized in running the program. These values were

[1] Recreation residence owners have been encouraged to thin and limb trees on their recreation residence lots to a distance of 100 feet from structures. Completed Defensible Space Rating Forms with thinning and pruning guidelines were sent to all Recreation Residence permit-holders in the spring of 2003.

based on historical weather data obtained from a RAWS (Remote Automated Weather Station) located in the project area. This data provided a set of standard, or "typical," fire weather inputs. Another set of values were used to represent extreme fire weather (See Appendix F for methodology and values). Additional sets of data were utilized to represent fuels conditions for conifer stands. Several Nexus runs were made utilizing generic—not site-specific data—for three types of conifer stands. In addition, six Nexus runs were made utilizing data from three stands within the Benchmark Project Area (Appendix F). The following tables display outputs from Nexus runs. The first table displays runs based on expected fire weather, the second table displays outputs based on extreme fire weather.

Table 3-5. Nexus Outputs Based on Expected Fire Weather

Stand Type	Fire Type		Torching Index (MPH)		Crowning Index (MPH)	
	Untreated	Treated	Untreated	Treated	Untreated	Treated
Douglas-fir/Lodgepole pine	Passive Crown Fire	Surface	13.1	336.8	15.1	22.2
Lodgepole pine	Passive	Surface	13.1	679.2	27.8	43.5
Mixed Conifer	Surface	Surface	43.1	1230.6	30	61.3
Stand # 01150149050024	Surface	Surface	34.1	809.7	20.2	29.5
Stand # 01150150010014	Conditional	Surface	41.6	946.6	12	17.8
Stand # 01150157020022	Surface	Surface	741.4	1083.6	27.2	43.3

Table 3-6. Nexus Outputs Based on Extreme Fire Weather

Stand Type	Fire Type		Torching Index (MPH)		Crowning Index (MPH)	
	Untreated	Treated	Untreated	Treated	Untreated	Treated
Douglas-fir/Lodgepole pine	Active	Conditional Active	0	230.9	11.9	17.7
Lodgepole pine	Active	Surface	0	466.2	22.2	34.9
Mixed Conifer	Conditional	Surface	26.5	845	24	49.2
Stand # 01150149050024	Active	Surface	22.4	607.7	15.9	23.5
Stand # 01150150010014	Conditional	Conditional	28	710.5	9.3	14.1
Stand # 01150157020022	Conditional	Surface	556.3	813.5	21.7	34.6

The values presented in the above tables are modeled outputs that reflect the Fire Type, Torching Index, and Crowning Index that are generated from a given set of weather and fuel inputs. For example, with the set of inputs for extreme fire weather, and a defined set of fuel characteristics for a Douglas-fir/Lodgepole stand, Nexus predicted Active Crown Fire in the untreated stand. The torching index would indicate that a fire start would reach the canopy of the stand without any wind in the untreated stand, while the treated stand would require a wind of 230.9 mph to initiate torching. The Crowning Index refers to the wind-speed required to sustain crown fire through a modeled stand. In the case of the Douglas-fir/Lodgepole pine stand, if left untreated, a wind of 11.9 miles would sustain crown fire. In the treated stand, a wind of 17.7 miles would be required to sustain crown fire.

Creating effective Community Protection Zones is also dependant on the reduction of surface fuels. Recent studies indicate that thinning without treating surface fuels can produce fires of greater severity than if no treatment was implemented. The most effective treatments combine thinning with slash treatment (Omi 2006). In the units identified for 20 to 30 foot crown spacing, slash produced by the treatment will be removed or burned, along with pre-existing surface fuels that present a hazard to human life or property.

To determine desirable levels of surface fuels in Community Protection Zone treatments it is helpful to refer to fuel models. In stands modeled as Fire Behavior Fuel Model 10, fuel loadings under the canopy will support surface fire—prior to treatment--that will resist control efforts with midflame windspeeds of five miles per hour or less (Anderson 1982). However, surface fuel loadings represented by fuel model 8 provide conditions far more advantageous to successful fire control efforts. The following interpretations from the Fireline Handbook show fire intensities and flame-length values that correspond to conditions advantageous to fire control efforts.

Table 3-7. Fire Suppression Interpretations

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
0-4	**0-100**	**Fires can generally be attacked at the head or flanks by persons using handtools.** **Handline should hold the fire.**
4-8	**100-500**	**Fires are too intense for direct attack on the head by persons using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft can be effective**

Several Behave runs were made to model Flame Lengths that correspond to Fuel Models 8 and 10 under design drought environmental conditions (Appendix F). Under the design conditions, Fuel Model 10 produced Flame Lengths exceeding 4 feet with midflame windspeeds of 5 miles per hour. Flame lengths with a midflame windspeed of 15 mph were modeled at 12.1 feet. For fuel model 8, under the same environmental conditions, flame lengths did not exceed 2 feet for midflame windspeeds of 5, 10, 15, 20, and 25 miles per hour (Appendix F).

Besides producing surface fire behavior that corresponds with successful fire control, reducing flame length and fire intensities also reduces the potential for crown fire. Shorter flame lengths are less likely to overlap with Crown Base Height and transition into crown fires. For example, flame lengths of 2 feet are less likely to initiate a crown fire in a stand with a Crown Base Height of 10 feet than are flame lengths of 8 feet in the same stand (Graham 1999).

Fuel loadings in forests characterized as Fuel Model 8 support surface fire that is far more subject to control efforts than fuel loadings associated with Fuel Model 10. Consequently, post-treatment conditions of fuels in the treatment units should attempt to correspond with the following values for Fuel Model 8 provided by Rothermel.

Table 3-8. Fuel Model Values for Estimating Fire Behavior

Variables	**Fuel model 8**	**Fuel model 10** (for comparison)
Total fuel load, < 3-inch, dead and live, tons/acre	5.0	12.0
Dead fuel load, ¼ inch, tons/acre	1.5	3.0
Live fuel load, foliage, tons/acre	0	2.0
Fuel bed depth, feet	0.2	1.0

Remote sensing indicates that treatment areas identified for 20 to 30 foot crown spacing between groups of trees correspond to stands, predominately, exhibiting characteristics of fuel model 8 or fuel model 10. In those areas characterized as fuel model 10, treatment should entail the reduction of existing ground fuels, along with any ground fuels produced from thinning treatments. Those areas corresponding to fuel model 8 may only require the treatment or removal of fuels created through thinning activities (Map A-6).

2. **Hand treatment utilizing power saws, followed by broadcast, pile or jackpot burning.** This treatment would be applied to the following units of the Benchmark Project: Benchmark #1, Benchmark #5, Mule Creek #1, Aspen #1, Ford Creek #1, Ford Creek #2. **Total Acres: 574**

Direct Effects: The direct effects of this treatment are to remove conifer species--such as Douglas fir, subalpine fir, and spruce--that are encroaching on mountain grasslands and to reduce young conifers as an understory component of adjacent conifer stands through thinning. In addition, fire should be introduced into the identified treatment areas to remove fuels produced by thinning, to create additional mortality in young conifers, and to act as an agent of disturbance (to promote the regeneration of aspen).

Indirect Effects: These treatments are intended to establish fuelbreaks in the project area. According to one definition, a fuelbreak is "a strategically located wide block, or strip, on which a cover of dense, heavy, or flammable vegetation has been permanently changed to one of lower fuel volume or reduced flammability (Green 1977)." The rationale for locating and creating fuelbreaks is to provide fire managers options to influence or control the spread of fire: "The primary reason for fuelbreaks, as well as any other type of fuel treatment, is to change the behavior of a fire entering the fuel-altered zone. Fuelbreaks may also be used as points of anchor for indirect attack on wildland fires, as well as for prescribed fires (Agee 2002)." In addition, fuelbreaks provide good places to locate fireline and for aerial delivery of retardant.

To create fuelbreaks in the identified units, three indirect effects are desired. The first indirect effect is to convert areas modeled as Fuel Model 5 to Fuel Model 1. On a fuel model map of the treatment areas, grassy openings are represented by Fuel Model 1 (Map A-6). Encroachment by young conifers is represented by fuel model 5. Treatments in these units will increase the size of natural openings by removing encroaching conifers. Fuels in grassy areas are characterized as light, or "flashy," and provide fire managers with a wider range of options in fire control. Firefighting tactics that include such activities as the construction of

handline, backfiring, and retardant application are far more effective in light fuels than they are in conifer stands (Agee 2000).

A second, but related, indirect effect of these treatments will be to convert those portions of the treatment areas represented by fuel model 8 from stands that are predominately multi-canopied to stands that are characterized by a single canopy. Researchers have documented that a wide-spread impact of fire suppression and grazing of domesticated animals has been to create stands characterized by several different age-classes of conifers (Keane 2002). These stands are more prone to support crown fires because younger age-classes of trees may serve as a "ladder" for fire to spread from the ground into the crowns of mature trees.

Besides removing younger conifers, these treatments are intended to promote conditions conducive to the restoration of aspen. Throughout the West, aspen stands have been shrinking as a result of fire suppression, grazing, and conifer encroachment (Arno 2005). From the perspective of fuels, the deterioration and loss of aspen stands is significant in that aspen is known as a "fire resistant species." In some cases, aspen stands can act as effective fuelbreaks and pure aspen stands "are considered a deterrent to crown fire spread because of the moisture often held in the dense under-story and the lack of aspen bark flammability (Shepperd 2006)." The suggested treatments for encouraging the restoration of aspen stands coincides with the removal of conifer encroachment from grasslands and the removal of young conifers from more mature conifer stands:

> Many times a combination of mechanical treatment and prescribed fire is the best course of action to regenerate aspen in mixed aspen-conifer stands. A combined treatment can provide a means of emulating natural fire regimes by providing maximum hormonal stimulation and optimal growth environments for aspen suckers as well as eliminating or reducing competing conifers (Shepperd 2006).

The treatments in these units are intended to increase the extent of natural grassy openings, remove younger conifers from mature conifer stands, and encourage aspen restoration. In combination, these results will provide conditions that will offer fire managers greater opportunity to influence or control fire behavior.

2. **Commercial harvest with 1/2 to 2 acre openings on 50% of the unit.** This treatment would be applied to the following units of the Benchmark Project: Fairmule #2, Fairmule #3. **Total Acres: 41**

<u>Direct Effects</u>: The direct effect of these treatments would be to create ½ to 2 acre openings on 50% of the unit. Excessive surface fuels and activity fuels would be piled and burned. These openings would be irregular in shape and distributed unevenly over the treatment area. Similar sized patches of trees will remain uncut to provide screening. The natural regeneration that will result in the openings will emphasize aspen and will be managed to maintain the effectiveness of the treatment. Over the treatment area, crown bulk densities would be reduced to levels at, or below, .10 kg/m³ and surface fuel loading would be reduced to levels previously identified for post-treatment conditions under treatment type 1 (**Commercial thinning with 20 to 30 foot crown spacing).**

Indirect Effects: The indirect effects of these treatments would be to create a fuel break in the vicinity of the Benchmark Wilderness Outfitters Ranch.

In Fairmule Unit #2, the indirect effects of treating aerial fuels and surface fuels would be to reduce the potential for crown fire, decrease the intensities of surface fire, and encourage the restoration of fire-resistant aspen stands. Openings would be located in close association with existing aspen clones and provide light necessary for suckers to proliferate (Shepperd 2002). Combined with overall reductions in Crown Bulk Density and surface fuels, aspen regeneration should enhance the fire-resistant nature of vegetation in the unit, and contribute to the durability of the treatments.

In Fairmule Unit #3, the indirect effects of treating aerial fuels and surface fuels would be to reduce the potential for crown fire and decrease the intensities of surface fire. While aspen suckering would also be encouraged in this unit, aspen clones are not as prevalent as in Fairmule Unit #2.

AIR QUALITY

Legal Requirements

The clean Air Act and its amendments were designed to: 1) protect and enhance the nation's air resources, 2) initiate and accelerate a national research and development program to prevent and control air pollution, 3) provide technical and financial assistance to state and local governments for development and execution of air pollution prevention and control programs, and 4) encourage and assist the development and operation of regional air pollution programs.

The 1970 amendments require the Environmental Protection Agency to identify air pollutants with adverse effects on public health and welfare, establishing primary and secondary National Ambient Air Quality Standards (NAAQS) for each identified pollutant. Additionally, each state is required to develop a plan for maintaining air quality standards. The NAAQS pollutant of concern in the project area is particulate matter because of its effect of human health and visibility.

The 1977 amendments include a process for designation of Class I, II, and III areas for air quality management. Class II areas possess good air quality with no air quality restrictions, however, they are still governed by NAAQS. Class I areas are the "cleanest" areas and get special visibility protection, including a limit in the allowable increase in pollutants and particulate concentrations. The Scapegoat and Bob Marshall Wilderness areas, approximately 1 mile and 4 miles to the southwest and northwest respectively, are Class I Airsheds. The Blackfeet Indian Reservation approximately 44 miles to the north of the project area is also a Class I Airshed, but it is located too far to the north to be effected by any activities associated with this project.

The Forest Service abides by the Montana Smoke Management Memorandum of Agreement, which establishes procedures to regulate the amount of smoke produced by prescribed fire and identifies airsheds for management purposes. The Montana/Idaho State Airshed Group, Smoke Monitoring Unit regulates burning activity in the project area. The project area falls

within Montana Airshed 9. All burning activities conducted by the Forest Service in Montana must be coordinated through the Smoke Monitoring Unit.

Existing Condition

Air quality for the analysis area is considered good to excellent for most of the year. Smoke from wildland fire and prescribed fire and dust from native and gravel surfaced roads are the principle factors affecting air quality. To minimize air quality concerns, prescribed fires are scheduled when atmospheric conditions are conducive to smoke dispersal and Montana Airshed Group guidelines are followed during all burning operations.

Environmental Consequences

The principal factor affecting air quality in the analysis area is wood smoke. Dust generated from native and gravel surfaced roads during use by vehicles and maintenance may also temporarily affect air quality, but are generally low in severity and short in duration and will result in no measurable effect to air quality.

Direct and Indirect Effects on Air Quality

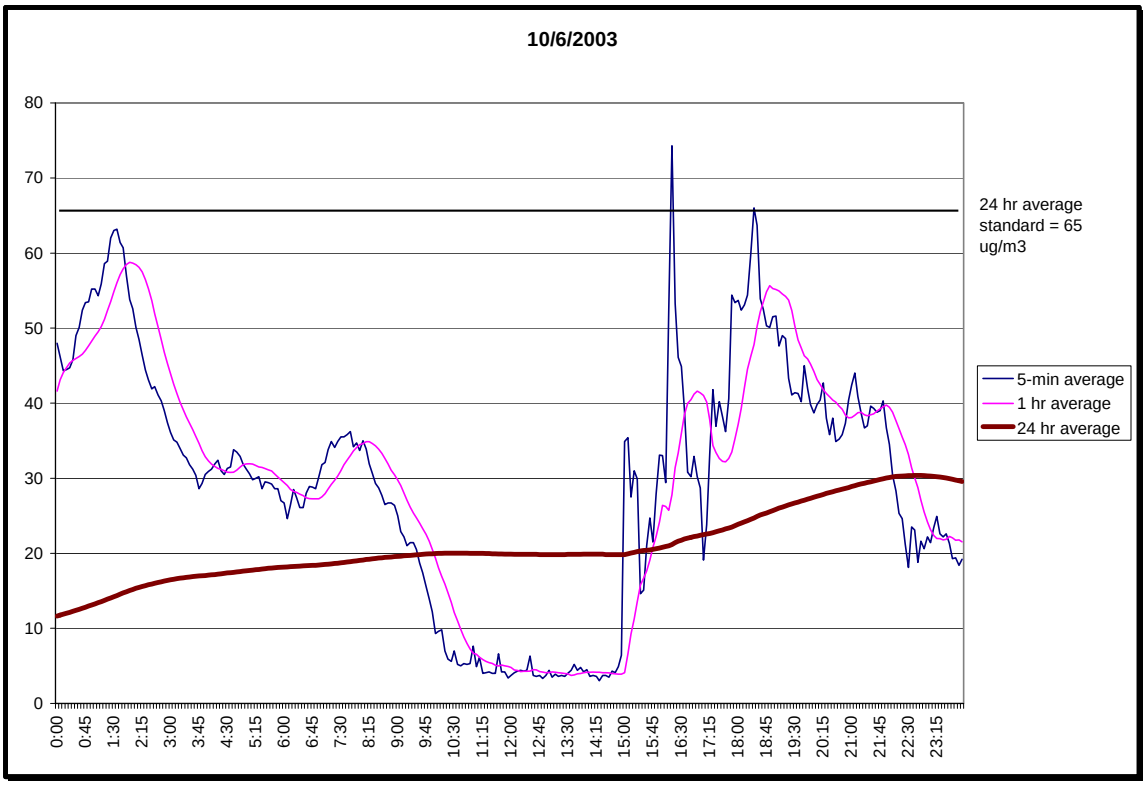
Two types of prescribed fire will be utilized in the Benchmark Hazardous Fuels Reduction Project. Broadcast burning of natural fuels would occur and jack pot or pile burning associated with activity fuels generated by mechanical fuel reduction activities. Both types of prescribed burning would generate smoke and have the potential to adversely impact the air quality within the project area and the adjoining Class I Airsheds. All prescribed burning activities would be coordinated through the Montana Airshed Group to ensure that atmospheric conditions were conducive for good smoke dispersion and fuel consumption.

Broadcast burning would produce the greatest amount of particulate of the two burning types. Approximately 530 acres would be broadcast burned under this project proposal with the largest unit being approximately 230 acres. Each of the units would be burned separately so the greatest amount of particulate production would be from the 230 acre unit.

Prescribed burning of any type would have a temporary short term affect on the air quality within and immediately adjacent to the project area. Smoke would tend to settle into the Benchmark drainage during the night, but should be cleared out with the next days prevailing winds. This pooling of smoke in the valley bottom would cause short term adverse effect to air quality and visibility.

During the fall of 2003, a prescribed burn of over 4000 acres was conducted just west of the project area. A smoke monitor was placed at the Cobb Ranch approximately 2 miles northeast of the project area. At no time during the completion of that prescribed burn were the Montana Standards for PM 2.5 or 10 exceeded (see chart below). The scale of all prescribed burning planned for the Benchmark Fuels Reduction Project constitutes a fraction of the area treated by the South Fork Sun Project; consequently, it is extremely unlikely that the Montana Standards for particulate matter will be approached, much less exceeded.

Figure 3-1. South Fork Sun Prescribed Burn Smoke Monitoring, 2003



** PM 2.5 standards are based on the 24 average. The heavy red line indicates the 24-hr average. Note that the average does not approach the threshold line, represented in grey, at 65 ug/m3.*

The prevailing winds in the area are generally out of the southwest and west, but local winds at the Benchmark Remote Automated Weather Station (RAWS) are fairly evenly distributed out of all the cardinal directions. Southwest to northwest winds would tend to move any smoke produced up and away from the Benchmark drainage, dissipating it into the atmosphere. Northeast to southeast winds could move smoke into the Class I Airsheds of the Scapegoat and Bob Marshall Wilderness.' However, easterly winds in this area tend to come with higher humidity resulting in poor prescribed burning conditions. Piles or jackpots of fuel may be conducive to burning under higher relative humidity, but under conditions not conducive to broadcast burning. Local weather forecasts need to be reviewed prior to any broadcast burning so as to not degrade the air quality and the subsequent visibility of these Class I Airsheds.

7. EFFECTS COMMON TO ALL ALTERNATIVES

Cumulative Effects to Fuels

The cumulative effects area for the fire/fuels analysis is the same as the analysis area for direct/indirect effects. There are events outside of this area that may be discussed. This is due to the nature of fire moving across the landscape. The proposed action is intended to reduce the threat to human values posed both by fires initiating outside of the project area, and by fires initiating within the project area.

The risk posed by fires initiating outside the project area has been partially addressed by the South Fork Sun Project. This project proposed to utilize prescribed burning in the Scapegoat Wilderness to "reduce, to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness (FSM 2324.21)." In particular the project was developed to reduce the threat posed by fire originating within the Scapegoat and Bob Marshall Wilderness to values in the vicinity of the Benchmark Road and to private land, livestock, and improvements to the east of the Lewis and Clark National Forest boundary. The project addressed the potential of fire exiting the Wilderness near the confluence of Hoadley Creek and the South Fork of the Sun River, and in the vicinity of Elbow Pass. To date, prescribed burning on 4287 acres--out of 4300 acres planned for phase 1--of this project was implemented in 2003. The remainder of the project, including 5713 acres of prescribed burning, will be implemented when prescription parameters are met.

Even with the treatment of fuels along the South Fork of the Sun, the potential for fire to enter the project area from National Forest Lands to the west remains. In the Fall of 2006, the Cigarette Rock fire ignited near the southern perimeter of the South Fork Sun Project area. Driven by wind, the fire burned from the west to east, spotting across the Wood Creek Hogback and onto ridges within ½ mile of the Benchmark Road, triggering the evacuation of area campers, lodge-owners, and recreation residents. Fall precipitation limited the fires spread to 2271 acres. Evacuations and area closures along the Benchmark Road also occurred in 2007. These measures were taken due to the Ahorn Fire. This fire originated near the confluence of Ahorn Creek and the West Fork of the South Fork of the Sun River. During the months of July and August, the Ahorn spread from west to east, covering an area of 52,505 acres. In its movement, the Ahorn fire came within ¼ mile of the area defined for the Benchmark Fuels Reduction Project. In combination, the Cigarette Rock and Ahorn fires have modified fuels to the west of the project area. It is expected that this modification may reduce the size and intensity of fires occurring in these areas in the future and may increase the effectiveness of fire management actions aimed at controlling fires as they move toward values at risk. However, these fires have underscored the vulnerability of the Benchmark area to large wind-driven fires and focused attention on the condition of fuels within the project area.

Fire History for the Benchmark Fuels Reduction Project area, and on land immediately adjacent to the project area, includes a number of lightning and human-caused ignitions (Map A-5). The majority of these fire-starts were controlled at relatively small acreages. Exceptions include the Glade Creek Fire of 1996 that burned 43 acres, and the Ford Creek Fire of 2006 that was controlled at 323 acres, after triggering the notification of Recreation Residents along the Benchmark Road of potential evacuation.

Several prescribed fire treatments have also occurred in the vicinity of the proposed Fuels Reduction Project. These treatments include the Ford Basin prescribed fire of 1991 and the Ford-Fairview project of 1999—treatments that covered 200 and 2232 acres, respectively. These prescribed fire treatments were implemented to the north of the Benchmark Road and will not impact fire behavior within the project area. In addition, several vegetation treatments have occurred along the Benchmark Road. Fuel modeling of the Benchmark area reflects the impact of these treatments on fuels (Map A-6). In the vicinity of the Benchmark Wilderness Ranch, these treatments have converted fuels, in a restricted area, from fuel model 10 to fuel model 8. Additional vegetation treatments have occurred on the Cobb Ranch immediately to the east of the project area. These treatments, which can be characterized as over-story thinning of mature conifers, included approximately 50 acres of treatment in 1998 and an additional area of under 100 acres accomplished in 2007.

Vegetation treatments along the Benchmark Road and on the Cobb Ranch will enhance the effectiveness of the proposed fuels reduction project. For example, the Cobb Ranch treatments adjoin, and will compliment, fuels reduction treatments on Ford Creek Units #1 and #2, by reducing crown and surface fuel loadings and promoting conditions conducive to aspen restoration. Similarly, past vegetation treatments in the vicinity of the Fairmule Units have reduced fuel loadings and removed trees infected with mistletoe. The Glade Creek Fire and the Ford Creek Fires also occurred in close proximity to recreation residence tracts and will complement fuels reduction in the vicinity of Glade Creek Unit #1 and, to a far lesser degree, in the vicinity of the Aspen Units.

As mentioned previously, Recreation Residents have reduced fuel loadings on their respective lots. During the fire season of 2007, fire crews further reduced fuels on recreation residence lots; however, these efforts did not significantly modify fuels beyond the boundaries of the lots.

While a number of wildfires and vegetation treatments (both mechanical and prescribed fire) have occurred in the vicinity of the Benchmark Fuels Reductions Project, these events have not significantly altered fuel conditions in the Project Area. Mapping of vegetation—derived from satellite imagery—reflect large expanses of heavy fuels in close association with structures and National Forest boundaries (Map A-6). In addition, this mapping suggests high and moderate departures in Condition Class in all of the proposed treatment units (Map A-7). Finally, fire history for the area demonstrates that, despite its fuel condition, the Benchmark area has not witnessed large, landscape scale, fire in the recent past as have forested lands to the south and north of the project area. These fires include the Canyon Creek Fire of 1988 that burned over 240,000 acres, approximately five miles to the south of the project area; the 2007 Ahorn Fire that burned 52,505 acres immediately to the west and north of the project area; and the 2007 Fool Creek Fire that burned 60,000 acres, approximately 24 miles north of the project area.

Cumulative Effects to Air Quality

Cumulative smoke effects of this project, and other burn projects scheduled for implementation in the general area, would be managed through the Montana/Idaho Airshed Group. The Cobb and Weisner ranches were called to identify similar projects that they will be conducting on their private property. The Weisner Ranch does not plan any fuels reduction projects on their ranch, but the Cobb Ranch thinned conifer stands next to the National Forest boundary, immediately adjacent to the project area, in 1998 and 2007. These treatments were conducted with the intention of reducing fuels next to the forest boundary. Combined harvests covered an area of less than 150 acres. The Cobb Ranch project has been completed, thus eliminating the potential of cumulative effects to air quality.

Adverse Effects That Cannot Be Avoided

Smoke from prescribed burning would temporarily reduce air quality. Short-term negative effects on recreation and visual quality could result from smoke. These effects can be minimized by burning under atmospheric conditions conducive to smoke dispersion and during periods of light visitation.

8. Conclusion

The Action Alternative for the Benchmark Fuels Reduction Project is closely defined to reduce the threat posed by wildfire approaching values at risk along the Benchmark Road. Proposed treatments would modify fuel conditions in close association to these values and are not intended to alter fire behavior on a landscape scale. The effectiveness of these treatments, and their durability, will be highly dependant on maintaining defensible space around cabins, lodges, campgrounds and administrative sites in the area. In addition, subsequent treatments may be needed to maintain the integrity of fuel modification in the project area over time. Agee and Skinner make the following observations concerning the effectiveness of fuel treatments over time: "If fuel treatments are small and scattered, or a long time has elapsed since treatment (generally 10-15 years or more), they will be less effective in fragmenting the landscape fuel loads, and their efficacy at the stand level can be overwhelmed by intense fires burning in adjacent areas (Agee and Skinner, 2005)." For these reasons, a monitoring plan has been developed for the project area and should be utilized to evaluate the condition of treatment units over time, and to determine when additional work should be implemented (Appendix E). An additional entry into the units may be required in as little as 10 years. It is anticipated that subsequent treatments would target accumulating surface fuels such as might result from wind events, as well as ladder fuels appearing through conifer regeneration. Excessive surface and ladder fuels could be treated with prescribed fire utilizing pile, jackpot, or broadcast burns. In some cases these re-entries may require the thinning of young conifers prior to the application of prescribed fire. Reentry to remove mature, standing conifers likely will not be required to maintain these treatments into the foreseeable future.

C. SOILS RESOURCE

1. *INTRODUCTION*

Current soils conditions and anticipated impacts from the No Action and Action Alternative are described below. Timber harvest, prescribed fire, road building and road decommissioning are the management actions being considered. Minimizing the impacts to soils from timber harvest and prescribed burning, leaving adequate amounts of large down woody debris, and noxious weed control will be key to meeting Forest Plan and Regional Soil Quality Standards.

2. REGULATORY FRAMEWORK

Lewis and Clark National Forest, Forest Plan Requirements

Management Standard F-1: Utilize adequate soil and water conservation practices to protect soil productivity and to control nonpoint water pollution from project activities, using as a minimum, practices specified in any State-developed "Best Management Practices."

Management Standard E-4: (3) use all necessary measures to minimize soil damage and soil erosion on timber sale areas.

(4) Limit equipment use where ground conditions are such that excessive damage would result.

(7) Give consideration to limitations on land types as described in Lewis and Clark Soil Resource Inventory (Holdorf, 1981).

Management Standard F-3: (1) Require application of Best Management Practices to project activities to ensure meeting or exceeding State water quality standards.

(2) Develop additional Best Management Practices during the environmental analysis process and incorporate them into all land use and project plans as a principal mechanism for controlling non-point sources and meeting soil and water quality or other resource goals.

(10) In accordance with NFMA, RPA and Multiple Use-Sustained Yield Act, all management activities will be planned to sustain site productivity.

(11) Require prompt revegetation of disturbed areas, especially cut and fill slopes, to control surface erosion. To stabilize disturbed areas, seed with grasses, forbs and deep-rooted native shrubs, where natural establishment of native cover is not expected within two years. Ideally the seedbed should be firm with a roughened surface. The slope must be stable, usually less than 2:1. Steeper slopes can be benched or terraced. Compacted soils should be ripped from eight to twelve inches.

(13) Achieve a 70 percent vegetative or litter cover level on cut and fill slopes and other soil disturbance areas within 2 growing seasons or a natural level of vegetative and litter cover when it is less than 70 percent.

Management Standard P-2: (4) Leave approximately 10 tons of fuel per acre, where available. This should be material over four inches in diameter, which is randomly scattered over the area. Material should touch the ground for faster decomposition.

Forest Service Region 1 Soil Quality Standards

Soil Quality Standards on Forest Service Lands require that 85 percent of an activity area remain in an acceptable soil quality condition (FSM 2550, R-1 Supplement 2500-99-1). An activity area is defined as a land area affected by a management activity to which soil quality standards are applied. Activity areas must be feasible to monitor and include harvest units within timber sale areas, prescribed burn areas, grazing areas or pastures within range allotments, riparian areas, recreation areas, and alpine areas. *All temporary roads, skid trails, and landings are considered to be part of an activity area.* Specified transportation facilities and dedicated trails are excluded. Soil quality standards do not apply to intensively developed sites such as mines, developed recreation sites, administrative sites, or rock quarries. Soil quality is maintained when erosion, compaction, displacement, rutting, burning, and loss of organic matter are maintained within defined soil quality standards. Detrimental soil conditions occur when soil hydrologic function and site productivity are adversely affected. *Severely burned soil* has had detrimental physical and biological changes resulting from high severity burns of long duration. High severity fires consume the litter layers, damage root crowns of sprouting brush and grasses, bake the soil surface, consume fuels greater than ¾ inch in diameter, and leave white or reddish colored ashes (FSH 2509.13). *Detrimental soil displacement* is the removal of 1 or more inches (depth) of any surface soil horizon, usually the A horizon, from a continuous area greater than 100 square feet. *Detrimental soil compaction* is a 15 percent increase in natural bulk density. *Detrimental soil rutting* occurs when wheel ruts are at least 2 inches deep in wet soils. Rills, gullies, pedestals, and soil deposition are all indicators of *detrimental surface erosion.* Soil loss of 1 to 2 tons per acre per year is a general limit of soil erosion. *Detrimental soil mass movement* is any soil mass movement caused by management activities. *Detrimental loss of soil organic matter* is site specific, but recommendations from Graham (1994) for down woody debris by habitat type are appropriate for forested types.

3. AREA OF ANALYSIS

The soils analysis area for the project is the proposed 20 units, 1/3 mile of temporary road and approximately 16 landings adjacent to the Benchmark road. A yet to be determined amount of hand dug fire line may be needed around a portion of the perimeter of several units. Additional information is included on existing system roads, trails and past harvest for perspective only. Soils field work was completed by a journeyman level soil scientist in 2005 and 2006.

4. EFFECTS ANALYSIS METHODS

Existing data and information on soils and vegetation was gathered for the project from Forest files. Past management activities within the project area were summarized and displayed as maps where appropriate. Each proposed treatment unit was traversed in the field and all units had soil profiles exposed and described by a journeyman level soil scientist. Soil profiles were exposed and described at the intensity of approximately one per 25 acres. Existing detrimental soil impacts within the units were documented according to the most recent protocols for Region 1, Forest Service at the time of fieldwork. Anticipated soil impacts from proposed treatments were determined based on literature, monitoring or modeling. Once anticipated impacts were determined, they were added to existing

detrimental soil impacts for each unit and the total compared to Region 1 Soil Quality Standards. Mitigation measures were incorporated for each unit to minimize impacts to soils.

5. EXISTING CONDITION

a. **Natural characteristics**

Table 3-9 below summarizes the proposed treatment units and the affected land types for the Action Alternative. Treatment units and land types are illustrated on Map A-3.

Table 3-9. Summary of Treatment Units and Land Types

Unit Name & Site Number	Location	Land type	Proposed Treatment	Fuels Treatment
Ford Ck #1, (193 ac)	SWSE Sec 1, T19N, R9W	161	Hand treatment with power saws	Broadcast and/or jackpot burn
Ford Ck #2, (84 ac)	NENE Sec 13, T19N, R9W	161	Hand treatment with power saws	Broadcast and/or jackpot burn
Double Falls #1, (1 ac)	NWNE Sec 15, T19N, R9W	21A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Double Falls #2, (42 ac)	SENW Sec 15, T19N, R9W	21A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Aspen #1, (44 ac)	SESW Sec10, T19N, R9W	161	Hand treatment with power saws	Broadcast and/or jackpot burn
Aspen #2, (39 ac)	NENW Sec 15, T19N, R9W	161	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Green Timber #1 (9 ac)	SWSW Sec 31, T20N, R9W	71A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Lick Creek #1, (3 ac)	NENW Sec 36, T20N, R10W	13A/71A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Lick Creek #2, (4 ac)	SWNE Sec 36, T20N, R10W	13A/71A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings

Mule Ck #1, (13 ac)	SWNE Sec 26, T20N, R10W	71A/13A	Hand treatment with power saws	Broadcast and/or jackpot burn
Mule Ck #2, (17 ac)	NENW Sec 26, T20N, R10W	13A	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Glade Ck #1, (9 ac)	SWNWNE Sec 16, T20N, R10W	24	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Glade Ck #2, (7 ac)	NENE Sec 16, T20N, R10W	24	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Fairmule #2, (22 ac)	SENE Sec 22, T20N, R10W	24	Commercial harvest with mechanized equipment	Hand pile in unit and burn piles, burn slash piles at landing
Fairmule #3, (19 ac)	NWSW Sec 23, T20N, R10W	71A	Commercial harvest with mechanized equipment	Hand pile in unit and burn piles, burn slash piles at landing
Fairmule#4 (1 ac)	SWNE Sec 22, T20N, R10W	24	Commercial thin with mechanized equipment	Hand pile in unit and burn piles, burn slash piles at landing
Benchmark #1 (236 ac)	SESE Sec 9, T20N, R10W	71A	Hand treatment with power saws	Broadcast and/or jackpot burn
Benchmark #2, (8 ac)	SESW Sec 9, T20N, R10W	71A	Thin with hand and mechanized equip	Hand pile and burn piles
Benchmark #3, (10 ac)	NESWSE Sec 16, T20N, R10W	71C	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings
Benchmark #4, (6 ac)	NW Sec 9, T20N, R10W	24/71C	Commercial thin with mechanized equipment	Hand pile in unit and burn, burn slash piles at landings

Descriptions of the affected land types are found below. The descriptions are based on Holdorf (1981) and information gathered in the field.

Land type **13A** consists of nearly level to hilly (0 to 25 percent slopes) glaciated deposits supporting a mix of forested and grassland vegetation (Holdorf 1981). The unit occurs at elevations of approximately 5000 to 6000 feet. Soils in the analysis area are weakly to moderately developed forested soils with light brown loam and sandy clay loam topsoil 3 to 7 inches thick and light brown loam subsoils containing 10 to 50 percent rounded gravels and cobbles. Soils are over 40 inches deep and well drained. Vegetation is dominantly fescue grassland with some included aspen, and scattered limber pine or Douglas fir.
Land type **21A** consists of moderately steep (25 to 40 percent) mountain slopes generally facing north or east (Holdorf 1981). Elevations range between 5000 and 6000 feet. The shale and sandstone bedrock is generally covered with thin deposits of loamy glacial drift. Vegetation is mixed Douglas fir and lodgepole pine forest with Douglas fir or Spruce/twinflower habitat types noted in the field. Soils are weakly developed forest soils with surface layers of litter and duff underlain by brown loam or fine sandy loam topsoil about four to eight inches thick. The subsoil is brown clay loam or clay with 35 to 50 percent cobbles and gravels. The soils average between 20 and 60 inches deep and are underlain by fractured sandstone bedrock. They are well drained.

Land type **24** consists of nearly level glacial outwash terraces supporting lodgepole pine forest generally between 5000 and 6000 feet elevation (Holdorf 1981). The land type supports mixed conifer forest. Forested vegetation habitat types noted in the field were subalpine fir/dwarf huckleberry, subalpine fir/twinflower and spruce/twinflower. Soils are generally well developed forest soils with surface layers of litter and duff underlain by brown or grayish-brown gravelly loam topsoils 10 to 20 inches thick. The subsoil is brown or reddish-brown clay loam with 15 to 35 percent gravels and cobbles. The substratum is stratified sands and gravels. Soils are well to somewhat poorly drained.

Land type **71A** consists of moderately steep to steep (25-60 percent) slopes underlain by interbedded sandstones and shales (Holdorf 1981). The land type occurs at elevations of approximately 5000 to 6000 feet. Vegetation is mixed lodgepole pine and Douglas fir forest. Habitat types noted in the field included subalpine fir/grouse whortleberry and subalpine fir/dwarf huckleberry. Soils are weakly to moderately developed forest soils forming mostly in weathered bedrock with some wind deposited silt surfaces on north and east aspects. Surface layers of litter and duff are underlain by gravelly loam and sandy clay loam topsoil. The subsoil is a brown sandy clay loam or clay loam containing 35 to 75 percent angular cobbles. Soils in the analysis area were all over 40 inches in depth and well drained.

Land type **71C** is found on hilly to steep (25 to 60 percent) mountain slopes underlain by interbedded sandstones and shale bedrock (Holdorf 1981). The land type occurs at elevations of 5000 to 6000 feet. Vegetation is primarily lodgepole pine forest. Habitat types noted in the field were subalpine fir/dwarf huckleberry and subalpine fir/twinflower. Soils are weakly to moderately developed forest soils mostly formed in weathered bedrock with some surfaces of wind deposited silt. Surface layers of litter and duff are underlain by brown loam or sandy loam topsoil six to twelve inches thick. The subsoil is brown sandy loam or clay loam containing 35 to 75 percent angular cobbles. Soils range from 20 to 40 inches in depth and are well drained.

Land type **161** is a complex of fescue grasslands and mixed limber pine and Douglas fir found on gently sloping to moderately steep (0 to 40 percent) mountain foothills. The underlying bedrock is interbedded sandstones and shales. The land type occurs between 5000 and 6000 feet in the analysis area. Habitat types noted in the analysis area include Idaho fescue/slender wheatgrass, Rough fescue/Idaho fescue, shrubby cinquefoil/rough fescue, Douglas fir/snowberry and subalpine fir/twinflower. Grassland and shrubland soils are weakly to moderately developed grassland soils with dark brown loam and sandy clay loam topsoil, and brown loam subsoil with 35 to 50 percent cobbles. The soils in the analysis area were greater than 40 inches in depth with few exceptions and well drained. Soils under forested habitat types are weakly to moderately developed with litter and duff layers about one inch thick. Beneath the surface layer the topsoil was light brown loams and gravelly loams about 4 to 8 inches thick underlain by light brown to light grayish brown subsoils with varying amounts of coarse fragments. Soils are greater than 40 inches in depth and ranged from well to poorly drained.

Taxonomic Classification of Soils

The soils in italics for each Land type come from Holdorf (1981). The additional listed soils were found in the field in the soils analysis area. A summary table of fieldwork data on soils and large down woody debris can be found in Appendix B. Again fieldwork on the project was completed by a journeyman level soil scientist in 2005 and 2006.

13A—*Typic and Argic Cryoborolls, loamy-skeletal, mixed*
Typic Cryochrepts, loamy-skeletal, mixed
Typic Cryoboralfs, loamy-skeletal, fine-loamy and fine, mixed

21A—*Andic Cryochrepts, loamy-skeletal, mixed*
Typic Haplustepts, fine-loamy, mixed
Typic Cryoboralfs, loamy-skeletal, mixed
Mollic Cryoboralfs, fine-loamy, mixed

24—*Glossic Cryoboralfs, loamy-skeletal, mixed*
Typic Haplustalfs, loamy-skeletal, mixed
Typic Cryoboralfs, loamy-skeletal, mixed
Typic Cryochrepts, loamy-skeletal, mixed
Fluvents, coarse-loamy and loamy-skeletal, mixed

71A & C—*Typic and Andic Cryochrepts, loamy-skeletal, mixed*
Typic Cryoboralfs, loamy-skeletal, mixed
Typic Haplustepts, loamy-skeletal, mixed
Typic Haplustalf, loamy-skeletal, mixed, moderately deep

161—*Typic and Argic Cryoborolls, fine-loamy and loamy-skeletal, mixed*
Typic Cryochrepts, loamy-skeletal, mixed
Typic Argiustolls, fine-loamy, mixed
Udic Haplustepts, coarse-loamy, mixed

Table 3-10. Summary of Land Type Ratings and Interpretations (Holdorf (1981), National Soil Survey Handbook (1996) and (USDA 2006).

Land Type	Water Erosion from Compacted Topsoil (1)	Sediment Delivery Efficiency (2)	Skid Trail Off Site Sediment Pollution Hazard (3)	Soil Rutting Hazard (4)	Limitations to Logging (5)	Limitations to Prescribed Fire (6)
13A	Low	Low	Low	Moderate-Severe	Not rated	Slight
21A	Moderate	Moderate	Moderate	Moderate-Severe	Moderate	Moderate
24	Low	Low	Low	Moderate-Severe	Low	Moderate
71A	Low	Low	Low	Moderate-Severe	Moderate	Moderate-Severe
71C	Moderate	Low	Moderate	Moderate-Severe	Moderate	Moderate
161	Moderate	Low	Moderate	Moderate-Severe	Not rated	Moderate-Severe

(1) Holdorf 1981) The rating is for water erosion on soils bare of vegetation and compacted by traffic to the point that infiltration rates are very slow. This condition results from two-track roads and skid trails. The rating considers resistance to detachment and movement of exposed soil material and the ease of establishment of erosion control seedings as it affects the time the soil is susceptible to erosion. It does not consider climatic factors, cover or slope factors which are reduced to a common level by the nature of these practices.

(2) (Holdorf 1981) A rating of the probability of eroded material becoming stream sediment. Assumed to be a function of slope and drainage density. As slope increases and distance between stream channels decreases the sediment delivery efficiency increases.

(3) (Holdorf 1981) Logging skid trails, system trails and primitive wheel track roads are the major practices evaluated. They all share the common properties of being bare of vegetation, having topsoils compacted by traffic to the point that infiltration and permeability rates are very slow and occurring on variable grades up to about 25 percent maximum. They are often difficult to effectively drain because they are lower than the surrounding land surface.

(4) (Holdorf 1981) A rating based on an estimate of the length of time the soil is susceptible to damage from the operation of equipment. The rating considers soil moisture conditions, texture and coarse fragment content.

(5) (Holdorf 1981) A rating of the limitations to logging by machine skidding or the various moderate to long line cable systems available. The following limitations are considered: slope, rock outcrop, slope mass failure, wet ground, compacted topsoil erosion and non-commercial forest.

(6) (National Soil Survey Handbook (1996) and USDA (2006). The affects of prescribed burning on the vegetation are influenced by the soil. The soil properties and qualities considered are slope, soil texture, drainage class, depth to restrictive layer, and the presence and thickness of an organic layer on the surface. Soils rated slight have few limitations that affect the reestablishment of vegetation. Soils that have moderate limitations require post-burning practices to achieve the desired results. Soils that have severe limitations require post-burning practices to achieve the desired erosion control.

b. <u>Human Influence</u>

Limited, old cattle sign was noted in Ford Creek Units 1 and 2, Aspen Unit 1 and Fairmule Unit 2 including trailing and manure. No areas of concentrated use were noted and minor detrimental soil impacts were found related to livestock grazing. Horse and mule use was noted in Benchmark Unit 1 especially within ½ mile of the Forest Service barn and corrals. Vegetation removal, soil displacement and trailing were noted.

Forest records and notes taken during fieldwork in 2005 and 2006 show many known locations of spotted knapweed, Hound's Tongue and Canada thistle and few locations of leafy spurge and Dalmatian toadflax along the Benchmark Road. Heaviest mapped concentrations are between the Forest boundary and Squirrel Creek, mostly on the north side of Benchmark Road and between Fairview Creek and South Fork Sun River Trailhead on both sides of Benchmark Road. Ford Creek Unit 1, Aspen Creek Unit 1, Fairmule Unit 2, Glade Creek Units 1 and 2, and Benchmark Units 1 and 4 have noxious weeds mapped within. Potential impacts to soils from noxious weeds are discussed under Direct and Indirect Effects.

The main access route to the project area is the Benchmark Road, Forest Road (FR) 235. It is gravel surfaced, receives maintenance yearly but is one of the most heavily used roads in the District. Sections of washboard, washing and shallow rutting are commonly found. Shorter spur roads to Double Falls, Benchmark Campground, parking areas and special use cabins along Benchmark Road seldom see maintenance and are rutted with potholes.

A number of recreation facilities are found along the Benchmark Road: trailheads at Double Falls, Wood Lake Campground and picnic area, Benchmark Campground and trailheads and Southfork Campground, packer corrals and trailheads. Improvements to these facilities are ongoing and as recent as 2006 at Wood Lake. By definition, these administrative areas are not part of the soils analysis area (FSM 2550, R-1 Supplement 2500-99-1). Associated soil impacts from construction and use of these facilities include vegetation removal, soil displacement, soil compaction and rutting.

Forest records show approximately 23 wildfire starts within 2 miles of the soils analysis area. All but five fires since 1945 have been less than an acre. A 1996 fire along Benchmark Creek just east of Benchmark Road grew to approximately 55 acres with few long term impacts noted. A 1945 fire approximately ½ miles north of Benchmark Station in Section 9 burned approximately 2270 acres. Burned stumps and charcoal were noted in the soils of Benchmark Unit 1 and 4 during 2006 fieldwork. The 2006 Cigarette Rock fire burned approximately 2271 acres nearly all in the Straight Creek drainage west of Wood and Ford Creeks. In 2006 the 323 acre Ford Creek fire burned between Red Creek and North Fork Ford Creek approximately ½ mile north of the Benchmark Road. Approximately 85 to 90 percent of the Ford Creek fire perimeter was unburned or showed low burn severity and as much as 15 percent moderate severity. Adequate functioning buffers exist between the Ford Creek fire and the two drainages bounding it with few long term impacts anticipated. The 2007 Ahorn fire burned to within a mile north and west of Benchmark Station. The project area should see little impact from the fire itself. Forest vegetation at cabins near Benchmark and Glade Creek and Benchmark Campground was thinned with hand crews. Some of the slash was chipped and scattered with the rest hand piled. Soil impacts from these actions are minor.

Forest records indicate limited past timber harvest within and adjacent to the soils analysis area. Table 3-11 below summarizes the harvest location, time and kind of harvest.

Table 3-11. Past Timber Harvest Within or Adjacent to Soils Analysis Area

Stand Number	Location	Location Relative to Proposed Units	Type of Harvest, Year and Size
15102001	SW ¼ Sec 26 T 20N, R10W	¼ mile south of Mule Ck Unit #2	Selection Cut, 1982, 10 ac
15702012	NE ¼ NW ¼ Sect 22, T 20N, R10W	400 yards NW Fairmule #2	Clearcut, 1998, 20 ac
15701024	SE ¼ Sec 22 and SW ¼ Sec 23, T20N, R10W	Within and South of Fairmule #3	Precommercial thinning, 1 ac, 1989
15702003	NW ¼ SE ¼ Sec 16, T20N, R 10W	Includes Glade Ck #2	Precommercial thinning, 18 ac, 1995
15702001	SW ¼ NE ¼ Sec 16, T20N, R10W	Includes Glade Ck #1	Precommercial thinning, 11 ac, 1983
15704002, 15704003, 15704004	SE ¼ Sec 9, T20N, R10W	Within and south of Benchmark #1, 2	Precommercial thinning, 24 ac, 1982 and 1993

Evidence of old cut trees and fire wood cutting adjacent to existing roads was noted. Very limited detrimental soil impacts were seen from these activities within the soils analysis area. A summary of detrimental soil impacts is found in Table 3-12 below.

c. <u>Desired Condition</u>

Manage National Forest System lands under ecosystem management principles without permanent impairment of land productivity and maintain or improve soil quality (Forest Service manual, R1 Supplement 2500-99-1). Design and implement management practices that maintain or improve soil quality. Protection of the soil resource should be emphasized and restoration practices should be implemented where necessary. Soil quality is maintained when erosion, compaction, displacement, rutting, burning and loss of organic matter are maintained within defined soil quality standards.

6. ENVIRONMENTAL CONSEQUENCES

Approximately 197 acres of commercial thinning and timber harvest, 570 acres of hand treatment followed with prescribed burning and 1800 feet of temporary road construction/rehabilitation are proposed. Mechanically harvested units would be ground yarded to approximately 16 small landings located next to existing system roads and temporary roads. Mechanical harvest would occur with frozen ground or adequate snow cover and prescribed burning would occur under cool spring or fall conditions. Landings, processor burn piles, temporary roads and any fireline would be rehabilitated following use where soils are detrimentally impacted. Noxious weed control would continue in the project area.

a. Effects Common To All Alternatives

Established road surfaces are, for practical purposes, eliminated from the productive soils base. Soil erosion and sedimentation from established roads occurs because roads lack vegetative cover and the running surface is compacted. Increased use, especially by heavy vehicles, damages road drainage (Seyedbagheri 1996). Poor road drainage accelerates erosion rates by allowing runoff to accumulate on the roads, often collecting water from upslope (Trombulak et al 2000). Small soil particles that are easily removed by runoff are another result of increased use by heavy vehicles (Seyedbagheri 1996; Trombulak et al 2000). Applying Best Management Practices (BMPs) that maintain road drainage, minimize use when the subbase is wet and stabilize cut and fill slopes will reduce soil impacts (Seyedbagheri 1996; Megahan et al 1992).

Maintenance of roads loosens soils and can lead to contributions of sediment to stream systems (Ketcheson and Megahan 1996). Following BMPs that establish effective road and trail drainage systems and stabilize cut and fill slopes will effectively reduce erosion in as little as several years (Seyedbagheri 1996).

b. Alternative 1 - No Action Alternative

1. Direct and Indirect Effects

Under this alternative no commercial harvest, prescribed burning, temporary road construction or fireline construction would occur at this time. Some soil impacts from existing roads and trails would continue as described above. Current livestock grazing impacts would likely continue within the proposed treatment units. Minor areas of vegetation removal, soil compaction and displacement are anticipated where livestock trail, bed and loaf. Some continuing soil impacts from noxious weeds would occur as described below under Alternative 2.

2. Cumulative Effects

The cumulative effects area for soils would be the same as the soils analysis area as described above (FSM 2550, R-1 Supplement 2500-99-1). The discussion of additional soil impacts found above under the heading of Human Influence is provided for perspective. The project file contains the list of past, present and reasonably foreseeable activities which is the basis for describing cumulative effects. Only those projects with measurable impacts to soils were considered.

The Record of Decision for Birch Creek South portion of the Rocky Mountain Ranger District Travel Management Plan was signed in October 2007 (USDA Forest Service 2007). Existing system roads and trails in the project area will continue to be present with some modification of use. Some short segments of unauthorized travel to dispersed camping sites may be decommissioned/obliterated in the future, but the exact methods are yet to be determined. The segments and methods of decommissioning/obliteration would be considered in an additional NEPA document. Benchmark road does receive regular maintenance.

The past timber harvest described above on National Forest lands showed little impact to soils in the soils analysis area. On adjacent areas soil compaction would slowly lessen from the action of wetting/drying and freeze/thaw cycles. Bare ground would grow effective vegetative cover. Erosion rates would lessen as ground cover increases.

No additional timber harvest is planned in the soils analysis area at this time. A limited amount of timber harvest has recently occurred just east of the Forest Boundary adjacent to Ford Creek (approximately 150 acres) and this activity may continue. Likely soil impacts from harvest on private lands would include vegetation removal, displacement, compaction and rutting.

Prescribed fire and wildfire have had little recent impact to soils in the soils analysis area. Additional discussion of recent past wildfire is found under the heading of Human Influences above. If wildfire were to burn through the soils analysis area a variety of soils impacts would be likely dependent upon climate, topography, fuels and timing. A range of burn severity from low to severe would be expected. Moderate to high fire severities would likely result in an increased amount of bare soil, accelerated erosion, slow recovery of effective vegetative cover, and loss of soil nutrients and soil microbes. Areas burned with low fire severity may benefit from a short-term release of nutrients available to plant growth and a change in the kinds and amounts of vegetation.

Soil impacts from recreation activities within developed recreation sites, at trailheads and within administrative sites adjacent to the soils analysis area are likely to continue similar to present. Soil impacts in the future from dispersed camping and off road travel would be localized and of minor extent.

Noxious weeds in the soils analysis area will continue to be monitored and treated as funding allows. Minor increases of plant and increases in bare soil are anticipated with little overall changes in soil conditions related to these plants as long as noxious weed BMP's are followed.

3. Forest Plan and Other Regulatory Framework

The No Action Alternative, Alternative 1, would meet the soils related portion of the Lewis and Clark National Forest Plan.

c. Alternative 2 – Proposed Action

1.Direct and Indirect Effects

Yarding trees, the potential increase of noxious weeds within and near treatment units, impacts to nutrient cycling from removal of large woody debris and prescribed burning have the potential to affect soils in the analysis area.

Yarding with tractors, construction of landings, burning slash at landings, pile burning in the units and broadcast burning will expose mineral soil and have the potential to compact, displace or puddle the soils of *all land types* in the analysis area (Holdorf 1981; Clayton 1990; Elliot et al, 1999). Exposed soils of these land types are susceptible to erosion from runoff (Holdorf 1981; Clayton 1990; USDA 1996). Soil compaction, erosion, displacement

and puddling all impact long term soil productivity by reducing the exchange of gases, reducing water infiltration, reducing or eliminating the most productive layer of soil and disrupting the most highly biologically active layers of soil (Clayton 1990; Harvey et al, 1994; Elliot et al, 1999). The use of Best Management Practices (BMPs), especially limiting land based equipment use to periods when soils are dry, frozen or have an adequate snow covering, designating skid trails, designing and maintaining skid trail and landing drainage systems and limiting ground based harvest to slopes less than 40 percent will minimize soil compaction, displacement, puddling and erosion (Page- Dumroese et al 2006; Seyedbagheri 1996; Grier et al 1989). Soils under landings and skid trails will be the most severely affected on all land types (Nakamura 1990; Elliot et al 1999). Leaving a minimum of 10 tons per acre of coarse woody debris three inches or greater in diameter (Graham et al, 1994; USDA Forest Service 1986) after slash treatment will help minimize soil impacts and encourage recovery of nutrient cycling (Garrison and Moore 1998; Harvey et al 1994).

Knapweed, leafy spurge and hounds tongue are able to exploit soils exposed by logging operations and burning. Heavy invasions of spotted knapweed (*Centaurea maculosa*) can become nearly monocultures with allelopathic affects on native vegetation (Ridenour and Calloway 2001; LeJeune and Seastedt 2001). Bare soil amounts can increase, kinds and amounts of roots shift to those of the dominant invader and nutrient balances (specifically phosphorus) are altered. Impacts to soils increase as the degree of spotted knapweed establishment increases.

Leafy spurge (*Euphorbia esula*) is a deep rooted, long lived perennial that is difficult to control (Lym 1991; Ball et al 2001). It spreads by both seeds and roots and can occupy flood plains to ridges to mountain slopes (Goodwin et al, 2006). Soil disturbance promotes the establishment of leafy spurge (Lym 1991). After leafy spurge invasion, plant species richness decreases often to only other introduced Eurasian species such as smooth brome and Kentucky bluegrass. Similar to spotted knapweed, bare soil can increase and kinds and amounts of roots shift to those of the dominant invader.

Hounds tongue (*Cynoglossum officinale*) is a biennial or short lived perennial with a thick, black branching taproot extending to depths of over 40 inches (USDA Forest Service 2006a). Hounds tongue rosettes can withstand drought stress, allowing the plant to delay flowering till conditions are improved. Hounds tongue often occurs in dense stands, but may also occur as a small but regular proportion of regional flora. Seeds remain viable for only 2-3 years and are known to be dispersed by attaching themselves to cattle. Houndstongue often occurs in disturbed sites including logging roads and heavily grazed areas. Where it has established on disturbed sites such as roads and around old buildings, it may persist indefinitely. Fire or logging creates conditions that are favorable for establishment of hounds tongue, especially bare soil. Following BMPs for noxious weeds (FSM 2000 Supplement R-1 2000-2001-1) and herbicide control can be effective in slowing the spread of spotted knapweed, leafy spurge and hounds tongue. However, the risk of noxious weed spread increases when known populations are within or adjacent to planned soil disturbance.

Prescribed fire has not only physical effects on soils, but also chemical and biological effects (Hungerford et al 1991; Harvey et al, 1994; Martin et al 2001). Physical changes include reduction in soil cover, loss of duff and litter, loss of organic matter from mineral soil and erosion. These changes influence texture, bulk density and porosity of soils. Chemical

changes occur as nutrients are volatilized, (nitrogen, phosphorus and sulfur) turned to ash and redistributed. Some nutrients are lost or reformed, pH is changed (typically increased due to ash), cation exchange capacity is changed (generally the greater the heating, the greater the chances of ion deficiencies) and displaced hydrocarbons may coat soil particles causing water repellency. Biological effects include microorganism population increases or decreases (typically a decrease due to heating, loss of moisture and reduced gas exchange followed by an increase attributed to reinfection and an improved environment with respect to soil physical changes over time), shifts (often a reduction of mycorrhizae with an increase in bacteria and root fungi) and changes in activity which can influence nutrient cycling, forest growth and forest diseases. Generally, the greater the fire severity the greater the negative impacts to soils. Low impact burning can cause short term increases in the availability of plant nutrients, reduction in disease or pathogens and thinning of over-crowded forests, all of which can promote healthy systems (Neary et al, 1999) but impacts are highly variable. Limiting the size of cleanly burned areas, limiting the timing of burning and adhering to burn prescriptions that include considerations of fire weather, slope, aspect, soil moisture and fuel moisture can reduce soil impacts.

Following prescribed fire treatment of units it is important to leave adequate amounts of large down woody debris to encourage recovery of nutrient cycling (Harvey et al, 1994). Appendix B under the heading of Soil Quality includes recommended amounts of large down woody debris (Graham et al 1994). The recommended and existing amounts vary about the Forest Plan Standard P-2:(4) *"Leave approximately 10 tons of fuel per acre, where available. This should be material over four inches in diameter, which is randomly scattered over the area. Material should touch the ground for faster decomposition."*

Burning piles of slash, primarily at landings, has the potential to consume duff layers and cause physical damage to the surface mineral layer of all analysis area soils (Harvey et al, 1994; Massman et al, 2003). Some plant nutrients stored in the burned material are converted to a gaseous state and lost from the site by burning. Nitrogen and sulfur are especially susceptible (Harvey et al, 1994). Burning slash piles, especially large piles with prolonged burn times will produce the undesirable effects described above. Burning piles under winter conditions would reduce the extent of these impacts.

Soil damage in the future from high intensity wildfires on these harvest and prescribed fire units would be variable. The degree and effects of soil heating depend on fuel characteristics, weather, topography and timing. A range of soil damage from slight to severe would be anticipated.

Soil Quality Standards have been introduced under the heading of Regulatory Framework. Soil Quality Standards on Forest Service lands require that 85 percent of an activity area remain in an acceptable soil quality condition (FSM 2550, R-1 Supplement 2500-99-1). Activity areas and detrimental soil impacts are defined above. When more than 15 percent of the soil resources are in low quality or non-functional condition, additional negative effects become difficult to mitigate or restore. Degraded soil processes begin to severely constrain ecosystem productivity. At this threshold, off-site effects generally become pervasive and severe (Powers 2006; Harvey et al 1994; Everett 1994; Page-Dumroese et al 2000).

Management goals should strive to create as little detrimental disturbance as possible, not just keep from exceeding standards. In areas where less than 15 percent detrimental soil conditions exists from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 15 percent. In areas where more than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration should not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality (FSM 2550, R-1 FSM 2500-99-1).

Little evidence of prior impacts was noted in the proposed treatment units primarily because previous timber harvest was avoided in unit layout. Table 3-12 below summarizes existing detrimental soil disturbance for the treatment units.

Table 3-12. Existing Detrimental Soil Impacts

Unit Number and (Acres)	Old Timber Harvest (1)	Livestock Grazing (2)	Off Road Travel (3)	Camping and Parking (4)	Totals
Ford Ck #1 (193)	0	T	T	T	T (<ac)
Ford Ck #2 (84)	0	T	0	0	T(<ac)
Aspen #1 (44)	0	0	T(<ac)	0	T(<ac)
Aspen #2 (39)	0	0	T (1ac)	T	T(1ac)
Double Falls #1(1)	0	0	0	T	T (<1ac)
Double Falls #2 (42)	0	0	T	T	1 ac
Green Timber #1 (9)	0	0	T	T	T(<1ac)
Lick Ck #1 (3)	0	0	T	T	T(<0.5ac)
Lick Ck #2 (4)	0	0	T	T	T(<0.5ac)
Mule Ck #1 (13)	0	0	0	0	0
Mule Ck #2 (17)	0	0	T	T	T(<1ac)
Fairmule #2 (22)	0	T	T	0	T(<1ac)
Fairmule #3 (19)	0	0	T	T	T(<1ac)
Fairmule #4 (1)	0	0	T	0	T(<1ac)
Glade Ck #1 (9)	T	0	T(<1ac)	0	0.5 ac
Glade Ck #2 (7)	0	0	T	0	T(<0.5ac)
Benchmark #1 (236)	0	T(1-2ac)	T(1-2ac)	T	2-3ac
Benchmark #2 (8)	0	T	T	0	T(<1ac)
Benchmark #3 (10)	0	0	T	T	T(<1ac)
Benchmark #4 (6)	0	T	0	0	T (<1ac)

T=trace, less than an acre

(1) Detrimental soil impacts include displacement, compaction, loss of organic matter, burning
(2) Detrimental soil impacts include displacement, compaction and bare ground
(3) Detrimental soil impacts include rutting, displacement and compaction.
(4) Detrimental soil impacts include rutting, displacement and compaction.

Table 3-13 summarizes the potential soil disturbance for Alternative 2 as described in the proposed action with Best Management Practices detailed in the Hydrology/Watershed report and with soils mitigation/restoration measures applied. See Appendix C for a breakdown of calculations used to generate this table.

Table 3-13. Anticipated Detrimental Soil Impacts Following Proposed Treatments for Alternative 2

Treatment Units (Ac)	Maximum Aerial Extent (Ac) of Detrimental Soil Impacts According to SQS (15% of Unit)	Potential Detrimental Soil Impacts from Proposed Action	Applicable Mitigation Measures	Acres of Anticipated Detrimental Disturbance Plus Existing Detrimental Disturbance (percentage of unit)
Ford Ck #1 (193)	29	Handwork/Burn (2)(3)	(C), (D), (E)	0.5-15.0 (0-8%)
Ford Ck#2 (84)	12.5	Handwork/Burn (2)(3)	(C), (D), (E)	0.5-6.2 (0-7%)
Aspen #1 (44)	6.6	Mechanized/Handwork/Burn (2)	(C), (D), (E)	0.6-4.8 (1-11%)
Aspen #2 (39)	5.9	Mechanized thinning/Burn piles (1) 600 ‘ temp rd	(A), (B), (C), (D)	1.4-3.7 (4-9%)
Double Falls #1 (1)	0.2	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.3-0.4 (30-40%)
Double Falls #2 (42)	6.3	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	1.3-3.8 (3-9%)
Green Timber #1 (9)	1.4	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.8-1.3 (9-14%)
Lick Ck #1 (3)	0.5	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.3-0.5 (10-16%)
Lick Ck #2 (4)	0.6	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.3-0.5 (8-13%)
Mule Ck #1 (13)	2	Handwork/Burn (2)	(C), (D)	0-1 (0-8%)
Mule Ck #2 (17)	2.6	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	1-2 (6-12%)
Fairmule #2 (22)	3.3	Mechanized thinning/Burn piles (1) (50% untreated)	(A), (B), (C), (D)	0.7-2.0 (3-9%)
Fairmule #3 (19)	2.9	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	1.1-2.2 (6-12%)
Fairmule #4 (1)	0.2	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.3-0.4 (30-40%)
Glade Ck #1 (9)	1.4	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.7-1.2 (8-13%)
Glade Ck #2	1.1	Mechanized thinning/Burn	(A), (B), (C), (D)	0.3-0.7

(7)		piles (1)		(4-10%)
Benchmark #1 (236)	35.4	Handwork/Burn (2)(3)	(C), (D), (E)	2.5-20.2 (1-9%)
Benchmark #2 (8)	1.2	Handwork/Burn piles	(C), (D)	0.6-1.2 (8-15%)
Benchmark #3 (10)	1.5	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.9-1.5 (9-15%)
Benchmark #4 (6)	0.9	Mechanized thinning/Burn piles (1)	(A), (B), (C), (D)	0.8-1.2 (13-20%)

Anticipated Detrimental Impacts

1) Detrimental compaction and displacement from piling logs
2) Detrimental burning (Robichaud 2000; Covert et al 2005)
3) Severe limitation for burning on slopes greater than 55% leading to high risk of erosion (USDA 1996; USDA 2006)
4) Detrimental displacement, compaction and rutting from harvest under dry conditions (Klepac et al 1999)

Mitigation Measures

A) Winter harvest which reduces detrimental compaction, displacement and rutting of soils (Grier et al 1989; Page-Dumroese et al 2006)
B) Rehabilitation of landings and temporary/non-system roads to recover soil and hydrologic functioning
C) Leave a minimum of 10 tons per acre down woody debris greater than 4 inches following slash treatment to help reestablish nutrient cycling (Graham et al 1994; USDA Forest Service 1986)
D) Limit burning to conditions that ensure light to moderate severity fires, strive for a burn mosaic at the scale of tens of acres and burn piles under winter conditions
E) Avoid burning on slopes greater than 55% to minimize erosion following the burn and encourage reestablishment of effective vegetation cover (remove acres of 55% and greater slopes from treatment units)

Three small proposed units, Double Fall #1 (1 acres), Fairmule #4 (1 acre) and Benchmark #4 (6ac) have the potential to exceed R-1 Soil Quality Standards by tenths of an acre from anticipated and existing detrimental soil impacts with appropriate mitigation measures applied. As with other harvest units these three small units will have landings rehabilitated after use to initiate recovery of soil and water functioning. With these measures committed to it is thought that detrimental soil impacts will be held to within Soil Quality Standards or that disturbed areas will be trending toward recovery which will eventually bring these units within Soil Quality Standards.

2. Cumulative Effects

The cumulative effects area for soils is the same as the soils analysis area as described above. Additional information outside the soils analysis area is included for perspective. Cumulative effects for Alternative 2 are the same as for Alternative 1 above.

3. Forest Plan and Other Regulatory Framework

Table 3-14 summarizes the compliance of Alternative 2 with Forest Plan Standards.

Table 3-14. Forest Plan Compliance

Forest Plan Standard	How the Standard is Addressed in the Project
E-4: (3) use all necessary measures to minimize soil damage and soil erosion on timber sale areas.	Appendix D lists appropriate soil and water BMPs that were analyzed and will be applied for this project
E-4: (4) Limit equipment use where ground conditions are such that excessive damage would result.	Appendix D lists appropriate soil and water BMPs that were analyzed and will be applied for this project
E-4: (7) Give consideration to limitations on land types as described in Lewis and Clark Soil Resource Inventory (Holdorf, 1981).	Incorporated into project design.
F-1: Utilize adequate soil and water conservation practices to protect soil productivity and to control nonpoint water pollution from project activities, using as a minimum, practices specified in any State-developed "Best Management Practices."	Appendix D lists appropriate soil and water BMPs that were analyzed and will be applied for this project. Noxious weed BMPs (FSM 2000 Supplement R-1 2000-2001-1) and herbicide control incorporated into affects analysis as well.
F-3: (1) Require application of Best Management Practices to project activities to ensure meeting or exceeding State water quality standards.	Appendix D lists appropriate soil and water BMPsto be applied for this project and BMPs are incorporated into affects analysis. Noxious weed BMPs as found in FSM 2000, Sup. R-1 2000-2001-1 also analyzed and will be applied.
F-3: (2) Develop additional Best Management Practices during the environmental analysis process and incorporate them into all land uses and project plans as a principal mechanism for controlling non-point sources and meeting soil and water quality or other resource goals.	Appendix D lists appropriate soil and water BMPs to be applied for this project and BMPs are incorporated into affects analysis. Noxious weed BMPs as found in FSM 2000, Sup. R-1 2000-2001-1 also analyzed and will be applied.
F-3: (10) In accordance with NFMA, RPA and Multiple Use-Sustained Yield Act, all management activities will be planned to sustain site productivity.	R-1 Soil Quality Standards are described and incorporated into analysis. Limiting impacts from prescribed burning, harvesting under winter conditions, leaving adequate amounts of greater than 4 inch down woody debris and minimizing spread of noxious weeds are stressed.
F-3: (11) Require prompt revegetation of disturbed areas, especially cut and fill slopes, to control surface erosion. To stabilize disturbed areas, seed with grasses, forbs and deep-rooted native shrubs, where natural establishment of native cover is not expected within two years. Ideally the seedbed should be firm with a roughened surface. The slope must be stable, usually less than 2:1. Steeper slopes can be benched or terraced. Compacted soils should be twelve ripped from eight to twelve inches.	Incorporated into the analysis and specifically included as mitigation.
(13) Achieve a 70 percent vegetative or litter cover level on cut and fill slopes and other soil disturbance areas within 2 growing seasons or a natural level of vegetative and litter cover when it is less than 70 percent.	Incorporated into monitoring and mitigation.
P-2: (4) Leave approximately 10 tons of fuel per acre, where available. This should be material over four inches in diameter, which is randomly scattered over the area. Material should touch the ground for faster decomposition.	Recommended amounts of down woody debris found in Appendix B (based on Graham (1994) and Lewis and Clark NF Forest Plan) would meet the Forest Plan Standard.

Mitigation Measures and Monitoring:

Mitigation measures for the project as a whole to ensure meeting Lewis and Clark Forest Plan and Regional Soil Quality Standards would include:

1) Rehabilitation/decommission landings following use. These steps would help restore soil functioning and help minimize establishment of noxious weeds. Rehabilitation/decommissioning efforts would include relieving detrimental soil compaction where needed by shallow ripping to approximately 8-12 inches in depth, respreading any bermed soil and slash across the impacted area, providing permanent drainage, seeding with native species of grasses and scattering slash and rock over the impacted area to discourage unauthorized travel and noxious weed establishment.
2) Limit use of land based harvest equipment to winter periods with a minimum of 4 inches of frozen soil or approximately 20-24 inches of snow cover. Avoid skidding logs in all drainage channels. Minimize crossing drainages with logging equipment.
3) Limit prescribed burning of all areas to prescription conditions that would ensure light to moderate severity fires. Suggested prescription conditions that would promote light to moderate severity fires include:

   a) Early spring or late fall/winter timing to minimize the length of time and area that is black.

   b) Litter, duff and soil moisture conditions that limit the loss of litter and duff.
4) Prescribe burn in a mosaic at the scale of tens of acres to minimize erosion and reduce loss of nutrients, especially on shallow soils. Avoid burning on slopes steeper than 50 percent, particularly those steep slopes adjacent to drainages.
5) Limit burning of slash piles to *winter conditions* to minimize detrimental burning of soils.
6) Leave a minimum of 10 tons per acre down woody debris greater than 4 inches in diameter following slash treatment on all harvest units to help reestablish nutrient cycling.
7) Rehabilitate temporary road used to access treatment units following use. Relieve compaction where needed to approximately 6-12 inches in depth. Pull bermed material back across travel way, provide permanent drainage, place available rock and wood on surface and seed with approved native species mix.
8) Follow BMPs for noxious weeds found in FSM 2000 Supplement R-1 2000-2001-1.
9) Monitor noxious weed spread, landings and severely burned areas with timely treatment of problem areas.
10) Monitor harvest/thinned areas after treatment of slash to determine detrimental soil impacts and BMP effectiveness.
11) Rehabilitate hand dug fireline after use. Pull bermed material back on line, provide permanent drainage and place available rock and wood on disturbed surface.
12) Limit mechanical harvest to slopes less than 40 percent.

D. WATERSHED

1. INTRODUCTION

The watershed analysis focuses on the current watershed condition and the effects of the implementation of the alternatives as described in Chapters 1 and 2, on the water resources. It includes evaluation of the sediment sources, water yields and past activities that contributed to existing conditions.

2. REGULATORY FRAMEWORK

Forest Plan Direction

The Lewis and Clark National Forest Plan describe Forest-wide standards that apply to the water resources. This direct management is to maintain soil productivity and water quality, (p. 2-7 and 2-8). State water quality standards will be met through application of best management practices. Soil productivity will be maintained and sediment resulting from soil erosion will be minimized by the application of soil and water conservation practices.

Management Standard E-4:

(2) Manage the timber resource to enhance riparian values by:

(a) Protecting streamside vegetation when removal could result in increased stream temperature or increased turbidity, bedload, and suspended solids which would be detrimental to aquatic habitat.

(b) Minimizing the amount of debris entering the stream channels and lakes by using correct logging and construction operations. If debris enters the streamcourse in amounts which may adversely affect natural flow of the stream, water quality, or fish resources, then debris will be shell be removed in a manner that will cause the least disturbance to the streamcourse.

(c) Locate log landings away from riparian areas or where surface runoff will not discharge directly into the channel.

(e) Locate slash piles away from riparian areas so residues will not reach perennial streams.

(3) Use all necessary measures to minimize soil damage and soil erosion on timber sale areas.(Best Management Practices)

(4) Limit equipment use where ground conditions are such that excessive damage would result.

(5) In plans and contract requirements, stress prevention of erosion and prevention of channel clearing, rather than using remedial measures.

(6) Limit tractor skidding to slopes of 45 percent or less depending on soil type.

(7) Give consideration to limitations on landtypes as described in Lewis and Clark Soil Resource Inventory (Holdorf 1981)

Management Standard F-1:

(1) Utilize adequate soil and water conservation practices to protect soil productivity and to control nonpoint water pollution from project activities, using as a minimum, practices specified in any State-developed "Best Management Practices."

Management Standard F-3:

(1) Require application of Best Management Practices to protect activities to ensure meeting or exceeding State water quality standards.

(2) Develop additional best Management Practices during the environmental analysis process and incorporate them into all land uses and project plans as a principal mechanism for controlling non-point sources and meeting soil and water quality or other resource goals.

(3) Meet State water Quality standards as required by the Clean Water Act (33 U.S.C. 1323), and as detailed in the Memorandum of Understanding to Implement the 208 Program on National Forests in the State of Montana. Coordinate with the State of Montana concerning stream channels as agreed to in the Memorandum of Understanding with the State of Montana Fish and Game Commission.

(4) Require a watershed analysis of projects involving significant vegetative removal to ensure that the project, considered with other activities, will not increase water yields or sediment beyond acceptable limits. The analysis should identify any opportunities for mitigating adverse effects on water related beneficial uses, including capital investments for fish habitat or watershed improvements.

(5) Conduct an environmental analysis for all management actions planned for flood plains, wetlands, riparian zones, or bodies of water prior to implementation. Adopt the necessary mitigation measure to minimize risk of flood loss, restore and preserve flood plain values, and to protect wetlands.

(6) (7) Not applicable

(8) Require drainage structures on disturbed areas where it is necessary to control erosion.

Management Standard L-4

(1) Not applicable.

(2) Not applicable.

(3) Design and construct roads and other facilities to protect riparian areas, to control erosion, and to protect lands and resources.

(4) Locate facilities, including roads, drill pads, pipelines, as far from riparian areas as practical. This will generally be no closer than 100 feet. Width of buffer strips should vary with slope, erosion hazard, and ground cover density.

(5) Cross riparian areas only when necessary. Such crossings will be specially designed to minimize adverse environmental effects.

(6) Consider the total value when evaluation dictates the need for a road paralleling a stream. For example, a stream channel change, properly designed and constructed, might result in a road with less adverse impact then would construction of a road across a steep slope.

(7) Consult the Montana Department of Fish Wildlife and Parks and the Montana Department of Health and Environmental Sciences, Water Quality Bureau (Form FG_124) prior to any construction in or adjacent to stream channels, in order to protect the aquatic ecosystem.

(8) Maintain stream side vegetation if possible. Replace what is destroyed in order to meet the needs of the aquatic environment.

(9) Do not operate heavy equipment in stream courses, except if essential to contraction activities. Heavy equipment use must be specifically authorized by the District Ranger.

(10) Place the toe of fill material from road construction, maintenance, and other earth-moving activities above the high-water line. Use construction methods and/or structural barriers to prevent fill material from washing downstream. Keep road widths to a minimum when construction must encroach on a stream channel.

MONTANA STREAMSIDE MANAGEMENT ACT

The Montana Streamside Management Act (SMZ) establishes management zones along streams and wetlands. The SMZ is intended to provide a buffer between the stream and forest activities to help keep sediment from the upland entering streams. This act prohibits several forest practices within the SMZ. Activities on the Lewis and Clark National Forest must comply with the SMZ law.

Most of the streams and drainages within the project area are classified as **Class 1** or **Class 2** based on definitions in Montana Guide to Streamside Management Zone laws and Rules (MDSL 1994). Class 1 streams are streams that support fish, or the stream normally flows during six months of the year or more and contributes surface flow to another stream, lake or other body of water (OBW). Class 2 stream are stream segments that do not support fish, and normally do not have surface flow six months of the year or more, but do contribute surface flow to another stream, lake or OBW. The following requirements apply to the SMZ:

- On slopes of less than or equal to 35%, the SMZ boundary is 50-feet (slope distance) from the ordinary high water mark (OHWM). On slopes greater than 35% the SMZ boundary is 100-feet (slope distance) from the OHWM.
- Retain at least 50% of the trees greater to or equal to 8-inch DBH on each side of stream or 10 trees per 100-foot segment whichever is greater.

- For SMZ's wider then 50-feet, select most retention trees within 50-feet of the stream. The remaining retention trees may be left anywhere in the SMZ segment, but whenever possible, favor bank edge trees and trees leaning towards the stream.
- Maintain a diversity of trees species and size class that are representative of the pre-harvest stand.
- Protect and retain sub-merchantable trees and shrubs to the fullest extent possible.
- Broadcast burning and the operation of wheeled or tracked vehicles are prohibited within the SMZ.
- Depositing slash in streams is prohibited. These activities would require a special permit from the State of Montana.

CLEAN WATER ACT

Section 303(d) directs states to list water quality impaired streams (WQLS) and develop total maximum daily loads (TMDL) to control the non-point source pollutant. In Montana, agencies are instructed to use the 1996 303(d) list of Water Quality Impaired Streams even though the 2004 list has been approved. For this project, both the 2004 and 1996 lists were considered.

Ford Creek is listed on the 2004 Montana 303(d) List of Impaired Waterbodies (MTDEQ, 2004) from 2 miles above the confluence with Smith Creek to the confluence with Smith Creek, for partially supporting aquatic life and cold water fisheries. It has been assessed for fully supporting drinking water, swimming, agriculture and industrial uses. Probable causes of impairment are siltation, bank erosion, channel incisement, riparian degradation, fish habitat degradation, and other habitat alterations. Probable sources are hydro-modification, agriculture, and grazing related sources. The listed segment of stream is located southeast and approximately 10-miles down stream of the project location, and the forest boundary.

3. AREA OF ANALYSIS

DISTRICT: **Choteau R.D.**

LEGAL LOCATION: **T20N, R10W, SEC. 9, 16, 22, 26, 36**

T20N, R9W, SEC. 31

T19N, R9W, SEC. 10, 15

WATERSHEDS: **100301040203 (Wood Cr), 100301040702 (Ford Cr), 100301040202 (Straight Cr)**

PERENNIAL STREAMS: **Wood Cr., Ford Cr., Benchmark Cr., Lick Cr., Glade Cr., Straight Cr., Mule Cr., Fairview Cr., Whitewater Cr., Green Timber Cr.**

4. EFFECTS ANALYSIS METHODS

The primary watershed issues in the Benchmark analysis area are:

- ✓ Stream Sedimentation/Water Yield
- ✓ Stream Channel Condition

STREAM SEDIMENTATION/WATER YIELD

Stream sedimentation effects will be evaluated by assessing: Sediment delivery from roads (including log hauling and mitigation reductions), sediment delivery due to vegetation and fuels management (including: timber yarding, landings, temporary roads and burning) and wildland fire.

For this analysis, a cumulative equivalent clearcut area (ECA) of 25% or less is considered to be a low risk for causing measurable (detectable) changes in water quantity. Troendle (1983) states: "It has been generally noted that 20-30% of the watershed has to be harvested before a significant change in flow can be detected". This statement is based on data displayed in Hydrology, Chapter III. *In* An approach to water resources evaluation of non-point silvicultural sources (Troendle and Leaf, 1980). Data pertaining to Colorado and Arizona was collected in watersheds with mean annual precipitation ranging from 19 to 32 inches. Proposed activity's in the project area lie at elevations with mean annual precipitation (28 in/yr) between 20 and 30 inches (USDA-SCS, 1977), with the majority falling as snow. This level of precipitation is adequate to maintain streamflows throughout the year along the entire mainstem reach and most tributaries. Since mean annual precipitation is a major factor in water yield modeling, it is appropriate to extrapolate this data and reference to the Benchmark Fuels Reduction project area.

Concerning road density, the Interior Columbia Basin Assessment correlated road density in relation to surface fines and found "The effect of roads on surface fines is unclear, though the highest mean values were found in the highest road density class" (Quigley, 1997). The road density class referred to is 1.7 to 4.7 miles/miles^2. Benchmark Fuels Reduction project area has an existing road density of <1 miles^2.

Past timber harvest activities have been concentrated in the headwater tributaries of Wood Creek drainage. See Table 3-16 for a summary of the timber harvests. These past harvest acres would have normally been converted to an equivalent clearcut area. ECA calculations reflect different harvest prescriptions that remove different levels of forest canopy. The results standardize these harvest areas to a percentage of a clearcut acre. For example, 10 acres of 2-story harvest that removes 60% of the canopy is equal to 6 ECA acres, and 10 acres of commercial thinning that removes 40% of the canopy is equal to 2.5 ECA acres. The relationship of percent canopy removal to ECA acre is nonlinear as presented in Forest Hydrology Part II (USDA-FS, 1974). ECA calculations were looked at but not used for the analysis area watersheds, because there have been almost no measurable timber harvest activities, road density are very low, and acres of past fire activity has been limited in extent.

Existing cumulative effects models are not adequate to quantify to a single cumulative value, the effects of all the diverse activities in the drainage including wildfire/prescribed fire, camping, OHV use, grazing, floodplain development, timber harvest and road construction. The only way to address these cumulatively is to address each activity individually and then qualify, in general terms, the cumulative effects between specific activities where appropriate.

Stream Channel Condition

Stream channel condition effects will be evaluated by assessing existing stream channel conditions and water yield. The existing condition of streams as they were found during field surveys will make analysis more meaningful and specific to the analysis area.

Stream surveys in the treatment area were completed in 1994 in conjunction with the Sun River Range Analysis. During the 1993 and 1994 field season, riparian zones of grazing allotments were assessed for current stream channel, fisheries, and riparian vegetation condition. The methodology used to assess these conditions included channel classification, riffle stability index, pebble counts, and channel stability ratings.

Channel typing was carried out according to the Rosgen Channel Classification System (Rosgen,1996). Channel characteristics that were quantified included bankfull width and depth, floodplain width, water slope and channel sinuosity.

The Riffle Stability Index was determined according to the procedures developed on the Idaho Panhandle National Forest (Kappasser, 1993). The stability index is a measure of the percentage of the bed material that moves under the average high flow discharge. To obtain this index number, channel substrate is measured across representative riffle and deposit formations. The mean size of the depositional material is then related to the cumulative distribution curve of the riffle substrate.

In addition to the above quantitative measurements, bank alteration, bank and channel substrate composition, riparian vegetation, woody debris loads and channel stability were assessed qualitatively. Bank alteration in terms of cover and stability was estimated as a percent of the total reach (Bauer and Burton, 1994). Substrate was visually estimated for the percent of boulder, cobble, gravel and sand. Riparian vegetation was described in terms of percent of different vegetation types. Debris was described in terms of the size, amount, and percent of the stream effected. Photographs were taken of general conditions along most reaches and at all quantitative measurement locations.

Properly Functioning Condition (PFC) (USDI – BLM, 1995) was also used on all the surveyed streams within the analysis area.

5. EXISTING CONDITION

Natural Characteristics

a. Existing Sediment Sources

Watersheds within the project area have had many disturbances that would impact streams. Disturbances within the watersheds would include, but not limited to high intensity flooding, roads, timber harvests, fire, and grazing. There are currently approximately 39 miles of roads and approximately 109 acres of timber treatment of varying degree completed within the watersheds located within the analysis area. Field reviews during the summer of 2005 of past harvest units revealed that all units had regenerated to various degrees and were providing no visible impacts to any of the stream systems. See Table 3-16 for the past timber activities within the watersheds. High intensity flooding has perhaps played the largest role in stream

alteration in recent history. Information contained in U.S. Geological reports on the 1964 and 1975 floods indicate that significant floods occurred within and around the Ford and Wood Creek drainages in 1908, 1953, 1964 and 1975. The 1964 flood produced the highest recorded instantaneous discharge levels across the Rocky Mountain Front, while the 1975 flood produced the highest total volume of flood waters. This information suggests that Ford and Wood Creek drainages are susceptible to significant flood events. The high intensity flooding during the springs of 1964 and 1975 created alluvial fans at the bottoms of many of the stream channels located within the analysis area. Although these fans can be technically identified as riparian areas, they will not be identified as such for the purpose of this analysis. Upon field reviews of the areas, it was identified that none of the fans created from past flooding were being accessed by the streams during normal high flows.

Active grazing allotments and impacts from grazing continue to be contributing to some degradation of the streams within the project area, although found to be minor. Stream bank trampling, channel widening and increase water temperatures are a few of the impacts to water quality and stream function that can occur from grazing. All surveyed stream segments within the analysis area were rated as being in a functioning condition. See Tables, 3-15 and 3-16, for a summary of the surveys.

The watersheds within the analysis area have not seen any large scale fire within the last 50 years. Within the past 2 years 3 fires have occurred within and adjacent to the analysis area.

In 2006 the **Ford Cr Fire** was located in the North Fork of Ford Cr, burning 323 acres. 85%was determined to be low severity and the remaining 15% moderate severity. A field review by forest service specialists, after the fire, determined much of the low severity burn in shrub land and grassland vegetation was showing re-growth of rough fescue and wheat grasses. The portion of the burn with moderate severity was well buffered from North Fork Ford Creek by a mix of low severity and unburned vegetation. Even though as much as half of the moderate severity burn was on slopes of approximately 30 percent or greater, little detrimental erosion and very little or no sediment is anticipated to reach Ford Creek.(USFS Green/Hamann, 2006)

The **Cigarette Fire** also burned in the project area during 2006. This 2,071 acre fire burned primarily in the Straight Creek drainage, with approximately 96 acres burning into the Ford Creek drainage. Of the 96 acres in the Ford Creek drainage, all of it was on the upper slopes in bedrock and talus slopes in sparse vegetation. Some localized inputs of sediment is expected to enter Straight Creek and some channel changes may occur due to the 1,975 acres that burned within this watershed. The additional input is not expected to have a long term down stream detrimental affect to water quality. No long term effects to water resources are expected from this fire.

The **Ahorn Fire** occurred during the 2007 fire season burning 52,505 acres primarily, west and north of the analysis area. A small portion did burn into the headwaters of Benchmark Creek, one of the watersheds analyzed for this project. It is estimated that 238 acres of the upper Benchmark watershed did burn to some degree. Of the 238 acres burned, approximately 162 acres or 68 percent of the burned area was classified as low severity, with 56 acres receiving moderate severity while the remaining 20 acres was classified as high

severity. Given the location within the watershed and the small percentage of acres burned it is estimated there would not likely be a measurable impacts from this event to the watershed.

The **Benchmark Airfield** is located at the headwaters of Wood Creek. The 6000 foot by 100 foot asphalt runway including two parking aprons was built in 1966. It is used primarily for recreational and some fire related air traffic. The runway, taxi ways, and parking areas equate to approximately 16 acres of asphalt covered area. The nearest stream, (Wood Creek) is over 100 feet at its closest point. This area, being built over 40 years ago, has had sufficient time to adjust to and heal from the initial impacts from the construction of this airfield, with Wood Creek handling any increased flows that may have occurred The proposed activities in this drainage are not expected to increase flows to Wood Creek and would not add to any increased flows from this airfield.

b. Existing Stream Conditions

Straight Creek

Approximately 5 acres of actual activity are planned within the Straight Creek watershed. This activity would consist of hand treatment utilizing power saws, followed by broadcast, jackpot and/or pile burning. Treatment will be directed at reducing the younger age-class trees in a manner conducive for subsequent treatment with broadcast or jackpot burning. Mechanical equipment will not be utilized in this unit (no forest products will be removed from the unit and any re-distribution of slash will be accomplished by hand). Due to the un-measurable amount of impact from this activity and no other activities are planned within the watershed, no further analysis is deemed necessary for the Straight Creek watershed.

Ford Creek, Wood Creek, and Tributaries

Using the Pfankuch method, and stream survey data collected as described above, stream studies completed in 1993 and 1994 indicated all the reaches to be in good condition. Channel bottom composition ranged from silt/sand to gravel/cobble. The surveys indicate most impacts are from grazing and were only a minor contributor to degradation along these reaches. Past flooding was considered the major cause of stream alteration.

Field reviews of additional streams within this watershed were completed in the fall of 2005 and the spring of 2006. The reviews found most remaining streams to be in good to fair condition. One unnamed tributary to Ford Creek located within the Aspen Tract was found to be moderately impacted by cattle grazing and will be addressed further in the anticipated effects to soil and water resources section of the write-up**.**

Ford Creek

Five separate reaches were surveyed in 1993 on Ford Creek The Pfankuch method of stream classification was completed on all 5 reaches, with all reaches having a rating of good. Deposition of sand and silts were observed in some of the reaches with some filling of pools. PFC was also completed in 1994, with all the reaches being determined to be in a functional condition.

Whitewater Creek

In 1991, a cursory walk through survey was completed on Whitewater Creek. The reach was determined to be in a functional condition. A light to moderate amount of sand and gravel deposition was observed, with some filling of pools.

Wood Creek

In 1993, 2 reaches were surveyed along Wood Creek. The Pfankuch method of stream classification was completed on both reaches. The lower reach, which is classified as perennial, was determined to be in good condition. The upper reach, from elevation 5,600 feet and above was rated as poor, mostly grazing impacts. The upper reach is classified as intermittent, typically only flowing during spring runoff or very high intensity storm events. A light to moderate deposition of sand and gravel was observed. PFC was completed in 1994, with both reaches being determined to be in a functional condition.

Fairview Creek

In 1993, 4 reaches were surveyed along Fairview Creek. The Pfankuch method of stream classification was completed. All 4 reached were rated in good condition. Moderate deposition of sand and gravel was observed. PFC was completed in 1994, with all the reaches found to be in a functional condition.

Benchmark Creek

In 1991, a cursory walk through survey was completed on Benchmark Creek. The reach was determined to be in a functional condition. A moderate amount of sand and gravel deposition was observed.

Green Timber Creek

In 1993, the Pfankuch method of stream classification was completed on Green Timber Creek and it was determined to be in good condition. Moderate deposition of sand and gravel was observed. PFC was completed in 1994 and the reach was determined to be in a functional condition.

Mule Creek

In 1993, the Pfankuch method of stream classification was completed on Mule Creek and it was determined to be in good condition. Moderate deposition of sand and gravel was observed. PFC was completed in 1994 and the reach was determined to be in a functional condition.

Lick Creek

In 1993, the Pfankuch method of stream classification was completed on Lick Creek and it was determined to be in good condition. Moderate deposition of sand and gravel was observed. PFC was completed in 1994 and the reach was determined to be in a functional condition.

Summary of Stream Conditions

Livestock grazing occurs on both National Forest System lands and private lands throughout the drainages. Bank trampling has destabilized some channel banks along localized portions of the mainstems and tributaries. Impacts to Ford Creek, Wood Creek and tributaries from grazing are light, except for the upper reach of Wood Creek which is addressed above. Moderate amounts of fine sediment from natural sources are evident in these streams.

Road segments were determined to be a minor source of sediment within the project area. With only 39 miles of roads within the project area little sediment was observed where it is at road crossings or where the road is located adjacent to stream channels. Past harvest activities do not appear to be contributing to water quality based on these studies. All logging actives (109 acres) in the project area have occurred in the Wood Creek watershed. Studies along Wood Creek and its tributaries show no evidence of existing impacts from past timber actives.

c. Desired Condition

The desired future condition of all riparian areas and stream reaches is to reach a properly functioning condition that meets State Water Quality Standards which fully support all appropriate beneficial uses.

6. EFFECTS COMMON TO ALL ALTERNATIVES

Stream Channel Condition

Stream channel condition can change as a result of water yield increases brought on by large areas of tree mortality (fire, insects, or disease) or from excessive harvests (MacDonald and Hoffman, 1995, Stednick 2006). In the last five years, fire and insect mortality has resulted in some changes in cover in the analysis area. Research has shown harvest, fire and insect mortality and the resulting reduction in cover on less then 20% to 25% of a watershed would not result in measurable changes in water yield (Stednick 1996). Potts (1984) found that 35% mortality resulted in a 15% increase in water yield. The primary influences of water yields is precipitation and research has shown that to achieve a measurable increase of water at least 25% of the basal area (cover) would have to be removed (Stednick, 1996). Even though fire, insect disease and harvest can result in channel changes because of water yield increases, floods are the major source of channel change and are caused by climate fluctuations (temperature and precipitation) rather than forest management (MacDonald and Hoffman, 1995).

Channel stability surveys were completed on most reaches in 1976, 1993 and 1994. The 1976, 1993 and 1994 surveys were compared to determine if significant changes in stability parameters had occurred. These ratings were made according to procedures developed by Pfankuch, (Pfankuch, 1978). See Tables 3-15 and 3-17, for summaries of stream surveys and conditions.

Sedimentation

The largest source of sediment contributions is expected to be from hauling timber within the sediment contributing distance to the stream. A study conducted to quantify log hauling effects on forest roads during wet (not frozen, winter, dry) conditions found that logging traffic produces 20-25 times as much sediment compared to no traffic (Foltz, 1996). This represents the 'worst case scenario' as contract provisions and BMPs limit activities to periods when erosion and sedimentation can be limited. Other studies show that logging traffic on an unsurfaced road can increase sediment production by a factor of 1.9, while others show heavy truck traffic can result in 2.1 times (Burroughs and King, 1989). Due to the fact the there will be a very small volume of timber actually harvested from this project, the number of logging trucks associated with this project will be minimal, that along with the fact that logging operations will be conducted during winter months when the ground is frozen, there is very little chance that this activity will produce sediment from timber harvest log hauling.

The underlying geology within the project area includes limestone, sand stones and shales. These structures have weathered to form steep limestone cliffs and slopes throughout the drainages. Natural stream sediment is mainly due to in-stream erosion of loose alluvium. Other erosion processes do occur including dry creep (gravitational movement of surface soils) and mass wasting. These other processes are evident along portions of the mainstems and the tributaries of Ford Creek and Wood Creek. Moderate amounts of fine sediment from natural sources are evident in all streams.

7. EFFECTS BY ALTERNATIVES

a. Alternative 1 - No Action Alternative

Direct and Indirect Effects:

In this alternative there would be no manipulation of vegetation within the analysis area. There would be no new road construction. There would be no increases of sediment contribution from increased traffic on roads. There would be no opportunities for the limited watershed mitigation/improvements that could take place as a result of this proposal; existing sediment sources would continue to contribute sediment to streams. There would be no changes to soil and water resources in the short term. The risk of catastrophic wildfire effects within the analysis area in the long term would not be reduced with this alternative.

Cumulative Effects:

The project file contains the list of past, present and reasonably foreseeable activities which is the basis for describing cumulative effects. Only those projects with measurable impacts to watershed condition were considered.

The Record of Decision for Birch Creek South portion of the Rocky Mountain Ranger District Travel Management Plan was signed in October 2007 (USDA Forest Service 2007). Existing system roads and trails in the project area will continue to be present with some modification of use. Approximately 1.5 miles of short segments of unauthorized travel routes may be decommissioned/obliterated in the future, but the exact methods are yet to be

determined. The segments and methods of decommissioning/obliteration would be considered in an additional NEPA document. Benchmark road does receive regular maintenance.

Prescribed fire and wildfire have had little recent impact to streams in the analysis area. Should high severity fire not occur in the future, or only burn in a small portion of the project area, the cumulative effects of the No Action Alternative would likely be a continuation of the status quo. Watershed conditions would likely continue on the same trend as currently exists.

If high severity fire burns an extensive portion of the Wood Creek and Ford Creek Watersheds in the future, the existing chronic sediment inputs from anthropogenic sources would overlap with fire related sediment. This could prolong the effects of fire related sediment under normal precipitation regimes. Should large storm event occur in any steep, heavily burned watershed, there is a high risk of debris flow events occurring.

b. Alternative 2 – Proposed Action

There would be a slight chance of increase in risk of sediment contributions to streams from increases in traffic on roads and a low probability of sedimentation due to vegetation and fuels management. Watershed conditions with this alternative would likely remain much the same as no additional impacts should be forthcoming from this alternative. However the potential sediment contributions from a large catastrophic fire would be reduced in the area of the treatments, which would in turn reduce the chances of severely increased sedimentation from a wildfire.

Approximately .3 mile of temporary road is proposed for construction with this alternative. This is an existing jeep trail that would be improved to accommodate the logging vehicles. After use, the temporary road would be scarified, seeded, and slashed. The locations of this road is discussed further in the unit specific effects, and shown on Maps 2-1 and 2-3.

Summary of Stream Channel Condition

Based on a number of factors (current channel condition/stability, bank vegetation, estimated water yield increases, project design and mitigation), the risk of channel changes in the mainstems of the Ford Creek and Wood Creek by implementing Alternative 2 is low. Within the subwatersheds, the risk of channel change from Alternative 2 varies by stream from low to very low. If a large severe fire burned the area, the risk of changing current stream conditions in the subwatersheds is high.

Direct and Indirect Effects to Water Resources:

Ford Creek Units 1 (193 acres) and 2 (83 acres) These two units will be treated by hand, utilizing power saws to thin portions of the units. The thinning would include the felling of young lodgepole pine and Douglas fir over selected portions of the units. When the downed trees have cured, the units will be treated with either jackpot and/or broadcast burning. There are no streams or riparian areas located within or near the unit boundaries, the nearest stream is Wood Cr. approximately 300 feet, and no road building planned for these units. Due to the

location of the units and their distance to channels, there are no anticipated detrimental effects to water resources from the proposed actions.

Aspen Tract Unit 1(44 acres) Proposed treatment for this unit would include non-commercial thinning, followed by prescribed fire treatment. This thinning would be directed toward young Douglas Fir and lodgepole pine of under forty feet in height. Following thinning, surface fuels and additional young conifers would be treated through jackpot burning, pile-burning, and/or a broadcast burn. No new roads will be built for this unit, using only existing roads for access. There is an intermittent stream located within this unit. Based on adequate streamside management zones of 50 feet on slopes of 35% or less and streamside management zones of 100 feet on slopes greater than 35% and no new road building for this unit, the likelihood sediment being delivered to these streams and the adjacent riparian area is low. There are no anticipated detrimental effects to water resources from the proposed actions.

Aspen Tract Unit 2(39 acres) This unit will be commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). Trees would be removed leaving 20-30 foot spacing between tree crowns or groups of crowns. Hand slashing and piling would follow as needed. No new roads will be built for this unit, using only existing roads for access.

The un-named tributary to Ford Creek located on this unit's eastern boundary is a perennial stream that has been moderately impacted by livestock grazing, causing stream bank alteration and stream widening. The tributary was surveyed in the fall of 2005 and was determine to be in fair condition with a rating of functioning at risk. No treatment is planned within the SMZ and the use of mitigation measures described below, the probability of sediment being delivered to this stream and to the adjacent riparian area is low. No detrimental effects to water resources from the proposed actions are anticipated.

Double Falls Units 1 (2 acres) and 2 (42 acres) Treatment in these units is to commercially thin utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built. All commercial log hauling will be done over temporary bridge spans placed over existing private bridges.

Whitewater Creek is located approximately 100 feet west of Unit 2. It was determined in 1993 to be in a good, properly functioning condition. The 100 foot buffer should be adequate to assure no sediment is delivered to the stream. An un-named tributary to Ford Creek is also located within the boundary of unit 2; it is an ephemeral stream with no evidence of recent flows. A 50 foot SMZ would be adequate to ensure no sediment would enter Ford Creek from this source. On the northeastern portion of unit #2, Ford Creek intersects the unit; this is within reach #2 of the 1993 stream surveys which determined this reach to be in good condition and functioning. With no treatment planned within the SMZ and the use of

mitigation measures prescribed for this unit, the likelihood of sediment being delivered to these streams and the adjacent riparian area is low. There are no anticipated detrimental effects to water resources from the proposed actions.

Green Timber Creek Unit 1 (9 acres) Treatment in this unit is to commercial thin, utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment, (Page-Dumroese, Deborah et al. 2006**).** Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned. There are no anticipated detrimental effects to water resources from the proposed actions.

Lick Creek Units 1 (3 acres) Unit 2 (4 acres) Treatment planned in these two units is to commercial thin utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned. There are no anticipated detrimental effects to water resources from the proposed actions.

Mule Creek Unit 1 (13 acres) This unit will be treated by hand, utilizing power saws to thin portions of the units. The thinning would include the felling of young lodgepole pine and Douglas fir over selected portions of the units. When the downed trees have cured, the units will be treated with either jackpot and/or broadcast burning.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned. There are no anticipated detrimental effects to water resources from the proposed actions.

Mule Creek Unit 2 (17 acres) Treatment in this unit is to be commercial thinned utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned. There are no anticipated detrimental effects to water resources from the proposed actions.

Fairmule Unit 2 (22 acres) Treatment for this unit would include commercial harvest, with the objective of creating irregular openings of a quarter to half acre. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). All conifers would be removed from these openings with the intent of releasing existing aspen. About thirty to fifty percent of the unit would be in these small openings. The remaining fifty to seventy percent of the unit would remain untreated. Slash piles created during and after the treatment would be allowed to cure and then they would be burned.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Fairmule Unit 3 (19 acres) The proposed treatment for this unit would include a commercial harvest that would remove about fifty percent of the trees in the unit in patches of one half to two acres in size. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (Page-Dumroese, Deborah et al. 2006). Slash created from this treatment would be burned in piles following the harvest.

Approximately 1,800 feet of road will be reconstructed built on the southwestern edge of this unit between units 2 and 3 on an existing jeep trail. See Map XX for location of jeep trail. There are no streams or riparian areas located within or near the unit boundaries or the proposed road reconstruction planned. There are no anticipated detrimental effects to water resources from the proposed actions.

Fairmule Unit 4 (1 acre) The proposed treatment for this unit would include harvest that would create spacing of 20 to 30 feet spacing between crowns or groups of crowns. The work could be accomplished utilizing force account, with posts and poles offered to the public for sale, or it could be offered with other units for commercial harvest. As with similar units, slash piles would be burned following initial treatment. To reduce soil impacts in this unit, time-of-year and method of removing logs and piling slash would be given special consideration. Mitigations for this unit calls for the use of adequate buffers near riparian areas to limit any possible sediment contributions. No road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Glade Creek Unit 1 (10 acres) and Unit 2 (7 acres) Treatment in these units is planned as commercial thinning, utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Thinning in units may be accomplished utilizing personal use permits. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for these units. There are no anticipated detrimental effects to water resources from the proposed actions.

Benchmark Creek Unit 1 (236 acres) This unit will be treated by hand, utilizing power saws to thin portions of the units. The thinning would include the felling of young lodgepole pine and Douglas fir over selected portions of the units. When the downed trees have cured, the units will be treated with either jackpot and/or broadcast burning.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Benchmark Creek Unit 2 (8 acres) Treatment in this unit is planned as thinning with 20 to 30 foot crown spacing, utilizing mechanical equipment and hand tools. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. About one-third to one-half of the trees would be removed in this treatment unit, this work would be accomplished by Forest Service Crews (Force Account Funds), with post and pole material being removed and placed in decks for sale. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built. There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Benchmark Creek Unit 3 (12 acres), Unit #4 (11 acres) Treatment in these units is planned as commercial thinning, utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is a sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. (Page-Dumroese, Deborah et al. 2006). Trees would be removed to provide a break between the crowns, or groups of crowns, of at least twenty to thirty feet. Hand slashing and piling would follow as needed. Piles would be burned once cured. Existing roads will be used with no new roads being built.

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Benchmark Creek Unit 5 (5 acres) Hand treatment utilizing power saws, followed by broadcast, jackpot and/or pile burning. Treatment will be directed at reducing the younger age-class trees in a manner conducive for subsequent treatment with broadcast or jackpot burning. Mechanical equipment will not be utilized in this unit (no forest products will be removed from the unit and any re-distribution of slash will be accomplished by hand).

There are no streams or riparian areas located within or near the unit boundaries and no road building is planned for this unit. There are no anticipated detrimental effects to water resources from the proposed actions.

Table 3-15. Summary Table of Stream Surveys

Stream Name	Reach Number And Location. (by elevation)	Rosgen Stream Type	Remarks/Impacts
Ford Cr	R-1 (5000-5060)	C-3	Low grazing impacts
Ford Cr	R-2 (5060-5280	B-3	Low grazing impacts
Ford Cr	R-3 (5280-5440)	B-4	Low grazing impacts
Ford Cr	R-4 (5440-5480)	B-4	Low grazing impacts
Ford Cr	R-5 (abv. swamp)	B-4	Low grazing impacts
Whitewater Cr	R-1	A-3	Low grazing impacts
Wood Cr	R-1(lower end)	B-3	Low grazing, past flood impacts
Wood Cr	R-2(5600-5700)	Intermittent	Heavy Grazing
Straight Cr	R-1(5200-5280)	C-3B	No Grazing, past flood impacts
Straight Cr	R-2(5280-5350)	C-3B	No Grazing, past flood impacts
Fairview Cr	R-1(5460-6140)	C-3	Low Grazing, past flood impacts
Fairview Cr	R-2(6140-6240)	C-4	Low Grazing, past flood impacts
Fairview Cr	R-3(6240-6460)	B-2	No Grazing
Fairview Cr	R-4(6460-6520)	A-4	No Grazing
Benchmark Cr	R-1(5320-5420)	B-4	Low Grazing, past flood impacts
Green Timber	R-1(entire reach)	A-3	Low Grazing
Mule Cr	R-1(abv. Cabins)	A-3	Low Grazing
Lick Cr	R-1(5760-6320)	A-4	Low Grazing

Stream types; **A** = High gradient (4-10%), low sinuosity (<1.2). **B** = Moderate gradient (2-4%), moderate sinuosity (>1.2). **C** = Low gradient (<2%), high sinuosity (>1.4). **#** indicates dominant substrate size, **2** = Boulder, **3** = Cobble, **4** = Gravel. (Rosgen, D. 1996)

Table 3-16. Summary of Existing Timber Activities

Stand Identification #	Activity Code	Activity Discription	Acres Accomplished	Year Accomplished
15702012	4113	Stand Clearcut	20	1998
15102001	4151	Single-tree Selection Cut	10	1982
15702055	4260	Man-Caused Fire Damage	23	1996
15702054	4260	Man-Caused Fire Damage	2	1996
15704003	4521	Pre-commercial thinning	9	1982
15704004	4521	Pre-commercial thinning	5	1982
15702001	4521	Pre-commercial thinning	11	1983
15701024	4521	Pre-commercial thinning	1	1989
15704002	4521	Pre-commercial thinning	10	1993
15702003	4521	Pre-commercial thinning	18	1995

Cumulative Effects

Cumulative effects for Alternative 2 are the same as for Alternative 1 above.

Best Management Practices (BMP)

Descriptions of BMPs and a description of past BMP inspection are included in Appendix D.

Recommended mitigation:

- Any small springs and wetlands not identified but found within the proposed treatment units will have a 50-foot buffer around these sensitive areas and should not be entered with mechanical equipment.
- After harvest operations the temporary road in Fairmule Unit #2; all skid trails and landings should be scarified to promote vegetation recovery.
- Slash pile burn areas should be inoculated with undisturbed soil to enhance recovery.
- All treatment in units planned as commercial thinning, utilizing mechanical equipment should be accomplished in the winter periods with a minimum of 4 inches of frozen soil or approximately 20-24 inches of snow cover. Avoid skidding logs in all drainage channels. Minimize crossing drainages with logging equipment.
- Stream crossings in Double Falls Units 1 and 2 should be at existing crossings with temporary bridges placed over the existing private bridges to eliminate the need to build more stream approaches and protect the private bridges. Additional sediment control should be used (waddles, silt fence) at temporary road crossings to further mitigate sediment entering stream.

Table 3-17. Summary of Stream Studies (Pfankuch**): Benchmark Fuels Reduction**

Stream	Date	Reach[1]	Upper Bank	Lower Bank	Bottom	Total	Rating[3]	PFC[4]
Ford Cr	09/14/1993	R-1	19	25	31	75	Good	Functioning
Ford Cr	09/14/1993	R-2	26	21	29	76	Good	Functioning
Ford Cr	09/16/1993	R-3	23	32	40	95	Fair	Functioning
Ford Cr	09/16/1993	R-4	26		29	82	Fair	Functioning
Ford Cr	09/16/1993	R-5	17	19	31	67	Good	Functioning
Whitewater Cr[2]	07/16/1993	R-1						Functioning
Wood Cr	09/22/1993	R-1	15	22	53	90	Fair	Functioning
Wood Cr	09/16/1993	R-2	29	41	46	116	Poor	Functioning
Straight Cr	09/22/1993	R-1	16	21	55	92	Fair	Functioning
Straight Cr	08/16/1978	R-2	30	43	43	116	Poor	Functioning
Fairview Cr	09/20/1993	R-1	27	24	31	82	Fair	Functioning
Fairview Cr	09/20/1993	R-2	23	28	31	82	Fair	Functioning
Fairview Cr	09/22/1993	R-3	23	36	36	95	Fair	Functioning
Fairview Cr	09/17/1993	R-4	21	37	48	106	Fair	Functioning
Benchmark Cr[2]	08/15/1991	R-1						Functioning
Green Timber [2]	06/16/1991	R-1						Functioning
Mule Cr	09/23/1993	R-1	15	15	21	51	Good	Functioning
Mule Cr	09/23/1993	R-2	20	18	25	63	Good	Functioning
Lick Cr	09/23/1993	R-1	24	28	38	90	Fair	Functioning

Rating: <38 = Excellent, 39-76 = good, 77-114 = Fair, >115 = Poor

[1] Reaches designated in1977/78 do not correspond to later years.

[2] Limited study completed.

[3] Rating (USDA 1978)

[4] Proper Functioning Condition (USDI 1998)

E. FISHERIES

1. INTRODUCTION

AREA OF ANALYSIS

DISTRICT: **Choteau R.D.**
LEGAL LOCATION: **T20N, R10W, SEC. 9, 16, 22, 26, 36**
T20N, R9W, SEC. 31
T19N, R9W, SEC. 10, 15
WATERSHEDS: **100301040203 (Wood Cr), 100301040702 (Ford Cr), 100301040202 (Straight Cr)**
PERENNIAL STREAMS: **Wood Cr., Ford Cr., Benchmark Cr., Lick Cr., Glade Cr., Straight Cr., Mule Cr., Fairview Cr., Whitewater Cr., Green Timber Cr.**

2. REGULATORY FRAMEWORK

Most of the regulatory framework in the Forest Plan for activities that may affect aquatic habitats is directed at protecting water quality and riparian habitat, as described in the Watershed section of this document. For example, management standards provide for timber harvest in streamside zones to enhance riparian values, and Best Management Practices are required for all activities in order to minimize soil erosion that could result in stream sedimentation. For road construction and maintenance alone, there are over twenty management standards to protect water quality, stream channels and riparian areas. Similarly, Forest-wide standards for fish habitat include direction for managing soil and vegetation in riparian areas to meet fisheries needs. Management prescriptions for riparian areas (MA-R) include direction to give preferential consideration to riparian-dependent resources, and to maintain or enhance important identified fish habitat.

Additionally, as described in the Watershed section, the Montana Streamside Management Act provides protection for aquatic habitats by regulating timber harvest in the streamside zone. The Montana Streambed Protection Act requires that stream crossings be designed to minimize impacts to channel function and aquatic life, especially fisheries; coordination with Montana Fish, Wildlife and Parks is accomplished through the 124 permit process.

3. EFFECTS ANALYSIS METHODS

The primary fisheries concerns are that the proposed actions will increase sediment delivery or otherwise change habitat conditions (water yield, water temperature, woody debris recruitment, etc.) in streams which support fish populations.

4. EXISTING CONDITION

Fish occupy habitat in most of the perennial streams in the project area. Fish present include brook trout, rainbow trout, mottled sculpins, and a newly-introduced population of westslope cutthroat trout (sensitive species) in North Fork of Ford Creek that is located upstream of any proposed treatment units.

Perennial streams adjacent to treatment units were surveyed in 2006 to determine if fish were present (USDA Forest Service 2006). Information for Straight, Whitewater, and Green Timber Creeks was obtained from District files.

Table 3-18. Summary of Fisheries in Project Area

Stream	Fish Species Present
Ford Creek	Brook trout
Woods Creek	Brook trout and mottled sculpins
Lick Creek	No fish
Mule Creek	Brook trout
Fairview Creek	Brook trout, rainbow trout, and mottled sculpin
Benchmark Creek	Brook trout and rainbow trout
Straight Creek	Brook trout
Whitewater Creek	No fish
Green Timber Creek	No fish
Glade Creek	No fish habitat (dry channel)

5. EFFECTS COMMON TO ALL ALTERNATIVES

Due to existing and predicted forest conditions (see Fuels section), there will continue to be a high probability of stand-replacing fire across most of the project area for the foreseeable future, regardless of management actions. One large fire or multiple fires may cause watershed-level changes that adversely affect aquatic habitats in the project area and further downstream. However, connectivity of habitats within the watersheds should allow recovery of fish and other aquatic organisms in all watersheds. Natural recovery of fish, amphibian and invertebrate populations after fire events varies based on local conditions, but would be expected to occur within 10-15 years after a fire (Dunham et al., 2007; Minshall, 2003; Dunham et al., 2003).

6. EFFECTS BY ALTERNATIVE

a. Alternative 1 - No Action Alternative

1. Direct and Indirect Effects

In this alternative there would be no manipulation of vegetation within the analysis area. There would be no new road construction. There would be no increases of sediment contribution from increased traffic on roads. There would be no opportunities for the limited watershed mitigation/improvements that could take place as a result of this proposal; existing sediment sources would continue to contribute sediment to streams. There would be no changes to soil, water, or fisheries resources in the short term. The risk of catastrophic wildfire effects within the analysis area in the long term would not be reduced with this alternative.

2. Cumulative Effects

The potential for significant cumulative effects of past, present, and reasonably foreseeable actions on fish habitats and fish populations was evaluated by considering the Watershed

Report, past activities listed in the "Cumulative Effects List for Benchmark Fuels Project" (project file), and natural occurring events. There are no indications that past land management activities or natural occurring events have limited fish populations in project area streams. Brook trout populations (Wood Creek, Ford Creek, Lick Creek, Fairview Creek, Benchmark Creek, and Mule Creek) are robust with multiple age classes present and there is abundant evidence of successful reproduction (USDA Forest Service 2006). Surveys indicate that the wild fish populations have been able to adapt to natural events, such as wild fire and floods and will continue to so for future natural events.

b. Alternative 2 – Proposed Action

1. Direct and Indirect Effects

Ground disturbance associated with the proposed treatments may generate sediment movement, but units are well-buffered from streams and pose little or no risk of increasing sediment loads to waterways. Changes in woody debris recruitment to fishery streams are not expected, due to unit location, implementation of Streamside Management Zone rules with tree retention requirements, and very limited extent of stream canopy alteration. Changes in water temperature or nutrient input are not expected to exceed natural variation under typical successional processes (e.g., fire, windthrow, flood) for forest community types in the project area.

Ford Creek Units #1 (193 acres) and #2 (83 acres), Green Timber Creek Unit #1 (9 acres), Lick Creek Unit #2 (4 acres), Fairmule Unit #3 (19 acres): Units are either treated by hand using power saws or commercially thinned/harvested during winter months when ground is frozen or there is sufficient snow cover to decrease the chances of soil and water impacts of mechanized treatment. Downed trees in thinning units will be treated with either jackpot and/or broadcast burning once cured. In commercial units slash will be piled and burned. There are no streams or riparian areas located within or near these units. There are no anticipated detrimental effects to water (see Watershed Section) or fishery resources from the proposed actions.

Lick Creek Unit #1 (3 acres): This unit will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of this unit (see Watershed Section). The unit boundary is more than 60 feet away from Lick Creek. No fish were found in Lick Creek during 2006 fish surveys (USDA Forest Service 2006). Because of the adequate stream buffer and the absence of fish in Lick Creek; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Aspen Tract Unit #1 (44 acres): This unit will initially be treated by hand, utilizing power saws to thin portions of the units, and will later be treated with either jackpot, pile-burning, and/or broadcast burning. There is an intermittent stream located within this unit. Because streamside management zones (SMZs) of 50 feet on slopes of 35% and 100 feet on slopes greater than 35% are being implemented and, the fact that there is no new road construction for this unit; the likelihood of sediment being delivered to this stream and the adjacent riparian area is low. There are no anticipated detrimental effects to water (see Watershed Section) or fishery resources from the proposed actions.

Aspen Tract Unit #2(39 acres): This unit will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of this unit. The un-named tributary to Ford Creek located on this unit's eastern boundary is a perennial stream. With no treatment planned within the SMZ and the use of mitigation measures prescribed for this unit (see Watershed Section), the likelihood of sediment being delivered to these streams and the adjacent riparian area is low. There are no anticipated detrimental effects to water or fishery resources from the proposed actions.

Double Falls Units #1 (2 acres) and #2 (42 acres): These units will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of this unit. An un-named tributary to Ford Creek is located within the boundary of unit # 2, but it is an ephemeral stream with no evidence of recent flows. A 50 foot SMZ will be adequate to ensure that no sediment will enter Ford Creek from this source. Whitewater Creek is located approximately 100 feet outside the west perimeter of unit #2, and the 100 foot buffer will be adequate to assure that no sediment is delivered to the stream. Ford Creek intersects the northeastern portion of unit #2, and no treatment is planned within the SMZ. The likelihood of sediment being delivered to these streams and the adjacent riparian area is low. There are no anticipated detrimental effects to water resources from the proposed actions (see Watershed Section). The fishery in Ford Creek above Double Falls consists of an abundant brook trout population represented by multiple age classes. There are no anticipated detrimental effects to fishery resources from the proposed actions.

Mule Creek Units #1 (13 acres) and #2 (17 acres): Unit # 1 will initially be treated by hand, utilizing power saws to thin portions of the units and later be treated with either jackpot and/or broadcast burning. Unit # 2 will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment in either unit (see Watershed Section). The unit boundaries are more than 100 feet away from Mule Creek. There is a small brook trout population in Mule Creek consisting of multiple age classes. Because Mule Creek is outside the unit boundaries and well buffered from sediment delivery; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Fairmule Unit #2 (22 acres): This unit will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of these units (see Watershed Section). The unit boundaries are outside the SMZ, more than 50 feet away from Fairview Creek. Fishery surveys in 2006 found a small but robust population of brook trout, as well as a single individual rainbow trout and a mottled sculpin (USDA Forest Service 2006). Because Fairview Creek is outside the unit boundaries and well buffered from sediment delivery; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Fairmule Unit 4 (1 acre): This unit will be treated either by force account (posts and poles offered to public for sale) or commercially. Timing and methods for removing logs and piling slash will be considered to decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of these units (see Watershed Section). The unit boundaries are outside the SMZ, more than 50 feet away from Fairview Creek. Fishery surveys in 2006 found a small but robust population of brook trout, as well as a single individual rainbow trout and a mottled sculpin (USDA Forest Service 2006). Because Fairview Creek is outside the unit boundaries and well buffered from sediment delivery; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Glade Creek Unit #1 (9.5 acres) and Unit #2 (7 acres): Treatment in these units is planned as commercial thinning, utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment (see Watershed Section). No new roads will be built to treat these units. Glade Creek is a dry channel that is located outside of these units and no other streams or riparian areas are located within or near the unit boundaries. There are no anticipated detrimental effects to water or fishery resources.

Benchmark Creek Unit #1 (236 acres): This unit will initially be treated by hand, utilizing power saws to thin portions of the units and later be treated with either jackpot and/or broadcast burning. Benchmark Creek flows along the southern boundary of the unit. The unit is at least 100 feet away from Benchmark Creek. Fishery surveys conducted in 2006 detected a large robust population of brook trout, as well as a single individual rainbow trout (USDA Forest Service. 2006). Because the unit is being treated by hand, and has a large low-slope (<10%) riparian buffer; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Benchmark Creek Unit #2 (8 acres): This unit will be treated by utilizing mechanical equipment and hand tools. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. This work will be accomplished by Forest Service Crews (Force Account Funds), with post and pole material being removed and placed in decks for sale. Hand slashing and piling would follow as needed. Piles would be burned once cured. No new roads will be built (see Watershed Section). Because there is more than 200 feet of low slope (< 10%) riparian buffer, and units will be treated during winter to mitigate ground disturbance; there are no anticipated detrimental effects to fishery resources from the proposed actions.

Benchmark Creek Units #3 (10 acres) and #4 (6 acres): These units will be treated by commercial thinning utilizing mechanical equipment. Treatment will occur during the winter months when the ground is frozen or there is sufficient snow cover to further decrease the chances of soil and water impacts of mechanized treatment. No new roads will be built for treatment of these units (see Watershed Section). There are no streams or riparian areas located within 60 feet of the unit boundaries. Because there are adequate low slope (< 10%) riparian buffers, and units will be treated using winter mitigation measures; there are no anticipated detrimental effects to fishery resources from the proposed actions.

2. Cumulative Effects

In addition to the cumulative effects for the no action alternative: there are no anticipated detrimental effects to fishery resources from the proposed actions, because streams are well-buffered from units and changes in woody debris recruitment, water temperature, and nutrient input are not expected to exceed natural variation. The proposed project will not cause an increase in cumulative effects to the fisheries resource because there are no anticipated detrimental effects from the project.