United States

Department of Agriculture

**Forest Service**

Beaverhead-Deerlodge National Forest

Pintlar Ranger District

# WEST FORK ROCK CREEK

# WATERSHED ASSESSMENT

January 31 , 2007

*Cover Photo:* Bowles Creek, Cameron Rasor, June 20, 2005

# TABLE OF CONTENTS

(This page left blank intentionally)

# Fact Sheet
## West Fork Rock Creek Watershed

**USGS Hydrologic Unit #:** 1701020210 (5th Code HUC)

**County:** Granite

**Ecoregion: (M3332)** Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Provide

**Watershed Size:**

| | |
|---|---|
| **Acres** | 60,000 |
| **Mi² Miles** | 93.3 |

**Stream Length:** 57.4 miles

**Elevation:**

| | |
|---|---|
| Source | 8,610 feet |
| Mouth | 5,621 feet |
| Total Relief | 2,989 feet |
| Average Elevation | 6,787 feet |

| 6th Code Sub-watersheds | HUC # | Stream Miles |
|---|---|---|
| Bowles Creek | 170102021001 | 11.2 |
| Sand Basin Creek | 170102021002 | 16.2 |
| NF Rock Creek | 170102021003 | 11.1 |
| WF Rock Creek | 170102021004 | 18.8 |

| Land Use Cover | % of Watershed |
|---|---|
| Forested | 86% |
| Non-forested | 14% |

| Ownership | Federal | State | Private |
|---|---|---|---|
| Bowles Cr. | 12,953 | 0 | 0 |
| Sand Basin Cr. | 11,910 | 0 | 0 |
| North Fork Cr. | 12,032 | 0 | 0 |
| West Fork Cr. | 15,268 | 680 | 6830 |

(This page left blank intentionally)

## Executive Summary

Watershed analysis is a process used to characterize the human, biological and physical conditions, processes, and interactions within a watershed. By looking at the ecosystem as a whole, the analysis provides a systematic way to understand and organize ecosystem information. Watershed analysis is an intermediate analysis between land management planning and project planning. It helps us understand how past land use activities interacted with the physical and biological environments in the landscape. The analysis focuses on specific issues, values and uses identified within the landscape that are essential for making sound management decisions. This document presents a current understanding of the processes and interactions of concern occurring within the West Fork of Rock Creek watershed.

The West Fork of Rock Creek watershed is situated on the Pintler Ranger District of the Beaverhead-Deerlodge National Forest (BDNF). An eleven-member team from the Pintler Ranger District and the Supervisor's Office of the Beaverhead-Deerlodge National Forest conducted this analysis. The team members consisted of a wildlife biologist, transportation specialist, fire and fuels specialist, hydrologist, fisheries biologist; range conservationist, recreation planner, GIS specialist, writer-editor, and a team leader (see Section 7).

The team generally followed the six-step process as outlined in the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis. This document is organized by "Steps". The watershed analysis process includes the following steps:

**Step 1 - Characterization of the watershed** – a summary of the dominant conditions and interactions within the watershed.

**Step 2 - Identification of issues and key questions**

**Step 3 - Description of current conditions**

**Step 4 - Description of reference conditions** - in general this is the historical condition, prior to the influence of European settlement. Since historical conditions for hydrologic parameters are generally not available, the "Watershed and Aquatics" sections of this document will focus on "desired condition" (see Step 4, page 1).

**Step 5 - Synthesis and interpretation of information** – a comparison of current and reference conditions including discussion of similarities, differences, causes and trends.

**Step 6 - Management recommendations and priorities**.

This document presents the information gathered by the eleven-member core team. It is not a decision document under the National Environmental Policy Act (NEPA), nor does it initiate or result in land management allocations. It does not select specific projects for implementation. Rather, the Pintler Ranger District will use this analysis to determine which specific projects would move the watershed toward the desired condition described in the Deerlodge National Forest Land and Resource Management Plan. Such projects will then be analyzed individually by a separate interdisciplinary team. Project analysis will include involvement by the public and result in a site-specific decision as required by the National Environmental Policy Act (NEPA).

## Section 1 Goals and Methods

The Northern Region of the Forest Service developed a Restoration and Protection Strategy in 2006 (Draft 2/3/06) to create an integrated approach for accomplishing regional ecosystem restoration and protection of social values at risk. The Beaverhead-Deerlodge Forest Plan Revision effort brings that strategy to the ground by targeting specific watersheds for a detailed analysis.

The Revised Forest Plan (Draft in 2005, Final in 2007) identifies fifteen watersheds across the Forest as having high priority for assessment and subsequent restoration. These watersheds are designed to focus time and attention to areas across the forest where multiple issues can be addressed through an integrated restoration planning effort. Until the revised Forest Plan is signed, all restoration work will comply with the 1987 Deerlodge Forest Plan as amended.

The Draft Revised Forest Plan identified more priority restoration watersheds in Rock Creek than any other subbasin on the Forest. The current Forest Plan highlights the outstanding fishery by providing unique management direction for Rock Creek in coordination with the Lolo National Forest. This determination is supported by a Sub-basin Assessment of the entire Rock Creek drainage http://www.fs.fed.us/r1/lolo/projects/index-rock-cr-sbr.shtml. After selecting the Rock Creek drainage as a priority for further analysis, an Interdisciplinary Team was formed. The team reviewed all sub-watersheds in the Rock Creek drainage to determine where multiple resource benefits could best be achieved through an integrated restoration analysis at the 5th code scale. The outcome of this review was the selection of the West Fork of Rock Creek watershed. While West Fork is neither the most important fisheries nor the most degraded watershed in Rock Creek, it does provide an opportunity to meet multiple resource objectives through an integrated analysis.

The watershed characterization was developed by an interdisciplinary team, under guidance by the District Ranger, using the Federal Guide for Watershed Analysis – Ecosystem Analysis at the Watershed Scale (Version 2.2, August 1995) as a guideline. The purpose is to identify projects and priorities for restoring watershed conditions.

The interdisciplinary team identified and described ecological processes of greatest concern and evaluated how well the processes are functioning. From this information, the team developed a list of issues and questions that may drive recommendations and projects. The list is not prioritized and it is not all inclusive. The following items represent those issues and questions relative to reasonable management of the national forest portion of the watershed.

### 1. Aquatic Health

A variety of concerns related to watershed conditions helped drive this analysis. The concerns revolved around the influence of watershed conditions on riparian health, water quality, and aquatic habitats. To address these concerns, the following questions were formulated:

- *What is the existing condition of the watershed and fish populations?*
- *How are watershed conditions influencing water quality and aquatic habitats?*
- *Is the riparian vegetation of the proper species and density to provide for stream channel stability and maintain quality aquatic habitats?*

### 2. Vegetation Health

Past management, wildfires, and the alteration of natural disturbance processes have changed the function, pattern, composition, structure, and density of vegetation within the watershed. Noxious weed infestations are a growing concern and have the

potential to impact ecosystem health and biodiversity. The following questions have been formulated to address the vegetation concerns in the watershed.

- *How have landscape patterns of vegetation communities and seral stages changed over time?*
- *What opportunities do we have to restore vegetation community structures to desired levels?*
- *How widespread are noxious weeds and how are they affecting watershed health?*
- *What strategies can be used to slow or prevent the spread of noxious weeds?*

**3. Wildlife habitat**

Changes in vegetation patterns and composition resulting from wildfire, fire exclusion, timber management, grazing, and road building have the potential to alter wildlife conditions. The following questions have been formulated to address these concerns.

- *How have wildlife abundance, distribution, diversity, and habitat quality been altered in the watershed?*
- *What is the condition of winter range forage?*
- *Are there problem areas that are contributing to reduced wildlife habitat capability?*

**4. Recreation**

The enjoyment of the natural resources in the watershed can be compatible with sustainable ecosystem conditions and contribute to the viability of local communities. However, when the uses in the watershed are not properly designed or monitored, watershed conditions may deteriorate. The following questions are designed to address this concern.

- *What is the pattern of recreation use and how is it affecting watershed health?*

- *How should the watershed provide for future recreation uses and needs?*

**5. Transportation**

It is important to have a road and trail network in the watershed that meets management objectives while minimizing long-term negative effects on natural resources. In order to determine the optimal sustainable transportation network, the following questions were developed.

- *How will roads be managed to meet present and future needs while minimizing impacts to resources?*
- *Are there opportunities for the Montana Department of Transportation to mitigate watershed impacts of the Skalkaho Highway?*

**6. Livestock Grazing**

Livestock grazing has the potential to alter vegetation patterns, noxious weed infestations, and wildlife use patterns. Much has been done to reduce the impact of grazing on the stream corridor, but more needs to be done to minimize the long-term effect of grazing on riparian conditions. The following questions were developed to address these concerns.

- *How has livestock grazing influenced the condition of the watershed?*
- *How is livestock grazing affecting channels and riparian vegetation?*
- *What are the cumulative impacts between livestock grazing and wildlife grazing?*

**7. Natural and Prescribed Fire**

Large-scale vegetation patterns in the watershed are a reflection of wildfire and fire suppression. The following question was developed to understand the effects of fire on the landscape.

- *How has fire and fire suppression changed the landscape over time?*

## Section 2 Introduction

This report provides summary characterization of the aquatic, terrestrial, and human features, conditions, processes, and interactions within the National Forest portion of the West Fork Rock Creek watershed (5th Level Hydrologic Unit Code 1701020210) (**Map 1 -** Location of the West Fork Rock Creek).

The assessment area is the National Forest portion of the West Fork Rock Creek hydrologic unit, referred to as the West Fork Rock Creek (WFRC) watershed in the rest of the report (**Map 2 –** Ownership). This area is administered by the staff of the Beaverhead-Deerlodge National Forest, located in the Pintler Ranger District office in Philipsburg, Montana and the Supervisors Office in Dillon, Montana.

The West Fork Rock Creek watershed is one of ten 5th code drainages that make up the Rock Creek Sub-basin. Rock Creek flows north from the continental divide for approximately 70 miles to it's confluence with the Clark Fork River, about 25 miles east of Missoula, Montana. Rock Creek flows into the Columbia River, which in turn flows into the Pacific Ocean along the border between Oregon and Washington. Rock Creek is internationally recognized as a blue ribbon trout stream and is a popular destination for fishing and recreation.

The headwaters of the Rock Creek drainage, which lies largely on the Beaverhead-Deerlodge National Forest, is comprised of seven smaller watersheds, all of which support bull trout, a species listed as threatened under the Endangered Species Act. The upper basin of Rock Creek consists of the West Fork, Ross Fork and Middle Fork basins which lie adjacent to one another, and share many similar watershed characteristics (**Map 3 -** 6th Code Watershed Boundaries). They provide a significant portion of flow for the main stem of Rock Creek. They converge at nearly the same point, creating a dendritic (tree-like) drainage pattern.

## Section 3 West Fork Rock Creek Setting

The West Fork watershed is 93.3 square miles, approximately 60,000 acres, and includes mostly Forest Service land ownership with some patented mining claims and additional parcels of private, state and BLM lands along the lower main stem.

### *National Forest Land Management Summary*

The Beaverhead-Deerlodge National Forest Plan is currently under revision. A new Plan is expected to be in effect before 2008. Until the revised Plan is signed, we will continue to implement the existing Plan. Information presented in this assessment relating to land allocations, goals, objectives or desired conditions comes from the current (1987) Deerlodge Forest Plan. Recommendations made in **Section 4** will be evaluated for their consistency with both the current and anticipated Forest Plans.

Resource elements for which the Forest Plan provides management direction include wildlife, fish, watershed, range, recreation, and timber and protection, http://www.fs.fed.us/r1/b-d/forest-plan/index-plan-current.shtml. The direction given varies with each management area.

Nearly half of the watershed is allocated to timber management areas (E1), some of which recognizes the existence in Rock Creek of the sensitive soil types and mitigation needed for fish (E2). See **Map 4** – Deerlodge Forest Plan Management Areas. The West Fork Buttes is identified as wildlife winter range (D2, E3 and C1). The streamside areas are identified for riparian management emphasis (F1). A small portion of this watershed in the West Fork Buttes, is specifically allocated to rangeland grazing (D2). The other half of the area is allocated to undeveloped Management Areas with a recreation emphasis (A4 is mostly non-motorized and A5 which has some motorized routes). The Crystal Creek Campground Area is the only

developed recreation area (A1). The majority of this watershed is inventoried as roadless.

## 3.1 Human Values

Historically, Rock Creek has been a regular seasonal camping area and travel corridor to the Philipsburg Valley. This is known from tribal tradition and archaeology. Three tribes have either areas of interest or ceded lands in Rock Creek: Confederated Salish and Kootenai Tribes of the Flathead Reservation, The Kootenai Tribe of Idaho, and Shoshone-Bannock Tribes of the Forest Hall Reservation of Idaho.

The first European recognition of Rock Creek began when the Lewis and Clark expedition passed by Rock Creek and named it the "Rocky Fork of the Clark's Fork of the Columbia" in 1805, but Rock Creek was not explored by Europeans until the 1860's. In the 1880's, the first cattle ranches homesteaded and the first bridge was built across the Clark Fork to access Rock Creek. By the 1890's gold and sapphires were discovered and forests were cleared for homesteads.

***Recreation***

Today, the West Fork of Rock Creek Watershed provides a range of recreational opportunities in a variety of settings. The eastern 1/3 of the watershed provides more of a roaded setting while the western 2/3 provides more of a primitive to semi-primitive, non-motorized setting. There are three primary travel routes providing access within the watershed. See **Map 5** – Recreation Sites and Trails.

Portions of the Sapphire Wilderness Study Area (01-421), Emerine Roadless Area (01-423) and Stony Mountain Roadless Area (01-801) are located within this watershed.

Camping within the watershed takes place primarily in dispersed sites with little to no development. The watershed is also a popular winter snowmobile area with three primary marked and maintained trails. The snowmobile trails are groomed by the Bitterroot snowmobile club. Most of the snowmobile use historically has been from the Bitterroot side, however this is changing as use is increasing from the Philipsburg side.

The entire watershed provides hunting opportunities for both elk and deer. The western portion of the watershed receives its hunting use primarily during the archery season. Early and heavy snows usually push the animals out of this upper basin early in rifle season. The Eastern portion of the watershed is used most extensively during the fall rifle season. There is both roaded and unroaded hunting available in this part of the watershed. There are approximately 4 square miles in the far eastern portion of the watershed that have a number of old logging roads. These roads are in states of disrepair with lots of mud holes and eroded tracks.

### *Sites and Facilities*

Crystal Creek Campground is a small 3 unit campground located within the watershed. It is located near Skalkaho Pass and is currently in poor condition. There is an older style wooden toilet with a vault in this campground. This is the only public toilet located in the watershed.

The Skalkaho Highway (HWY 38) runs east-west through the watershed. It is located adjacent to or in close proximity to the West Fork of Rock Creek. The highway is generally open from the end of May until December 1, however anytime after September, snow can make travel difficult. After December 1, the State closes the highway and it is used as a groomed snowmobile trail. The snowmobile club from the Bitterroot valley grooms this trail as well as trails up Sand Basin Creek and the West Fork of Rock Creek.

Adjacent to the Skalkaho Highway in the eastern end of the watershed is located Gem Mountain Sapphire. Gem Mountain is a popular private business that offers tourists the opportunity to wash buckets of gravel to find sapphires. They also offer some camping facilities to those wishing to stay.

The only other developed recreation site within the watershed is the Mud Lake Fishing access. Mud Lake is a small lake surrounded by muskeg. In the early 1990's a boardwalk was constructed across the muskeg to access the lake. Because of the muskeg, this is the only way to access the lake for fishing. This boardwalk is in fair condition, although it will become a large deferred maintenance project in the future.

The West Fork Administrative Site is located on the eastern end of the watershed. This is an old Forest Service Station that was used as an organization camp for a number of years. One of the older sleeping cabins has been renovated and is being used as a Recreation Rental Cabin. With the exception of this rental cabin, the other structures are in poor condition and would take considerable investment to renovate.

There are a number of dispersed campsites located throughout the watershed. The majority of them are located along the West Fork of Rock Creek above its confluence with Sand Basin Creek and along Sand Basin Creek. There are a few sites adjacent to the West Fork along the Skalkaho Highway; however there are not that many flat spots between the highway and the creek to offer up many sites. These dispersed sites are not hardened and are accessed by user created two track roads. The sites and access roads are muddy during wet weather conditions. As would be expected, most of these dispersed sites are adjacent to or in the vicinity of the streams.

There are a number of summer trails located throughout the watershed, however most are within the western ½ of the area. The more popular trails access specific features. These trails and the features they access are as follows:

- Fuse Lake Trail #12: Accesses Fuse Lake, a grayling fishery.
- Medicine Lake Trail #15: Accesses Medicine Lake, a cutthroat fishery.
- Crystal Creek Trail #10: Accesses Stony Lake, a cutthroat fishery.
- Signal Rock Trail #131: Accesses Signal Rock, a prominent viewpoint on the Bitterroot Divide.

The following trails are also located within the watershed and are used primarily during the fall hunting season:

- Bitterroot Divide Trail #313
- Fox Peak Trail #18
- Maukey Gulch Trail #17
- Mount Emerine Trail #16
- West Fork Trail #13
- Bowles Creek Trail #14
- Bowles Creek Trail #132
- Basin Gulch Trail #11

The Medicine Lake Trail, Signal Rock Trail, Bitterroot Divide Trail, Fox Peak Trail, West Fork Trail, Bowles Creek Trail and the Bowles Creek Spur Trail are all closed by order to wheeled motorized use. While the other trails are not closed by order to wheeled motorized use the only one that receives some light wheeled motorized use is the Crystal Creek Trail #10.

Mount Emerine is a dominant feature within the watershed. There is an old road to the top of this mountain from the east. The road was constructed to access a fire lookout that has since been dismantled. The road is gated and closed administratively for the last mile. This is primarily to reduce vandalism to a Forest Service Repeater site, located on top of the mountain. It is a relatively short hike from the gated closure to the top of the mountain. While offering a spectacular view, there are not many people that take this walk.

Recreational Use in this watershed is on the increase as are most areas within the western United States. Campsites that once appeared as flat spots with matted grass are now are devoid of vegetation and have muddy, rutted two tracks accessing them.

Trails within the watershed, for the most part, have not changed significantly through the years because of increasing recreational use. This is because the use has been mostly non-motorized. If motorized use were to increase there would be a downward trend in trail condition due to the existing trail locations and the increased tread disturbance from motorized use.

The shorelines of Medicine Lake, Fuse Lake and Stony Lake are all showing increased disturbance due to the increase in use over the years. Bare areas of soil, more fire rings, less firewood, hacked up trees and scattered garbage are all shoreline signs of increased use.

## 3.2 Land Ownership

Private lands exist exclusively in the lowermost 6$^{th}$ field watershed. These lands consist of patented mining claims, former timber company lands and privately held grazing and irrigated pasture land. In 1998, 2,379 acres, located within and around

the patented mining claims at Gem Mountain, were traded to Big Sky Lumber Company as part of the Gallatin II land exchange. Subsequent to this exchange, virtually all merchantable timber was harvested. Sapphire production continues on private claims in this sub-watershed.

## 3.3 Climate

Average annual precipitation varies from 40 inches along the divide to 14 inches per year in the lower elevations. Spring melt of winter snow pack accounts for most of the runoff, which occurs at the same time as the high precipitation months of May and June, causing peak flow events. By mid to late July, streams return to their base flow with only low response to summer rains.

## 3.4 Geology and Soils

Rock Creek flows along the eastern margin of the Sapphire Mountains. This mountain block was created by tectonic activity. Thrust faulting was followed by small granitic and gabbroic intrusions in meta-sedimentary rocks.

The soils and geology of the West Fork watershed are naturally split into two distinct sections; the upper half (roughly west of Fuse Creek) and the lower half (east of Fuse Creek). The kinds of soils found in the watershed are the result of several factors (parent material, topography, climate, organisms, and time). The soils are different in their physical and chemical properties, and therefore, different in their susceptibility to erosion and compaction and their capacity for water infiltration. Glaciation exerts a dominant influence on the landscape at the higher elevations. Granitic rocks form a band across the upper end. The lower elevation area is a mixture of sedimentary, belts, and volcanic parent material. The floodplains are

underlain by alluvial deposits. Much of this material consists of rounded cobbles and boulders; the remainder being sand and silt.

The upper half of the watershed has a fairly homogenous geology that consists almost exclusively of granitic parent material. The landforms in this portion of West Fork are primarily glaciated mountain slopes with a minor component of mass wasted slopes near Sand Basin Creek. Sand Basin Creek, Bowles Creek, and West Fork Rock Creek all reside mainly within the Sapphire Batholith (granite bedrock) and respond in a hydrologically similar manner. Higher drainage density and dendritic drainage patterns are generally associated with the Batholith. Sandy soils, also associated with the Batholith, tend to be subject to increased surface erosion due to reduced particle cohesion. Once in the stream channel, these particles are resistant to running water and form extensive plane-bed stream channels that provide poor aquatic habitats. For this reason, erosion from roads and stream bank erosion are of a higher concern in the upper half of the West Fork watershed.

The lower half of the watershed has a more complex geology and consists of metasediments, sandstones and shales, tertiary sediments, volcanics, and valley bottom alluviums. The landforms in the lower portion of the watershed are equally varied and consist of steep glaciated mountain slopes, frost shattered mountain ridges, breaklands, low relief hills, and open valley bottoms. The North Fork of the West Fork resides mainly within Belt series bedrock. Soils and landforms associated with Belt series generally exhibit relatively less erosion hazard. Watersheds within Belt series tend to display less dendritic drainage patterns and lower drainage densities, meaning peak flow events tend to be less responsive and flashy.

The following table displays the break down of landtypes and acres within the West Fork Rock Creek watershed (Ford et al. 1997). See **MAP 6** – Landtype Associations.

**Table 1. Landtypes of the West Fork Rock Creek Watershed**

| Landtype | Subsection | Acres | Description |
|---|---|---|---|
| 10 | M332Bd | 7,319.5 | This LTA occurs in a valley bottom landscape setting, which is typically composed of floodplains and terraces. Parent material is alluvium deposited over a variety of bedrock types. |
| 20 | M332Bc | 1,171.5 | This map unit occurs on a very steep, deeply eroded or faulted landscape setting which is typically composed of structural or stream breaks. Parent material is colluvium and residuum derived from metamorphosed Precambrian sedimentary bedrock and from small areas of volcanic bedrock (mostly rhyolite and andesite). |
| 35 | M332Bg | 12,762.3 | This map unit occurs in a high elevation broad ridgetop position which is typically composed of weakly expressed glaciated slopes and basins that were formed by ice -cap glaciers, minor valley glaciers, and periglacial frost shattering. Parent materials are a complex of frost shattered residuum and colluvium intermixed with glacial till derived from Precambrian calc-silicate and quartzitic rocks. |
| 40 | M332Bc | 39,253.0 | This map unit occurs in a steep, alpine glacial landscape setting. Parent materials are metasediments composed of argillites, siltites and quartzites with alpine glacial till scattered throughout; which is typically, medium textures. |
| 51 | M332Bc | 33,990.8 | This map unit occurs on gently to moderately sloping glacial landscape settings. Parent material is alpine glacial till, alluvium, and residuum derived from granitic sources. |
| 60 | M332Bc | 3,429.5 | This map unit occurs in a nonglaciated steep mountain slope setting, below the zone of strong frost shattering, which is typically composed of moderately dissected mountain slopes, ridge tops, and narrow valley bottoms. Parent materials are colluvium and residuum underlain by Precambrian Belt rocks such as argillite, quartzite, and siltite. |
| 64 | M332Bd | 8,884.8 | This map unit occurs in a non-glaciated steep mountain slope landscape setting, below the zone of strong frost shattering, which is typically composed of steep mountain slopes, moderately steep ridge tops, and minor amounts of narrow valley bottoms. Parent materials are colluvium and residuum underlain by volcanic andesites and rhyolites. |
| 68 | M332Bd | 7,069.5 | This LTA occurs in a mountain landscape setting, which is typically composed of stream dissected mountain slopes. Parent materials are residuum underlain by sandstone and shale bedrock. |
| 70 | M332Bc | 17,998.3 | This map unit occurs in a high elevation mountain ridge landscape setting which is typically composed of frost shattered ridge tops and mountain slopes. Parent materials are colluvium and residuum underlain by Precambrian sedimentary Belt rocks. |
| 75 | M332Bc | 13,759.7 | This map unit occurs in a high elevation mountain ridge landscape setting which is typically composed of frost shattered ridge tops and mountain slopes. Parent materials are colluvium and residuum underlain by Precambrian calc-silicate (calcium-bearing) and quartzitic rocks. |
| 81 | M332Bc | 95,762.2 | This map unit occurs in a moderately steep, highly dissected mountain slope landscape setting which is typically composed of dissected slopes, ridge tops, and noses of spur ridges. Parent materials are colluvium and residuum underlain by highly weathered granitic bedrock. |

| | | | |
|---|---|---|---|
| 83 | M332Bc | 6,088.6 | This map unit occurs in a moderately steep, highly dissected Tertiary-age valley fill landscape setting which is typically composed of dissected slopes, ridge tops, and planar terrace treads. Parent material is old, weathered alluvium derived from mixed sources. |
| 90 | M332Bc | 1,132.8 | This LTA occurs in a mountainous landscape setting, which is typically composed of mountain slopes and ridges. Parent materials are old landslide deposits underlain by well weathered volcanic and metasedimentary rock. |

Overall, the primary sources of sediment within the watershed are associated with roads, past logging activities and stream bank erosion. Roads are a primary concern as they are the link between sediment source areas and stream channels. Mining has dramatically altered stream channel characteristics in many of the first order tributaries of the West Fork in the lower watershed. Mining operations continue in this area, largely on private land, maintaining the existing disturbed condition.

## 3.5 Past Watershed Assessment Efforts

The West Fork Rock Creek analysis tiers to two larger scale analyses; the Rock Creek Subbasin Review (1998) (RCSR) and the Interior Columbia Basin Ecosystem Management Project (1997). Both of these analyses provide a broad examination of conditions, trends, and potential opportunities associated with management of the Basin's natural resources. The Rock Creek Subbasin Analysis in its entirety can be found on the web at:

http://www.fs.fed.us/r1/lolo/projects/index-rock-cr-sbr.shtml

The West Fork Rock Creek analysis tiers to data, information, findings and recommendations of the two larger sale analyses. This document seeks to streamline the analysis and does not repeat all of the broadscale resource information available in the Subbasin Review. Additional data and recommendations specific to key issues and questions in the West Fork are refined for this assessment.

## 3.6 Existing Watershed Restoration Projects

Several projects have been accomplished over the past decade in the West Fork watershed in an attempt to improve watershed conditions. These activities include:

- Aggregate surfacing on Sand Basin and West Fork roads
- Culvert replacement in Sand Basin
- Culvert barrier removed on Skalkaho road
- Road decommissioning and conversion to the Fuse Lake Trail
- Spot paving on the Skalkaho Highway (MT-38) by State Department of Transportation
- Riparian exclosure fences on Sand Basin and West Fork Creeks
- Water bars installed on Signal Rock Trail
- Improved grazing management practices
- Annual road maintenance
- Annual noxious weed treatment

The effects of these actions have been a reduction in human related impacts to riparian, stream channel and instream habitats, with the goal of improving the existing conditions to better meet the needs of native fish.

## Section 4 West Fork Rock Creek Watershed Characterization

Due to the diversity in topography, there are a variety of stream types. Upper elevations are dominated by high gradient streams which are less sensitive. Lower reaches and wider valley segments composed of alluvium are dominated by more sensitive stream types with moderate to broad floodplains. Transport dominated channel types connect the steeper segments to low gradient channel types. Parent material within the valley bottom and watershed influences particle size of stream substrate. Stream substrate formed from granitic material tends to have a high component of sand, while Belt rocks tend to produce more cobble substrates.

**Table 2. Watershed Characteristics for the West Fork Rock Creek**

| 6th HUC# | Size (acre) | Parent Material dominant/ sub-dominant | Miles of Stream <2%/>2% gradient | Vegetation* % forest/ % non-forest/ % shrub | Riparian* (acres) |
|---|---|---|---|---|---|
| Bowles (01) | 12,953 | Granitics / Glacial deposits | 8.3 /42.5 | 98 / t / 2 | 1290 |
| Sand Basin (02) | 11,910 | Granitics / Belts | 16.6 / 40.2 | 96 / 3 / 1 | 1489 |
| North Fork (03) | 12,032 | Granitics / Belts | 5.6 / 34 | 95 / 5 / t | 978 |
| West Fork (04) | 22,778 | Volcanics / Glacial deposits | 15.8 / 64.4 | 83 / 9 / 8 | 1949 |
| Total | 59,673 | | 46.3 / 181.1 | 91 / 5 / 4 | 5706 |

***** Vegetation classes derived from riparian layer prepared for BDNF Forest Plan Revision, 2005.

The following Table summarizes the types of permitted activities taking place within the watershed.

**Table 3. Permitted Activities on Federal Lands in the West Fork of Rock Creek**

| HUC Name | HUC Size (acres) | Allotment acres | # Allot-ments | Acres Regeneration Harvest | # Rec. Sites [1] | # Special Use Permits | # Mining Sites |
|---|---|---|---|---|---|---|---|
| Bowles | 12,953 | 10,713 | 1 | 397 | 2 | 1 | 0 |
| Sand Basin | 11,910 | 11,473 | 2 | 823 | 3 | 1 | 0 |
| North Fork | 12,032 | 12,039 | 2 | 794 | 5 | 2 | 0 |
| West Fork | 22,778 | 20,356 | 4 | 2,365[2] | 3 | 7 | 8 |
| Total | 59,673 | 54,581 | 5 | 4,379 | 13 | 11 | 8 |

[1] Includes both developed and "dispersed" recreation sites. Some sites contain multiple camping sites.

[2] Does not include private land timber harvest.

### *TMDL Status*

In comparison to other major drainages in western Montana, Rock Creek has been relatively unaltered by human activities. However, on a local basis, substantial actions have occurred. The lower end of West Fork Rock Creek is one of those localized areas.

The Clean Water Act requires each state to identify water bodies that are water quality limited (Section 303(d) and 40 CFR (Part 130)). After water quality limited water bodies have been identified, they are prioritized and targeted to measure the Total Maximum Daily Load (TMDL). When final approval is granted by the EPA, the list of water quality limited streams becomes part of an annual report to the State of Montana (305(b) Report).

The 1996 and 1998 Montana 305(b) list of Water Quality Limited Segments lists 20 miles of the West Fork of Rock Creek as "threatened" for cold water fishery-trout. Siltation (probable cause) from logging road construction/maintenance, silviculture, and agriculture (probable sources) are shown as reasons for impairment of beneficial uses. The 2004 303(d) lists the West Fork Rock Creek as a Category 5 impaired waterbody, meaning that one or more uses are impaired and a TMDL is required. The probable causes are mercury and heavy metals. The source of these metals is of yet unknown.

## 4.1 Aquatic Habitat Characterization

Instream habitat conditions are generally fair on National Forest System lands. The upper portion of the watershed contains moderate quality habitat for native species. The granitic geology throughout the upper portion of the watershed influences substrate composition. The substrate contains naturally high levels of sand sized material, limiting spawning and rearing potential, along with over winter habitat availability and food productivity. In reaches affected by land management, pool habitat and substrate composition have been adversely affected by increased sedimentation resulting from human activities - primarily roads, but also timber harvest, livestock grazing and mining.

Both riparian vegetation condition and streambank stability have been reduced, primarily a result of livestock grazing, a marked decline in the riparian shrub community in the Sand Basin area, and by the Skalkaho Highway lower in the watershed. Large woody debris recruitment potential has been reduced by activities along the road/stream intersection in accessible areas throughout the watershed.

Stream channel and instream habitat conditions in the lower West Fork subwatershed (#1004) are fair and trending downward as a result of land use practices and declining riparian vegetation health. See **MAP 7** – Stream Function. Streambank stability is reduced and the width/depth ratio is high. Pool quantity marginally meets Riparian Management Objectives described in the Inland Native Fish Strategy (INFSH). Channel migration is occurring and bedload movement is widespread. Sensitive stream reaches in headwater areas used by cattle typically exhibit changes in channel dimensions, pattern and profiles resulting in functioning-at-risk conditions in a static or downward trend. Also, the Signal Rock fire in upper West Fork Rock Creek (Bowles Creek subwatershed #1001) appears to be delivering

increased volumes of sediment which is also contributing to functioning-at-risk stream conditions.

High summer water temperatures likely affect the suitability of this watershed to support strong populations of native aquatic species in the West Fork. Numerous sites have been monitored off-and-on sin+ce the mid 1990s. While none of these sites have a long continuous record, they all indicate relatively warm water temperatures. Bowles Creek, an unroaded stream located in the headwaters of the West Fork exceeded 15$^{o}$C throughout the summer in two of three years. Daily maximum water temperatures exceeded 15$^{o}$C throughout the July-August period in four consecutive years near the mouth of the West Fork.

***Riparian Management Objectives*** - Both the Inland Native Fish Strategy interim direction (http://maps.wildrockies.org/ecosystem_defense/Resources_Species_Topics/Fish/INFISH_PACFISH/INFISH_Interim_DN.pdf) and the Revised Forest Plan aquatic objectives and standards specify riparian management objectives to protect aquatic habitats. Aquatic specialists reviewed the riparian management objectives and compared them to site specific conditions in the West Fork watershed. They determined that the interim RMO's are appropriate for this watershed.

The West Fork watershed is important for native fish species in the Rock Creek Subbasin. Both bull trout and westslope cutthroat trout (WCT) are present, status for both species is strong. See **Map 8 -** Distribution of Native Fish Species and **Table 4** for a list of aquatic species. Rainbow trout and eastern brook trout are presumed absent. This is the only watershed in upper Rock Creek that contains only native fish species (with the exception of grayling in Fuse Lake). Rainbow trout and eastern brook trout are *presumed absent*. A single brown trout was captured in 1994 in the lowest subwatershed (Gerdes, pers. com.). No other records indicate this species

presence in this watershed although sampling in adjacent watersheds in 2005 found brown trout established in previously undocumented locations. The presence of this species is of great concern. Documenting the extent of colonization of the West Fork watershed by brown trout is a high priority action.

**Table 4. Aquatic Species Inhabiting the West Fork of Rock Creek**

| Species Name | Special Status | Native | Abundance |
|---|---|---|---|
| Bull trout | ESA – threatened | Yes | Uncommon |
| Westslope cutthroat trout | USFS – sensitive<br>MFWP – Species of Concern | Yes | Common |
| Mountain whitefish | None | Yes | Common |
| Longnse sucker | None | Yes | Common |
| Longnose dace | None | Yes | Common |
| Slimy sculpin | None | Yes | Common |
| Brown trout | None | No | Rare |
| Artic grayling | None | No | Fuse Lake – planted |
| Boreal Toad | USFS – sensitive<br>MT – Species of Concern | Yes | Rare |
| Tailed frog | None | Yes | Uncommon |
| Western spotted frog | None | Yes | Common |
| Longtoed salamander | None | Yes | Common |

This watershed provides some bull trout spawning and rearing habitat. It provides habitat for both resident and migratory fish. Our sampling indicates the presence of moderate densities of juveniles, sub-adults and adults (resident sized) during the summer. Total amount of spawning is low due to limited suitable habitat in the granitic geology of the watershed. Spawning does occur between Coal Gulch and Fuse Creek. A few redds have been located in this section and radio-tagged fish have been tracked to this reach during the spawning season. This reach does contain a substantial amount of suitable spawning gravel, but both spawning and rearing habitat is limited by the quantity of sand filling the interstitial spaces. The upper West Fork (above Sand Basin Creek), Bowles Creek and the North Fork all provide some rearing habitat. Mud Lake, in the headwaters of the North Fork, does support bull trout. We don't have any information on location of spawning for these

fish. Populations appear to be stable. Bull trout and westslope cutthroat trout densities, in the upper portion of the watershed, have remained stable over a 60 year period (Upper Camp-Duncie EIS, 1992).

The West Fork watershed supports both resident and migratory westslope cutthroat trout (WCT) from Rock Creek. Genetic analysis has been performed on WCT in the downstream subwatershed, indicating the population may be genetically pure, although an unknown strain of cutthroat trout were planted in the Sand Basin area between 1933 and 1953. In 1999, Montana entered into an MOU and Conservation Agreement for WCT with Federal land management and regulatory agencies to protect existing populations and ensure the long term persistence of WCT within their historic range. Populations that were either genetically pure, or only slightly hybridized were designated as *conservation populations*. The West Fork Rock Creek supports a conservation population of WCT.

Table 5 displays the miles of stream occupied by bull trout and westslope cutthroat trout *conservation populations* in each 6$^{th}$ field watershed.

**Table 5. Fish Populations by 6th Code Watershed**

| Species | Bowles 1001 | Sand Basin 1002 | North Fork 1003 | West Fork 1004 | Total miles |
|---|---|---|---|---|---|
| **Bull trout** | 9.9 | 10.3 | 8.5 | 7.9 | 36.6 |
| **Westslope cutthroat trout** | 10.4 | 11.2 | 13.4 | 11.7 | 46.7 |
| **Bull trout Critical Habitat** | 0 | 0 | 0 | 4.6 | 4.6 |

Westslope cutthroat trout occupy 21% of the total stream miles (MFWP 2004) and bull trout occupy 16% of the watershed. The USFWS (2005) designated 4.6 miles (2%) of the watershed as critical habitat for the recovery of bull trout. Critical

habitat was designated only on stream segments flowing through privately owned land.

Whirling disease has not been detected in this watershed, although low densities of T. tubifex worms were found in the downstream subwatershed.

No systematic amphibian surveys have been done in the West Fork watershed. We do have incidental observations of long toed salamanders, spotted frogs and rocky mountain tailed frogs. There are no reports of boreal toads. Efforts should be made to survey potential habitat for toads to document their presence or absence in the watershed.

Western pearlshell mussels do exist in West Fork streams. Anecdotal information suggests their numbers may have declined substantially over the past few decades. Efforts should be undertaken to map their distribution and abundance in the watershed.

In 2002, the Forest surveyed 20 known culverts on perennial streams in the West Fork drainage. Fish passage issues on two of these culverts, one on Sand Basin Creek and one on the North Fork have been addressed. All remaining inventoried culverts impede aquatic organism passage. Additional surveys are still needed at a few crossings to document their effect on aquatic organism passage.

Sediment delivery from roads, including the Skalkaho Highway and roads built in the past for timber management, adversely impacts aquatic systems in this watershed. This watershed also contains numerous culverts that block, or inhibit, movement by aquatic organisms. Cattle grazing in the Sand Basin allotment continues to impact stream channel conditions in 6$^{th}$ field watersheds 01, 02 and to a lesser extent 03.

The impact by livestock grazing is exacerbated by the decline in woody riparian vegetation. Mining in the lower West Fork subwatershed continues to pose a risk to fish in this watershed. Invasion of watershed streams by non-native salmonids is an increasing threat to the native fish assemblage.

## 4.2 Vegetation Characterization

The West Fork Rock Creek is predominantly a forested environment. See **Map 9 –** Vegetation Cover Types. Forested cover comprises 51,548 of the 59,814 acres of the assessment area (86%). Of that, 74% is lodgepole pine, 9% is Douglas-fir, 12% is spruce/subalpine, 4% is whitebark pine, and less than 1% is deciduous trees or ponderosa pine. Twenty two percent of the forested stands were affected by insects or fire since the year 2000. Insect infestations affected 2,600 acres scattered throughout the watershed. ("Northern Region Insect and Disease Report", 2005.) See **MAP 10** – Insect Infestations Fire affected 8,649 acres concentrated in three different areas. See **MAP 22** – Past Wildfires. Over 4,300 acres of timber (8%) have been treated with regeneration harvest in this watershed (see **Table 3 and Map 11 –** Past Timber Harvest). Most of the harvest activities occurred in the Sand Basin and Beaver Creek drainages. When harvest occurs adjacent to stream channels, it can affect stream shading, LWD recruitment, and instream sediment levels.

Historically, the lowest elevations and south aspects were warm and dry to very dry and supported grasslands and forests of small open stands of Douglas-fir and lodgepole pine. Ponderosa pine was a rarity in this part of the Rock Creek subbasin although it was common in the lower end. Mid and upper elevation forests were dominated by lodgepole pine with spruce and subalpine on moist and wet sites. The highest elevation forests were a combination of whitebark pine, subalpine fir and spruce with small stands of subalpine larch. Prior to the settlement of this area,

noxious weeds were not present. Riparian vegetation consisted of cottonwoods (on the main stem of Rock Creek) and willows with riparian grasses, sedges and forbs. Insects and diseases were a part of the natural ecosystem but wildfires kept stand conditions from being greatly susceptible by maintaining open canopies and a mix of tree species.

Patterns of vegetation, species composition, structure and disturbance processes at the landscape level in Rock Creek have been altered by management. The Upper Columbia River Basin Assessment developed a rating of forest integrity for lands in the Columbia River Basin. Measures of forest integrity included such elements as tree stocking levels, amount and distribution of exotic species, amount of snags and down wood, changes in fire severity, disruptions to hydrologic regimes, and others (PNW-GTR-382). The Rock Creek Subbasin was rated as moderate.

Over 4,300 acres of timber have been treated with regeneration harvest since the mid-1960's. Logging has removed trees from some of the warm dry sites and even more of the lodgepole pine sites. Logged areas have regenerated and most are well stocked with seedling to sapling size trees, see **Map 11** - Past Timber Harvest. Aside from the logged areas, forests are older and more densely stocked than in the past. Douglas-fir stands tend to have multiple stories and lodgepole pine stands are starting to have more shade tolerant species move into the understory. Openings are being colonized by conifers, namely Douglas-fir and Rocky Mountain juniper, but with occasional lodgepole pine as well. Aspen clones in stands are densely stocked and the pine is in competition with spruce and subalpine fir except for the harshest sites that tend to be only whitebark pine. Subalpine larch occupies niches on northeasterly aspects. Noxious weeds are common and are influencing the natural diversity of grasslands and riparian areas.

### *Riparian Vegetation*

Historically, riparian vegetation was dominated by willows with riparian grasses, sedges and forbs. Vegetation in riparian areas has shifted from native willow/sedge communities to more grasses and forbs with less willow. Riparian vegetation on the WFRC amounts to approximately 1,195 acres and ranges from willow dominated to grass/sedge/forb mix. There are no significant marshlands in WFRC Succession and lack of wildfire have allowed conifer species to move into sites that previously had low numbers of those shade tolerant trees. Open shrub riparian habitats comprised of willow, dogwood, and alder exist in small patches. Willow and dogwood are in a downward trend from a number of factors.

Upland conifers have encroached upon riparian areas to the point where many riparian shrub species have been suppressed or eliminated from many riparian areas. On some stream reaches conifers are overtopping riparian vegetation, on other reaches, the riparian shrub community has died out and vegetation is a grass/sedge/forb mix. Succession and lack of wildfire have allowed conifer species to move into sites that previously had low numbers of these trees.

Livestock use has contributed to changes in riparian vegetation by over utilizing woody species and aiding the spread of exotic species like bluegrass and timothy in some drainages. Loss of beaver and increases in big game populations also contributed to changes in riparian vegetation. Bluegrass and timothy are aggressive species which out-compete native riparian grasses. On a few reaches the riparian area is still dominated by willows. Conifer dominated upper stream reaches are not appreciably changed except for increased density of trees in the riparian areas.

### *Sensitive Plants*

The West Fork Rock Creek Watershed contains two known Region 1 Sensitive Plant species. The sensitive species are Payson's bladderpod (*Lesquerella paysonii*) and

Missoula phlox (*Phlox kelseyi var. missoulensis*) which are located in the West Fork Buttes Botanical Special Interest Area (See **Map 12** - West Fork Buttes Botanical Special Interest Area). Payson's bladderpod has two known occurrences in Montana and is globally imperiled. Missoula phlox has 15 known occurrences in Montana and is globally secure.

The 486 acre West Fork Buttes Botanical Special Interest Area (SIA) was designated by the Regional Forester in November 1996. Designation of the SIA provides administrative and public recognition of the biological significance of the site. Specifically, the designation recognizes the site's unique habitat and the two sensitive plant populations occurring there.

The area contains a number of other plant species unusual for the region. In addition, the site supports a noteworthy grassland community dominated primarily by bluebunch wheatgrass (*Pseudoroeneria spicata*), which is ecologically representative of late seral stage.

The site's accessibility from Montana Highway 38 contributes to making it an important place of education and study for the Forest Service's sensitive plant program. The unusual plant species, and their habitat, make the site a potentially important area for research on the species biology and management related to population viability.

### *Noxious Weeds*

In general, the West Fork Rock Creek Watershed is not as infested with noxious weeds as the lower elevation watersheds of the Subbasin are. However, noxious weed management in this watershed is vital in order to keep the spread of weeds out of this watershed. The majority of the weeds are located in the 1004 sub-

watershed (See **Map 13** - Noxious Weed Locations). The following Table lists the known weeds in the watershed.

**Table 6. Known Noxious Weeds in the West Fork Watershed**

| Common Name | Scientific Name |
|---|---|
| Spotted knapweed | *Centaurea maculosa* |
| Canada thistle | *Cirsium arvense* |
| Musk thistle | *Cardurus nutans* |
| Ox-eye daisy | *Chrysanthemum leucanthemum* |
| Houndstongue | *Cynogbssum officinale* |
| Black henbane | *Hyocyamus niger* |
| Tall buttercup | *Rannunculus acris* |
| *Sulfur cinquefoil | *Potentilla recta* |
| *Yellow toadflax | *Linaria vulgaris* |

*Weeds not yet mapped but found in the watershed.

Spotted knapweed is the most common weed in the watershed and although only mapped in a few areas, individual plants can be found almost everywhere, especially in the 1004 sub-watershed. Spotted knapweed is mostly found along roads, open parks and old logging units. Canada thistle is mostly found up the many gulches that lead to the summit of West Fork Buttes. Ox-eye daisy and Tall buttercup are aggressive weeds that exploit open meadows and pastures. They have been mapped in this watershed and if not closely monitored and treated may exponentially spread throughout the meadow systems on the Forest. Houndstongue and Black henbane have only been mapped in two areas. However, eradicating these weeds should be a top priority before they become the next weed epidemic in this watershed.

Invasive weeds pose a serious threat to big game grass forage productivity. Losensky (1987) found that on conifer/grassland, or pure grassland habitat types, invasive weeds have the potential to not only invade, but to replace native grasses.

Invasive weeds provide little, if any forage to wintering deer, elk and bighorn sheep. Lavelle (1986) found that the diet of a wintering elk herd was composed of less than 10% invasive weeds. Baty (1995) found that the chemical composition of those invasive weeds makes them generally unpalatable for ungulates (see range report for more detailed invasive weed conditions on in the WFRC).

The West Fork Buttes Botanical Special Interest Area (SIA) easy accessibility puts this habitat at risk from weed infestations. Spotted knapweed (*Centaurea maculosa*) is rapidly spreading from roadsides into the SIA. In 2004, volunteers from Partners for Plants conducted a monitoring survey in the SIA to identify and flag noxious weed infestations. Following the survey, the Forest Service began to treat the noxious weeds within the SIA.

## 4.3 Wildlife Characterization

A wide variety of wildlife species occupy the diverse habitats of the West Fork Rock Creek. Species of interest include Threatened and Endangered (T&E), Nonessential Experimental (NE), and Management Indicator Species (MIS). **Table 7** lists those species of interest known or suspected of occurring on the Forest, status, habitat preference, and whether the habitat or species are present in the West Fork Rock Creek assessment area.

More detailed information about the habitat availability and population levels for each species can be found in the Wildlife Specialist Report of the Project File for this watershed assessment.

**Table 7. Wildlife Species Considered in the West Fork of Rock Creek**

| Common Name<br>Scientific Name | Status | Habitat Preference | Species/ Habitat Present |
|---|---|---|---|
| Canada Lynx<br>*Lynx canadensis* | T | Wet subalpine fir/lodgepole pine/Douglas-fir from 5500 to 8000 feet in elevation; vertical structural diversity in the under story for denning and abundant snowshoe hare prey; lack of human disturbance during denning. | Y |
| Grizzly Bear<br>*Ursa horribilis* | T | Habitat generalist. Large tracks of undisturbed habitat. | Y |
| Gray Wolf<br>*Canis lupus* | NE | Habitat generalist. Lack of human disturbance (low road densities); abundant prey (elk) required. | Y |
| Bald Eagle<br>*Haliaeetus leucocephalus* | T | Nesting trees/platforms near an open water body (> 80 acres) or major river system; available fish and water bird species prey. | Y |
| Fisher<br>*Martes pennati* | S | Moist coniferous forested types (including mature and old growth spruce/fir), riparian/forest ecotones. | Y |
| Great Basin Pocket Mouse<br>*Perognathus parvus* | S | Dry grassland. | N* |
| North American Wolverine *Gulo gulo* | S | Large areas of unroaded security habitat; secure denning habitat; ungulate carrion in winter. | Y |
| Northern Bog Lemming<br>*Synaptomys borealis* | S | Wet riparian sedge meadows, bog fens. | Y |
| Pygmy Rabbit<br>*Brachylagus idahoensis* | S | Dense clumps of big sagebrush or greasewood forage on grasses (wheat grass, bluegrass) in summer and sage in winter. | N* |
| Greater Sage Grouse<br>*Centrocercus urophasianus* | S | Wet riparian meadows used for brood rearing. Sagebrush types used or nesting. | N* |
| Townsend's Big-Eared Bat, *Corynorhinus Townsendii* | S | Roosts in caves, mines, rocks and buildings; Forages over tree canopy, over riparian areas or water. | Y |
| Harlequin Duck<br>*Histrionicus histrionicus* | S | During breeding season, found near large fast flowing mountain streams | Y |
| American Peregrine Falcon<br>*Falco pereginus anatum* | S | Cliff nesting (ledges); riparian foraging (small bird species prey). | Y |
| Black-backed Woodpecker<br>*Picoides arcticus* | S | Old growth and mature forests; landscapes disturbed by fire, wind, and drought that result in insect epidemics (forage and nesting). | Y |

| | | | |
|---|---|---|---|
| Flammulated Owl *Otus flammeolus* | S | Mature (> 9 inches dbh) and old growth ponderosa pine/Douglas-fir with abundant moth species prey. | Y |
| Northern Goshawk *Accipiter gentiles* | S, MIS | Mature and old growth Douglas-fir for forage and nesting. | Y |
| Trumpeter Swan *Cygnus buccinator* | S | Large lakes | N* |
| Pine Marten *Martes Americana,* Hairy Woodpecker *Picoides tridactylus* | MIS | Lodgepole pine mature and old growth, spruce/ subalpine fir mature and old growth. | Y |
| Pileated Woodpecker *Dryocopus pileatus*, Northern Goshawk, *Accipiter gentillis* | MIS | Douglas-fir old growth for forage and nesting. | Y |
| Three-Toed Woodpecker *Picoides tridactylus* | MIS | Old growth and mature forests; landscapes disturbed by fire, wind, and drought that result in insect epidemics (forage and nesting). | Y |
| Northern Water Shrew *Sorex palustris* | MIS | Riparian, near mature or old growth forest. | Y |
| Western Jumping Mouse *Zapus princeps* | MIS | Riparian areas with or without a shrub or tree over story. | Y |
| Belted Kingfisher *Ceryle alcyon* | MIS | Slow moving water for foraging; earthen banks where burrows can be excavated. | Y |
| Blue-Winged Teal *Anas discors* | MIS | Riparian, breeds near lakes, ponds, reservoirs. | N* |
| Warbling Vireo *Vireo gilvus* | MIS | Riparian zone and deciduous trees and mixed coniferous/deciduous forest along streams. | Y |
| Willow Flycatcher *Empidonax traillii* | MIS | Riparian, willows along streams and the edges of forests adjacent to streams. | Y |
| Montane Vole *Microtus montanus* | MIS | Grasslands, natural bunchgrass communities, but may also use early seral sagebrush habitats. | Y |
| Sage Thrasher *Oreoscoptes montanus* | MIS | Sagebrush obligate. | N* |
| Elk, Mule Deer, | MIS | Habitat generalist. Winter range in lower elevation conifer/shrub/grasslands. | Y |
| Moose | MIS | Often associated with willow riparian areas. | Y |
| Mountain Goat | MIS | Alpine habitat year-round. | Y |
| Big Horned Sheep | MIS | Alpine habitat in spring, summer, fall. | Y |
| Blue Grouse | MIS | Aspen riparian, grass/shrub/forest ecotones. | Y |

T-Threatened, E- Endangered, S- Sensitive, MIS- Management Indicator Species
NE- Nonessential experimental

* The assessment area is situated outside the range of distribution for the great basin pocket mouse, pygmy rabbit, and the greater sage grouse and there is not substantial standing water to support Trumpeter Swans; these species are not addressed in this assessment.

The Forest Plan identifies Management Indicator Species that are used to judge effects of land management activities on various habitats. Management efforts have historically been directed toward indicator species on the premise that management for these would ensure habitat management for the other wildlife represented by that species (Baydack et al. 1999).

The Deerlodge Forest Plan (1987) identifies 13 MIS to represent broad cover types, including old growth (lodgepole pine, spruce/subalpine fir, Douglas-fir, and snags), riparian (shrub, tree, wet meadow, and marshland), dry grassland/shrublands, and species that are commonly hunted (**Table 7**). Habitat acreage was estimated using Field Sampled Vegetation Module (FSVeg) which houses all Forest Inventory and Analysis (FIA) plot and satellite imagery land cover classification system (SILC3) which uses satellite imagery to classify vegetation across all land ownerships.

**Table 8. MIS Habitat on FS Lands in the West Fork Rock Creek**

| MIS HABITAT DESCRIPTION | MIS SPECIES | TOTAL ACRES IN WFRC |
|---|---|---|
| Old Growth: lodgepole pine (dbh >9"), spruce/ subalpine fir (dbh >9") | hairy woodpecker, pine marten | 4,250<br>333 |
| Old Growth: Douglas-fir (dbh > 9") | northern goshawk, pileated woodpecker | 6,994 |
| Burned or insect-killed forest (snag, cavity habitat) | three-toed woodpecker | 10,700 |
| Dry grassland/sage | sage thrasher, montane vole | 5,558 |
| Riparian: shrub, tree, wet meadows, marshland | northern water shrew, warbling vireo, belted kingfisher, willow flycatcher, w. jumping mouse, blue-winged teal | 1,195 |
| Commonly hunted species managed by the State of Montana | elk, mule deer, moose, blue grouse, big horned sheep, and mountain goat | see below |

### *Old Growth & Forested Habitats*

The Deerlodge Forest Plan (USFS 1987, II-26) defines old growth as "those [stands] that are past full maturity and are showing decadence. They most often have two or more layers or stories, eight or more trees per acre that are of large diameter for the site, and an age of 200 years or older on the largest trees." Many wildlife species depend on habitat features found in old growth such as old large trees, accumulations of large dead woody material, canopy characteristics, and species composition.

Old Growth information is not available at 5$^{th}$ field HUC, however using Green et al. (1992) definitions, old growth is estimated to comprise 31% of forested cover in the Upper Rock Creek landscape. Of this estimated old growth, 84% is lodgepole, 10% is Douglas-fir, and 6% is spruce/subalpine fir (USFS 2006). Based on current best available habitat information for the Deerlodge National Forest, it appears that old growth habitat is abundant and well distributed across the landscape.

### *Burned or Insect-killed Forest (Snag/Cavity Habitat)*

Snag development, either at low levels in healthy stands or from large fire events or insect outbreaks, is desirable on a landscape scale to provide for the diversity of dependant wildlife species. Forest Inventory and Analysis (FIA) data was used to estimate large snags (> 10 inches dbh) in the Upper Rock Creek landscape by dominant tree species (Bush and Leach 2003). The average >10 inch snag density for the Upper Rock Creek which encompasses the assessment area is 14.5 snags per acre, and the average Forest-wide is 9.78 snags per acre. Both estimates exceed Forest Plan standards and meet Region One management recommendations (USFS 2000). FIA does not provide information at the compartment scale identified in the 1986 plan and systematic snag inventories on a compartment-wide basis have not been completed.

Upper elevation lodgepole pine forests are susceptible to attack by mountain pine beetle and to increased infection of dwarf mistletoe while whitepine blister rust is a threat to whitebark pine. These disturbances are expected to cause substantial mortality in the future, contributing to snag recruitment.

### *Grassland/Sage Habitats*

Dry grassland/sage habitats dominated by sagebrush, bluebunch wheatgrass, and Idaho fescue cover approximately 5,489 acres of the WFRC area and appear as scattered parks. See **Map 9 –** Vegetation Cover Types. Historically, fire played a key role in maintaining these open parklands, with fire intervals that ranged from 23 to 65 years (Barrett 1997). Small patches of sage are found in lower east side of WFRC but the assessment area is mostly forested.

### *Riparian Habitats*

Riparian zones are the diverse plant and animal communities that occur at the interface between terrestrial and aquatic ecosystems. They include wet meadows, seeps and springs, and the more well-defined zones of vegetation along ephemeral, intermittent, and perennial streams (Saab et al.1995). Wildlife use of riparian habitats is disproportionately high relative to their limited occurrence in forested landscapes (I.E. Thomas et al. 1979, Knopf et al.1988, Saab et al. 1995). On the Deerlodge National Forest, riparian areas have been altered through livestock grazing, timber harvest, fire suppression, mining, trail and road construction, water developments, and the loss of beaver. Habitat has become lost or much reduced for certain species and species assemblages (USFS 1997). For example, beaver have been eliminated from the area (the effects of which are summarized in Mariani 1997), conifer succession has decreased sunlight (and water availability) to plants, and moose browse heavily on the live plants that are left (evidenced by clubbing and depressed growth).

### *Commonly Hunted Species (MIS)*

***Elk*** - West Fork Rock Creek drainage is located in the Sapphire and Rock Creek Elk Management Units (EMU) identified in the 2004 Montana Fish, Wildlife and Parks EMU and comprises portions of HD 211 and 216. The management objective for the Rock Creek EMU is to "manage the elk population in a healthy condition within 20% of the objective of 2,500 observed elk and cooperate with private and public land managers in management of elk habitats to provide a diversity of elk hunting experiences." Population estimates in 2004 (3,745) exceed Sapphire EMU objectives (3,400) However recent flight data documented 400 head, which is 200 head below management objective for HD 211 (Vinkey pers. comm.), both estimates are within the 20% recommended range of elk population variability (MFWP 2004) . MFWP (2004) identifies unregulated Off-Road-Vehicle and other vehicle use contributing to increased elk vulnerability as management challenges for both the Rock Creek and Sapphire EMUs.

During the hunting season, secure areas on Forest Service lands are important to reduce the displacement of elk to adjacent private lands and to reduce the vulnerability of bulls to hunter-caused mortality (Christensen et al. 1993, Hillis et. al 1993). Secure habitat is defined as blocks greater than 10 acres in size located greater than 500 meters from an open road (ICST 2003). See **Map 14**- Secure Wildlife Blocks. Currently, the assessment area provides elk with about 71% and 61% secure habitat in Hunting Districts 211 and 216 respectively (USFS 2005).

The analysis area contains approximately 4,419 acres of designated big game winter range located in two areas on the West Fork Buttes. See **Map 15** - Winter Range. These winter range areas are located on approximately 1,492 acres of private land, 374 acres of State land, 572 acres of BLM land, and 2,399 acres of FS land. Conditions for elk and mule deer were historically considered excellent in this area

due to productive forage and an absence of weeds. Currently forage in the West Fork Buttes area is declining severely due to noxious weeds establishment near roads and fire exclusion with subsequent conifer encroachment. Conifer encroachment has reduced the amount of forage in grassy parks throughout the forest, and isolated populations of spotted knapweed, Canada-thistle and others occur near two-track roads leading into the winter range areas and in the winter range areas themselves (see Vegetation, Noxious Weeds, page 20). The Forest has been pursuing an aggressive noxious weed treatment program over the past several years that will continue to address infestations on winter range in the foreseeable future. Road densities are high in elk winter range, however, road closures as designated on the Forest Travel map, are in effect from September 1st through June 15th.

***Moose*** - The assessment area supports a moose population year-round that increased in number from nearly 0 in 1940 to the point today that allows them to be hunted by the public through a limited permit system. Hunting Districts (HD) 210 and 211 govern moose harvest in WFRC. MFWP hunting tag distribution in these HDs has increased in the past years suggesting moose numbers are sufficient for these areas. However, moose population in the WFRC may currently be in decline (Vinkey pers. comm.).

Moose tend to use lower elevations during winter and move to higher elevations following snowmelt. There is 9,400 acres of modeled moose winter range on WFRC. Preferred forage plants in the WFRC are in a downward trend (discussed in the aspen and shrub riparian sections). During periods when food is lacking, a "starvation" response occurs wherein moose will shift browsing patterns to less suitable plants (such as aspen bark) or increase travel distance to find suitable forage (Franzmann and Schwartz 1997). In the WFRC area moose (and probably elk) have caused widespread bark damage immature aspen stands and willow

communities. In the last three years, the BDNF has maintained riparian exclosures on 5 acres in the WFRC that may address wildlife browsing concerns.

***Bighorn Sheep -*** In 2003, populations were estimated to be 200 in HD 216 (MWFP 2003). There are 2764 acres of modeled sheep habitat in the WFRC, none of which is considered winter range.

***Mountain Goat*** - MFWP (2003) estimates populations in this HD to be 15. Goats were once present near Fox Peak, but are currently nearly absent. Approximately 50 individuals exist in the entire Pintler Ranger District (Vinkey pers. comm.). The WFRC has approximately 1887 acres of modeled goat habitat located near Skalkaho pass. The WFRC encompasses goat HD 223 and 261 however goat habitat in this watershed is only found in HD 261, which is closed to hunting.

### *Other Wildlife Issues*

**Aspen:** Aspen is of ecological importance to many species of wildlife such as snowshoe hare, lynx, fisher, northern goshawks, hairy woodpeckers, moose, and blue grouse. DeByle (1985) gives a general review of the importance to and use of aspen communities by numerous and varied wildlife species from neotropical migrant birds to large ungulates. Aspen trees, living and dead, are extremely important to breeding cavity nesting birds (Li and Martin 1991, Conway and Martin 1993). Aspen across the Forest (and regionwide) is considered a community at risk because it is declining in patch size and vigor through competition for available light and water from conifer succession, and heavy browsing of succor growth by wild ungulates and domestic livestock, and reduced fire frequency (i.e. Houston 1973, Loope and Gruell 1973, Hodge 1997, White et al. 1998).

Aspen covers about 150 acres (< 1%) of the analysis area, occurring in upland and riparian settings in stands that range in size from a few trees to clones of 20 acres in size. See **Map 9**. In the WFRC area, most aspen stands are mature (80 to 100 years old) with little to no variation in age classes in the understory. Aspen sucker growth is severely suppressed, as evidenced by the amount of shading by conifers within and adjacent to stands as well as the heavy clubbing caused by browsing wild ungulates and domestic livestock. Heavy bark damage on mature aspen trees is widespread, from moose that feed on aspen bark in times when preferred browse (willows and dogwood) is lacking (Franzmann and Schwartz 1997).

Thus far, treatment for aspen on the BDNF has had mixed results (Rohrbacher pers. comm.) and therefore no specific management recommendations are given at this time. However, treatments for encroaching conifers, and mitigation for heavily browsed areas will most likely benefit the remaining aspen clones.

**Secure Habitat:** Road densities of greater than 1 mile/mile2 have been shown to reduce habitat security and increase mortality for a range of mammals, including elk, bears, wolverines, and lynx (Lyon 1983; Hornocker and Hash 1981; Britell, et al. 1989). Both elk and grizzly bears species will avoid vehicles, thereby reducing habitat otherwise available to them. Secure areas for these species can also provide relatively secure movement areas for other wide ranging species. Secure areas for elk and grizzly bears can also provide core areas, linkage, and connectivity across forest landscapes.

A summary of data collected from a 2001, statistical survey of the people entering the BDNF showed that the top five activities that drew the public here (based on percent participation in all listed activities) were to view wildlife (59%), picnic/gather with their families (27%), view scenery (26%), hunt (all types; 24%), or fish (all

types) 22% (summarized in Swanson 2004). Long-term forecasts of Montana Forest use by the public predict that wildlife viewing, followed by fishing and hunting will be the most rapidly expanding activities. As a result, the demands for both non-motorized and motorized recreation are expected to increase in the assessment area.

A considerable amount of research has demonstrated the adverse impacts of roads, trails and motorized vehicle activity have on habitat and wildlife (recently summarized in Joslin and Youmins 1999, Foreman et al. 2003, and Gaines et al. 2003). Increasing use of an area causes increasing conflicts and risks to wildlife resources that can be displayed in three broad categories including;

1) **habitat alteration**, particularly effecting those species inhabiting riparian corridors and other limited habitats like seeps, springs, and seasonally wet areas (Cole and Landres 1995, Douglass et al. 1999, Maxell and Hokit 1999),

2) **disturbance and displacement** from otherwise suitable habitat during different seasons of the year from presence and activities of people (Knight and Gutzwiller 1995, Canfield et al. 1999, Skovlin et al. 2002),

3) **increased vulnerability** to road mortality, hunting and trapping (See elk security discussion) and,

4) **increased noxious weed establishment** by providing ideal germination sites and a conduit to the transfer of noxious weed seeds.

There is an estimated road density of 1.22 mi/mi$^2$ with 93 miles of roads in WFRC predominantly concentrated in the North Fork Rock 6$^{th}$ field HUC (1.8 mi/mi$^2$). See **Table 8. Also See Map 16 – Road Locations and Map 17 – Road Density**. Conversely, there is approximately 30,000 acres of roadless area providing security habitat for a variety of wildlife.

## 4.4 Transportation

### *Road System Description*

The Skalkaho Road – also known as Forest Highway 91 and Montana Highway 38 – parallels Rock Creek through the full length of the drainage. Approximately ninety miles of National Forest System Roads ("system" roads) network the drainage, as well as many unauthorized (non-system) roads. See **MAP 16** – Road Locations. The vast majority of the road system is located within the lower quarter of the watershed; most of the remaining roads provide access to the middle and upper reaches of the watershed in Sand Basin Creek and the North and West Forks of Rock Creek. Some road decommissioning was accomplished in this watershed in the past.

The majority of the system roads in the area are local roads maintained for high-clearance vehicles only (maintenance level 2), though some are suitable for passenger car use (maintenance level 3). Most of the roads are native-surfaced, with some aggregate-surfaced routes and some spot-surfaced segments. See **MAP 16** for the location of numbered routes.

### *Road Conditions*

With diminishing funding, Forest road maintenance typically focuses on higher-standard, higher-use roads or those with critical resource protection needs or health and safety issues. (These are often arterials or collectors, or local roads accessing campgrounds or other heavily-used sites.) Consequently, the overall condition of the Forest's road system is deteriorating. Roads in this watershed are no exception. As described above, most of the routes in West Fork Rock Creek are local low-standard, native-surfaced roads. Only a few of the roads in the drainage receive regular annual maintenance.

The Skalkaho Highway parallels the West Fork to its headwaters, encroaching on the channel frequently. Road surface material is routed to the stream in many locations.

Numerous segments adjacent to the West Fork were paved in 1991 to reduce sediment delivery to the stream.

Road condition surveys have been performed across the Forest since 1998. At least two roads in this watershed – #5070 Sand Basin Creek Road and #5071 West Fork Road – were surveyed to determine annual maintenance, deferred maintenance, and capital improvement needs. The deferred maintenance work items identified during these surveys can provide insight as to the extent of the road maintenance backlog. These two maintenance level 3 roads total 17.4 miles in length. The total deferred maintenance cost for only the drainage-related work items (i.e., culvert/arch repair or replacement) totals $28,542, for an average cost of $1,638/mile. These drainage-related costs equate to 85% of the total deferred maintenance costs for these roads. Drainage-related maintenance items are an important consideration, of course, when addressing watershed protection concerns. Another identified deferred maintenance work item – surface replacement – may be an equally important watershed protection concern, depending on the likelihood that road-generated sediment from the affected road segments will reach a live stream.

***Roads Analysis***

In 1999, the roads analysis process was introduced as a means of informing Forest Service planners and decision-makers of road system opportunities, needs and priorities in support of land and resource management plan objectives. Roads analysis may be conducted at several scales, including Forest-scale and watershed- or project-scale.

A Forest Scale Roads Analysis was completed in 2004 for the Forest's "backbone" road system. The analysis included all all arterial and collector roads (regardless of maintenance level) plus selected local roads considered suitable for passenger car

use (objective maintenance level 3, 4, &5). The purpose of this analysis was to assess broad-scale issues related to road management on the Forest, including: environmental, social, and economic issues, right-of-way needs, and interrelationships with other agencies. The roads analysis report includes a display of the Forest road system with risks and opportunities identified for each analyzed road, as well as management priorities.

**Table 9** displays the value and risk ratings from the roads analysis for roads in the West Fork Rock Creek watershed. The column for "watershed risk" is highlighted. As defined in the roads analysis, "watershed risk" assesses the threat to watershed integrity caused by: 1) erosion and significant delivery of sediment from the road prism to a perennial stream system; 2) a reasonable potential of delivering chemicals to streams/lakes from road surfaces or through noxious weed treatments in amounts capable of causing harm to aquatic organisms; 3) a change in timing and/or magnitude of stream flow through extensions of the channel network; 4) stream crossings which notably alter stream hydraulics or restrict fish passage (unless desired to meet native fisheries objectives); and/or 5) infringement of roads on streams which cause obvious changes in channel, floodplain or wetland function.

Based on the above overview pertaining to watershed risk, the following criteria were used to assign a ***high***, ***moderate***, or ***low*** rating to each road or road segment:

**High** = the road represents a significant threat to watershed integrity by having high impacts to stream function and/or its beneficial uses OR the road represents a moderate threat to watershed integrity by having moderate impacts to stream function or its beneficial uses, and aquatic TES species are present.

**Moderate** = the road represents a moderate threat to watershed integrity by having moderate impacts to stream function or its beneficial uses, and aquatic TES species are absent OR

The road represents a low threat to watershed integrity by having no significant impact to stream function or its beneficial uses, and aquatic TES species are present.

**Low** = the road represents little or no threat to watershed integrity by having no significant effects on stream function or its beneficial uses, and aquatic TES species are absent.

**Table 9. Value and Risk Ratings from the Forest-scale Roads Analysis for Roads in West Fork Rock Creek**

| Route # | Length (miles) | Res Mgt Value | Pvt Access Value | Recr Use Value | Wildlife/ Plant Risk | Wtrshd Risk | Heri-tage Risk | Remarks |
|---|---|---|---|---|---|---|---|---|
| 200 | 5.5 | H | H | M | M | H | L | WCT barrier |
| 1559 | 2.26 | H | H | M | M | H | L | WCT barrier |
| 5027 | 1.00 | H | M | M | M | M | L | |
| | 5.49 | H | M | M | M | L | L | |
| | 3.41 | H | M | M | H | L | L | |
| 5028 | 2.8 | H | H | M | M | M | L | WCT present |
| 5060 | 2.0 | H | M | M | M | H | L | -WCT barrier, last ½ mile mtnc level 2 |
| | 5.3 | H | M | M | M | M | L | -2 barriers |
| 5070 | 7.53 | H | L | H | M | H | H | |
| | 3.07 | H | L | M | M | H | L | |
| 5071 | 1.25 | H | L | H | M | M | L | Bull trout present |
| | 5.57 | H | L | H | M | H | L | Bull trout barriers |

A number of major roads in the West Fork Rock Creek have *HIGH* watershed risk ratings. Because these roads all have moderate or high value for other resource uses as well, decommissioning or closing these roads to mitigate impacts is not a

likely option. Where risk is associated with barriers to fish movement (culverts) or road maintenance, recommendations to mitigate impacts will be made in this assessment.

Site specific road analysis for the maintenance level 1 and 2 roads and level 3, 4, & 5 local roads not included in the Forest-scale roads analysis will be done for the West Fork Rock Creek at a later date. Although this watershed assessment identifies opportunities to decommission or close local system roads and/or unauthorized roads, roads analysis or travel analysis and subsequent NEPA analysis must be completed before any such recommendations can be implemented.

### *Road Density Concerns for other Resources*

Road densities for the watershed are variable; from 0.6 miles/sq. mile in the upper portion of the watershed to 1.8 miles/sq. mile in the lower portion. See **Map 17**. The density of roads on sensitive soil types is also high, primarily in the lower subwatershed. Twenty percent (20%) of the length of perennial streams in the entire watershed have a road within 300 feet of the channel. Excluding the Skalkaho Highway, most roads were constructed in conjunction with timber harvest activities.

**Table 10. Road Density for the West Fork of Rock Creek**

| 6HUC # | Area (miles$^2$) | Miles of Road | Road Density | Miles of Road W/in 300' of a stream | % of stream miles w/in 300' of a road | # Inventoried Culverts |
|---|---|---|---|---|---|---|
| Bowles (01) | 20.3 | 11.6 | 0.6 mi/mi$^2$ | 6.2 | 9.6% | 11 |
| Sand Basin (02) | 18.6 | 20.0 | 1.0 mi/mi$^2$ | 7.3 | 19.5% | 5 |
| North Fork (03) | 18.8 | 17.9 | 1.0 mi/mi$^2$ | 9.1 | 28.2% | 7 |
| West Fork (04) | 35.6 | 64.6 | 1.8 mi/mi$^2$ | 14.8 | 23.0% | 15 |

Road densities of greater than 1 mile/mile$^2$ have been shown to reduce habitat security and increase mortality for a range of mammals, including elk, bears,

wolverines, and lynx (Lyon 1983; Hornocker and Hash 1981; Britell, et al. 1989). Secure areas for elk and grizzly bears are directly impacted by motorized vehicle disturbance. Both species will avoid vehicles, thereby reducing habitat otherwise available to them. Secure areas for these species can also provide relatively secure movement areas for other ungulates and forest carnivores such as Canada lynx. Secure areas for elk and grizzly bears can also provide core areas, linkage, and connectivity across forest landscapes. Without telemetry showing precise movement patterns, we cannot identify specific crossings for large ungulates or forest carnivores.

## 4.5 Livestock Grazing

This watershed contains three entire livestock grazing allotments (Sand Basin , West Fork Buttes, and Beaver Creek), one special use pasture, inclusions of two additional allotments (Ross Fork and Stony Creek), and grazing on private and State lands in the lower subwatershed, see **Map 18 –** Grazing Allotments and Pastures. Most of the capacity in Sand Basin, Beaver Creek and the special use pasture occurs in riparian areas and much of it on easily eroded soil types. The Sand Basin allotment contains 3,684 acres of riparian habitat, the Ross Fork allotment 161 acres, Beaver Creek 1,174 acres and the West Fork Buttes allotment has 639 acres of riparian habitat. Livestock grazing has had localized, adverse affects on riparian vegetation and streambank/channel stability in the watershed.

Public lands within the West Fork Rock Creek Watershed are an important source of annual forage for four permittees in four grazing allotments. See **Map 18** - Grazing Allotments and Pastures. **Table 11** shows the allotments, permitted use, animal months, and the identified grazing systems.

**Table 11. Allotment Permitted Use and Grazing System**

| Allotment Name | Livestock | | Period of Use | | Animal Months | Grazing System |
|---|---|---|---|---|---|---|
| | Number | Kind | From | To | | |
| Beaver Creek | 50 | cattle | 07/01 | 09/30 | 151 | 2 pasture deferred rotation |
| *Ross Fork | 251 | cattle | 06/21 | 09/30 | 842 | 2 pasture deferred rotation |
| Sand Basin | 200 | cattle | 07/01 | 09/15 | 572 | 4 pasture rotation |
| *West Fork Buttes | 150 | cattle | 06/16 | 10/15 | 602 | 5 pasture modified rest rotation |

* Portions of these allotments are outside the analysis area.

### *Allotment Status and General Range Conditions*

Beaver Creek Allotment

The Beaver Creek Allotment is approximately 5,720 acres and contains the East and West pastures. See **Map 18** - Grazing Allotments and Pastures. The allotment is known for its excellent moose habitat. The dominate vegetative overstory on the Beaver Creek Allotment is lodgepole pine (*Pinus contorta*) and douglas-fir (*Pseudotsuga menziesii*) with small patches of subalpine fir (*Abies lasiocarpa*) in the wetter sites. Pinegrass (*Calamagrostis rubescens*) dominates the understory followed by dwarf huckleberry (*Vaccinium caespitosum*) and beargrass (*Xerophyllum tenax*). The wet meadows are composed of various willow species, carex species and tufted hairgrass (*Deschampsia caespitosa*).

The history of grazing the Beaver Creek Allotment has varied greatly. Focusing in the late 1970's and early 1980's, the allotment was grazed with 100 cattle from 08/01-08/31. Production/Utilization studies were conducted on the allotment in 1981, 1982, and 1984 to determine the livestock grazing capacity of the allotment. The data showed that the estimated capacity was 255 animal months. Therefore, in 1986 the permitted use was increased to 200 animal months with a specified use of 100 cattle from 08/01-09/30. The Allotment Management Plan was finalized in 1986. In 1999 the grazing permit for the allotment was acquired by Gorham Properties and

the permit was modified to the existing number and use periods identified in **Table 12**.

**Table 12. Beaver Creek Deferred Rotation System**

| | | |
|---|---|---|
| Year 1 | East | 07/01-08/15 |
| | West | 08/16-09/30 |
| Year 2 | West | 07/01-08/15 |
| | East | 08/16-09/30 |

The Beaver Creek Allotment contains two designated monitoring areas (DMA). See **Map 20** - Designated Monitoring Areas. One is in the West Pasture and the other in the East Pasture. This allotment has not received much attention the last few years because it has been identified as a low priority bull trout allotment. What little monitoring has been done shows that the allotment has been meeting grazing standards.

Ross Fork

The Ross Fork Allotment is approximately 30,565 acres and includes Zekes Meadows, Moose Meadows, Stephens Reservoir, and Helm Creek pastures. Only about 2,969 acres of the Ross Fork Allotment are included in the West Fork Rock Creek 5$^{th}$ Hydrologic Unit. This area lies in the Stephens Reservoir Pasture. See **Map 18** - Grazing Allotments and Pastures. Management direction for the Ross Fork Allotment is derived from the 1999 Biological Opinion (BO). See **Map 19** - Grazing Allotments Effected by the 1999 Biological Opinion. This BO was prepared for the ongoing allotments in the Upper Clark Fork River, Rock Creek, and Middle Clark Fork River section 7 subbasin on the Columbia River population segment of bull trout.

The vegetation makeup of this area is very similar to the Beaver Creek Allotment. The dominate vegetative overstory is lodgepole pine (*Pinus contorta*) and douglas-fir

(*Pseudotsuga menziesii*) with small patches of subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) in the wetter sites. The understory is composed of Pinegrass (*Calamagrostis rubescens*), beargrass (*Xerophyllum tenax*), and dwarf huckleberry (*Vaccinium caespitosum*). On the north end of the Stephens Reservoir Pasture, lie small parks containing mountain big sagebrush (*Artemesia tridentata vaseyana*), Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and rough fescue (*Festuca campestris*). The wet meadows are composed of various willow species, carex species and tufted hairgrass (*Deschampsia caespitosa*).

The Ross Fork Allotment has been grazed by livestock since the early 1900's. Records indicate that the allotment was grazed by up to 300 head of cattle until 1957, when the present number was established. In addition, the season of use has been shortened by 15 days and now ends on September 30th. The Allotment Management Plan was finalized in 1999 and is used as a management tool. The allotment has two permittees which graze separate herds on the allotment. Each herd uses a two pasture deferred rotation grazing system. The current permittees on the allotment are Steve and Mary Christensen and Tri Sky LLC. The Christensen's have a Term Grazing Permit for 32 cattle and a Private Land Grazing Permit for 22 cattle. The Tri Sky LLC has a Term Grazing Permit for 172 cattle and a Private Land Grazing Permit for 25 cattle. The Stephens Reservoir Pasture is grazed by cattle belonging to Tri Sky LLC and has the following grazing rotation:

**Table 13. Stephens Reservoir Pasture Rotation**

| | | |
|---|---|---|
| Year 1 | Stephens Reservoir | 06/16-08/15 |
| Year 2 | Stephens Reservoir | 08/16-09/30 |

The Ross Fork Allotment contains one monitoring area. See **Map 20** - Designated Monitoring Areas within the West Fork Rock Creek 5th Hydrologic Unit. It is located north of Stephens Reservoir and rarely gets monitored. Allotment inspection notes

indicate that the Stephens Reservoir Pasture gets moderately utilized every year with some years exceeding grazing standards. This portion of the allotment is a low priority because of bull trout concerns in the Zekes Meadows, Moose Meadows, and Helm Creek pastures.

Sand Basin

The Sand Basin Allotment is approximately 35,321 acres and includes North Fork, Log Flume, Sand Basin, and West Fork pastures. See **Map 18** - Grazing Allotments and Pastures. Management direction for the Sand Basin Allotment is derived from the 1999 Biological Opinion (BO) (See **Map 19** - Grazing Allotments Effected by the 1999 Biological Opinion). This BO was prepared for the ongoing allotments as noted under the description of the Ross Fork Allotment.

The Sand Basin Allotment lies in the headwaters of the West Fork Rock Creek. The area is characterized by dense stands of timber interspersed with wet meadows. The dominant vegetative overstory is lodgepole pine (*Pinus contorta*) and subalpine fir (*Abies lasiocarpa*) with patches of Engelmann spruce (*Picea engelmannii*) surrounding the meadows. Small amounts of douglas-fir (*Pseudotsuga menziesii*) occur at low elevations and whitebark pine trees (*Pinus albicaulis*) colonize the highest elevation. The understory is composed of pinegrass (*Calamagrostis rubescens*), beargrass (*Xerophyllum tenax*) and dwarf huckleberry (*Vaccinium caespitosum*). The wet meadows are composed of various carex species, tufted hairgrass (*Deschampsia caespitosa*) and redtop (*Agrostis alba*).

The history of grazing in the Sand Basin area varies from cattle grazing in the early 1920's to sheep grazing in 1942. In 1953 the Johnson Brothers acquired the grazing permit and began grazing 200 cattle in Sand Basin. The current permittee is Johnson Tuning Fork Ranch. His Term Grazing Permit is for 200 cattle from 07/01-09/15.

Season long grazing and poor distribution has made grazing this allotment very difficult. Transitory range and riparian areas are the only sources of livestock forage with riparian grazing providing most of the forage. The Allotment Management Plan was completed in 1980, it is out of date and not used as a management tool. Due to the difficult grazing conditions on the allotment, a simple rotation grazing system has been developed. Although this system is not ideal for the permittee or plant health, it has allowed for the riparian guidelines to be met and is maintaining current riparian conditions. The system is used yearly as follows:

**Table 14. Sand Basin Allotment Rotation System**

| | | |
|---|---|---|
| Log Flume | 200 cattle | 07/01-07/15 |
| West Fork | 100 cattle | 07/15-08/31 |
| Sand Basin | 100 cattle | 07/15-08/31 |
| Log Flume | 200 cattle | 09/01-09/15 |
| North Fork | 200 cattle | * |

*North Fork Pasture is used when the grazing system is accelerated because the forage has been exhausted or standards were approached in the other pastures prior to 09/15. Average use in this pasture is approximately 100-200 cattle from 08/10-09/15 for 146 Animal Unit Months.

The Sand Basin Allotment contains three monitoring areas (See **Map 20** - Designated Monitoring Areas) within the West Fork Rock Creek 5$^{th}$ Hydrologic Unit. These DMAs are monitored weekly while the cows are within the effected pastures because of strict guidelines stated in the 1999 Biological Opinion and subsequent Incidental Take Statements. In 1999, 2000, and 2001 the grazing standards outlined in the Deerlodge Riparian Mitigation Measures were exceeded in the Sand Basin Allotment. As a result of this, formal consultation with the Fish and Wildlife Service under the Endangered Species Act was reinitiated prior to the 2002 grazing season. Following reinitiating, the Forest Service and the permittee worked diligently to improve livestock distribution in order to lessen the impacts of grazing on riparian

areas. Due to these efforts, the Deerlodge Riparian Mitigation Measures have been met since 2002.

West Fork Buttes

The West Fork Buttes Allotment is approximately 14,617 acres and includes the Sapphire, Montgomery Gulch, Moffet, Browns Gulch, and Emerine pastures. Only about 10,525 acres of the West Fork Buttes Allotment are included in the West Fork Rock Creek 5th Hydrologic Unit (See **Map 18** - Grazing Allotments and Pastures). This allotment is the driest and lowest elevation allotment in the West Fork Rock Creek 5th HU. It is known for its important big game winter range. This allotment also contains the highest concentration of noxious weeds in the West Fork Rock Creek 5th Hydrologic Unit.

The vegetation of the West Fork Buttes Allotment varies from arid bluebunch wheatgrass (*Pseudoroegneria spicata*) sites to moist lodgepole pine (*Pinus contorta*) sites. The dominate tree species are douglas-fir (*Pseudotsuga menziesii*) on the mid-elevation sites, followed by lodgepole pine (*Pinus contorta*) on the moist, upper elevation sites. The understory of the timbered transitory range consists of pinegrass (*Calamagrostis rubescens*) and Sandberg bluegrass (*Poa secunda*). This allotment contains several acres of mountain big sagebrush (*Artemesia tridentata vaseyana*) which is very rare on the Pintler District. The sagebrush parks are composed of several grasses including Sandberg bluegrass (*Poa secunda*), Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and rough fescue (*Festuca campestris*). There are also several grassland parks that consist of Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and rough fescue (*Festuca campestris*).

The history of use in this allotment is simple compared to the other allotments in the West Fork Rock Creek 5th Hydrologic Unit. The numbers of cattle and the season of use has remained relatively the same from 1968 to 2001. In 2001 the Forest Service conveyed approximately 2,379 acres of National Forest land into private ownership within the West Fork Buttes Allotment. As a result of this Gallatin Land Exchange, the grazing permit was reduced from 200 cattle to 150 cattle with the season of use remaining the same. The current permittees are Tom and Barbara Sanders. Their Term Grazing Permit is for 150 cattle from 06/16-10/15. The Allotment Management Plan was completed in 2005 and is used as a management tool. The grazing rotation is as follows:

**Table 15. West Fork Buttes Allotment Grazing Rotation Schedule**

| | | | |
|---|---|---|---|
| Year 1 | Emerine | 150 cattle | 06/16-07/31 |
| | Moffet | 150 cattle | 08/01-08/15 |
| | Montgomery Gulch | 75 cattle | 08/16-10/15 |
| | Browns Gulch | 75 cattle | 08/16-10/15 |
| | Sapphire | | REST |
| Year 2 | Sapphire | 150 cattle | 06/16-07/15 |
| | Emerine | 150 cattle | 07/16-08/31 |
| | Montgomery Gulch | 75 cattle | 09/01-10/15 |
| | Browns Gulch | 75 cattle | 09/01-10/15 |
| | Moffet | | REST |
| Year 3 | Montgomery Gulch | 75 cattle | 06/16-09/15 |
| | Browns Gulch | 75 cattle | 06/16-09/15 |
| | Emerine | 150 cattle | 09/16-10/15 |
| | Moffet | | REST |
| | Sapphire | | REST |
| Year 4 | Sapphire | 150 cattle | 06/16-07/31 |
| | Moffet | 150 cattle | 07/31-08/31 |
| | Montgomery Gulch | 75 cattle | 09/01-10/15 |
| | Browns Gulch | 75 cattle | 09/01-10/15 |
| | Emerine | | REST |

The West Fork Buttes Allotment does not contain any DMAs within the West Fork Rock Creek 5th Hydrologic Unit. The main focuses on this allotment are improving the native grasslands, maintaining low utilization levels on big game winter range,

eliminating noxious weeds and maintaining the integrity of the West Fork Buttes Botanical Area.

## 4.6 Natural and Prescribed Fire

Fire is an integral part of the Rock Creek landscape and its exclusion has influenced the vegetation communities within the watershed. Although other agents of change such as insects, disease and timber harvest also affect vegetation, fire is generally the most influential.

Vegetation is generally described in terms of plant communities or habitat types. Habitat types are associated with fire groups and are described in "Fire Ecology of Western Montana Habitat Types" (Fischer and Bradley 1987). A fire group is comprised of several different habitat types and is based on the response of tree species to fire and the roles these tree species take during successional stages. The frequency and severity of a fire that typically occurred are key factors in identifying each fire group. There are nine fire groups for the timber habitat types that occur in the analysis area. These fire groups and number of acres in each HUC are listed in **Table 16** and depicted on **Map 21 –** Fire Groups by Severity Class. The relative area of each fire group in the Rock Creek watersheds is located in **Table 17**. Fire Group Zero is a collection of miscellaneous and special habitats, such as grasslands category includes grass habitat types that occur at the lower and middle elevations, rocky areas and other sites such as wet meadows and aspen groves.

**Table 16. Fire Group Acres for Each Watershed**

| | Acres Per Hydrological Unit (NF Lands) | | | | |
|---|---|---|---|---|---|
| Fire Group | Lower Rock | Upper Rock | Sand Basin | West Fork | Total |
| Zero - Grassland | 5097 | 862 | 627 | 314 | 6900 |
| One | | | | | |
| Four | 969 | 5 | | | 974 |

| | | | | | |
|---|---|---|---|---|---|
| Five | 254 | 3 | | | 257 |
| Six | 306 | 367 | 112 | 98 | 883 |
| Seven | 8970 | 7207 | 6516 | 9509 | 32202 |
| Eight | | | | | |
| Nine | 6732 | 2229 | 4365 | 2787 | 16113 |
| Ten | 407 | 1370 | 278 | 323 | 2378 |
| **TOTAL** | **22735** | **12043** | **11899** | **13030** | **59707** |

**Table 17. Percentage of Fire Group Acres for Each Watershed**

| | Relative Acreages Per Ecological Landscape Unit (NF Lands) (%) | | | |
|---|---|---|---|---|
| Fire Group | Lower Rock | Upper Rock | Sand Basin | West Fork |
| Zero - Grassland | 22 | 7 | 5 | 2 |
| One | | | | |
| Four | 4 | | | |
| Five | 1 | | | |
| Six | 1 | 3 | 1 | 1 |
| Seven | 39 | 60 | 55 | 73 |
| Eight | | | | |
| Nine | 30 | 19 | 37 | 2 |
| Ten | 2 | 11 | 2 | 2 |

Prior to the 1860's, fires in the area were more frequent and generally less severe than they are today. For example, lightning caused fires were common in the mountains and burned freely whereas the American Indian used fire extensively in the valleys. Historically, low elevation fires in drier areas, such as those characterized by Fire Groups Zero - Grasslands, Four, Five and Six, occurred frequently, resulting in low intensity fires that cleared lower ground fuels without affecting the trees in the overstory. Crane and Fischer (1986) estimate mean fire-free intervals (MFI) for Fire Groups Four, Five and Six at 5 and 45 years. Fire Group Seven which becomes more

prevalent at the middle elevations is estimated to have a longer MFI that ranges from 40 to 100 years. A mix of understory burns and stand replacement fire occurred in this Fire Group. Fire Groups Eight, Nine and Ten are generally found at the higher elevations and experienced understory and stand replacement fires at intervals of 100-300 years. Severe fires usually occurred during periods of drought. Fires in these groups left a mosaic a different age classes across the landscape.

The settlement patterns influence fire intervals in all Fire Groups. For example, in the lower elevations fire scars depict a mean fire interval of 20 years until the early 1900s. However at that time, a combination of events occurred that interrupted the regular occurrence of fire in this system. Permanent settlements, intense grazing, and initiation of successful fire suppression programs interacted to extend the average time between large fires in the area. Effects to the vegetation communities include denser stands of trees, multistory stands and areas converted from grasslands to forests. Over time, these patterns resulted in fuel conditions increasing to the hazardous levels they are today. The increase in fuel loading has resulted in larger fires that occur more frequently when compared to historic conditions.

Historically, frequent understory fires maintained stands of Douglas-fir and ponderosa pine (Fire Groups Four, Five, and Six) in a park like condition. Fire suppression has extended the time between fires and has allowed the establishment of a shade tolerant understory. The understory vegetation has increased the amount of vegetation, dead debris and ladder fuels. Therefore, a fire start will more likely result in a stand replacement fire rather than the historically occurring under-burn.

The lack of fire in the middle and upper elevations (Fire Groups Seven, Eight, Nine and Ten) has resulted in a change from a mosaic of different age classes and tree densities to a more continuous cover of mature trees. A fire start under the current

conditions would more likely result in a stand replacement fire with less of a mosaic in the burn area.

The type of fire occurring in Fire Group Zero – Grasslands has also changed. The fuel in these areas has changed from what was mostly grass to a mix of grass, seedlings, saplings and intermediate size trees. As the grasslands become more forested, fires that occur are burning more intensely.

**Table 18. Comparison of Acres Associated with Fire Severity for Each Watershed**

| Fire Group | Low Severity *5-45yrs | Mixed Severity *40-100 | High Severity *100-300 |
|---|---|---|---|
| Lower Rock CR | 6626 | 8970 | 7139 |
| Upper Rock CR | 1237 | 7207 | 3599 |
| Sand Basin | 729 | 6516 | 4643 |
| West Fork | 412 | 9509 | 3110 |
| Total | 9004 | 32202 | 18491 |

* Fire return intervals

Since the 1998 Subbasin Review three major wildfire events took place in the upper reaches of Rock Creek affecting a total of **8,784 acres** or **15%** of the West Fork Rock Creek watershed. The Middle Fork complex burned during the summer of 2000, the Signal Rock fire during 2005 and the Sand Basin fire during 2006.

The Middle Fork fire complex is comprised of several fires which either joined together, or were in close enough proximity to be considered as one unit or complex. This fire burned 3,538 acres in the West Fork Rock Creek watershed. Ground truthing burn intensities interpreted from satellite imagery and/or aerial surveillance was limited to a few areas easily accessed by road. Because a majority of lands burned within “large blocks of undeveloped lands” (Management Areas A4 and A5, Deerlodge Forest Plan), there were few values-at-risk identified during the BAER

watershed analysis process. No watershed restoration activities were proposed under BAER.

The Signal Rock fire burned 4,546 acres on lands managed similar to those within Middle Fork complex (MA4 and MA5). BAER activities were limited to preventative best management practices on Trail 313 to minimize erosion and reduce future maintenance needs that could be exacerbated due to the fire.

The Sand Basin fire burned 700 acres in the summer of 2006 while this watershed assessment was being completed.

The following Table combines the acres of moderate and high burn intensity acres for the Middle Fork Complex and Signal Rock fires. (Fire intensity mapping was not completed for the Sand Basin fire because it was less than 1,000 acres.) Moderate and high burn intensity exhibits the greatest likelihood that watershed function might be affected in terms of increases in water and/or sediment yield. The ultimate effect would be reflected through changes in stream channel stability, function, and aquatic habitat. Low intensity acres are not included because effects to watershed function, if present, would be limited and/or short-term. See **Map 22 –** Past Wildfires for the location of the fires, mapped by burn intensity. The watershed acres affected in column four of this table are not equivalent to the 6$^{th}$ code hydrologic units described previously in this analysis. The 6$^{th}$ code HUC's were delineated into smaller drainages, roughly equivalent to 7$^{th}$ code HUC's, that represent a better scale for describing watershed the impacts of wildfire on peak flows.

**Table 19. Acres Burned in Specific Drainages by Burn Intensity in 2000 and 2005**

| Drainages | Moderate | High | Total | Watershed Acres Affected | % Burned in Moderate or High Intensity |
|---|---|---|---|---|---|
| Bowles Creek | 549 | 153 | 702 | 5311 | 13 |
| Sand Basin Creek | 1027 | 464 | 1491 | 3945 | 38 |

| | | | | | |
|---|---|---|---|---|---|
| North Fork WF Rock Creek | 136 | 213 | 349 | 7171 | 5 |
| Upper WF Rock Creek | 1781 | 1330 | 3111 | 7770 | 40 |
| TOTAL | 3493 | 2160 | 5653 | 24,197 | 23 |

The accepted threshold for appreciable changes in stream flow regimes is a 25-30% or greater loss of overstory vegetation. While 40% of the Upper West Fork drainage experienced a combination of moderate to high burn intensities, it has likely surpassed this threshold. The resulting changes in snow pack accumulation and melt rates can increase peak flows, leading to a possible decrease in channel stability, thus higher in-channel erosion and subsequent deposition. The end result could be a loss of stream channel function and suitable habitat for fish and other aquatic organisms. A decrease in transpiration often results in measurable increases in base flows during the growing season.

Stream flow regime changes may be detected both during high flow and low flow periods. No pre-fire stream flow data exists for any stream within these smaller analysis watersheds. Post-fire increases in peak flow can be approximated through comparisons of stream flow measurements of the Upper West Fork and an unburned watershed with similar characteristics, expressing flow on a per unit area basis. Stream survey sites including channel morphology measurements exist on North Fork West Fork, Sand Basin and West Fork Rock Creek. These sites can serve to monitor long-term changes in channel dimensions, pattern and profile.

On May 22, 2006, flow measurements were made on WF Rock (above Bowles), Bowles, and Sand Basin Creeks. The peak flow from snowmelt appeared to have occurred about 3 days earlier (referenced the USGS MF Rock Creek gage). The WF Rock appeared to have peaked about 1 foot higher than when measured. Tributaries of WF Rock near the Signal Rock Trail head deposited sand on their floodplains, something not seen at other locations. These sediments are likely the result of

increased post-fire surface erosion. Table 20 summarizes the flow measurements, expressing them in per unit area basis (CFS/square mile).

**Table 20. Flow Measurements Per Unit Area**

| Stream | Date | Flow | Flow per unit area |
|---|---|---|---|
| WF Rock | 5/22/2006 | 89.3 CFS | 7.4 CFS/Square Mile |
| Bowles | 5/22/2006 | 81.6 CFS | 9.8 CFS/Square Mile |
| Sand Basin | 5/22/2006 | 46.8 CFS | 4.1 CFS/Square Mile |

Because WF Rock had 40% of its watershed burned and Bowles only had 13% burned, one might expect a greater per unit area discharge associated with WF Rock than Bowles. The results indicate that this was not the case on this particular day. Sand Basin had about 20% of its watershed burned, but the flow per unit area is the lowest of the three streams. Other variables may have a more dominant role in determining peak flows than just vegetation removal as a result of fire. These might include aspect, overall watershed gradient, and soil/wetland storage of runoff. For example, Bowles Creek appears to have more southern aspect slopes than the other two watersheds, allowing a faster rate of snowmelt. Another possibility is that during the actual peak which occurred about three days earlier, the flow per unit area rates compared somewhat differently than on the date the measurements were made. A more definitive conclusion would require additional monitoring.

### *Fire Management*

Prescribed fire is an important part of managing our landscapes. **Table 16** illustrates the acres associated with each 6$^{th}$ code HUC by fire group and highlights which subwatersheds one might concentrate management based on acres that are outside the natural range of variability. As stated earlier, frequent low severity fires maintained grasslands and stands of Douglas-fir and ponderosa pine (Fire Groups Zero, Four, Five, and Six) in a park like condition. As the grasslands become more forested in the absence of fire, fires that occur are burning more intensely.

The West Fork Buttes burn project treated approximately 1500 acres of the low severity acres in the Lower Rock Creek 6th code HUC and the Signal Rock Fire burned approximately 4000 acres of the mixed/high severity acres in the sand basin 6th code HUC, these activities would need to be taken into account when prioritizing future projects.

***Air Quality***

The air quality within the analysis area is generally considered to be good. The area meets all federal and state ambient air quality standards. The point sources of air pollution would be found in Philipsburg, Hamilton, and Darby, Montana. Particulates are the primary pollutant emitted from these sources.

Air quality in the analysis area may also be impacted by particulates generated by local nonpoint sources of air pollution. These nonpoint sources include prescribed fire and wildfire, wood burning stoves, road construction, vehicle traffic on unpaved roads, and agricultural activities.

Dust resulting from vehicle traffic use within the analysis area is of short duration and is considered to have minor impacts on air quality. In addition to commercial use of the roads for logging and mining, there are several roads that provide access to private land, recreation, sight-seeing, wood gathering, hunting and fishing.

All open burning in Montana is regulated by the restrictions and standards of the Air Quality Bureau of Montana. Major prescribed burners, of which the Forest Service is one, have formed the Montana/Northern Idaho Airshed Group. This group has established an air quality monitoring unit that provides daily air quality predictions and restrictions to its members from September 1 to November 30. The major goal of the group is to "minimize or prevent the accumulation of smoke in Montana when prescribed burning is necessary." The practices established by the Airshed Group are

considered Best Available Control Technology by the State Air Quality Bureau. The Forest Service is permitted to burn based on compliance with burning restrictions set by the Airshed Group.

The Prevention of Significant Deterioration portions of the 1977 Clean Air Act Amendments (P.L. 95-95) classified areas of the country as Class I, II, or III. Class I areas area are all international parks, all national wilderness, memorial parks greater than 5,000 acres, and all national parks greater than 6,000 acres that existed on August 7, 1977. (P.L. 95-95, Part C, Sec.162(a)). All other areas (unless designated at a later time) are Class II.

The land within the analysis area is designated as a Class II. This classification allows a specific maximum increase of sulfur dioxide, nitrogen dioxide, and particulates above base line concentration. Currently, there are no emissions sources within or near the area that count against this increment.

The nearest Class I area, located approximately 14 miles southeast of the analysis area, is the Anaconda Pintlar Wilderness. The most stringent Federal and State air quality regulations apply to this and other Class I areas. Federal land managers are also required to protect the Air Quality Related Values (AQRVs) of these Class I lands. AQRVs have been developed for the Anaconda Pintlar Wilderness.

# Section 5 Findings

This section provides recommendations based on the analyses presented above. This section also identifies monitoring activities that are needed in association with these recommendations. Data gaps and limitations of the analysis are also documented. Recommendations are designed to identify management activities that are responsive to needs identified in this watershed scale analysis. Specifically, management actions which address differences between current and reference conditions, where there is a need to provide restoration, maintenance, or protection of ecosystem components in order to sustain the health and productivity of natural resources. Any actions or projects, which utilize the information presented in this Watershed Analysis, will be analyzed on a site-specific basis by an interdisciplinary team and will include both public involvement and disclosure of decision as prescribed by the National Environmental Policy Act (NEPA).

## 5.1 Watershed Condition

***Risk from recent wildfire:*** The effects of wildfire on watersheds and associated beneficial uses are usually considered part of the range of natural variability. However, if the effects combine with additional anthropogenic effects, the results may be unacceptable. For example, the fire may have removed pre-existing barriers to livestock movement which may cause a re-distribution of animals into sensitive stream reaches not previously accessed by cattle. Or cattle use on existing primary range may need to be postponed until plant recovery occurs. Another example might be increased large woody debris loading which could interfere with culvert efficiency.

**Recommendation:**

- Monitor changes in stream channel function associated with increased sediment loads and/or increased peak flows. Follow up monitoring will determine any detrimental impacts by considering the effects of fire combined

with any existing land management effects like roads, bridges/culverts, livestock management, and timber harvest.

***Risk from grazing:*** Stream reaches affected by livestock include portions of the lower West Fork, Sand Basin, and upper West Fork Rock Creeks.

**Recommendation**:

- Improve livestock management and take actions which help in meeting livestock management goals and/or directly improve stream habitat conditions. An example would be to create barriers to cattle and introduce large woody debris by dropping trees along streambank. Other actions may include building and maintaining riparian exclosure fences. Fences that exclude large ungulate wildlife may be necessary in many cases.

***Risk from roads and trails:*** Road densities are high, primarily in the lower subwatershed (1.8 miles/sq. mi. in West Fork). Twenty percent (by length) of perennial streams in the watershed have a road within 300 feet of the channel. In situations where the road is close to the stream channel, sediment delivery can be higher than natural conditions, changing stream channel characteristics and reducing the quality of aquatic habitat.

**Recommendation:**

- Conduct transportation analysis to identify roads and trails to be removed from the system.
- Decommission unneeded roads and trails identified in the transportation analysis.
- Reduce the watershed effects of roads and trails by implementing proper Best Management Practices.

## 5.2 Aquatic Species and Habitat

Overall, the status of native fish and other aquatic organisms inhabiting this watershed is threatened by the existing condition of instream and riparian habitat parameters. The likely invasion of non-native fish into the watershed heightens the risks facing the native aquatic organism community from the existing condition of riparian and instream habitats. The aquatic community in the West Fork watershed is **functioning at risk** due to the factors listed.

**Recommendation**:

- Restore riparian shrub communities through willow planting and removal of conifer species.
- Replace road/stream crossing structures that inhibit or prevent aquatic organism movement.
- Cooperate with the State of Montana to limit invasion of non-native fish species into the watershed.
- Reduce impacts from cattle to the streambanks so native grasses and forbs can replace non-native species.

## 5.3 Vegetation

***Risk from absence of fire as a natural disturbance:*** The West Fork Watershed is closer to normal fire disturbance processes than other portions of the Rock Creek Subbasin, at least in terms of mid and high elevation forested stands. Almost 17% of the watershed has been affected to some degree by wildfire since 2000. At this point in time, there could be a greater risk to watershed function by disturbing more of the forested stands with fire than leaving them.

Fuel model analysis shows a disproportionate amount of low severity acres in Lower Rock Creek. On closer inspection, many of these acres are actually rock and scree.

West Fork Buttes is the exception, where the large acres of grassland type are changing to a mix of grass, seedlings, sapling and intermediate size trees. As these grasslands become more forested, fires that occur are burning more intensely. More intense fires may change soil stability and productivity and species composition.

**Recommendations:**

- Monitor the West Fork Buttes prescribed burn of 2000. Determine if we met our objectives on all of the acres proposed. Retreat areas not meeting objectives as allowed by the NEPA process (section 18.1).
- Identify opportunities t treat vegetation for multiple resource objectives.
- Wait 7-10 years before treating forested stands.

***Risk to sensitive species:*** Maintaining the West Fork Buttes SIA is a high priority because the SIA provides a niche to be occupied by rare species that are adapted to the specialized local conditions of the site. In addition, maintaining the sensitive species is important because they are a part of biodiversity and support a healthy environment by providing soil stability, clean air and water. Noxious weeds are a serious threat to the viability of sensitive species and the integrity of their habitat.

**Recommendation:**

- Conduct additional monitoring of sensitive plant populations.
- Aggressively treat noxious weeds in the SIA.

***Risk to riparian vegetation:*** The woody shrub component of riparian zones in the West Fork Rock Creek watershed is severely diminished. Loss of riparian shrubs affects a multitude of species from fish to amphibians, from small birds to large ungulates. Without riparian shrubs and deciduous trees like aspen, important species for rebuilding riparian health (beaver) cannot return.

**Recommendation:**

- Reduce encroachment of conifer species in selected riparian zones.
- Plant willows to restore the shrub community in areas where willows are no longer present.
- Reduce impacts from cattle to the streambanks so native grasses and forbs can replace non-native species.

***Risk from noxious weeds:*** Invasive weeds compete with native grasses and forbs. They are impairing forage productivity on winter range and on the West Fork Buttes Botanical Special Interest Area (SIA) where Payson's bladderpod and Missoula phlox (sensitive species) grow. Noxious weeds provide little if any forage value to wintering deer, elk, and bighorn sheep. They compete with and displace sensitive native plants. It is possible for large scale noxious weed infestations to affect the number and health of wintering ungulates. It is also possible for these infestations to replace sensitive plant species and bluegrass on the SIA.

**Recommendation:**

- Aggressively treat weeds in the following areas:
    - along the Skalkaho Highway, in meadows, and open parks.
    - on the West Fork Buttes Botanical Special Interest Area
    - on big game winter range
- Prevent Black henbane, Houndstongue, Oxeye daisy and Tall buttercup from getting well established.

## 5.4 Wildlife Species and Habitat

There are no eminent threats to individual wildlife species but there are concerns about changes in habitat conditions. The most evident changes in habitat from historic reference conditions include loss of riparian habitat, reduction in security

habitat due to roads, reduced coverage and condition of aspen stands, and reduction of quality in winter range for ungulates.

***Risk from loss of riparian habitat:*** Impacts from domestic livestock and wild ungulates have contributed to the current degraded condition of some riparian areas on WFRC. Woody species in particular, such as aspen and willow are in poor condition throughout WFRC and are essential for beaver re-establishment and existence. Riparian woody species also provide structure for nesting, forage, and cover for many avian species. Conifers have encroached on riparian habitats, replacing the important woody shrub component.

**Recommendation:**

- Restrict ungulate impacts in degraded riparian areas to promote riparian recovery and improve wildlife habitat for sensitive species such as the Harlequin duck and the Northern bog lemming in addition to several Deerlodge riparian MIS (Warbling Vireo, Willow Flycatcher, Blue-Winged Teal, Northern Water Shrew, Western Jumping Mouse, Belted Kingfisher).

- Remove conifer that have encroached into the riparian zone to reduce competition for light, nutrients, and water on the already stressed shade intolerant riparian species.

***Risk from noxious weeds:*** Invasive weeds negatively affect forage production in winter range.

**Recommendation**

- Conduct annual inspections along roads, fire lines, campgrounds, and other sites with high potential for infestation.

- Continue efforts to eradicate or reduce weed invasions (particularly noxious weeds) to benefit wildlife habitat.

***Risk of reduced levels of secure wildlife habitat:*** High road density levels in the area are a threat to the security and increase the mortality for a number of wildlife species. The reduction of motorized use increases wildlife secure areas, decreases noxious weed transport, decreases vulnerability to road mortality, hunting and trapping, and improves habitat conditions for riparian species. In addition, Montana Fish Wildlife and Parks identifies illegal ORV use as an issue for both the Sapphire and Rock Creek EMUs.

**Recommendation:**

- Decommission or obliterate roads, barricade access points, and incorporate seasonal access restrictions in the WFRC to enhance wildlife security, in particular in the heavily roaded West Fork Rock watershed 6$^{th}$ field HUC.
- Enforce and monitor closure techniques (gates, barricades etc.) to limit unauthorized use of roads during critical wildlife periods.

***Risk of losing aspen clones:*** In the WFRC area, most aspen stands are mature (80 to 100 years old) with little to no variation in age classes in the understory. Aspen sucker growth is severely suppressed, as evidenced by the amount of shading by conifers within and adjacent to stands as well as the heavy clubbing caused by browsing wild ungulates and domestic livestock. Moose feeding on aspen bark as a last resort (considered a “starvation” response) when preferred browse (willows and dogwood) is lacking (Franzmann and Schwartz 1997) has resulted in heavy widespread bark damage.

**Recommendation:**

- Thus far, direct treatment for aspen on the BDNF has had mixed results (Rohrbacher pers. comm.) and therefore no specific management recommendations are given at this time. However, treatments for encroaching conifers, and mitigation for heavily browsed areas will most likely benefit the remaining aspen clones.

***Risk of reduced quality of winter range forage:*** Fire suppression in WFRC has allowed significant conifer encroachment in winter range. Although conifer encroachment may provide additional cover for native ungulates, it also reduces forage production which is more limiting to winter survival in this area.

**Recommendation:**

- Monitor past conifer removal projects on winter range in comparison to untreated winter range to determine if additional mitigation is needed.

## 5.5 Recreation

***Risk:*** Recreational use in this watershed is on the increase as are most areas within the western United States. Dispersed camping is concentrating in riparian zones, exacerbating impacts to streambanks and riparian vegetation. Shorelines of lakes in the area are showing disturbance due to the increase in use. Bare soil, more fire rings, less firewood, damaged trees and scattered garbage are all obvious signs of increased use.

**Recommendation:**

- Harden dispersed sites by the placement of aggregate surfacing on both the sites and access roads

- Construct at least one hardened parking pad per site so as to reduce further disturbance to the surrounding vegetation
- Evaluate dispersed camping sites immediately adjacent to the streamside and construct alternative sites away from the creek
- Evaluate opportunities to replace Crystal Creek Campground at a different location.

***Risk:*** This watershed continues to show increased use, especially along the Skalkaho Highway, a main tourist highway during the summer. There are presently no public developed camping opportunities or toilet facilities offered within the entire watershed along this highway.

**Recommendation:**

- Construct a developed campground in the watershed within the vicinity of either Sand Basin Creek or West Fork of Rock Creek but far enough away to not be an impact to the creeks. This would help to reduce some of the disturbance associated with camping at dispersed sites.
- Explore partnership opportunities at Skalkaho Pass for development of a day-use site.

***Risk:*** Trails within the watershed, for the most part, have not changed significantly through the years in spite of increased recreational use. This is because the increased use has been mostly non-motorized. However, if motorized use were to increase there would be a downward trend in trail condition due to the existing trail locations and the increased tread disturbance from motorized use.

**Recommendation:**

- Conduct travel management planning to determine which trails within the watershed should be closed to wheeled motorized use.
- Evaluate the opportunity for alternative motorized opportunities in the watershed to offset closures required for watershed protection.

## 5.6 Livestock Grazing

***Risk:*** In order for livestock grazing to be compatible with habitat needs of bull trout and westslope cutthroat trout in West Fork Rock Creek streams, good livestock management is imperative. Continue to provide sustainable grazing opportunities for domestic livestock from lands suitable for forage production. Use of forage by livestock will maintain or enhance the desired structure and diversity of plant communities on grasslands, shrub lands, and forests. Use must be managed to protect or restore riparian function. Currently, livestock browsing in riparian shrub communities is contributing to suppression of willows and trampling of streambanks. Noxious weeds are competing with forage production and native plant communities.

**Recommendation:**

- See watershed and aquatic habitat sections for riparian area recommendations.
- Aggressively treat weeds in Beaver Creek and West Fork Buttes allotments.
- Update the Sand Basin Allotment Management Plan with a new prescribed grazing rotation schedule which has the flexibility to give the allotment periodic rest from livestock grazing.

## 5.7 Transportation

***Risk:*** Drainage-related maintenance items are an important consideration for improving water quality.

**Recommendation:**

- The total deferred maintenance cost on 17.4 miles of system roads in the West Fork totals $28,542 for only the drainage-related work items (i.e., culvert/arch repair or replacement). The average cost is $1,638/mile. These drainage-related costs equate to 85% of the total deferred maintenance costs for these roads.
- Complete site specific road analysis for the maintenance level 1 and 2 roads and level 3, 4, & 5 local roads not included in the Forest-scale roads analysis.

## 5.8 Summary of Recommendations

Several common themes developed between the individual resource recommendations. The following concerns and associated recommendations will benefit numerous resources:

1. **Restore willows and reduce conifer encroachment in riparian zones** to address decline of riparian shrub health.

2. **Treat noxious weed, particularly in the West Fork Buttes SIA and adjacent winter range** to address the increase in noxious weeds and the subsequent decline in habitat quality.

3. **Reduce high road densities in the North Fork by decommissioning non-essential roads and reduce watershed impacts from the remaining roads by implementing best management practices** to reduce instream sedimentation and address wildlife security issues

## Section 6 Integrated Priorities

**Table 21. Integrated Project Priorities for 2006 in the West Fork Rock Creek**

| 2006 Priority | West Fork Rock Ck. Project Description | Likely Level of NEPA Required | Treated Acres | Resource Objectives | Estimated Cost | Accomplishment in FY06 |
|---|---|---|---|---|---|---|
| 1 | Treat conifer encroachment in the Sand Basin area | CE | 50 | Address willow decline caused by overtopping by conifers-restrict livestock movement | $10,000 | Scoping for CE initiated |
| 2 | Implement Road BMPs in Sand Basin | No NEPA required | 52 | Reduce sediment contributions from roads by improving road drainage | $ 8,000 | YES - See Map 24 |
| 3 | Weed treatment around Mud Lake | Forest-wide Weed EIS | 5 | Reduce the spread of noxious weed infestation in wetlands | $ 500 | YES - 278 acres Plus SIA See Map 23 |
| 4 | Weed treatment in the SIA | Forest-wide Weed EIS | 10 | Protect sensitive plant species, and improve wildlife habitat | $ 2,000 | YES – See MAP 23 |
| 5 | Treat ox-eye daisy in meadows | Forest-wide Weed EIS | 50 | Reduce risk of noxious weed infestation in meadows | $ 8,000 | YES – See MAP 23 |
| 6 | Replace culverts in Beaver Creek on Roads 5060 and 200 | No NEPA required | 2 | Facilitate fish passage/reduce risk of road failure and resulting sedimentation | $15,000 | Replaced culvert on Road 5060 |
| | | | **169** | | **$43,500** | |

**Table 22. Integrated Out-year Priorities for the West Fork Rock Creek**

| Priority | West Fork Rock Ck. Project Description | Likely Level of NEPA Required | Treated Acres | Resource Objectives | Estimated Cost |
|---|---|---|---|---|---|
| 1 | Willow reestablishment in Sand Basin area | CE | 12 | Improve water quality and habitat diversity in riparian areas currently devoid of willows. | $5,000 |
| 2 | Harden dispersed recreation sites and access spurs along Skalkaho Highway, Sand Basin Road and West Fork Road | OK | 5 | Reduce the impact of recreational use within riparian areas. | $10,000 |
| 3 | Replace 4.5 foot culvert on RD 200 | OK | 5 | Facilitate fish passage/reduce risk of road failure and resulting sedimentation | $8,000 |
| 4 | Weed treatment in the West Fork Buttes winter range | OK | 2400 | Protect sensitive plant species, and improve wildlife habitat | $24,000 |
| 5 | Decommission roads in Beaver Creek | RA/EA | 20 | Eliminate chronic sources of sediment and reduce overall road maintenance costs. | $15,000 |
| 6 | Implement BMPs on Bowles Creek Trail | CE | 9 | Reduce the long term effect of trails on riparian areas and water quality. | $5,000 |
| | Burn willows and aspen in Beaver Creek | CE/EA | 40 | Increase the sprouting potential of decadent stands of willow and aspen. | $5,000 |
| 7 | Extend existing wildlife riparian exclosures | CE | 12 | Protect newly established stands of willow from the pressures of browsing. | $10,000 |
| 8 | Burn low severity areas (West Fork Buttes) | CE/18.1 | 2400 | Return low severity areas to natural range of variability. | $10,000 |
| 9 | Treat conifer encroachment in parks | CE/18.1 | 4000 | Release suppressed willow communities from conifer encroachment. | $20,000 |
| 10 | Treat conifer encroachment in the winter range | CE/18.1 | 2400 | Release suppressed willow communities from conifer encroachment. | $15,000 |
| 11 | Control recreation access and cattle use in Cow Camp Meadows | ? | 10 | Eliminate the effects of recreation and livestock grazing on riparian areas. | $10,000 |

**Monitoring Needs**:

1. Establish a permanent monitoring point based on the Region 1 Aquatic Integrated Ecosystem Unit protocol for the West Fork Rock Creek watershed at the response reach in lower West Fork. Remeasure every 5 years to show trend. Incorporate this data into the Region One AEUI data base.

2. Monitor long-term post-fire changes in channel dimensions, pattern and profile through follow-up at stream survey sites where channel morphology measurements already exist on North Fork West Fork, Sand Basin and West Fork Rock Creek.

## Section 7 Participants

**District Ranger**: Charlene Bucha Gentry

**Team Leader:** Bryce Bohn, Hydrologist

**Core Team Members:**

Steve Gerdes, Fisheries Biologist

Dave Salo, Hydrologist

Joe Brabender, Fire and Fuels Specialist

Cameron Rasor, Range Management Specialist

Amie Shovlain, Wildlife Biologist

Bill Sprauer, Recreation Specialist

Dan Svoboda, Soils Specialist

Craig Simonsen, Transportation Planner

Jim McNamara, GIS Specialist

Janet Bean-Dochnahl, Writer Editor

## Section 8 References

**Aderhold, M.W**., 1972. The history, winter range, and current status of the Rock Creek, Montana bighorn sheep herd. Masters thesis. University of Montana, Missoula, MT 104 p.

**Barrett, S.W.** 1997.Historical fire regimes on the Beaverhead-Deerlodge National Forest, Montana – Beaverhead Portion. Unpublished Final Report. 37 p.

**Baty, G. R**. 1995. Resource partitioning and browse use by sympatric elk, mule deer and White-tailed deer on a winter range in western Montana. M.S. thesis. University of Montana, Missoula, MT. 227 p.

**Britell, J.D., R.J. Toelker, S.J. Sweeney, and G.M. Koehler**. 1989. Native cats of Washington. Washington Department of Wildlife. Olympia, WA.

**Bush, R. and A. Leach.** 2003. Detailed estimates of old growth and large snags on the Beaverhead-Deerlodge National Forest. Unpublished Report. 5 pp.

**Canfield, J. E., L. J. Lyon, J. M. Hillis, and M. J. Thompson**. 1999. Ungulates. Pages 6.1-6.25 *in* Joslin, G. and H. Youmans (coordinators). Effects of recreation on Rocky Mountain wildlife: a review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 p.

**Christensen, A.G., L.J. Lyon, and J.W. Unsworth.** 1993. Elk management in the Northern Region: consideration in forest plan updates or revisions. Gen. Tech. Rep. INT-303. Ogden, UT. USDA, For. Ser., Intermountain Res. Sta. 10 p.

**Clough, L.T. 2000.** Nesting habitat selection and productivity of northern goshawks in west-central Montana. M.S. Thesis, Univ. of Montana, Missoula, MT. 87 p.

**Coffin, K.W.** 1994. Population characteristics and winter habitat selection by pine marten in southwestern Montana. M.S. Thesis, Montana State Univ., Bozeman. 94 p.

**Cole, D. N. and P. B. Landres**. 1995. Indirect effects of recreation on wildlife. Pages 183-202 in Knight, R. L. and K. J. Gutzwiller (eds.). Wildlife and recreationists: coexistence through management and research. Island Press, Washington, D.C. 372 p.

**Conway, C.J., and T.E. Martin.** 1993**.** Habitat suitability for Williamson's sapsuckers in mixed-conifer forests. J. Wildl. Manage. 57(2):322-328.

**Crane, M.F., and W.C. Fischer.** 1986. Fire ecology of the forest habitat types of central Idaho. Gen. Tech. Rep. INT-218. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

**DeByle, N.V.** 1985**.** Wildlife. pp 135-152 In: DeByle, N.V. and R.P. Winohur, editors. Aspen: ecology and management in the western United States. USDA Forest Service, Gen. Tech. Rep. RM-119, 283 p. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, CO.

**Dobkin, D.S.** 1994. Conservation and management of Neotropical Migrant Landbirds in the northern Rockies and Great Plains. Univ. of Idaho Press, Moscow, ID. 220 p.

**Douglass, K. S., J. Hamann, and G. Joslin**.1999. Vegetation, soils, and water. Pages 9.1-9.12 *In* Joslin, G. and H. Youmans (coordinators). Effects of recreation on Rocky Mountain wildlife: a review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 p.

**Faaborg, J., M. Brittingham, T. Donovan, J. Blake.** 1993. Habitat fragmentation in the temperate zone: a perspective for managers. pp 331-338. in : Finch, D.M.; Stangel, P.W. eds. Status and management of neotropical birds; 1992. Sept. 21-25; Estes Park, CO. Gen. TEch. Rep. RM-229, Fort Collins, CO: USDA, For. Serv., Rocky Mountain For. and Range Exp. Sta. 422 p.

**Fager, C.W.** 1991. Southwest Montana pine marten research project, Progress Report. Montana Dept. of Fish, Wildlife and Parks, Helena. 73 p.

**Fischer, W.C., and A.R Bradley**. 1987. Fire ecology of western Montana forest habitat types. Gen. Tech. Rep. INT223. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

**Foreman, R.T., A.P. Clevenger, C.D. Cutshall, V.H. Dale, L. Fahrig, R. France, C.R. Goldman, K. Hernue, J.A. Jones, F.L. Swanson, T. Turrentine, T.C. Winter**. 2003. Road ecology: science and solutions. Island Press, Washington, D.C. 424 p.

**Ford, G.L., C.L. Maynard, J.A. Nesser, and D.S. Page-Dumroese [eds.].** 1997. Landtype Associations of the Northern Region: A first approximation. U.S. Dept. of Agriculture, Forest Service, Region 1. Missoula, MT. Unpublished.

**Franzmann, A.W., and C.C. Schwartz [eds.].** 1997. Ecology and management of North American Moose: a Wildlife Management Institute book. Smithsonian Institution Press, Washington, D.C. 640 p.

**Gaines, W.L., Singleton, P.H., Ross, R.C**. 2003. Assessing the Cumulative Effects of Linear Recreation Routes on Wildlife Habitats on the Okanogan and Wenatchee National Forests. Gen. Tech. Rep. PNW-GTR-586. Portland, OR: U.S. Department of Agriculture, Forest Service, Northwest Research Station. 79 p.

**Gerdes, S.**, Fisheries Biologist, Pintler Ranger District

**Green. P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann.** 1992. Old-growth forest types of the Northern Region. R1 SES 4/92. Missoula, MT.

**Habeck, J.R.** 1990. Old-growth ponderosa pine-western larch forest in western Montana: ecology and management. The Northwest Environmental Journal. 6:271-292. Univ. of Washington. Seattle, WA.

**Hamann. B., H. Johnston, J. Gobielle, M. Hillis, S. Johnson, L. Kelly, P. McClelland.** 1999. Birds, Chapter 3, *in* effects of recreation on rocky mountain wildlife: a review for Montana, Montana Committee on Effects of Recreation on Wildlife, Montana Chapter of the Wildlife Society, 307 p.

**Harris, M.A**. 1982. Habitat use among woodpeckers in forest burns. M.S. Thesis, University of Montana, Missoula, MT.

**Harris, R.B.** 1999. Abundance and characteristics of snags in western Montana forests. Gen. Tech. Rep. RMRS-GTR-31. Ogden, UT: USDA. Forest Service, Rocky Mountain Research Station. 19 p.

**Hejl, S.J., R.L. Hutto, C.R. Preston; and D.M. Finch.** 1995. Effects of silvicultural treatments in the Rocky Mountains. pp 220-244: in : T.E. Martin and D.M. Finch, eds. Ecology and management of neotropical migrant birds - A synthesis and review of critical issues. Oxford Univ. Press. New York.

**Hillis, M., L. Clough, and D. Lockman**. 2003. U.S. Forest Service Region One northern goshawk assessment. Unpubl. Report, USDA Forest Service, Missoula, MT. 13 p.

**Hodge, R.J.** 1997. Where have all the succors gone: a comparison of aspen treatments on the Deerlodge National Forest. M.S. Thesis, University of Montana, Missoula, MT. 92 p.

**Hornocker, M.G. and H.S. Hash.** 1981. Ecology of the wolverine in northwestern Montana. Canadian Journal of Zoology. 59:1286-1301.

**Houston, D.B.,** 1973. Wildfires in Northern Yellowstone National Park. Ecology 54, 1111±1117.

**Hutto, R.L.** 1995. Distribution and habitat relationships. USFS Northern Region Songbird Monitoring Program, contract # R1-95-05. Second Report. Univ. of Montana, Missoula. 120 p.

**Hutto, R.L., and J.S. Young.** 1999. Habitat relationships of landbirds in the Northern Region, USDA Forest Service. Rocky Mountain Range and Experiment Station, Ogden, UT. Gen. Tech. Rep. RMRS-GTR-32. 72 p.

**Hutto, R.L., S.J. Hejl, C.R. Preston, and D.M. Finch.** 1993. Effects of silvicultural treatments on forest birds in the Rocky Mountains: Implications and management recommendations. pp 386-391. in :Finch, D.M.; Stangel, P.W. eds. Status and management of neotropical birds; 1992. Sept. 21-25; Estes Park, CO. Gen. Tech. Rep. RM-229, Fort Collins, CO: USDA, For. Serv., Rocky Mountain For. and Range Exp. Sta. 422 p.

**Interagency Conservation Strategy Team.** 2003. Final Conservation Strategy for the grizzly bear in the Yellowstone ecosystem. Missoula, MT 86 p.

**Joslin, G.** 1985. Montana mountain goat investigations, Rocky Mountain front. Montana Department of Fish, Wildlife, and Parks, Helena. 212 p.

**Joslin, G, and H. Youmans**. 1999. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307 p.

**Kirkley, J.** 1998 through 2004. A study of northern goshawk *Accipiter gentilis* in southwestern Montana: Summary of findings for 1998. Unpubl. Reps. Dept. of Environmental Sciences, Univ. of Montana-Western, Dillon, MT.

**Knight, R. L. and K. J. Gutzwiller** (eds.). 1995. Wildlife and recreationists: coexistence through management and research. Island Press, Washington, D.C. 372 p.

**Kujala, S.R.** Fisheries Biologist, Beaverhead-Deerlodge National Forest. Supervisor's Office. Dillon, MT.

**Lavelle, D. A**. 1986. Use and preference of spotted knapweed (*Centaurea maculosa*) by elk (*Cervus* elaphus) and mule deer (*Odocoileus hemionus*) on two winter ranges in western Montana. M.S. PhD. Thesis, University of Montana, Missoula, MT.

**Li, P., and T.E. Martin.** 1991**.** Nest-site selection and nesting success of cavity-nesting birds in high elevation forest drainages. The Auk 108:405-418.

**Losensky, J. B.** 1987. An evaluation of noxious weeds on the Lolo, Bitterroot and Flathead Forests. Unpublished Report. On file at Lolo National Forest, Missoula, MT

**Lyon, L.J.** 1983. Road density models describing habitat effectiveness for elk. Journal of Forestry 81: 592-595, 613.

**Mariani, J**. 1997. Wildlife section *In* Final Environmental Impact Statement, Beaverhead Forest Plan Riparian Amendment. U.S. Forest Service, Dillon, MT.

**Maxell, B. and G. Hokit**. 1999. Amphibians and reptiles. Pages 2.1-2.29 in Joslin, G. and H. Youmans (coordinators). Effects of recreation on Rocky Mountain wildlife: a review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307pp.

**Montana Fish, Wildlife, and Parks**. 2003. Hunting statistics across license years, summary report: trapping, hunting, and harvest. http://fwp.mt.gov/hunting/planahunt/

**Montana Fish, Wildlife, and Parks**. 2002, 2003, 2004. Furbearer survey across license years, summary report: trapping, hunting, and harvest, license years 1996 to 2000, and 2002.

**Montana Fish, Wildlife and Parks**. 2004. Draft State Elk Management Plan for Montana, Wildlife Division, Helena, MT.

**Montana Natural Heritage Program**. 2006. Montana animal field guide (for Montana federally listed threatened, endangered, Forest Service Region One Sensitive, and Deerlodge National Forest management indicator species). http://nhp.nris.state.mt.us/animalguide/speciesDetail.

**Montana Natural Heritage Program**. 2005. Bat Surveys on USFS Northern Region Lands in Montana: 2005. http://nhp.nris.mt.gov/reports.asp

**Quigley, T.M.; Haynes, R.W.; and Graham, R.T. (eds.).** 1996. Integrated scientific assessment for ecosystem management in the Interior Columbia Basin and portions of the Klamath and Great Basins. PNW-GTR-382. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

**Rohrbacher, A.W.** Wildlife Program Manager, Beaverhead-Deerlodge National Forest. Supervisor's Office. Dillon, MT.

**Samson. F.B.** 2006. A conservation assessment of the northern goshawk, black-backed woodpecker, flammulated owl, and pileated woodpecker in the Northern Region, Unpublished Report on File, USDA For. Serv., Missoula, MT.

**Skovlin, J. M., P. Zager, and B. K.** Johnson. 2002. Elk habitat selection and evaluation. Pages 531-555 in Toweill, D. E. and J. W. Thomas (eds.). North American elk: ecology and management. Smithsonian Institute Press, Washington, D.C. 962 p.

**Squires, J.R., T.J. Ulizio, L.F. Ruggiero. 2003.** Carnivore studies in the Pioneer Mountains and adjacent mountain ranges of southwest Montana. Unpubl. Final Report. USDA Forest Service, Rocky Mountain Research Station. Missoula, MT. 61 p.

**Swanson, C**. 2004. PowerPoint presentation summarizing national and Region One Forest Service recreation survey statistical data (collected 2001-2003). Prepared by Cindy Swanson, Regional Wildlife Director, Region One, USDA Forest Service, Missoula, MT.

**USFS.** 1987. Forest Plan Deerlodge National Forest, Butte, MT.

**USFS**. 1989. Settlement Agreement to 1987 Forest Plan. Deerlodge National Forest. Dillon, MT.

**USFS.** 1997**.** Final Environmental Impact Statement, Beaverhead Forest Plan Riparian Amendment. USDA Forest Service, Dillon, MT.

**USFS.** 2000. Northern Region snag management protocol. USDA, Forest Service, Missoula, MT. Unpubl. 34 p.

**USFS**. 2001. The distribution, life history, and recovery objectives for region one terrestrial wildlife species. July, 2001. USDA For. Serv., Region One, Missoula, MT.

**USFS.** 2005. Draft Revised Land and Resource Management Plan, Draft Environmental Impact Statement. USDA Forest Service, Beaverhead-Deerlodge National Forest, Dillon, MT.

**USFS**, 2005. Insect and Disease Report - Region 1, Forest Health Protection Missoula Field Office, Missoula, MT.

**USFS.** 2006. Sensitive Species List, USDA Forest Service, Region One, WWFRP, Missoula, MT.

**USFWS**. 2006. List of proposed, threatened, and endangered species present by county on the Beaverhead-Deerlodge National Forest. http://montanafieldoffice.fws.gov/

**Vinkey R.,** Wildlife Biologist, Montana Department of Fish, Wildlife, and Parks, Philipsburg, MT

**White, C.A., Olmsted, C.E., Kay, C.E**., 1998. Aspen, elk, and fire in the Rocky Mountain national parks of North America. Wildlife Society Bulletin 26, 449±462.

**Wright, M. and R.E.F. Escano.** 1986. Montana bald eagle nesting habitat macro-habitat description. USDA, Forest Service, Missoula, MT. 24 p.

**Wright, P.L**. 1996. Status of rare birds in Montana, with comments on known hybrids. Northwestern Naturalist 77:57-85.

(left blank)

## Section 9 Maps

Map 1. Location of West Fork Rock Creek
Map 2. Ownership
Map 3. 6th code Hydrologic Unit Code watershed boundaries
Map 4. Deerlodge Forest Plan Management Areas
Map 5. Recreation sites and trails
Map 6. Landtype Associations
Map 7. Stream Function
Map 8. Fish distribution by species
Map 9. Vegetation cover types
Map 10. Insect Infestations
Map 11. Past Timber Harvest
Map 12. West Fork Buttes Special Interest Are
Map 13. Noxious Weed Locations
Map 14. Secure Wildlife Blocks
Map 15. Winter Range
Map 16. Road Locations
Map 17. Road Density
Map 18. Grazing Allotments and Pastures
Map 19. Grazing Allotments Affected by the 1999 USFWS Biological Opinion on Bull Trout
Map 20. Designated Monitoring Areas
Map 21. Fire Groups by Severity Class
Map 22. Middle Fork and Signal Rock Fires by intensity
Map 23. Weed Spraying Accomplishments 2006
Map 24. Road BMP Accomplishments 2006