



Montana Department of Natural Resources and Conservation
Bozeman Unit
2273 Boot Hill Court, Suite 110
Bozeman, MT 59715

Bear Canyon Timber Sale Project

Draft Environmental Assessment

June, 2011





June 22, 2011

Dear Reader:

The enclosed Draft Environmental Assessment (EA) is now available for your review and comment. This document will be available for a 30-day public review period ending **July 22nd, 2011**. You may also access the Draft EA on our project website at <http://dnrc.mt.gov/trust/timber/information/BearCanyon/default.asp>.

Starting in May of 2010, the Montana Department of Natural Resources and Conservation (DNRC), Bozeman Unit, has been working on developing the proposed Bear Canyon Timber Sale Project. Through a series of public participation events and extensive field work, DNRC has developed one Action Alternative designed to meet the proposed project objectives and to address, to the extent practicable, issues and concerns raised by the public.

We invite you to:

- Review and submit comments on this Draft EA by **July 22nd, 2011**. Please submit comments:
 - **By Mail:**
Craig Campbell, Bozeman Unit Manager
ATTN: Bear Canyon
Timber Sale Project
Montana DNRC
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 - **By Email:** DNRCBearCanyon@mt.gov
 - **Online:**
<http://dnrc.mt.gov/trust/timber/information/BearCanyon/Comments.asp>.
- Attend an open-house public meeting on **July 13th** from **6:30 to 9:00 pm**. A brief presentation will be given at **7:00 pm**.

Thank you for your interest in this project and the management of state trust lands. We hope to hear from you!

Sincerely,

Craig Campbell

Bozeman Unit Manager

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Acronyms and Abbreviations

- 124 Permit** — Stream Preservation Act Permit
- 318 Authorization** — Short-Term Exemption from Montana’s Water Quality Standards
- ADS** — Aerial Detection Survey
- ARM** — Administrative Rules of Montana
- AUM**—Animal Unit Month
- BA** — basal area
- BBER** — Bureau of Business and Economic Research
- BCL** — Bear Canyon Landscape
- BMP** —Best Management Practices for Forestry
- BMW** — Gallatin National Forest Bozeman Municipal Watershed Project
- CMP** — corrugated metal pipe
- CWD**— Coarse Woody Debris
- DBH** — diameter at breast height
- DEQ** —Montana Department of Environmental Quality
- DF** —Douglas-fir
- DFC** —Desired Future Conditions
- DNRC** — Montana Department of Natural Resources and Conservation
- EA** —Environmental Assessment
- ECA**—Equivalent Clearcut Area
- EIS** —Environmental Impact Statement
- FI** — Forest Improvement
- Forest Management Rules** – Administrative Rules for Forest Management 36.11.401 through 456
- FWD** — Fine Woody Debris
- FWP** — Montana Department of Fish, Wildlife, and Parks
- GAP** — Gap Analysis Program
- GYE** — Greater Yellowstone Ecosystem
- HCP** — Habitat Conservation Plan
- ID Team** —Interdisciplinary Team
- Land Board** —Board of Land Commissioners
- LWD**—Large Woody Debris
- MCA** —Montana Code Annotated
- MEPA** —Montana Environmental Policy Act
- MMbf** —million board feet
- MNHP** —Montana Natural Heritage Program

Project Area – Bear Canyon Project Area

Proposed Action – Bear Canyon Timber Sale Project Action Alternative

RL – Random Lengths

RMZ – Riparian Management Zone

SFLMP – State Forest Land Management Plan

SLI – Stand Level Inventory

SMZ – Streamside Management Zone

SPTH – Site Potential Tree Height

SYC – Sustainable Yield Calculation

TLMD – Trust Land Management Division

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

WWPA – Western Wood Products Association

Chapter 1 Purpose and Need for Action

Purpose and Need

The Montana Department of Natural Resources and Conservation (DNRC) Trust Land Management Division (TLMD), Bozeman Unit is proposing the Bear Canyon Timber Sale Project (proposed action). The proposed action would be located approximately 5 miles southeast of Bozeman, Montana on state trust lands in the Bear Canyon area (see *Figure 1-1*). Harvest activities would take place on approximately 750[†] acres within Sections 1, 2, 3, and 11, Township 3 South (T3S), Range 6 East (R6E), and Sections 34 and 35 Township 2 South (T2S), Range 6 East (R6E). These sections totaling approximately 3,500[†] acres, along with existing and proposed roads needed to access and support proposed activities on these sections, will herein be referred to as the project area (see *Figure 1-2*).

Much of the Bear Canyon area contains mature Douglas-fir and lodgepole pine forests, many of which are overstocked and exhibit poor growth and vigor. These factors can predispose the forest and broader landscape to catastrophic losses from damaging agents such as insects, disease, and fire. Such losses are currently being seen in the Bear Canyon area, particularly in stands containing lodgepole pine that have elevated levels of tree mortality due to the statewide mountain pine beetle outbreak. Forest management activities would improve growth, vigor, and age class diversity while also providing a measure of protection and decreased risk against catastrophic loss from insects, disease, and fire. Active forest management in the Bear Canyon area would produce revenue for the trust beneficiaries while encouraging the development of sustainable forest conditions consistent with programmatic goals of managing for healthy and biologically diverse forests.

TRUST LAND MANAGEMENT DIVISION MISSION

“Our goal is to manage the State of Montana’s trust land resources to produce revenue for the trust beneficiaries while considering environmental factors and protecting the future income-generating capacity of the land.”

The lands involved in the proposed action are held by the State of Montana for the support of the State Normal School, State Industrial School, and Public Buildings (*Enabling Act of February 22, 1889*). The Board of Land Commissioners (Land Board) and the DNRC are required by law to administer these state trust lands to produce the largest measure of reasonable and legitimate return over the long run for these beneficiary institutions [1972 *Montana Constitution, Article X, Section 11; Montana Code Annotated (MCA) 77-1-202*].

[†] Acreage amounts are approximations. Acreage totals for area of proposed harvest and proposed project area throughout individual analyses may vary 10 to 15 acres from these approximations.

Figure I - 1. Bear Canyon Timber Sale Vicinity Map.

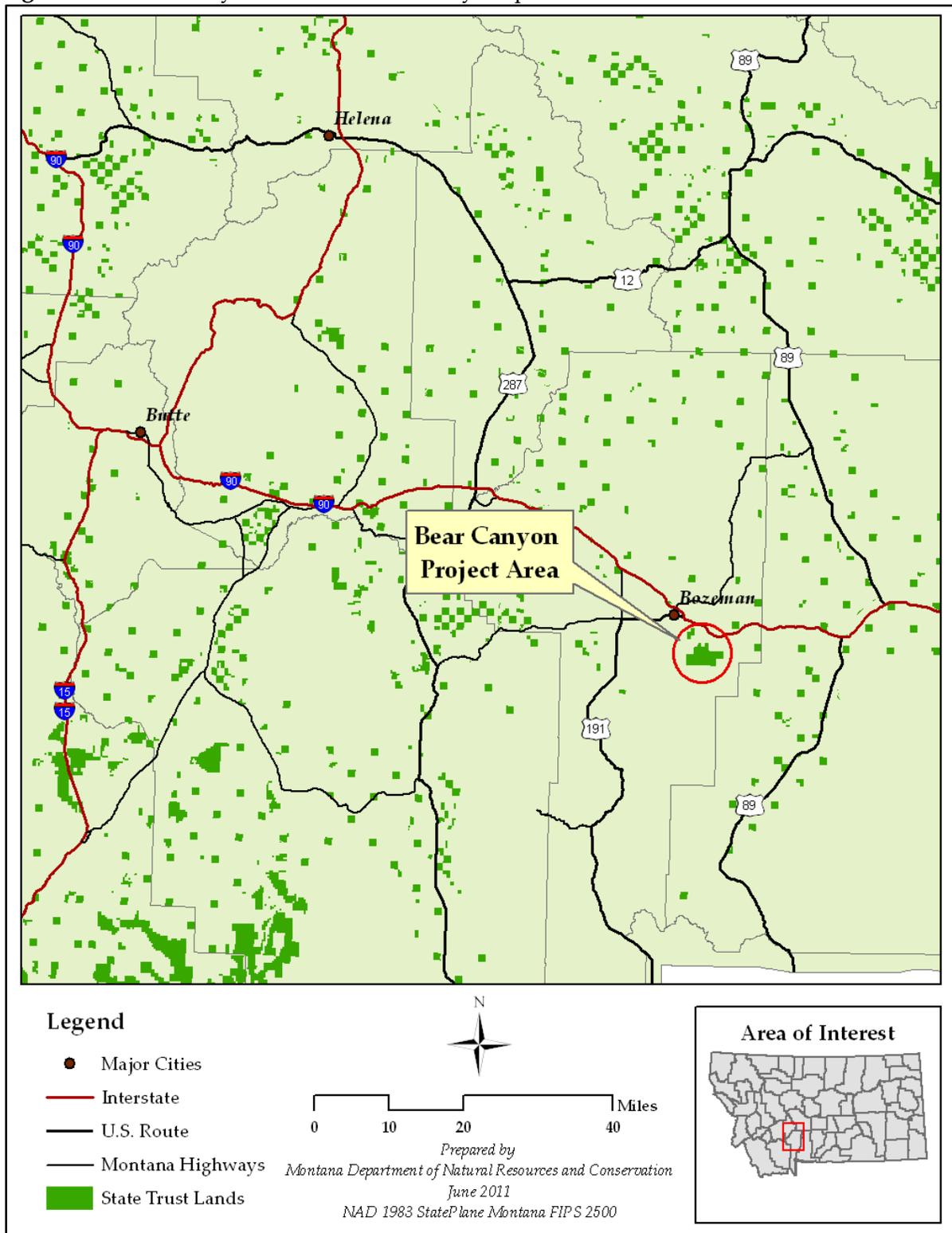
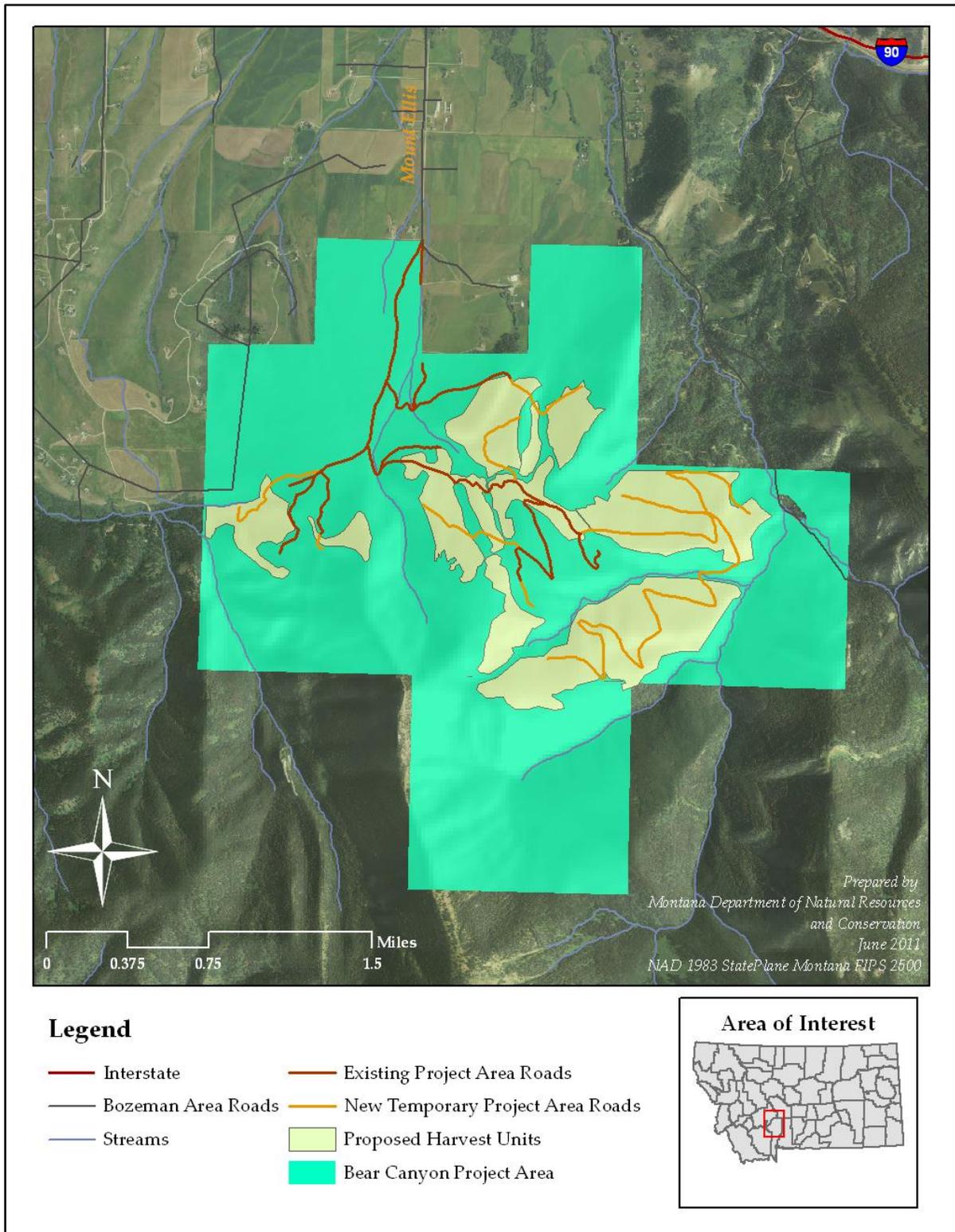


Figure I - 2. Bear Canyon Timber Sale Project Area.



DNRC strives to balance its fiduciary responsibilities with its stewardship responsibilities that are intended to promote biodiversity and subsequently protect the future income-generating capacity of the forest. All forested lands involved in the proposed action would thus be managed in accordance with the DNRC's State Forest Land Management Plan (SFLMP) and Forest Management Rules [*Administrative Rules of Montana (ARM) 36.11.401 through 456*]. DNRC would also comply with applicable state and federal regulations and agreements outlined in *Chapter 1 – Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations* and under similar headings in individual resource sections in *Chapter 3*.

Project Objectives

In order to fulfill its trust mandate and the management philosophy adopted through the SFLMP and Forest Management Rules, DNRC has developed the following project objectives:

- Manage the forest resource to promote improved health, productivity, and diversity.
- Capture the value of dead, dying, and decadent lodgepole pine.
- Generate revenue for the trust beneficiaries.
- Minimize fire and safety risks imposed by current forest conditions.
- Enhance and expand the existing transportation system to provide improved access for long-term future management of the area and fire suppression needs.

Description of Proposed Action

DNRC has developed one Action Alternative to meet the project objectives while considering, to the extent practicable, the various issues and concerns raised by the public. Below is a summary of the proposed project activities that collectively describe the proposed action. For a more detailed description of the Action Alternative and associated mitigations, see *Description of Alternatives* in *Chapter 2 – Alternatives*.

Under the proposed action DNRC generally proposes to:

- harvest an approximate 6 million board feet (MMbf) from approximately 750 acres within the project area using a combination of group selection, selection cutting, and clearcutting silvicultural prescriptions;
- construct 6.9 miles of new road that would be closed with slash and debris;
- reconstruct or maintain 5.5 miles of existing roads to meet Montana Best Management Practices for Forestry (BMPs);
- conduct prescribed burning activities including slash pile and broadcast burning; and
- conduct weed spraying along existing and proposed roads.

Relevant Agreements, Laws, Plans, Permits, Licenses and Other Authorizations

Management activities on the lands within the proposed project area must comply with the following agreements, laws, plans, permits, licenses, and other authorizations. Individual resource analyses in *Chapter 3* may either expand on the following information or include other relevant agreements.

Enabling Act of 1889 and 1972 Montana Constitution

By the Enabling Act approved February 22, 1889, the U.S. Congress granted certain lands to the State of Montana for support of common schools and other public institutions. These lands are held in trust for the specific trust beneficiaries to which they were assigned and ultimately for the people of the State of Montana (*1972 Montana Constitution Article X, Section 11*).

State Forest Land Management Plan

DNRC developed the SFLMP to “provide field personnel with consistent policy, direction, and guidance for the management of state forested lands” (DNRC 1996: Executive Summary). The SFLMP provides the philosophical basis, technical rationale, and direction for DNRC’s forest management program. The SFLMP is premised on the philosophy that the best way to produce long-term income for the trust beneficiaries is to manage intensively for healthy and biologically diverse forests. In the foreseeable future, timber management will continue to be the primary source of revenue and primary tool for achieving biodiversity objectives on DNRC forested state trust lands.

DNRC Forest Management Rules

DNRC Forest Management Rules (*ARM 36.11.401 through 456*) are the specific legal resource management standards and measures under which DNRC implements the SFLMP and subsequently its forest management program. The Forest Management Rules were adopted in March 2003 and provide the legal framework for DNRC project-level decisions and provide field personnel with consistent policy and direction for managing forested state trust lands. Project design considerations and mitigations developed for this project must comply with applicable Forest Management Rules.

Sustainable Yield Calculation

In addition to the SFLMP and Forest Management Rules, DNRC is required to re-calculate the annual sustainable yield for forested trust lands at least every 10 years (*MCA 77-5-221 through 223*). DNRC defines the annual sustainable yield calculation (SYC) as:

“...the quantity of timber that can be harvested from forested State lands each year in accordance with all applicable state and federal laws, including but not limited to the laws pertaining to wildlife, recreation and maintenance of watersheds and in compliance with water quality standards that

protect fisheries and aquatic life and that are adopted under the provisions of Title 75, Chapter 5, taking into account the ability of State forests to generate replacement tree growth (MCA 77-5-221)."

The SYC determines the amount of timber that can be harvested annually on a sustainable basis from state trust lands, given all applicable laws and environmental commitments described in the SFLMP and Forest Management Rules. Important ecological commitments related to biodiversity, forest health, threatened and endangered species, riparian buffers, old growth, and desired species mix and cover types were incorporated into the SYC. After incorporating these commitments into the model, the statewide annual sustainable yield was determined to be 53.2 MMbf of timber. The annual portion of the SYC for the Central Land Office, to which the Bozeman Unit belongs, is 3.7 MMbf.

Montana DNRC Forested State Trust Lands Habitat Conservation Plan

DNRC has been developing a Habitat Conservation Plan (HCP) under Section 10 of the Endangered Species Act (ESA) for several years. If successful, the process will culminate with issuance of an Incidental Take Permit by the U.S. Fish and Wildlife Service (USFWS). The Draft HCP/Environmental Impact Statement (EIS) was distributed for public review in June of 2009. The Final HCP/EIS was distributed for public review in August of 2010. The HCP identifies specific mitigation requirements for managing the habitats of grizzly bear, Canada lynx, and three fish species: bull trout, westslope cutthroat trout, and Columbia redband trout. As part of a phased-in approach to prepare for HCP compliance, DNRC planned this project to be in compliance with the current Forest Management Rules and all applicable conservation commitments contained in the Preferred Alternative in the Final EIS/HCP. Should a different alternative be selected, revisions to the project may be made to comply with the selected alternative.

Montana Environmental Policy Act

The Montana Environmental Policy Act (MEPA: *MCA 75-1-101 through 324*) provides a public process to assure Montana's citizens that a deliberate effort is made to identify impacts before the state government decides to permit or implement an activity that could have significant impacts on the environment.

DNRC's management activities on state trust lands are subject to the planning and environmental assessment requirements of MEPA. The statute requires DNRC and other state agencies to inform the public and other interested parties about proposed projects, the potential environmental impacts associated with proposed projects, and alternative actions that could achieve the proposed project objectives.

DNRC Administrative Rules for MEPA

DNRC Administrative Rules for MEPA (*ARM 36.2.521 through 543*) are specific legal requirements under which DNRC interprets and implements MEPA. DNRC is required to conform to these rules prior to reaching a final decision on a proposed action.

Montana Best Management Practices for Forestry

Montana BMPs consist of forest stewardship practices that reduce forest management impacts to water quality and forest soils. The implementation of BMPs by DNRC is required under *ARM 36.11.422*. Key forestry BMP elements include: streamside management; road design and planning; timber harvesting and site preparation; stream crossing design and installation; winter logging; and hazardous substances storage, handling, and application.

Stream Preservation Act Permit

Montana Department of Fish, Wildlife, and Parks (FWP) has jurisdiction over the management of fisheries and wildlife in the project area. A Stream Preservation Act Permit (124 Permit) is required for activities that may affect the natural shape and form of any stream or its banks or tributaries.

Short-Term Exemption from Montana’s Water Quality Standards

Montana Department of Environmental Quality (DEQ) has jurisdiction over water quality standards within the project area. A Short-Term Exemption from Montana’s Water Quality Standards (318 Authorization) may be required if temporary activities would introduce sediment above natural levels into streams or if FWP deems a permit is necessary after reviewing the mitigation measures in the 124 Permit.

Montana / Idaho Airshed Group

The DNRC is a member of the Montana/Idaho Airshed Group which was formed to minimize or prevent smoke impacts while using fire to accomplish land management objectives and/or fuel hazard reduction (Montana/Idaho Airshed Group 2010). As a member, DNRC must submit a list of planned burns to the Smoke Monitoring Unit describing the type of burn to be conducted, the size of the burn in acres, the estimated fuel loading in tons/acre, and the location and elevation of each burn site. The Smoke Monitoring Unit provides timely restriction messages by airshed. DNRC is required to abide by those restrictions and burn only when conditions are conducive to good smoke dispersion.

Air Quality Major Open Burning Permit

The DEQ issues permits to entities that are classified as major open burners (*ARM 17.8.610*). DNRC is permitted to conduct prescribed wildland open burning activities in Montana that are either deliberately or naturally ignited. Planned prescribed burn descriptions must be submitted to DEQ and the Smoke Monitoring Unit of the Montana/Idaho Airshed Group. All burns must be conducted in accordance with the major open burning permit.

Gallatin County Weed District Board

According to *MCA 7-22-2151*, DNRC is required to enter into written cooperative agreements with district weed boards throughout the state. These agreements must specify

mutual responsibilities for noxious weed management on state-owned lands. DNRC Bozeman Unit has entered into a written cooperative agreement with the Gallatin County Weed District Board and reports to the Board on a bi-annual basis.

Scope of Project and Public Involvement

This section describes the process by which the Interdisciplinary Team (ID Team) involved the public in identifying issues pertinent to the development of the proposed action and to the associated analyses within this Draft Environmental Assessment (EA). Two formal scoping periods; website and newsletter updates; correspondence with many interested individuals; one DNRC-hosted public meeting; and attendance at community group meetings account for the processes by which the DNRC invited interested individuals, agencies, and organizations to identify issues and concerns associated with this proposed project.

Scoping Periods

The ID Team held two formal scoping periods. In May 2010, DNRC initially solicited public comment through the distribution of the Proposed Bear Canyon Timber Sale Scoping Notice (*see Appendix A – May 2010 Scoping Letter*). The notice included proposed project area maps, project objectives, and contact information and was mailed to individuals, agencies, internal DNRC staff, industry representatives, and other organizations that had expressed interest in the Bozeman Unit’s forest management activities (*see Appendix A – Scoping List*). A public notice was also placed in the Bozeman Daily Chronicle newspaper. Interested parties were given 30 days to submit comments.

A second formal 30-day scoping period was held in October 2010. This scoping notice outlined a number of changes and refinements made since the initial scoping period in May (*see Appendix A – October 2010 Scoping Letter*). Interested parties were again given 30 days to submit comments and were invited to a public meeting in October.

Seventy-five (75) comment letters were received total between the two scoping periods (*see Appendix A – List of Respondents*). After reading each comment letter carefully, the ID Team identified over 115 issues raised by the public.

Website Updates

Prior to the distribution of the May 2010 initial scoping letter, DNRC developed a project website in order to provide project information and timely updates to the public (*see <http://dnrc.mt.gov/trust/timber/information/BearCanyon/default.asp>*). The Bear Canyon Proposed Timber Sale Project website provides answers to frequently asked questions about the project, a current map of the project area, a number of methods by which to submit comments on the proposed project, updates on the MEPA process, and project contact information.

Newsletter Updates

After the end of each of the formal scoping periods, the ID Team sent out newsletters and information sheets providing updates on public responses to the proposed action as well as project updates. The August 2010 newsletter summarized the issues identified in the comment letters received from the May 2010 scoping period. The February 2010 newsletter provided the public an update on the MEPA process since the public meeting held in October. Both the newsletter and information sheets provided interested individuals opportunities to submit comments on the proposed project and to contact members of the ID Team to ask questions regarding proposed activities.

Individual Correspondence

Many individuals contacted the Bozeman Unit either via phone or email to discuss issues and concerns about the proposed project on a one-on-one basis with the project leader. Since the release of the first scoping letter in May 2010, the Bozeman Unit Manager has met in person with 17 individuals and visited with approximately 25 persons over the phone. All of these individuals were invited to submit comments on the proposed project.

Public Meeting

Through notification placed in the October 2010 scoping letter, the public was invited to attend a public meeting to learn more about the proposed project. On October 28th, 2010, 14 individuals attended to learn more about the proposed activities, anticipated effects to resources within the project area, and opportunities by which to submit comments on the proposed project. An overview of the project was presented along with a discussion of forest health, historical activities, existing conditions, desired outcomes and the MEPA process.

Other Meetings

Throughout the development of the project, the Bozeman Unit Manager availed himself to attend regular meetings held by other groups to inform them of the proposed activities. The project leader attended two meetings held by the following organizations: an Eagle Rock Homeowners Association meeting in July 2010 and a League of Women Voters in April 2011. Again, attendees were invited to submit comments on the proposed project.

Issues Studied in Detail and Issues Eliminated from Further Analysis

Through careful consideration of each public comment submitted and through extensive field reconnaissance, the ID Team identified over 115 issues related to the proposed project. Issues pertain to statements that raise concern about the potential impacts the project may have on various resources. Of these 115 issues, the ID Team determined which would be analyzed in detail and which would be eliminated from further analysis. Issues to be analyzed in detail were determined to be relevant and within the scope of the project and were thus included in the impacts analyses and used to assist the ID Team in alternative development (*Table I-1*). Issues that were eliminated from further analysis were those that

were determined to be either not pertinent to alternative development or beyond the scope of the project and were thus not carried through in any of the impacts analyses (*Table I-2*).

Table I - 1. Issues studied in detail by resource area.

RESOURCE AREA	ISSUES STUDIED IN DETAIL
<p>Chapter 3 – Transportation</p>	<p>Increase in road densities may result in motorized use of the area which may adversely affect current recreational use of the area.</p>
	<p>Harvest activities may increase the amount of permanent roads within the project area.</p>
	<p>There is concern that DNRC may not adequately rehabilitate existing road problems or road problems that may result from harvest activities.</p>
	<p>Traffic and other harvest activities may adversely affect public safety along the haul route both within the project area and on the public roads leading to the harvest area.</p>
<p>Chapter 3 – Vegetation</p>	<p>There are concerns that harvest activities/silvicultural methods may not adequately address forest health and productivity, aesthetics, wildlife, and fire hazard.</p>
	<p>There are concerns that harvest activities /road building/weed spraying may harm/adversely affect native flora.</p>
	<p>There are concerns that harvest activities/roads may introduce/spread noxious weeds.</p>
<p>Chapter 3 – Watershed and Fisheries</p>	<p>Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams.</p>
	<p>Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed.</p>
	<p>Project activities may affect fish habitat by modifying channel form and function.</p>
	<p>Project activities may affect fish habitat by accelerating natural sediments delivery processes.</p>
<p>Chapter 3 – Geology and Soils</p>	<p>Traditional ground based harvest operations have the potential to compact and displace surface soils which can reduce hydrologic function, macro-porosity, and/or soil function.</p>
	<p>Harvest activities associated with the proposed action may cumulatively affect long term soil productivity.</p>
	<p>Activities associated with the proposed action such as timber harvest and road construction have the potential to affect slope stability through increased water yields and road surface drainage concentration resulting in the exceedence of resisting forces.</p>
	<p>The removal of large volumes of both coarse and fine woody material through timber harvest reduces the amount of organic matter and nutrients available for nutrient cycling possible affecting the long-term productivity of the site.</p>
	<p>The removal of large volumes of both coarse and fine woody material through timber harvest reduces the amount of organic matter and nutrients available for nutrient cycling possible affecting the long-term productivity of the site.</p>

RESOURCE AREA	ISSUES STUDIED IN DETAIL
Chapter 3 – Wildlife	There is concern that activities that would occur under the proposed action could affect important habitat attributes at a landscape scale that could adversely wildlife species and maintenance of biodiversity (i.e., cover types, forest age classes, old growth, stand structure, snags, coarse woody debris, patch characteristics, habitat connectivity and habitat linkage).
	There is concern that activities proposed in this project may adversely affect federally listed threatened and endangered species, and/or sensitive species, particularly grizzly bears and Canada lynx.
	There are concerns that potential increases in road density, motorized disturbance, and removal of forest cover through logging may adversely affect security habitat for elk, increasing the potential to reduce hunter opportunity, and/or increasing displacement of elk and conflicts on neighboring agricultural lands.
	There is concern that the construction of additional roads and removal of forest cover through logging may affect big game movements and use of the area, which would result in decreased hunting opportunities (particularly in proposed harvest in Sections 1, 2 and 11).
	There is concern that activities proposed in this project may create disturbance, increase road amounts, and reduce forest cover, which could adversely affect wintering moose, elk, and mule deer.
	There is concern that disturbance associated with active logging in spring, may disturb elk and other ungulates that may be rearing young.
Chapter 3 – Recreation	Harvest activities may affect the amount, location, use and condition of many existing trails and other developed facilities within the project area.
	Harvest activities may adversely affect recreational experiences within the project area including hiking, skiing, hunting, horseback riding, birding, mountain biking, and general enjoyment of the area.
	Harvest activities may occur during times of the year that are especially important to recreational users.
	Increase in road densities may result in motorized use of the area which may adversely affect current recreational uses within the project area.
Chapter 3 – Aesthetics	Harvest activities, such as road construction, slash/debris piles and harvest design, may adversely affect the visual quality of the landscape as seen from within the proposed project area, neighboring properties and the City of Bozeman.
	Activities associated with this project may increase local noise levels.
Chapter 3 – Economics	The proposed action may directly affect income in the regional forest products economy. This includes revenue for state trust beneficiaries, infrastructure development, and other forest improvements on state trust forestlands. The proposed action may also directly affect employment opportunities in the regional forest products economy.
Chapter 3 – Air Quality	Dust produced from harvest activities, road building and maintenance, and hauling associated with this project may adversely affect local air quality.
	Smoke produced from logging slash pile and broadcast burning associated

RESOURCE AREA	ISSUES STUDIED IN DETAIL
	with this project may adversely affect local air quality.

Table I - 2. Issues eliminated from further analysis and accompanying response.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
<p>Interest in DNRC collaborating with other agencies that are engaging in fuels reduction in order to make projects more economical and effective and to promote management at the landscape scale.</p>	<p><i>ARMs 36.11.417, 36.11.421(2), and 36.11.423(2)</i> require DNRC to consider cooperative planning efforts with neighboring landowners to promote biodiversity, minimize road construction needs, and minimize cumulative watershed effects. The Gallatin National Forest, Bozeman Ranger District proposed the Bozeman Municipal Watershed (BMW) Project for fuels reduction several years ago and was much farther along with project planning and development at the time DNRC initiated its proposal for the Bear Canyon Timber Sale. Also, several key aspects of both projects rendered formal cooperative planning less useful under the circumstances given that: 1) no vegetation treatment areas or boundaries would have been shared between the two projects given the distance between the two, 2) the projects do not share watershed tributary areas, thus the risk of cumulative watershed effects was minimal, 3) the road systems that would be used for both projects are distant from one another and benefits of shared use would not be realized by either agency, and 4) given the stage and location of the USFS project and urgency of the beetle outbreak on state trust lands, DNRC chose to move forward with the Bear Canyon Timber Sale proposal independently from the USFS BMW Project. DNRC staff have been in contact with USFS staff working on the BMW Project and will continue to look for practical opportunities to cooperate.</p>
<p>Concern that DNRC may not adequately analyze for cumulative impacts by not considering effects associated with the BMW Project.</p>	<p>DNRC considered the BMW Project in the development of this EA. For those resources where the cumulative effects analysis area encompasses the BMW Project, specialists considered the impacts associated with that project in the cumulative effects analysis. (<i>See Chapter 3 – Vegetation, Wildlife, Aesthetics, and Air Quality Analyses</i>)</p>
<p>Concern that road maintenance and rehabilitation costs on Mt. Ellis Lane will come out of the local taxpayers and not be paid for by the timber sale.</p>	<p>Mt. Ellis Lane is a county road and maintenance is performed on a regular basis by the county, funded by taxes paid by the road users though vehicle registrations, property and fuel taxes. As a measure to limit dust and reduce the needed maintenance on Mt. Ellis Lane a treatment of magnesium chloride would be applied once conditions were dry enough to for it to be effective. Light grading to the road surface would be provided to help maintain a</p>

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
	smooth the driving surface for the hauling activities.
Concern that harvest activities may have indirect adverse effects on the long term economic future of Gallatin Valley by diminishing the aesthetic of lands included in the proposed project area.	While DNRC understands the concern for the potential aesthetic impact associated with this project, we have found no evidence that forest management activities on landscapes within view of the city of Bozeman would hinder the economic future of the Gallatin Valley. We do recognize that the landscape aesthetic would change under the proposed action; however, we expect the effects to diminish over time as the harvested stands regenerate. <i>(See Chapter 3 – Aesthetics)</i>
Concern that DNRC has not fully considered how much revenue can be generated from other amenities other than timber (i.e. revenue generated by ecosystem services and recreational fees).	As state trust land managers, DNRC is charged with the responsibility of generating the largest measure of reasonable and legitimate revenue to the trust beneficiaries while protecting the revenue-generating capacity of state trust lands for future generations (<i>1972 Montana Constitution, Article X, Section 11; Montana Code Annotated [MCA] 77-1-202</i>). According to the SFLMP, DNRC has determined that the best way to produce long-term income for the trust beneficiaries from forested state trust lands is to manage those lands intensively for healthy and biologically diverse forests through the use of timber management activities. However, the SFLMP also states that DNRC would “pursue other income opportunities as guided by changing markets for new and traditional uses. These uses may replace timber production when their revenue exceeds long-term timber production revenue potential” (DNRC 1996). It is in the best interest of the trust beneficiaries for DNRC to consider other profitable revenue generating opportunities where appropriate, and DNRC has a long history of exploring and implementing a diversity of revenue generating uses and project types. At this time, DNRC has determined that forest management continues to be the best use of these project area lands in producing revenue over the long-term for the trust beneficiaries.
DNRC should sell the timber under more than 1 sale to provide opportunity for more than 1 business and to subsequently generate more revenue for the trust beneficiaries.	DNRC appreciates the fact that there are many interested bidders with differing capabilities. As with all DNRC forest management projects this project must cover the cost of development while making money for the trust beneficiaries. The cost of development would need to be included as part of the bid and we would be unable to fairly divide those cost between multiple sales, since access to the project area is dependent on the reconstruction transportation system beginning at the end of Mt.Ellis Lane.

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
Interest in DNRC developing an EIS.	According to DNRC’s Administrative Rules for MEPA, the agency is required to develop an EIS when issues related to the project are likely to involve significant impacts to the human environment. According to <i>ARM 36.2.524</i> , DNRC is required to consider a list of criteria in determining the significance of impacts. Through extensive field work and careful consideration of public comments and of the significance criteria, the ID Team has recommended that an EA provides an adequate analysis for this project. Ultimately, the Decision Maker will determine whether or not issues presented by the proposed action would likely involve any significant impacts to the human environment thereby requiring the development of an EIS (<i>see Chapter 1 – Decisions to be Made</i>).
Concern that DNRC is conducting this proposed project in a secretive manner.	Since the initial scoping period, DNRC has made an extensive effort to engage and invite interested individuals to learn more about and submit comments on the proposed project. See <i>Chapter 1 – Scope of Project and Public Involvement</i> for a list of activities and opportunities made available to the public throughout the development of this project.
Concern that the proposed benefits of the project do not outweigh the economic and aesthetic costs.	As state trust land managers, DNRC is charged with the responsibility of generating the largest measure of reasonable and legitimate revenue to the trust beneficiaries from actions such as this proposed timber sale. While we anticipate generating revenue from the proposed action, we are also charged to protect and enhance the future income generating capacity of the land. Our proposed treatments are aimed to do this by improving the growth, vigor, and age class diversity of forested stands while also providing a measure of protection and decreased risk against catastrophic loss from insects, disease, and fire. These actions in addition to expanding the existing transportation system throughout the area are viewed as an investment in the future management of these lands. Economic costs are considered in project development and in this Draft EA (<i>see Chapter 3 – Economics</i>). In addition, we do recognize that the landscape aesthetic would change under the proposed action; however, we expect the effects to diminish over time as the harvested stands regenerate and not result in a calculable and irreversible cost to the community (<i>see Chapter 3 – Aesthetics</i>).
Concern that the proposed project does not encompass a	DNRC recognizes that additional acres outside of the proposed project area are in need of management. However, in developing projects like this, DNRC must balance time, workload, cost, and

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
broader area.	management needs. At this time, the proposed action represents an area by which DNRC has determined it can manage effectively within the near term. Expanding the transportation infrastructure may allow for similar management projects in the future.
Interest in providing dog waste management education and materials.	DNRC recognizes that education on dog waste management could be a valuable part of a recreation or trails project. No funding would be available under the proposed action; however, DNRC would consider this for any future recreation project should an applicant propose one.
Supportive of the project.	Thank you for your comment.
Interest in DNRC considering controlled burning to manage the forest only if it does not result in increased roads.	Slash pile and broadcast burning would be a component of this project. We also propose to build 6.9 miles of new road, all of which would be closed with slash and debris after project activities have been completed. The road prisms would be kept intact for future management purposes. See <i>Chapter 3 – Transportation</i> for more information on the road system and <i>Chapter 3 – Vegetation</i> and <i>Chapter 3 – Air Quality</i> for more information on prescribed burning.
Interest in DNRC moving the trailhead further up the due-south road.	The trailhead at the end of Mt. Ellis Lane is primarily associated with the trail and recreational use. Expansion of this facility is not specifically related to the sale of timber, nor could the expansion of the trailhead be funded through the proceeds from the sale. This would be appropriate to be considered when there are proposals for recreation or trails.
DNRC should construct a trailhead parking area at the end of Mt. Ellis Road after logging operations are complete.	<i>Please see above response.</i>
Interest in creating a trail as a part of the Gallatin Front Trail by converting logging roads into a non-motorized trail connecting Bear Canyon, Mount Ellis, Triple Tree, and possibly Sourdough Canyon.	DNRC appreciates that this area is highly valued for recreational purposes. Under Montana state law, persons wishing to use state trust lands for recreation must obtain the appropriate license to do so (<i>see Chapter 3 – Recreation for a description of various licenses</i>). Fees collected with these licenses aid the DNRC in generating revenue for the trust beneficiaries from recreational use and development of those lands. Any development of trails on state

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
	<p>trust lands within the Bear Canyon area would thus require an applicant to apply for a license. This licensing procedure would then undergo its own MEPA review and decision process. To date, no user group or individual has sought a license for recreational trail development of these lands. Due to the special licensing procedures and requirements, DNRC views recreational trail modification and development as a project separate from this proposed timber sale project. Although DNRC has not considered recreation access as one of its project objectives, we have analyzed the potential impacts to recreation resulting from the proposed action (<i>see Chapter 3 – Recreation for more details</i>).</p>
<p>Interest in improving the trail system to provide for better public recreation access and connectivity (creating loops), revenue to the trust beneficiaries, and fire suppression access.</p>	<p><i>Please see previous response in addressing the interest in improving the trail system to provide for better public recreation access and connectivity and revenue to the trust beneficiaries.</i> Under the proposed action, DNRC would build 6.9 miles of new road, all of which would be closed with slash and debris after project activities have been completed. However, the road prisms would be kept intact for future management purposes including fire suppression activities.</p>
<p>Interest in GVLТ obtaining an annual lease for a trail across State Lands.</p>	<p><i>Please see above response.</i></p>
<p>Concern that mountain bike use may not be considered in planning the transportation and recreation system.</p>	<p><i>Please see above response.</i></p>
<p>Interest in placing a 'standards' bulletin board at trailhead (kiosk) informing users of the requirement to purchase a recreation license and other information.</p>	<p>This is currently signed informing users of the requirement to possess a General Recreational Use License to use these lands. We have also added a bulletin board next to the gate to help direct attention to this sign along with other information that may be of interest to users, including our scoping notices for this timber sale proposal.</p>
<p>Concern that existing trails and future trails within the project area be place in such a manner that they minimize displacement of wildlife.</p>	<p>Expanding the existing trail system or re-locating existing portions of trails are not actions being proposed as a part of this project. <i>See above related responses for additional details.</i> <i>Displacement of wildlife due to project-related activities and the cumulative influences of recreation are addressed in detail in the Wildlife section of this environmental analysis.</i></p>

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
Concern that DNRC may expand recreational opportunities for mountain bikers, which is disruptive to other users, disturbs wildlife, exacerbates erosion and may encourage trespass onto adjacent private land.	Expanding trail systems and developing the area for increasing recreational use is beyond the scope of this project proposal, and would not occur under the proposed action. Thus, the stated related impacts in this issue would not be anticipated. <i>See above related responses for additional details.</i>
There is concern that public use of the Triple Tree Trail in spring disturbs moose, elk, deer and their young. There is concern that this disturbance may continue if the existing trail remains open as it is, and that disturbance may increase if the trail system were expanded.	The Triple Tree Trail is not in the project area and expanding the existing trail system is not being proposed as a part of this project. <i>See above related responses for additional details.</i>
Concern that logging activities associated with the proposed action may affect wet areas and riparian habitat (egs. bogs, stream banks, elk wallows etc.), which may adversely affect associated wildlife.	Wet areas and riparian habitat would be restricted from harvest activities under the proposed action, alleviating the stated concerns. No impacts to these important areas and resources would be expected.
Concern that harvest activities may adversely affect native meadows and wildflowers that provide forage for elk.	Under the proposed action, limited activity in such areas would occur as activities would generally target dead and dying trees in forested uplands. Some road construction could occur in small portions of existing meadows, however impacts that would result in measurable changes in elk forage would not be expected. <i>Additional information regarding potential impacts to elk and forage can be found in the Chapter 3 – Wildlife subsection of this environmental assessment.</i>
Concern that harvest activities may adversely affect old growth.	According to data gathered during field reconnaissance, no oldgrowth occurs within the proposed harvest units. Thus, no impacts associated with harvesting of old-growth forest would be anticipated.
Concern that DNRC may	Some healthy Douglas-fir trees would be removed as indicated in

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
remove vigorous and healthy Douglas-fir trees (sections 3 and 35) which may otherwise be left for aesthetic and wildlife purposes.	this concern. This issue is addressed in more detail in the <i>Chapter 3 – Wildlife, Vegetation, and Aesthetics</i> .
DNRC should maintain existing old growth within the area.	<i>Please see above response.</i>
Interest in DNRC using scientific findings in determining forest conditions within the project area.	DNRC uses scientific data from various sources to assess and analyze forest conditions. The methods and data sources used to describe forests in the project area and broader landscape are described in <i>Chapter 3 – Vegetation</i> .
Concern that harvest operators may not take necessary precautions to limit bear attractants within the working environment.	DNRC would incorporate bear attractant requirements in contracts associated with the proposed action. Stipulations would require contractors to properly store and dispose of food, garbage, and other attractants in a bear-resistant manner. DNRC forest officers would regularly visit work sites to enforce that these stipulations as well as others related to the proposed project.
Concern that harvest activities may adversely modify lynx critical habitat.	Federally designated critical habitat for Canada lynx would not be affected by this proposal, thus this issue was not analyzed further. <i>Additional details can be found in Chapter 3 – Wildlife.</i>
Concern that the HCP may not be done in time to influence the design of this project.	As stated in <i>Chapter 1 – Relevant Agreements, Laws, Plans, Permits, Licenses and Other Authorizations</i> , DNRC has been developing an HCP under Section 10 of the ESA for several years. In anticipation of potentially receiving an incidental take permit within the next year, DNRC has developed a phased-in approach to prepare various projects for HCP compliance. As a part of this approach, DNRC has planned this project to be in compliance with the current Forest Management Rules and all applicable conservation commitments contained in the Preferred Alternative in the Final EIS/HCP. Should a different alternative be selected, revisions to this project may be made to comply with the selected alternative.
Interest in DNRC consulting with USFWS to properly assess impacts associated with the proposed action and to	DNRC has the obligation to not “take” threatened or endangered species under Section 9 of the ESA. Thus, DNRC minimizes risk to these species by applying Forest Management Rules designed to address important risk factors and habitat needs. Under

ISSUE ELIMINATED FROM FURTHER ANALYSIS	DNRC RESPONSE
minimize 'take' of threatened and endangered species in the area.	Section 9 of the ESA, state agencies are not required to formally consult with USFWS.
Activities associated with this project may affect cultural resources within the project area.	After thorough review of the project area and consultation with the State Historic Preservation Office database, the DNRC Archaeologist did not find any cultural or paleontological resource within the area. Should any resources be encountered during harvest operations, activities would be postponed and the DNRC Archaeologist would be contacted to verify findings. Appropriate measures would be employed to avoid potential impacts to those resources.

Relevant Past, Present, and Related Future Actions

In order to adequately address cumulative effects of the proposed action on pertinent resources, each analyst must account for the effects of past, present, and related future actions within a determined analysis area. The locations and sizes of the analysis areas vary by resource (watershed, vegetation, etc.) and species (grizzly bear, big game, etc.) and are further described by resource in *Chapter 3*.

Past, present, and related future actions on DNRC lands and adjacent ownerships were considered for each analysis conducted within this EA. DNRC often lacked data regarding actions on adjacent ownerships. Therefore, resource specialists were obliged to qualitatively describe and consider rather than quantify such actions for cumulative effects.

Following is the list of relevant actions considered in this EA:

Within the project area:

- DNRC 1980 to 1981 Bear Canyon Timber Sale – Harvest on approximately 90 acres within Section 2 T3S R6E and approximately 66 acres within Section 35 T2S R6E.
- DNRC 1990 to 1991 Lower Bear Canyon Viewshed Harvest – Harvest on approximately 90 acres within Sections 34 and 35 T2S R6E and Section 2 T3S R6E.
- DNRC 1993 to 1994 Upper Bear Canyon Multi-Product Timber Permit – Harvest on approximately 12 acres within Section 2 T3S R6E.
- DNRC 2007 Pre-commercial thinning – approximately 30 acres within Section 2 T3S R6E.
- DNRC 2010 Eight firewood permits – 40 cords total (5 cords per permit).
- Livestock grazing in Section 34 and 35 T2S, R6E.

Outside of the project area:

- DNRC 2007 Eagle Rock Fuels Reduction – Harvest on approximately 15 acres within Section 4 T3S R6E.
- USFS 2011, Gallatin National Forest, Bozeman Ranger District, Bozeman Municipal Watershed Project – Alternative 6. Approximately 4,700 acres. Project duration 3 to 5 years.
- Forest management projects on adjacent private ownerships.

Decisions to be Made

Draft EA

During the winter and spring of 2011, the ID Team developed the Draft EA. Issues received from the public and internal agency staff drove the analyses for the various resources. Upon publication, a letter of notification was sent to individuals on the scoping list (*Appendix A – Scoping List and List of Respondents*). The Draft EA was circulated to individuals, agencies, and organizations who requested a copy of the documents. The Draft EA was also placed on the DNRC website (http://dnrc.mt.gov/env_docs/default.asp). Comments to the Draft EA will be accepted for 30 days following publication.

Final EA and Decision Notice

After public comments are received, compiled, and addressed, DNRC will prepare a Final EA. The Final EA would primarily be a revision of the Draft EA that incorporates any necessary changes based on public comments received during the 30-day public review period. The Final EA would also include responses to comments received during the review period.

Following development of the Final EA, the Decision Maker will review public comments, the Final EA, and information contained in the project file. The Decision Maker will consider and determine the following:

- which alternative presented in the Final EA meets the project’s purpose and objectives;
- which alternative (or combination/modification of alternatives) should be implemented and why;
- if issues and concerns have been adequately addressed; and
- if there is a need for further environmental analysis or to prepare an EIS.

These determinations will be published and all interested parties will be notified. The decisions presented in the Decision Notice will become recommendations from DNRC to the Land Board. Ultimately the Land Board will make the final decision to approve or not approve the alternative selected by the Decision Maker.

Chapter 2 Alternatives

Introduction

The purpose of this chapter is to describe both the No-Action and Action Alternatives in detail. This chapter will focus on the:

- development of the Action Alternative;
- description of and summary comparison of project activities associated with the No-Action and Action Alternative;
- summary comparison of the predicted environmental effects associated with each alternative; and
- mitigations or measures designed to reduce impacts included in the Action Alternative.

Development of Alternatives

History and Development Process

An ID Team was formed to work on the proposed Bear Canyon Timber Sale Project in the fall of 2009. The ID Team consisted of a project leader and resource specialists from various disciplines including: fisheries, wildlife biology, hydrology, geology and soils, planning, and forestry. The role of the ID Team was to summarize issues and concerns, develop alternatives of the proposed action within the project area, and analyze the potential environmental effects of the alternatives on the human and natural environments.

The ID Team began reviewing resources in the proposed project area soon after the initial scoping period began in May 2010. Field reviews were conducted and data were collected within the project area to aid in the analyses for affected resources including: vegetation, watershed and hydrology, fisheries, wildlife, geology and soils, economics, air quality, recreation, and aesthetic resources. In-depth quantitative and qualitative analysis of the data assisted the ID Team in assessing the existing environment for each resource and in determining the potential environmental effects of each alternative on the affected resources.

Based on data collected from the field, and issues received from the public and internally, the ID Team developed one Action Alternative to meet the project objectives while considering, to the extent practicable, the various issues and concerns raised by the public. The Action Alternative incorporates harvest unit design, prescriptions, mitigations, and road development activities that allow the DNRC to conduct forest management activities consistent with direction contained in the SFLMP and the Forest Management Rules.

Description of Alternatives

Description of the No-Action and Action Alternatives

This section summarizes and compares the proposed activities associated with the No-Action and Action Alternatives (*Table II-1*). See *Figure II-1* for a visual description of various project activities associated with the Action Alternative.

Table II - 1. Summary description of alternatives and comparison of project activities.

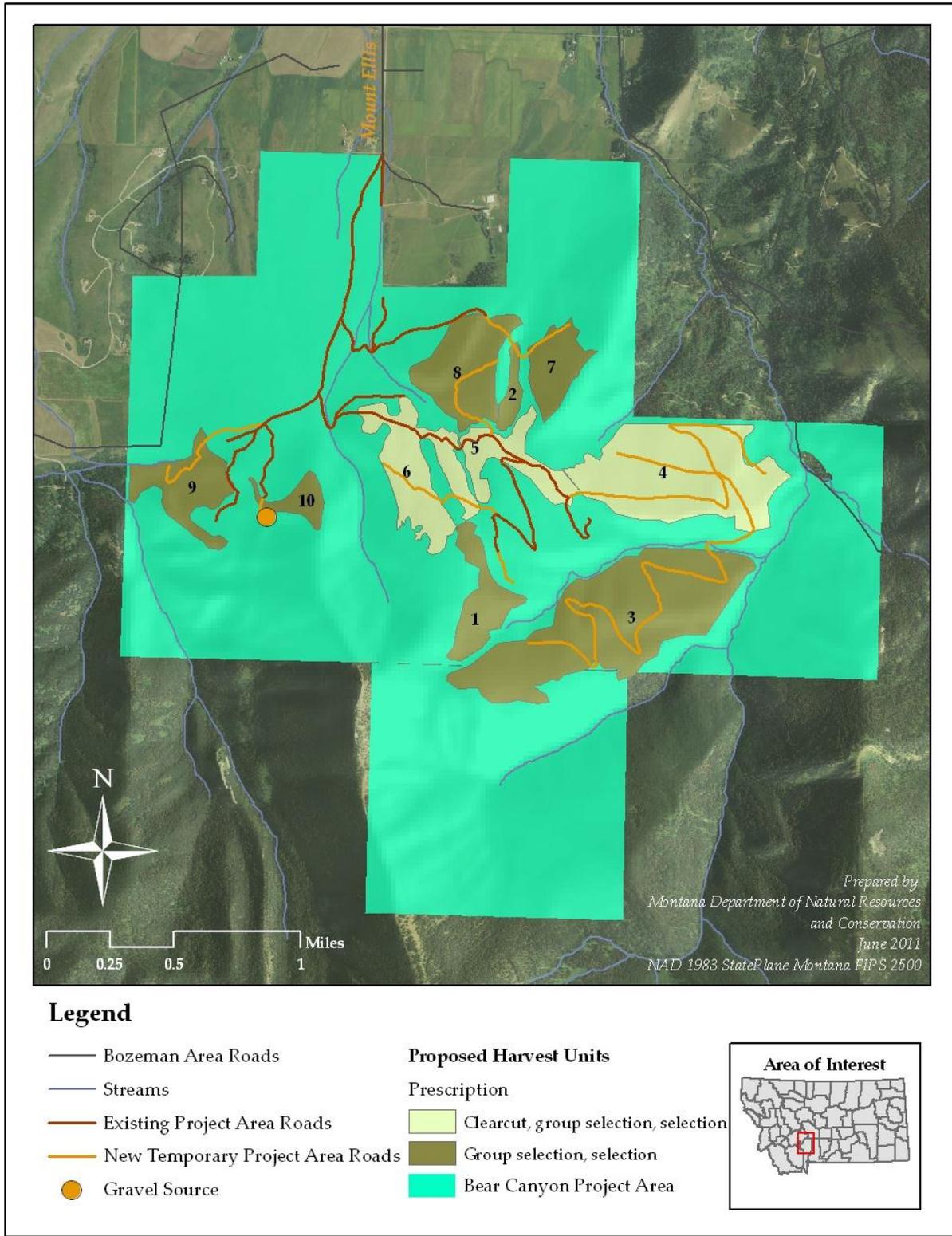
PROPOSED ACTIVITY	NO-ACTION	ACTION
Timber Harvest	None	<ul style="list-style-type: none"> • Harvest an approximate 6 MMbf¹ from approximately 750 acres within the project area using a combination of silvicultural treatments including group selection, selection cutting, and/or clearcutting. <ul style="list-style-type: none"> ○ Harvest Units 4, 5, and 6 – Clearcut with group selection and selection². ○ Harvest Units 1, 2, 3, 7, 8, 9, and 10 – Group selection and selection. • Remove 50 to 85 percent of total basal area (BA) throughout harvest units. • Remove most lodgepole pine and approximately 60 percent of Douglas-fir BA (and Englemann spruce where it exists). • Emulate mixed-severity fire regime. • Retain best-formed and most vigorous Douglas-fir (and Englemann spruce where it exists).
Road Construction / Maintenance	None	<ul style="list-style-type: none"> • Reconstruct and/or maintain 5.5 miles of existing road. • Construct 6.9 miles of new road.
Road Use / Restrictions	5.5 miles would be closed to public motorized use/open for administrative use	<p>During Harvest Operations:</p> <ul style="list-style-type: none"> • 12.4 miles of road would be closed to public motorized use/open for administrative and commercial use <p>Post-Harvest:</p> <ul style="list-style-type: none"> • 7.1 miles of road would be abandoned/closed with slash and debris. • 5.3 miles would be closed to public motorized use / open for administrative use.
Stream Crossings	Replace 1 corrugated metal pipe (CMP) and remove 1 native crossing	<p>During Harvest Operations:</p> <ul style="list-style-type: none"> • Install 7 new CMPs. • Replace 2 existing CMPs and remove 1 native crossing. <p>Post-Harvest:</p> <ul style="list-style-type: none"> • Remove all new stream and draw crossing CMPs.
Gravel Source Operations	None	<p>During Harvest Operations:</p> <ul style="list-style-type: none"> • Remove gravel from source in Section 3 T3S R6E for road construction and maintenance purposes.

PROPOSED ACTIVITY	NO-ACTION	ACTION
		Post-Harvest: <ul style="list-style-type: none"> • Reclaim site to stable cut slopes.
Prescribed Burning	None	<ul style="list-style-type: none"> • Conduct slash pile burning within some of the proposed harvest units following harvest activities. • Conduct broadcast burning within proposed harvest units following harvest activities, if the conditions allow.
Weed Management	Continue monitoring and treatment where necessary.	Monitor and treat roads, skid trails and landings for weed infestations as appropriate.
Tree Planting	None	Monitor natural regeneration of tree seedlings in harvest units and use planting as needed to adequately stock areas with insufficient amounts of natural regeneration.

¹ The estimated timber volume is based on stand volume data obtained from field reconnaissance and other available data used in the analysis. Advertised volumes may vary from preliminary estimated volumes due to increased statistical accuracy of measured data obtained during sale layout. While the estimated log volume may be different, the environmental effects are based on acres treated and postharvest stand conditions; these effects would remain similar to those shown in this Draft EA.

² While clearcutting would be the primary treatment throughout these harvest units, where Douglas-fir exists, group selection and selection cutting would be used to remove up to 60 percent of the basal area of Douglas-fir.

Figure II - 1. Project activities associated with the Action Alternative.



Proposed Schedule of Activities

If the Action Alternative is selected, harvest activities would begin as early as September, 2011 and would be expected to last approximately 2 to 3 years. *Table II-2* summarizes the proposed schedule of activities associated with the Action Alternative by outlining the timing (where it would occur within the project timeline, under what conditions, and during what time of the day and/or week) and duration of each activity.

Table II - 2. Proposed schedule of activities associated with the Action Alternative.

PROPOSED ACTIVITY	TIMING (where in project timeline and/or during what conditions)	TIMING (daily/weekly)	DURATION
Timber Sale Layout	June/July 2011	Early morning to early evening Monday through Friday (except major holidays).	1 to 2 weeks
Harvest Administration	Throughout harvest activities.	Early morning to early evening Monday through Friday (except major holidays).	Throughout harvest activities
Road Construction / Maintenance	Summer or fall. Soil moisture <20%. May be carried out in multiple stages.	Early morning to early evening on up to 7 days per week.	1 to 2 months total depending on capacity of contractor.
Stream Crossing Work	Summer or fall. Soil moisture <20%. May be carried out in multiple stages.	Early morning to early evening up to 7 days per week.	1 week total
Gravel Source Operations	Summer or fall. Soil moisture <20%. May be carried out in multiple stages.	Early morning to early evening up to 7 days per week.	3 weeks total
Harvest Activity within Harvest Units	June 15 th through March 15 th of 2012 and 2013. Soil moisture <20% (dry) and/or frozen conditions.	Early morning to early evening up to 7 days per week.	Approximately 9 months per year.
Log Hauling	June 15 th through March 15 th of 2012 and 2013. Soil moisture <20% (dry) and/or frozen conditions.	Early morning to early evening Monday through Friday (except major holidays).	Approximately 160 days per year.
Weed Management	Summer or fall throughout and after harvest activities are complete.	Early morning to early evening Monday through	Approximately 1 week in the summer and 1

PROPOSED ACTIVITY	TIMING (where in project timeline and/or during what conditions)	TIMING (daily/weekly)	DURATION
		Friday (except major holidays).	week in the fall per year.
Slash Pile Burning	October through November and March through April following closure of sale. Fall and spring wet conditions.	Early morning to early evening. May happen any day of the week depending on conditions.	1 to 2 weeks
Broadcast Burning	July through October following closure of sale. May be carried out in multiple stages.	Up to 24-hour per day activity. May happen any day of the week depending on conditions.	1 to 2 weeks
Tree Planting	Early summer or fall 5 to 10 years following the completion of harvesting activities.	Early morning to early evening. May happen any day of the week depending on conditions.	Less than 1 week per year.

Summary of Predicted Environmental Effects

Table II-3 summarizes the predicted direct, indirect, and cumulative environmental effects associated with both the No-Action and the Action Alternatives. The table outlines this information by resource area and issue studied in detail as indicated in Table I-1 in Chapter 1. For a more in-depth review of the potential effects associated with each alternative, please see Chapter 3.

Table II - 3. Summary comparison of predicted environmental effects.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
TRANSPORTATION			
Condition of Roads	Inadequate culverts, stream crossings, and sections of road exist.	No-Action: No change. Action: Roads and stream crossings would be maintained and built to meet BMPs.	No-Action: Inadequacies would continue to degrade. Action: After the sale is complete, culverts would be removed and roadbeds would be seeded. 7.1 miles of roads would be abandoned and closed with

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
Amount, Distribution, and Status of Roads	<ul style="list-style-type: none"> • 5.5 miles of existing roads • 1.1 mi/mi² project area road density • Managed as closed to motorized public use yet open for administrative and commercial use. 	<p>No-Action: No change. Action: 6.9 miles of new road would be built increasing road density to 2.5 mi/mi². 12.4 miles of road would be closed to motorized public use yet open for administrative and commercial use.</p>	<p>slash and debris. No-Action: No change. Action: 7.1 miles of road would be abandoned and closed with slash and debris resulting in pre-sale road density levels. Remaining 5.3 miles of road would be closed to motorized public use yet open for administrative and commercial use.</p>
Traffic	<ul style="list-style-type: none"> • Low levels of traffic associated with firewood permits and administrative use throughout project area. • Routes to project area receive residential, recreational, administrative, and low levels of commercial use. 	<p>No-Action: No change. Action: Increased administrative and commercial-use traffic throughout project area would be concentrated between June 15th and March 15th.</p>	<p>No-Action: No change. Action: Traffic on Mt. Ellis Lane and Bozeman Trail Road would increase during harvest operations. After the sale is complete, traffic would be expected to be slightly above current levels since future management activities might become more possible.</p>
VEGETATION			
Cover Types and Age Classes	<p>Cover Types: The project area and landscape are primarily forested with pure or mixed Douglas-fir and lodgepole pine stands; hardwood (aspen) groves are also common. Non-forested areas include grass and wildflower meadows, riparian areas, and shrublands.</p> <p>Age Classes: forests are primarily mature (90-120 years old), with recent harvest units 0-39 years old.</p>	<p>No-Action: No anticipated changes in the distribution, amount and species composition of forested and non-forested areas. Potential shifts from mature to young forests in areas affected by mountain pine beetle Action: No anticipated changes in the distribution, amount, and species composition of forested and non-forested areas, with the exception of 4 acres of mixed conifer that would be converted to Douglas-fir.</p>	<p>No-Action: No anticipated changes in the distribution, amount, and species composition of forested and non-forested areas. Potential shifts from mature to young forests in areas affected by mountain pine beetle and in areas that could potentially be harvested outside of the project area. Action: No anticipated changes in the distribution, amount, and species composition, of forested and non-forested areas, with the exception of 4</p>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
		Harvesting activities would increase the amount of young forests and decrease the amount of mature forests.	acres of spruce-fir that would be converted to Douglas-fir. Harvesting activities would increase the amount of young forests and decrease the amount of mature forests.
Forest Insects	<p>Mountain pine beetle is active on 32% of the project area and 46% of the landscape, with mortality ranging from 50 to 100% of lodgepole pine.</p> <p>Spruce budworm is causing minor amounts of damage in the project area and is active on less than 1% of the landscape.</p>	<p>No-Action: No change. Action: Salvage harvesting is unlikely to appreciably affect mountain pine beetle populations. Changes in the structure of harvested Douglas-fir stands could reduce susceptibility to spruce budworm.</p>	<p>No-Action: No change. Action: Salvage harvesting is unlikely to appreciably affect mountain pine beetle populations. Changes in the structure of harvested Douglas-fir stands could reduce susceptibility to spruce budworm.</p>
Fire Behavior and Ecology	<p>Stand structure is predominantly single- and two-storied, and canopy cover is generally continuous. Fires that reach the main canopy have potential to readily move through the overstory.</p> <p>Fire regimes are generally mixed severity with variable return intervals. Average fuel loading is 13 to 20 tons/acre.</p>	<p>No-Action: No change in stand structure, potential decrease in canopy cover due to mortality in lodgepole pine, and potential increase in fuel loading. Action: No change in stand structure, decrease in canopy cover, and decrease in fuel loading.</p>	<p>No-Action: No change in stand structure, potential decrease in canopy cover due to mortality in lodgepole pine and potential harvesting activities, and potential increase in fuel loading in unharvested areas. Action: No change in stand structure, decrease in canopy cover, and decrease in fuel loading.</p>
Threatened, Endangered, and Sensitive Plants	No species of concern identified in the project area or landscape.	<p>No-Action: No impact. Action: No impact.</p>	<p>No-Action: No impact. Action: No impact.</p>
Noxious	Canada thistle, hound's	No-Action: No change.	No-Action: No change.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
Weeds	tongue, and sulfur cinquefoil have been identified in the project area.	Continued monitoring and management of existing populations. Action: Potential to facilitate introduction or spread of noxious weeds, mitigation measures in place to minimize potential impacts.	Continued monitoring and management of existing populations. Action: Potential to facilitate introduction or spread of noxious weeds, mitigation measures in place to minimize potential impacts.
WATERSHED AND FISHERIES			
Water Quality	Good to Excellent, B-1 Classification by MT DEQ, minor impacts from stream crossing BMP departures and grazing leases.	No-Action: No impact, improving trend. Action: High probability of short-term, low level impacts, improving trend.	No-Action: No impact, improving trend. Action: Moderate probability of low level, short-term impacts.
Water Quantity	Naturally increasing from insect and disease mortality and associated canopy loss.	No-Action: No impact, naturally increasing. Action: High probability of long-term, low level impacts.	No-Action: No impact, naturally increasing. Action: High probability of long-term, low level impacts.
Fisheries Habitat	Poor due to intermittent and spatially discontinued base flows, steep stream channels with limited pool habitat and very limited seasonal connectivity.	No-Action: No impact, stable trend. Action: Low probability of short-term, low level impacts.	No-Action: No impact, stable trend. Action: Low probability of short-term, low level impacts.
GEOLOGY AND SOILS			
Physical Soil Properties	Naturally ameliorating impacts from previous harvest on skid trails on a small portion of the area	No-Action: No impact, improving trend. Action: High probability of low to moderate level impacts for moderate durations.	No-Action: No impact, improving trend. Action: No cumulative effects. Impacts similar to those of direct and indirect effects.
Slope Stability	Localized areas of poor to fair stability and evidences of past slope failure in isolated areas.	No-Action: No impact, stable trend. Action: Moderate probability of moderate to high level impacts.	No-Action: No impact, stable trend. Action: Moderate probability of low to moderate level cumulative effects.
Erosion	Erosively stable with no rill or gully erosion	No-Action: No impact, stable trend.	No-Action: No impact, stable trend.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	observed outside of road prisms in the project area.	Action: Moderate probability low level impacts.	Action: No cumulative effects expected.
Site Nutrients	Spatially variable dependant on aspect, elevation, habitat type, duff depth and amount of FWD.	No-Action: No impact, increasing trend. Action: Low probability of low level impacts.	No-Action: No impact, increasing trend. Action: No cumulative effects expected.
Long-term Productivity	Moderately productive due to soils, elevation, climate, and precipitation.	No-Action: No Impact, potentially decreasing trend. Action: Low probability of low level impacts.	No-Action: No Impact, potentially decreasing trend. Action: Low probability of low level impacts.
WILDLIFE			
Coarse Filter Cover Types	Primarily pure or mixed Douglas-fir and lodgepole pine stands; hardwood (aspen) groves present. Non-forested areas include grass and wildflower meadows, riparian areas, and shrublands.	No-Action: No anticipated changes in the distribution, amount and species composition of forested and non-forested areas. Potential shifts from mature to young forests in areas affected by mountain pine beetle. Action: Minimal anticipated changes in the distribution, amount, and species composition of forested and non-forested areas in the project area.	No-Action: No anticipated changes in the distribution, amount, and species composition of forested and non-forested areas. Potential shifts from mature to young forests in areas affected by mountain pine beetle and in areas that could potentially be harvested outside of the project area. Action: Minimal anticipated short or long-term changes in the distribution, amount, and species composition, of forested and non-forested areas in the CE analysis area.
Age Classes, Old Growth and Stand Structure	No old growth present in project area. Age Classes: forests are primarily mature (90 to 120 years old), with recent harvest units 0 to 39 years old. Existing	No-Action: Potential shifts from mature to young forests in areas affected by mountain pine beetle and CWD would increase in affected sites potentially	No-Action: Potential shifts from mature to young forests in areas affected by mountain pine beetle and in areas that could potentially be harvested outside of the project area

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	stand structures in mature forest stands range from open Douglas-fir/limber pine parks on exposed dry sites with shrub/grass understory vegetation to dense Douglas-fir/lodgepole stands with high amounts of ninebark and coarse woody debris.	inhibiting movements of animals in some areas. Dense older forest would increase over time in project area. Action: Age classes altered on 286 acres (8%) of 3,511-acre project area from 90 to 120 class down to 0 to 39 year class. 448 remaining treated acres would remain in 90 to 120 year age class. Forest structure altered on 734 acres increasing Non-forest/Sparse Forest Class by 502 acres (14% of project area.)	on neighboring lands in CE analysis area. CWD would increase in affected sites. General landscape trend of maturing dense, older forest over time. Action: 286 acres (0.8%) of the 33,422-acre cumulative effects analysis area would have age classes altered from the 90 to 120-year age class to the 0 to 39-year age class. Combined DNRC and USFS BMW effects could result in alterations in age classes on 2,117 acres (6% of CE analysis area). Considering both projects, the Non-forest/Sparse Forest Class could increase by 2,099 acres over the next 5 years.
Snags and Coarse Woody Debris	Many small snags (50 to 100 per acre in places) and few large snags >20 in. dbh occur in the project area. Coarse woody debris variable and ranges from 5 to >50 tons per acre.	No-Action: Snags and coarse woody debris expected to increase in short (several years) and long-term (several decades) on project area. Action: Snags would be reduced from existing amounts on 734 acres (21%) of the 3,511-acre project area. An average of 2 large snags and 2 large recruits per acre would be retained. Snags would remain unaffected on the remaining 2,777 acres in project area. Adequate coarse woody debris would be retained and follow recommendations of	No-Action: Minor increases in snags and coarse woody debris expected to increase in short (several years) and long-term (several decades) at the larger 33,422-acre CE scale. Action: Snags would be reduced on 734 acres (2%) of the 33,422-acre CE area. Considering both the DNRC project and USFS BMW project, snags could be affected on up to 5,003 acres (15%) within the CE analysis area. Adequate coarse woody debris would be retained following Graham et al. (1994) resulting in minimal adverse cumulative effects.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
Patch Characteristics and Connectivity	Dense mature forest occurs on ~2,532 acres (72%) of the 3,511-acre project area. Existing patches generally well connected and large.	<p>Graham et al. (1994).</p> <p>No-Action: Mature forest patches and connectivity of mature forest cover would tend to expand through forest succession on 3,511-acre project area. Action: Of the 3,511-acre project area, 1,893 acres would remain in mature forest cover with >40% canopy and 1,362 of those acres would possess >60% canopy. Non-forest would increase by about 286 acres. Patch sizes would be reduced, however, connectivity would remain relatively high.</p>	<p>No-Action: Mature forest patches and connectivity of mature forest cover would tend to expand through forest succession on 33,422-acre project area. Action: Of the 33,422-acre CE area, 26,378 acres (79%) would remain in mature forest cover with >40% canopy. If this DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover with >40% crown closure could be reduced to approximately 24,547 (73%) of the 33,422-acre cumulative effects analysis area. Patch sizes would be reduced, however, connectivity would remain relatively high and well-connected over ridges and saddles in the CE area.</p>
Habitat Linkage	Project area occurs within 1.3 miles of an important linkage area in the Bear Canyon/Bozeman Pass area.	<p>No-Action: No Change expected in habitat linkage. Action: Stand density would be reduced on 734 acres of mature forest and sparsely forested openings would be created on approximately 286 acres (8%) of the 3,511-acre project area. Minimal adverse risk is expected as appreciable connected cover would remain and no new open</p>	<p>No-Action: No Change expected in habitat linkage. Action: Stand density would be reduced on 734 acres of mature forest and sparsely forested openings would be created on approximately 286 acres (0.8%) of the 33,422-acre CE area. Minimal adverse risk is expected as appreciable connected cover would remain under the DNRC and USFS BMW project and no new open roads or</p>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
		roads or permanent developments would be constructed.	permanent developments would be constructed.
Sensitive Wildlife Species	Suitable habitat conditions were evaluated for 11 sensitive species. Risk was found to be minimal for all.	No-Action: No Change expected. Action: No direct or indirect effects to the 11 species would be expected.	No-Action: No Change expected. Action: No cumulative impacts to the 11 species would be expected.
Canada Lynx	Suitable habitat totals 1,426 acres (41%) of the 3,511-acre project area. Federally designated critical habitat does not occur in the project area.	No-Action: No direct or indirect effects to lynx would be expected. Action: Approximately 192 acres (13%) of the 1,426 acres of existing suitable lynx habitat would be removed within the 3,511-acre project area and converted to temporary non-habitat. 1,234 acres (86%) of suitable habitat would be retained, which would exceed retention measures required under ARM 36.11.435. Minor direct or indirect effects to lynx would be anticipated.	No-Action: No cumulative impacts to lynx would be expected. Action: Approximately 192 acres (0.9%) of 21,468 acres of existing suitable lynx habitat would be removed within the 33,422-acre CE analysis area. 21,276 acres (99%) of the existing suitable habitat would be retained. If both the DNRC and USFS BMW projects were to occur, 2,955 acres (8%) of lynx suitable habitat could be affected in some way and 838 acres (2%) could temporarily be converted to non-suitable habitat. Minor direct or indirect effects to lynx would be anticipated.
Grizzly Bear	Project area lies 21 miles north of GYE. Dense mature forest occurs on ~2,532 acres (72%) of the 3,511-acre project area. 5.5 miles of existing road, and restricted road density of ~1.0 mi./sq. mi. The project area receives appreciable recreational use during all seasons of the year.	No-Action: No direct or indirect effects to grizzly bears would be expected. Action: Of the 3,511-acre project area, 1,893 acres (54%) would remain in mature forest cover. 12.4 miles of road would be operational and used in conjunction with logging activities for the duration of the project (2 to 3	No-Action: No cumulative impacts to grizzly bears would be expected. Action: 26,378 acres (79%) of the 33,422 CE analysis area would remain in mature forest cover. If the DNRC and the USFS BMW projects were to occur, the acreage of mature forest cover could be reduced to approximately 24,547 (73%)

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
		<p>years) resulting in a temporary increase in road density from 1.0 mi./sq. mile, to 2.3 mi./sq.mi. on the 5.5 square mile project area. Bear attractants would be required to be stored in a resistant manner. Some displacement could occur. Minor adverse effects to grizzly bears would be expected.</p>	<p>of the CE analysis area. Combined project road amounts could result in a cumulative increase in temporary open roads of 21.2 miles and an increase in density to 2.0 mi./sq. mi. for 3 to 5 years. Bear attractants would be required to be stored in a resistant manner. Some cumulative displacement could occur. Minor adverse cumulative effects to grizzly bears would be expected.</p>
Elk Security	<p>About 626 acres of elk security habitat meeting requirements of Hillis et al. (1991) occur in project area. The 93,551-acre elk security analysis area is currently below 30% recommendation at 23%.</p>	<p>No-Action: No direct or indirect effects to elk or elk security would be expected. Action: Of the existing 626 acres of elk security habitat patches on the project area, 138 would be removed leaving 488 acres (78%) after logging. Motorized equipment could disturb and displace elk. Elevated risk of elk displacement onto neighboring private lands would be present during operations, and some additional game damage situations could result. Long-term displacement of elk would not be expected. Minor adverse effects would be associated with loss of security habitat and short-term displacement</p>	<p>No-Action: No cumulative impacts to elk or elk security habitat would be expected. Action: Of the 21,822 acres (23%) of security habitat patches in the 93,551-acre elk security analysis area, (99%) would remain after logging [less than the 30% recommended by Hillis et al (1991)]. Considering both the DNRC and USFS BMW projects, the acreage of mature forest cover could be reduced from 21,822 acres to 17,796 acres (19%) of the 93,551-acre cumulative effects analysis area (combined reduction 4,026 acres). Motorized equipment could disturb and displace elk. Elevated risk of elk displacement onto neighboring private lands</p>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
		of elk.	would be present, and some additional game damage could result. Long-term displacement of elk would not be expected. Minor adverse cumulative effects would be associated with loss of security habitat and short-term displacement of elk. Short-term reduction in hunter opportunity could occur.
Big Game Use of Sections 1,2 and 11	Harvest units of concern total 258.6 acres and contain minimal roads. General area receives appreciable recreational use.	<p>No-Action: No effects associated with harvest units in sections 1, 2 and 11 would be expected.</p> <p>Action: Harvest units 1 and 3 would be treated (258.6 acres) and 2.1 miles of temporary road would be used to access unit 3. Canopy cover would be reduced by 17% in unit 1 and 30% in unit 3. Changes in habitat use by resident elk would be expected. Long term or permanent displacement would not be expected. Use of the new road as a highly used recreational route would not be expected as it would be made impassible.</p>	<p>No-Action: No cumulative impacts to big game associated with sections 1,2 and 11 would be expected.</p> <p>Action: Resident animals may be displaced >1 mile during operations. If the DNRC and USFS BMW projects occur, forest with >40% canopy would remain on 24,573 acres (73%) of the 33,422-acre CE analysis area. Changes in habitat use by resident elk would be expected. Long term or permanent displacement would not be expected. Cumulative effects associated with the 2.1 mile new road segment would not be expected as it would be made impassible following use.</p>
Big Game Winter Range	Dense mature forest occurs on ~2,532 acres (72%) of the 3,511-acre project area. 5.5 miles of existing road, and restricted road density of ~1.0 mi./sq. mi. The project area receives	<p>No-Action: No direct or indirect effects to wintering big game would be expected as a result of proposed activities. In areas heavily affected by mountain pine beetle,</p>	<p>No-Action: No cumulative effects to wintering big game would be expected.</p> <p>Action: Of the 93,551-acre cumulative effects analysis area, approximately 73,625 total acres (79%) would remain in mature forest</p>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	<p>appreciable recreational use during all seasons of the year.</p>	<p>CWD would likely increase in affected sites potentially inhibiting movements of animals in some areas. Action: Stand density and winter cover would be reduced on 734 acres in the project area. Of the 3,511-acre project area, 1,893 acres (54% of project area) would remain in mature forest cover with >40% overstory canopy closure. There would be short-term added risk of disturbance and displacement of wintering animals that could result in minor adverse effects associated with logging operations, short term road construction, and road use. No long-term impact to winter range carrying capacity or crops on neighboring private lands attributable to temporary increases in road density would be expected.</p>	<p>cover. If the DNRC and USFS BMW projects were to occur, mature forest cover could be reduced by 5,409 acres. Also, short-term (3 to 5 years) cumulative disturbance associated with roads and logging activities could occur, which might elevate winter stress, and influence movement patterns and habitat use by wintering animals. Additional disturbance associated with forest management activities under both projects would be cumulative to existing high levels of public recreational use in the cumulative effects analysis area, resulting in increased temporary displacement of wintering animals into secure areas, or potentially onto neighboring private agricultural lands, where game damage could occur. Long-term displacement of wintering animals onto private lands would not be expected as a result of proposed project activities.</p>
<p>Disturbance of Elk, Moose and Deer in Spring</p>	<p>Calving areas may occur within the project area. Dense mature forest occurs on ~2,532 acres (72%) of the 3,511-acre project area. 5.5 miles of existing road, and restricted road density of</p>	<p>No-Action: No direct or indirect effects to elk, moose or deer in the spring season would be expected. Action: Of the 3,511-acre project area, 1,893 acres (54% of project area)</p>	<p>No-Action: No cumulative effects to elk, moose or deer in the spring season would be expected. Action: Across the cumulative effects analysis area, dense patches of mature forest cover would remain well-connected. Of</p>

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	~1.0 mi./sq. mi. The project area receives appreciable recreational use during all seasons of the year.	would remain in mature forest cover with >40% overstory canopy closure. Cover and potential calving areas would remain on much of the project area. Disturbance risk associated with project activities would be low as logging would be restricted from March 15 th to June 15 th each year.	the 93,551-acre cumulative effects analysis area, approximately 73,625 total acres (79%) would remain in mature forest cover. If the DNRC and USFS BMW projects both occurred, mature forest cover could be reduced on as much as 5,409 acres. The proposed DNRC action would contribute minor adverse cumulative impacts related to spring habitat used during parturition for moose, elk, and mule deer.
RECREATION			
Amount and Condition of Trails and Facilities	Recreational use is facilitated by existing trailheads, parking areas, trails, and public access and land management roads throughout and surrounding the project area.	No-Action: No change. Action: Traffic would increase through the Mt. Ellis parking area. Harvest Unit 4 that runs adjacent to portions of the Charlie's Face Trail would be closed to recreational use during harvest activities. Approximately 6.9 miles of new road would be available for recreational purposes only during the operating period.	No-Action: No change. Action: Compared to existing conditions, the amount of road managed as Motorized Use Restricted Year-Round would decrease by 0.2 miles. Harvest Unit 4 that runs adjacent to Charlie's Face Trail would be open to recreational use after harvest activities are complete.
Recreational Experience	Recreational activities include hiking, skiing, running, birding, mountain biking, horseback riding, hunting, rock climbing and general enjoyment of flora and fauna.	No-Action: User experience may change due to increased pine beetle mortality of stands. Action: Harvesting and harvest-related traffic would temporarily displace recreationists.	No-Action: User experience may change due to increased pine beetle mortality of stands. Action: Areas outside of the project area would continue to offer recreational opportunities. Once harvest operations have completed administrative use of the road system and activities

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
			within the harvest units would be reduced to near pre-sale levels.
Recreational Season	Recreational use occurs nearly year-round with the types of use changing seasonally. Spring breakup has the least use.	No-Action: No change. Action: Harvest activities would occur up to 9 months per year and would be concentrated June 15 th through March 15 th over a 2 to 3 year period.	No-Action: No change. Action: Areas outside of the project area would continue to offer recreational opportunities throughout the seasons. Once harvest operations have completed seasonal activities would return to pre-sale levels.
Motorized Use	With the exception of Bear Canyon Road/Trail which is managed by Gallatin County and the USFS, motorized use is not allowed as a recreational activity by the public on state trust lands within the area.	No-Action: No change. Action: No motorized public use would be allowed throughout the project area.	No-Action: No change. Action: No motorized public use would be allowed on state trust lands within the Bear Canyon area.
AESTHETICS			
Amount of harvest area and road visible	As seen from each observation point, 7 to 11 percent of the project has been harvested in the past and 3 to 4.5 miles of road are visible within the project area. Previous harvest and road miles are also visible on adjacent ownerships.	No-Action: No change. Action: Approximately 200 to 400 acres of the harvest area (17 to 29 percent of the project area) would be visible from the observation points. Number of road miles visible would likely increase.	No-Action: No change. Action: Increase in visible managed acres associated with the proposed action and as seen from 3 observation points is expected to be consistent with the trend of the surrounding landscape. Harvest units are expected to constitute most of the managed acres that would be seen from Bear View Lane.
Quality of views	Harvested acres and roads throughout the area introduce sharp lines and varying textures. Older harvest	No-Action: The viewshed would continue to noticeably change do the effect of the mountain pine beetle.	No-Action: The viewshed would continue to noticeably change do the effect of the mountain pine beetle.

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	units have started to blend in although they appear more geometric than more recent harvests that considered topography in their design.	Action: Lodgepole pine stands would be clearcut and would appear very light in color and sharper in form. Douglas-fir stands would retain some canopy and would appear darker in color and less sharp in form.	Action: Lands throughout the area would likely continue to experience similar forms, lines, textures, and colors as they do currently. Older harvest units would continue to regenerate, blending in line, texture, form, and color while newer harvest units would continue to introduce new attributes in sharper contrast to regenerating stands.
Noise	Several activities generate noise throughout the area including: residential and recreational traffic; firewood harvesting; recreational use; construction activities; and agricultural activities.	No-Action: No change. Action: Noise would be generated by harvest operations, harvest related traffic, road construction and administrative oversight.	No-Action: No change. Action: Noise during the daytime and on weekends would be expected to increase beyond current levels found within the cumulative-effects analysis area.
ECONOMICS			
Income	It is unknown how much income is generated in the two county areas for forestry, logging, and hauling activities. This information is difficult to collect due to the large number of small wood products manufacturers in the area.	No-Action: \$0 Action: \$1,561,840 total delivered log value.	No-Action: \$0 Action: Cumulative income effects are limited by the scale of the initial project. It is difficult to measure cumulative income effects with any certainty.
Employment	It is unknown how many jobs are available in the forestry, logging, and wood product sectors within the two county areas. State labor statistics identify over 2,700 jobs in the wood	No-Action: 0 Action: 50 wood products, forestry, and logging jobs	No-Action: 0 Action: Cumulative employment effects are limited, as more timber sales in the region are required to maintain employment in the forestry, logging, and wood

RESOURCE ISSUE	EXISTING ENVIRONMENT	DIRECT AND INDIRECT EFFECTS	CUMULATIVE EFFECTS
	products sector, and 700 jobs in the forestry and logging sector statewide.		products sectors.
AIR QUALITY			
Smoke	Air quality within the analysis areas is excellent with very limited local emission sources and consistent wind dispersion.	No-Action: No change. Action: Burning would occur during the months of July through November and March through April during conditions that are conducive to good smoke dispersion. Actual burning days would be controlled and monitored by DEQ and the smoke monitoring unit of the Montana/Idaho Airshed.	No-Action: No change. Action: All burning activities by major burners would continue to comply with emission levels authorized by the DEQ, Montana/Idaho Airshed Group, and the EPA.
Dust		No-Action: No change. Action: Direct and indirect effects to air quality resulting from dust are expected to be localized to the roadways and areas directly adjacent to the roadways.	No-Action: No change. Action: Providing that dust abatement would be used during dry conditions and gravel operations, half of the harvest operations would occur during frozen and/or wetter conditions, and construction activities would be short in duration, cumulative effects to air quality resulting from dust are expected to be minimal.

Mitigations or Measures Designed to Reduce Impacts

Table II-4 summarizes the mitigations or measures designed to reduce impacts associated with the Action Alternative. Mitigations and measures were designed based on resource conditions, requirements imposed by rules and regulations, and issues and concerns generated by the public during the multiple scoping opportunities.

Table II - 4. Mitigations or measures designed to reduce impacts associated with the Action Alternative.

RESOURCE	MITIGATION OR MEASURE
Transportation	Postings warning of harvest-related traffic would be placed at the entrance to the state land at the end of Mt. Ellis Lane and at the trailhead at New World Gulch.
	Logging truck weight limits would be restricted as conditions warrant.
	Hauling on roads would be limited to dry or frozen conditions.
	In order to limit dust and reduce the needed maintenance on Mt. Ellis Lane, a treatment of magnesium chloride would be applied once conditions were dry enough to for it to be effective.
	Light grading to the county road would be provided to help maintain a smooth the driving surface for the hauling activities.
	The use of compression brakes “jake brakes” would be contractually prohibited on the Mt. Ellis Lane haul route to reduce noise.
	At the intersections of Mt. Ellis Lane and Bozeman Trail Road, signs would be places within 500 feet of the intersection on both directions of traffic indicating that log trucks would be entering the roadway.
Vegetation	No-entry buffers surrounding any threatened, endangered, or sensitive plant species that are encountered during operations would be established to prevent impacts to such species.
	In order to reduce the introduction and spread of noxious weeds, washing of equipment would be required prior to entering the site.
	In order to reduce the spread of noxious weeds, grass seed would be sown on new roads not needed for long-term administrative access after harvesting operations have been completed.
	Spot application of herbicide along roadsides and other identified areas with noxious weeds would be used to control the spread of noxious weeds.
Watershed and Fisheries	Debris close and grass seed all new road construction not necessary for long-term administrative access.
	Remove all new stream crossing culverts and hydrologically stabilize the crossing site to reduce risk of long-term water quality impacts.
	Apply BMPs and BMP maintenance to all new and existing road segments.
	Replace two culverts not currently meeting BMPs and restore one native log/earthen fill crossing to reduce long-term risk of water quality impacts.
	No harvest or equipment operation within established SMZs or RMZs.
	Limit upland detrimental soil disturbance to 15% or less of a harvest unit.
Geology and Soils	Limit equipment operations to periods when soils are relatively dry, (less than 20% soil moisture), frozen or snow covered (12 inches packed or 18 inches unconsolidated) to minimize soil compaction and rutting, and maintain drainage features.
	Ground-based logging equipment (tractors, skidders, and mechanical harvesters) is limited to sustained slopes less than 45% on ridges, convex slopes; and 40% or less on concave slopes without winter conditions.
	The Forest Officer shall approve a plan for felling, yarding and landings in each harvest unit prior to the start of operations in the unit. The locations and spacing

RESOURCE	MITIGATION OR MEASURE
	<p>of skid trails and landings shall be designated and approved by the Forest Officer prior to construction.</p> <p>Levels of coarse and fine woody material will be retained on site as prescribed by the forest officer and recommended by the project soil scientist using guidance from the best available science (Graham et al. 1994). 10-20 tons/acre of material >3" is recommended for the Bear Canyon project area with as many needles and fine material as possible which are typically retained during skidding operations.</p>
Wildlife	<p>Given operability and human safety constraints, retain all existing non-merchantable snags where possible.</p> <p>Across all harvest units, retain at least 2 large snags and 2 large recruitment trees per acre (both >21 inches dbh, or largest available).</p> <p>In all harvest units retain large woody debris within ranges recommended by Graham et al. (1994).</p> <p>If a wolf den is found within 1 mile of active harvest units or within 0.5 miles of a rendezvous site, cease operations and consult a DNRC wildlife biologist for appropriate site specific mitigations before resuming activities.</p> <p>In harvest units without planned broadcast burning, retain as possible 3 to 5 slash piles (10 to 20 ft. diameter) to provide residual structure for small mammals, amphibians and other wildlife.</p> <p>Require DNRC employees and contractors to store any unnatural bear foods or attractants in a bear-resistant manner (contract clause requirement).</p> <p>Opening sizes in regeneration harvest units must be designed in a manner that requires any point within each unit to be within 600 feet of hiding cover -- in at least one direction.</p> <p>Where opportunities exist, retain leave trees and retention areas in a clumped fashion to emulate natural disturbance patterns and reduce sight distances for wildlife.</p> <p>Restrict mechanized operations from March 15 to June 15 to minimize risk of disturbance calving areas and nesting birds.</p> <p>Retain thickets comprised of subalpine fir and spruce where possible as desirable structure and species diversity for snowshoe hares and visual screening.</p>
Recreation	<p>During times of active harvesting operations, harvest units would be closed to recreationists for safety considerations. Closures would be well-posted at locations surrounding the harvest units and at the parking area and trailheads.</p> <p>Notification of potential log hauling and other associated traffic would be posted at the parking area and the trailhead.</p> <p>Areas receiving prescribed burning treatments would be closed during periods of operation. Appropriate signage would be posted surrounding the burn units as well as at the parking areas and trailheads.</p>
Aesthetics	<p>For all categories of stands, where the opportunities exist, the edges of the cutting units would be feathered into the surrounding trees to soften the edges and to create a more natural looking transition between stands.</p> <p>Topography would be used to reduce the acres of harvest visible from a specific observation point; opportunities to apply this would be most prevalent where</p>

RESOURCE	MITIGATION OR MEASURE
	<p data-bbox="462 239 678 275">Douglas-fir exists.</p> <p data-bbox="462 281 1414 348">Where possible, trees would be retained along roads in attempts to minimize the impacts to the viewshed as seen from the observation points.</p>
Air Quality	<p data-bbox="462 354 1377 457">In order to limit dust and reduce the needed maintenance on Mt. Ellis Lane, a treatment of magnesium chloride would be applied once conditions were dry enough to for it to be effective.</p> <p data-bbox="462 464 1398 567">Burning would most likely occur during the months of July through November and March through April during conditions that are conducive to good smoke dispersion.</p> <p data-bbox="462 573 1414 676">Actual burning days would be controlled and monitored by DEQ and the smoke monitoring unit of the Montana/Idaho Airshed Group and would meet EPA standards.</p>

Chapter 3 Affected Environment and Environmental Consequences

Introduction

This chapter covers the existing conditions (affected environment) and the predicted environmental effects (environmental consequences) of both the No-Action and the Action Alternative on the following resources: transportation, vegetation, watershed and fisheries, geology and soils, wildlife, recreation, aesthetics, economics, and air quality.

Transportation

The state trust lands sections in Bear Canyon are supported by a network of roads that provide access to both the forested state trust lands and the grazing state trust lands for the purposes of conducting forest management activities, grazing activities, fire suppression, and recreational use. In contrast to these and other benefits, roads and associated maintenance activities can affect many aspects of the natural environment, including stream connectivity, water quality (e.g., increased sedimentation from road surface erosion or mass wasting), habitat quality (e.g. increased fragmentation, avoidance of habitats), and wildlife use (e.g., increased human contact or hunting pressures).

The network of roads on the state trust lands in Bear Canyon are benefited by county road access providing legal access for forest and grazing management activities and for public recreation. In contrast to these benefits an increase in use or scope of the road system supporting state trust lands may have a cumulative effect on the access roads (e.g., increased traffic volume both public and management related, decrease in air quality, condition of road surface).

This section describes the affected environment and environmental consequences of the No-Action and Action Alternatives on DNRC's management of its transportation (road) resources in the Bear Canyon area. Specific road-related effects on other resources are discussed in the *Chapter 3 – Geology and Soils, Watershed and Fisheries, Wildlife, Air Quality, Recreation and Aesthetics analyses*. The following discussion of affected environment describes the policies, rules, and regulations that guide DNRC's management of roads on its lands, as well as the current status of the DNRC-managed roads in the Bear Canyon Timber Sale project area. The subsequent analysis of environmental consequences addresses issues raised during public scoping and describes likely changes to DNRC's road network in the Bear Canyon area and its management under the No-Action and Action Alternatives.

Analysis Areas

The project area will be the analysis area used to determine direct and indirect environmental effects of the transportation system included in the proposed action.

The analysis area used to determine the cumulative environmental effects of the transportation system included in the proposed action will include the 5,500 acres of blocked state trust land in the Bear Canyon area and the County Roads accessing the project area from US interstate 90. This analysis area will herein be referred to as the cumulative-effects analysis area.

Analysis Methods

Issues and Measurement Criteria

A number of concerns were raised during the scoping period regarding how potential impacts to the transportation system may affect the project area and the neighbors of the

project area. The following issue statements account for those concerns and ultimately guides this analysis:

- Increase in road densities may result in motorized use of the area which may adversely affect current recreational use of the area.
- Harvest activities may increase the amount of permanent roads within the project area.
- Concern that DNRC may not adequately rehabilitate existing road problems or road problems that may result from harvest activities.
- Traffic and other harvest activities may adversely affect public safety along the haul route both within the project area and on the public roads leading to the harvest area.

Quantitative and qualitative changes to the following measurement criteria are intended to ‘measure’ the extent of potential direct, indirect, and cumulative environmental effects the transportation system included in the proposed action may have on the area:

- condition of roads within and leading up to the project area
- amount, distribution, and status of roads
- traffic

In measuring traffic, DNRC developed calculations to determine how many harvest-related traffic trips would result under the Action Alternative. A ‘trip’ refers to travel in one direction. That is, a trip *to* the harvest site is counted as one event while the trip *from* the harvest site is counted as a separate event.

Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations

DNRC’s road-related activities supporting forest management activities on state trust lands include construction, reconstruction, abandonment, reclamation, maintenance, and use. These activities are typically conducted and funded through timber sale contracts, although some road maintenance is partially funded through DNRC’s forest improvement program. Road management standards were established in the SFLMP and subsequently adopted as part of the Forest Management Rules (*ARM 36.11.421*).

DNRC currently uses 5 levels of access classification as defined in the Forest Management Rules:

- **Open Roads.** Highways, county roads, unrestricted DNRC roads, roads with unknown access restrictions, and roads restricted by non-DNRC owners (either seasonally or year round).
- **Motorized Use Restricted Seasonally.** Roads that are seasonally restricted to motorized public access but have varying access restrictions for commercial and agency use (open or seasonally restricted).

- **Motorized Use Restricted Year-Round.** Roads that are restricted year-round to motorized public access but have varying access restrictions for commercial and agency use (open or seasonally restricted).
- **Abandoned.** Roads that are no longer used but that have not been restored. Culverts may be present and the road prism is evident; however, these roads are typically in some state of reforestation.
- **Reclaimed.** Includes roads that have been restored to natural conditions so that all structures (i.e., culverts) have been removed and the road prism is no longer evident. These roads are typically in some state of reforestation.

Affected Environment

Condition of Roads

The existing road system as depicted on *Figure T-1* below consist of approximately 5.5 miles of vegetated native surface roads. This system was originally developed to support the 1981 Clearcut Harvest in Section 2 T3S R6E and the Douglas fir harvest in Section 34 T2S R6E, then expanded and used again for the 1991 Viewshed Harvest in Section 3 T3S R6E and 35 T2S R6E (see *Chapter 1 – Relevant Past, Present, and Related Future Actions*).

Most of the road system developed to support these harvests is still serviceable, after maintenance and drainage improvements to meet BMPs with a few notable exceptions. Most prominent of the exceptions would be in *Section A* on the *Figure T-2* beginning at the end of Mt. Ellis Road and crossing the meadow in section 35 T2S R3E. This stretch of road was never properly designed as a road and has since eroded severely rendering it unusable in its current form. Other notable deficiencies in the existing road system are inadequate culverts (*Points B* in *Figure T-2*) in the road that accesses section 34 and a deteriorating log stringer stream crossing on the old guard road (*Point C* in *Figure T-2*).

Figure T - 1. Existing transportation system within and approaching the project area.

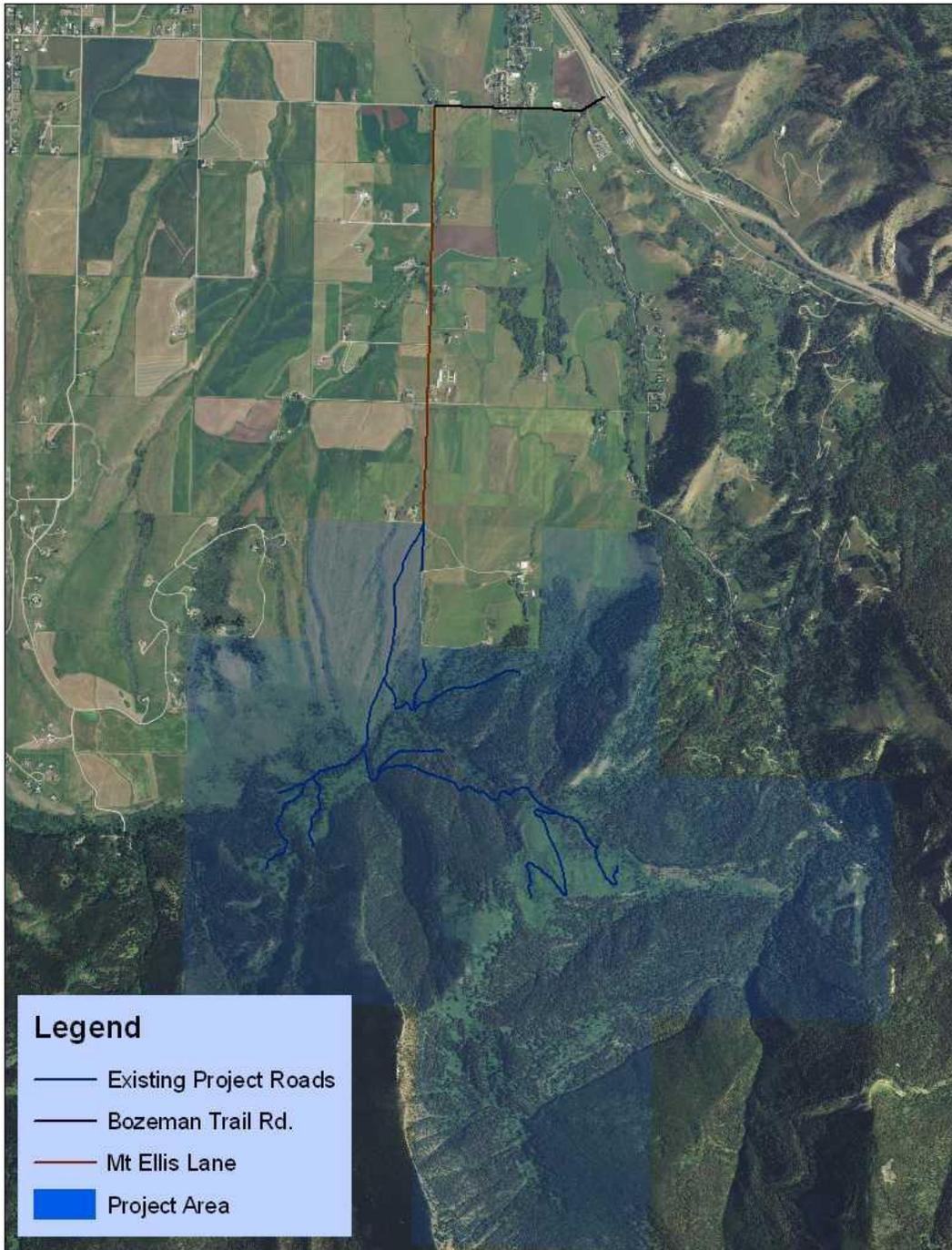
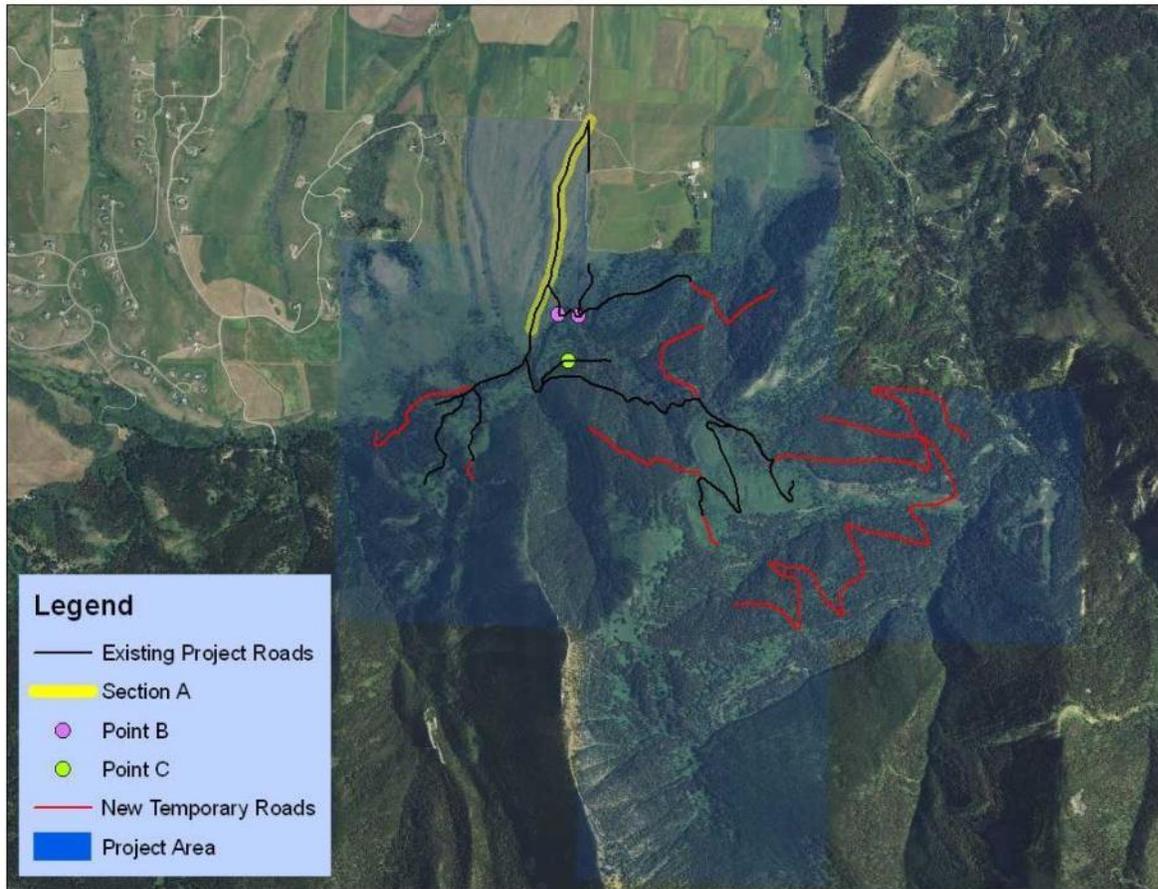


Figure T - 2. Transportation system issues not currently meeting best management practices.

Amount, Distribution, and Status of Roads

Miles of road present within an area can provide an indication of the degree of potential environmental impacts. All roads impact the natural environment to some degree; however, open roads receive more traffic than restricted roads and consequently can impact the environment to a greater degree.

The current road system supporting the project area consists of 5.5 miles of road that are designated Motorized Use Restricted Year-Round. There are no Open Roads within the project area. This management designation allows for motorized use by state officials and commercial use in association with trust land management activities (e.g. timber harvest, grazing, firewood), but does not allow for public or recreational motorized use. The public in possession of a recreational use permit or a hunting license while hunting (*see Chapter 3 – Recreation*) is allowed to use the existing road system for non-motorized travel. Maintenance on the existing road system is generally funded by forest management projects, without which it is not maintained.

While the miles of road, as discussed above, provides a measure of total potential impacts, road density [miles per square mile (mi/mi²)] measures road impacts relative to the amount of land covered by those roads. A higher road density within an area generally indicates a higher potential for effects on that area. The density of open roads measures the level of roads in an area receiving the heaviest use relative to the total amount of land area accessed by those roads. The total density of roads currently existing in the project area is approximately 1.1 mi/mi² with specific sections as high as 2.0 mi/mi².

Traffic

Over the past 10 years the motorized traffic within the project area has consisted of occasional administrative visits by state personnel (about once or twice a month during summer and fall), use by our grazing lessee, and some firewood permit holders. The majority of the use has been non-motorized recreational use, consisting of hikers, hunters, bicyclists, horseback riders and cross-country skiers. The recreational users have used not only the existing road system but the surrounding lands in accordance with the recreational use permit system. As the population pressures have increased in the Gallatin Valley the recreational use of the roads and surrounding lands have shown a corresponding increase, as evidenced by the use of the parking at the end of Mt. Ellis Lane.

Access Routes Leading Up to Bear Canyon Project Area

Access to the project area is provided by the county roads Mt. Ellis Lane and Bozeman Trail Road as illustrated in *Figure T-1*. Besides servicing the residents and providing administrative access to the state land, these roads also provide the public with recreational access to the state land. These roads receive regular maintenance from the county which is funded by taxes paid by the road users through vehicle registrations, property and fuel taxes. To protect users and the road infrastructure the county has established speed limits and seasonal weight limits for all vehicles using these roads.

Mt. Ellis Lane is a 1 ¾ mile gravel road servicing approximately 20 residences leading from Bozeman Trail Road to the state trust land. Average daily trips were measured in October of 2009 and October of 2007 and the totals were 199 and 258 average daily trips respectively. The county maintains the road as needed when their resources are available throughout the year. During periods of wet conditions, primarily in the spring, the County Road Department places weight restrictions of 300 pounds per square inch of tire width on vehicles to protect the road from damage. In 2004 the county established a 35 miles per hour speed limit on the road. Some residents along the road contract for magnesium chloride treatments to control dust in the vicinity of their residences.

Bozeman Trail Road is a chip-sealed road providing access to I-90 approximately ¾ mile from Mt. Ellis Lane. In September of 2010, 1,484 average daily trips were measured just to the west of the Bear Canyon Road. The speed limit on the road is 40 miles per hour with a speed zone of 15 miles per hour just prior to the Mt. Ellis Academy and Ft. Ellis Fire Department. The county has the ability to restrict the weight on the road if it appears necessary to reduce damage.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Roads within the project area would continue to be managed as Motorized Use Restricted Year-Round. General maintenance would not be conducted, but maintenance would be conducted on the two culverts that are not properly functioning and the deteriorating log stringer in Section 34 *Points B* and *C* in *Figure T-2*. Most of the road conditions would remain in their current condition with the exception of the culverts at *Points B* and *C*. The culverts at *Points B* would be maintained and improved to meet acceptable standards; the deterioration log stringer would be removed. The roads would continue to be used for administrative purposes and support the recreational uses associated with non-motorized travel.

The amount and distribution of roads within the project area would not change.

Motorized traffic by state personnel and associated trust land management activities would remain occasional. The recreational traffic would continue to increase reflecting the recreational pressures exhibited by a growing population.

Direct and Indirect Effects of the Action Alternative

Condition, Amount, and Distribution of Roads

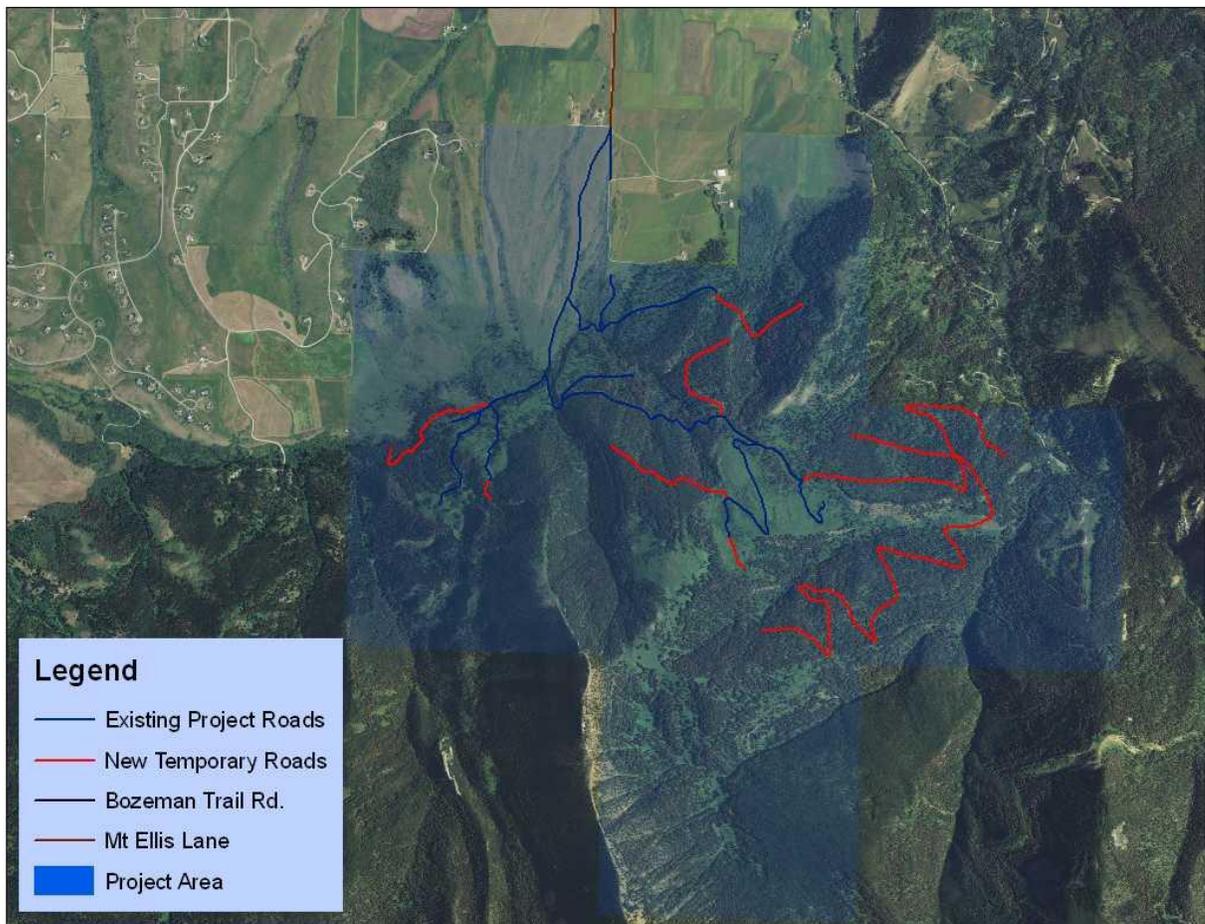
Under the Action Alternative, up to 6.9 miles of new road would be constructed to support harvest activities thereby resulting in a total mileage of 12.4 miles and road density of 2.5 mi/mi² within the project area (*Table T-1 and Figure T-3*). Road densities for specific sections could be as high as 3.5 mi/mi². Reconstruction and maintenance activities would take place on the existing 5.5 miles of roads in order to meet the BMP standards detailed in the *Chapter 3 – Watershed and Fisheries. Section A* at the entrance to the state trust lands on Mt. Ellis Lane would be redesigned and reconstructed (*see Figure T-2*). The culverts at *Points B* would be maintained and improved to meet the BMP standards, the log stringer at *Point C* would be removed and the road spur leading to it would be abandoned and debris closed, as detailed in *Chapter 3 – Watershed and Fisheries*.

During harvest operations, the existing roads and the new roads constructed would be managed as Motorized Use Restricted Year-Round. This management designation would only allow motorized use by DNRC and by the commercial users associated with harvest activities. Signs informing the public of road-use activities would be placed at the trailheads at New World Gulch and at the entrance to the state trust land at the end of Mt. Ellis Lane.

Table T - 1. Amount and densities of road associated with the No-Action and Action Alternatives expected during harvest activities.

Project Actions	Alternatives	
	No-Action	Action
Miles of Road Reconstruction and Maintenance to Meet BMPs	0	5.5
Miles of New Road Construction	0	6.9
Project Area Road Density (mi/mi ²)	1.1	2.5
Max Section Road Density (mi/mi ²)	2.0	3.5

Figure T - 3. Existing roads and new roads associated with the Action Alternative.



Traffic

The Action Alternative would result in increased administrative and commercial-use traffic. Traffic associated with administrative use would include: inspections of conditions and harvest activities; weed management; slash pile burning; and broadcast burning. Traffic associated with commercial activities would include: road construction, reconstruction and maintenance; log hauling; and transporting equipment and crews to the worksite. Some

activities would possibly decrease, such as the commercial use by firewood permit holders since that activity is likely to be curtailed due to conflicts with the timber sale itself. See *Table T-2* for a detailed summary of traffic associated with the Action Alternative.

Table T - 2. Administrative and commercial-use traffic associated with the Action Alternative.

Activity	Daily Operation	Weekly Operation	Monthly Operation	Conditions of Use	Total Trips Per Day
Road Construction, Reconstruction, and Maintenance	7:00 am to 6:00 pm	Up to 7 days per week	Summer or Fall (1 to 2 months total depending on capacity of contractor)	Dry conditions	2 to 4 trips per operating day
Log Trucks (1 to 5 trucks on rotation)	4:00 am (arrival) 5:30 am to 6:00 pm (hauling out)	Monday through Friday (except major holidays)	June 15 th through Mar 15 th (starting in 2012)	Dry or frozen conditions	5 to 15 trips per day
Loader Operator (1 to 2 vehicles)	4:00 am to 6:30 pm	Monday through Friday (except major holidays)	June 15 th through Mar 15 th (starting in 2012)	Dry or frozen conditions	2 to 4 trips per operating day
Harvest Crews (2 to 4 vehicles)	5:30 am to 6:30 pm	Up to 7 days per week	June 15 th through Mar 15 th (starting in 2012)	Soil Moisture < 20% or dry or frozen conditions	4 to 8 trips per day
Administration (beginning and end of harvest season)	8:00 am to 6:00 pm	3 to 5 days per week	2 months at beginning of harvest season and one month at end of harvest season		2 to 4 trips per day
Administration (mid-season harvest)	8:00 am to 6:00 pm	1 to 2 days per week	During harvest		1 to 2 trips per day

Over the 2 to 3 year operating period, traffic associated with administrative and commercial use would be expected to increase. The increase in administrative motorized traffic could be expected to be the most intense at the beginning and end of harvest operations. Traffic would be expected to occur mostly between June 15th and March 15th (160 days) when conditions are suitable for harvest activities [e.g. ground not dry (< 20 percent soil moisture)]

or frozen, weekends, or during major holidays]. The total harvest of 6 MMbf of timber would require approximately 1,500 total truck loads. This amount averaged over 160 hauling days would result in approximately 5 loads of logs per day. Since conditions and timber may not be available on a consistent basis, the loads per day are likely to vary with no hauling on some days and up to 15 or more loads on other days. In conjunction with the hauling of the timber, traffic would be generated by the harvest crews transporting to and from the site. Depending on the number of crew members, 6 to 12 trips per day would be expected.

Log hauling activities would be restricted on weekends and major holidays to minimize traffic conflict. Postings warning of harvest-related traffic would be placed at the entrance to the state land at the end of Mt. Ellis Lane and at the trailhead at New World Gulch. There would also be “Logging Operations” signs placed at the entry ways to active harvest areas along with some additional “Log Truck” signs placed intermittently throughout the project area.

Cumulative Effects of the No-Action Alternative

The transportation system roads managed as Motorized Use Restricted Year-Round would continue to be used for administrative purposes including; weed management, grazing management, firewood permits, and future forest management activities including timber permits and sales. Traffic and maintenance would continue in roughly the same pattern they have been for the last few years.

An increase in recreational traffic could be expected since recreational traffic has increased regularly in the Gallatin Valley at most of the access points to public lands.

Cumulative Effects of the Action Alternative

Condition, Amount, and Distribution of Roads

After harvest activities are complete, approximately 7.1 miles of road would be abandoned (*Table T-3*) thereby returning road densities to pre-sale levels. For these abandoned roads, culverts would be removed and the roadbeds would be seeded with grass and closed with debris while leaving the road prism in place. These roads would also be administratively closed for travel to allow them to re-vegetate. The remaining 5.3 miles of road would be managed as Motorized Use Restricted Year-Round and would be graded to eliminate ruts and ensure proper drainage then seeded to grass (*Table T-4*).

Table T - 3. Amount and densities of road associated with the No-Action and Action Alternatives expected after harvest activities are complete.

Project Actions	Alternatives	
	No-Action	Action
Miles of Road Within the Project Area	5.5	5.3
Post Project Area Road Density (mi/mi ²)	1.1	1.1
Post Project Max Section Road Density mi/mi ²	2.0	2.0

Table T - 4. Road miles by road status under the No-Action and Action Alternative after harvest activities are complete.

Status	Alternatives	
	No-Action	Action
Abandoned, closed with slash and debris	0	7.1
Motorized Use Restricted Year-Round (Closed to Public Motorized Use / Open for Administrative Use)	5.5	5.3

Traffic

At project completion the transportation system roads managed as Motorized Use Restricted Year-Round would continue to be used for administrative purposes including; weed management, grazing management, firewood permits, and future forest management activities including timber permits and sales. The improved access through the grazing land in Section 34 may provide for more opportunities to use permits to facilitate small forest management projects in the future. Future permits or sales would require an environmental analysis to comply with MEPA. Recreational use would be expected to increase as it has historically due to population pressures in the Gallatin Valley.

Log hauling and support traffic would increase during the seasons of harvest (June 15th to March 15th) on Mt. Ellis Lane and Bozeman Trail Road between the state land and I-90 concurrent with the harvest-related traffic outlined in *Table T-2*. Log hauling and support traffic on Mt. Ellis lane could result in up to 20 percent increase in traffic on days that experience peak use. The log trucks and support traffic would be contractually obligated to follow county regulations of speed and weight limits. The county has indicated that Mt. Ellis Lane has weight restrictions placed on it primarily in the spring due to concerns over degradation of the road base exacerbated by moisture, but if moist conditions were to occur at other times of the year the weight could be restricted as needed.

Log hauling and support traffic on Bozeman Trail Road could result in up to a one percent increase in traffic on days that experience peak use. Gallatin County has concerns regarding the degradation of the chip seal on the road during periods of moist conditions and could apply weight limits if conditions are warranted.

Mitigations to the haul route would include limiting hauling on both roads to dry or frozen conditions, just as they would be on the state transportation system. As a measure to limit dust and reduce the needed maintenance on Mt. Ellis Lane, a treatment of magnesium chloride would be applied once conditions were dry enough to for it to be effective. Light grading to the road surface would be provided to help maintain a smooth the driving surface for the hauling activities. The use of compression brakes “jake brakes” would be contractually prohibited on the Mt. Ellis Lane haul route to reduce noise. At the intersections of Mt. Ellis Rd. and Bozeman Trail Road signs would be places within 500 feet of the intersection on both direction of traffic indicating that log truck would be entering the roadway.

Vegetation

Introduction

The vegetation assessment describes the present conditions and components of the vegetation communities in the area, as well as the anticipated effects of both the No-Action and Action Alternatives on vegetation.

Issues and Measurement Criteria

Issues expressed during initial scoping internally and by the public are summarized by the following statements:

1. There are concerns that harvest activities/silvicultural methods may not adequately address forest health and productivity, aesthetics, wildlife, and fire hazard.

Measurement criteria: cover type distribution, desired future conditions, age class distribution, insect and diseases presence, stand structure

2. There are concerns that harvest activities /road building/weed spraying may harm/adversely affect native flora

Measurement criteria: species presence and forest cover type distribution

3. There are concerns that harvest activities/roads may introduce/spread noxious weeds.

Measurement criteria: species presence and distribution

Analysis Areas

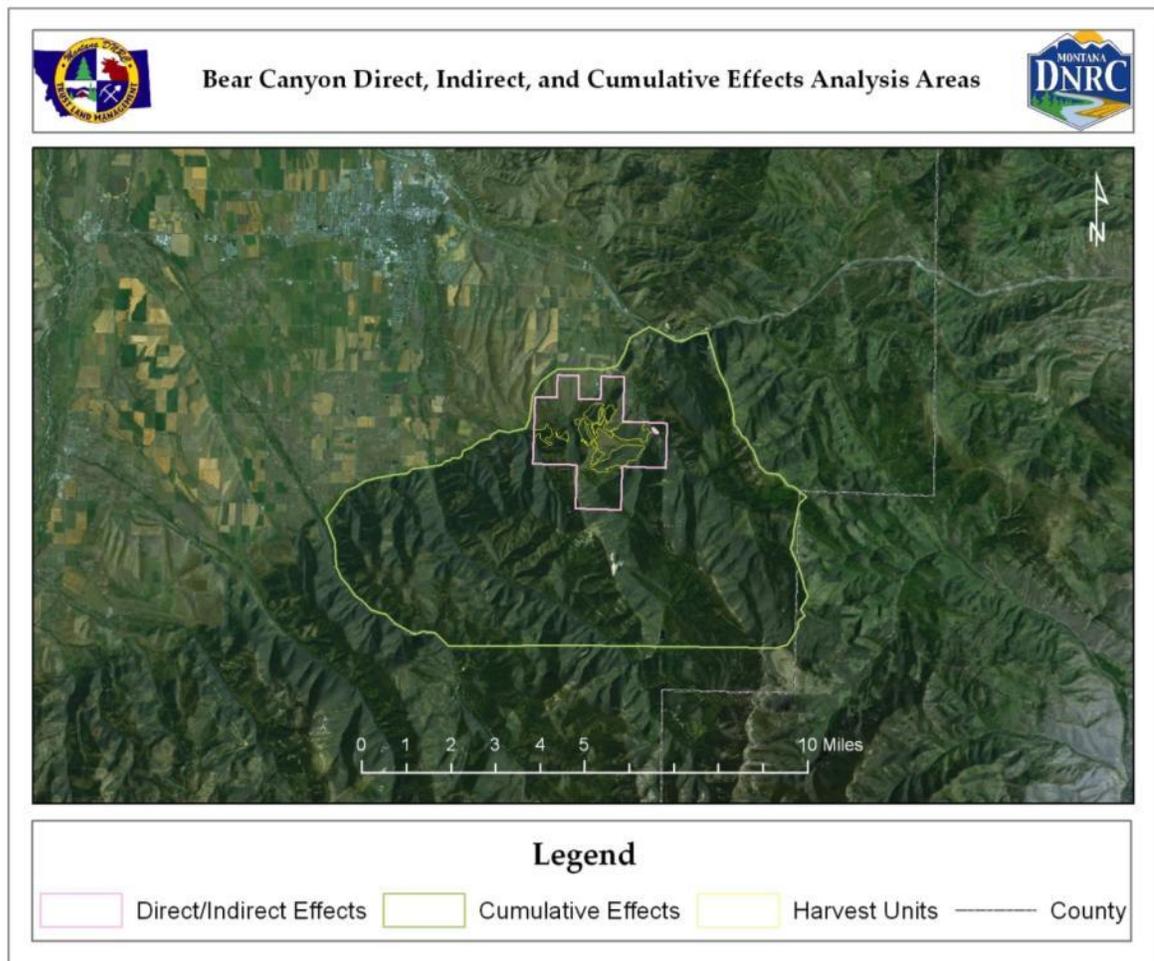
This analysis includes two geographic scales for assessing potential direct, indirect, and cumulative effects of the No-Action and Action Alternatives.

Direct and Indirect Effects Analysis Area

The analysis area for direct and indirect effects includes the state owned parcels in Sections 34 and 35 of T2S, R6E, and Sections 2, 3, 4, and 11 of T3S, R6E (*Figure V-1*). This area is referred to as the project area (*see Chapter I – Purpose and Need*).

Cumulative Effects Analysis Area

An analysis area, hereafter referred to as the Bear Canyon Landscape (BCL) was identified for the purpose of analyzing cumulative effects to forest vegetation associated with this project. This area of 33,422 acres is southeast of Bozeman and surrounds the project area (*Figure V-1*). Property ownership within this area is generally divided among three categories: National Forest lands managed by the USFS (64 percent), state trust lands (19 percent), and private ownership (14 percent). Mountainous terrain varying in steepness and topography is found throughout most of the area.

Figure V - 1. Vegetation analysis areas for direct, indirect, and cumulative effects.

Stand History and Past Management

The majority of the forests within the project area have no history of past management; however, timber harvesting has taken place on approximately 258 acres in the project area since the early 1980s. Harvesting activities have employed the following treatment types: intermediate treatments (thinning) to correct overstocking and promote growth, and to reduce fire hazard near private property; sanitation and salvage of insect-killed trees; and regeneration treatments including clearcutting, seed tree with reserves, and shelterwood with reserves treatments that aim to initiate the growth of a new stand of trees. Small-scale firewood cutting and 30 acres of precommercial thinning have also occurred in the project area (see Chapter 1 – *Relevant Past, Present, and Related Future Actions*).

As with the project area, the majority of forests in the BCL have no history of past management. Twelve acres have been recently harvested on state lands in the BCL that are not included in the project area, and GAP data indicates that approximately 450 additional acres (150 acres of private and 300 acres of National Forest land) in the BCL have been

harvested in the past 50 years. The harvesting on USFS land is concentrated in the southwestern portion of the BCL in the Hyalite and Bozeman Creek drainages.

Fire has been largely absent from the project area and BCL over the past 100 years, due primarily to effective suppression of fire starts that have occurred. Tree age data collected in the project area during 2010 indicated that most forests in the project area are relatively even-aged and are between 90 to 120 years old. The narrow distribution of tree ages indicates that one or two single, large disturbances in the late 1800s or early 1900s, most likely fires, initiated the development of the stands presently found in the project area and BCL.

Other relevant projects that have occurred in the past, are in progress, or planned in both the project area and BCL are listed in *Chapter 1 – Relevant Past, Present, and Related Future Actions*. The effects of past actions are included in the described affected environment for the project area and BCL.

Forest Cover Types and Age Classes

Analysis Methods

To assess the effects of the Action Alternative on forest cover types in the project area, current cover types listed in DNRC's Stand Level Inventory (SLI) were compared to the desired future condition (DFC) cover type using DNRC's model described in *ARM 36.11.405*. US Geological Survey Gap Analysis Program (GAP) data was used to describe cover types in the BCL.

Age classes of forested stands in the project area and BCL were determined using DNRC SLI data, aerial photographs, and pre-timber sale cruise data collected by DNRC foresters during the summer of 2010.

Affected Environment

Project Area Cover Types and DFCs

Within the project area, there are 2,723 acres of forested land and 786 acres of non-forest land (*Table V-1*). Of the forested acres, Douglas-fir is the most commonly occurring cover type; it is found on 51 percent (1,798 acres) of the project area (*Table V-1*). Douglas-fir forests are composed of at least 60 percent Douglas-fir; in the project area these stands are typically pure Douglas-fir stands or mixed-species stands containing Douglas-fir and lodgepole pine. In some instances, Engelmann spruce, subalpine fir, and limber pine are also present in small amounts. Stands classified as lodgepole pine are composed of at least 50 percent lodgepole pine, and in the project area are typically pure lodgepole pine stands or mixed stands containing small amounts of Douglas-fir. Subalpine stands are found on cool and cold sites, typically at higher elevations, and contain a mix of species including subalpine fir, Engelmann spruce, and lesser amounts of lodgepole pine and Douglas-fir. Mixed conifer stands are found below the subalpine zone and contain a similar species assemblage to subalpine types. Hardwood forests are dominated by quaking aspen or cottonwood

species. Non-forest stands are areas that have less than 10 percent tree canopy cover and are not capable of achieving greater than 10 percent tree canopy cover; these areas are typically dominated by grasses, forbs, or shrubs. In the project area, these areas include open hillsides and meadows containing grasses, wildflowers, and small shrubs such as ninebark.

Table V-1 also shows DNRC's DFC for the stands in the project area. The DFC represents that cover type that DNRC aims to manage toward in a given stand in order to implement its coarse-filter approach to managing for biodiversity (ARM 36.11.404). In the project area, all but 4 acres currently match their DFC, with the exception being 4 acres of mixed conifer that has a DFC of Douglas-fir.

Table V - 1. Current cover types and desired future conditions for the project area.

COVER TYPE	Pre-Treatment (Current Cover)		Post-Treatment		DFC	
	Acres	Percent*	Acres	Percent*	Acres	Percent*
Douglas-fir	1798	51	1802	51	1802	51
Hardwoods	144	4	144	4	144	4
Lodgepole pine	353	10	353	10	353	10
Mixed conifer	4	<1	0	0	0	0
Non-forest	786	22	786	22	786	22
Subalpine	424	12	424	12	424	12
TOTAL	3509	100	3509	100	3509	100

*numbers may not sum to 100 due to rounding.

BCL Cover Types

Within the BCL, there are 27,923 acres of forest land and 5,499 acres of non-forest land (Figure V-2; Table V-2). Of the forested acres, Douglas-fir is the most commonly occurring cover type; it is found on 50 percent (16,630 acres) of the BCL (Table V-2). Lodgepole pine (17 percent) and hardwood forests of aspen and cottonwoods (13 percent) are also common. Non-forest types in the BCL are predominately riparian areas, sagebrush steppe, montane shrublands, meadow communities, and montane grasslands. Small areas of pasture and cropland are also present.

Figure V - 2. GAP land cover data in the project area and Bear Canyon Landscape.

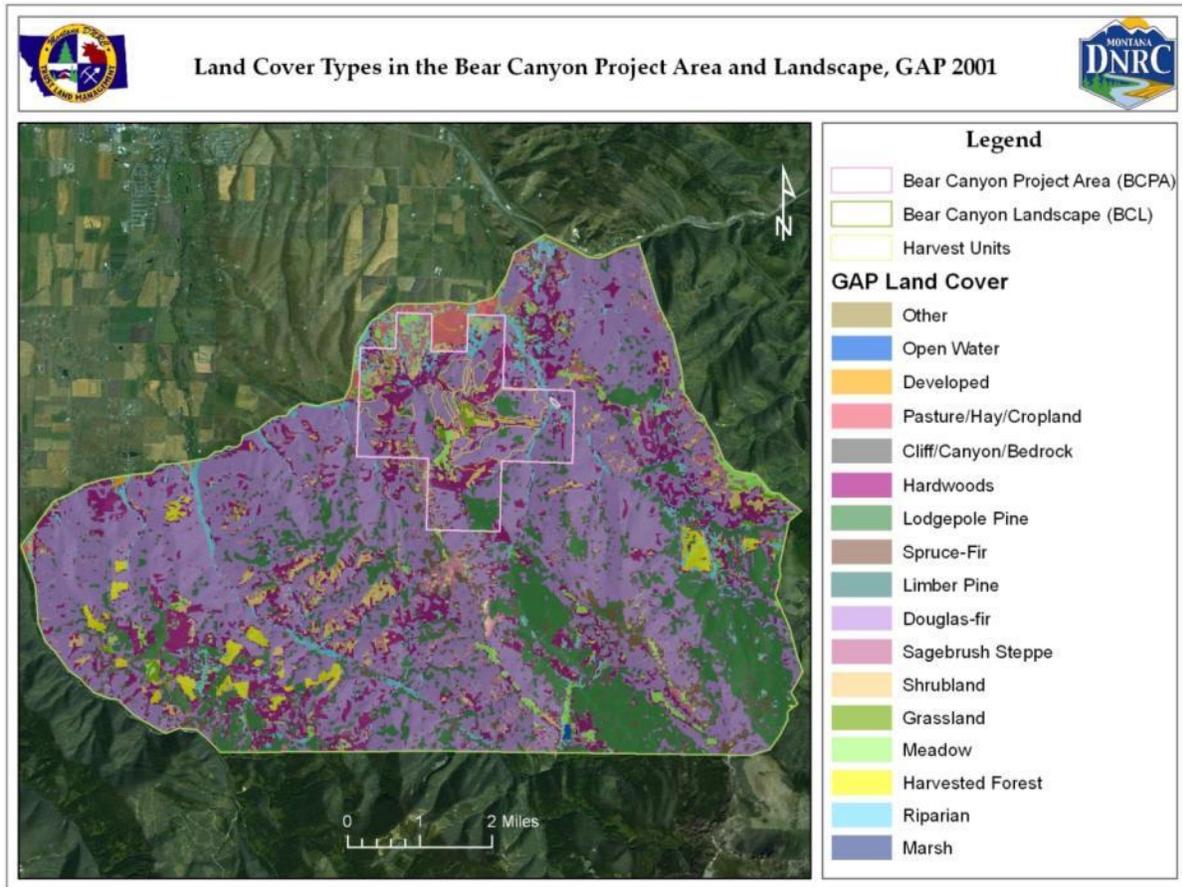


Table V - 2. Current cover types for the Bear Canyon Landscape.

<i>COVER TYPE</i>	Acres	Percent*
Douglas-fir	16,630	50
Hardwoods	4,212	13
Limber pine	24	<1
Lodgepole pine	5,796	17
Spruce-fir**	1,261	4
Non-forest	5,499	16
TOTAL	33,422	100

*numbers may not sum to 100 due to rounding.

**Spruce-fir in the BCL is analogous to the mixed conifer and subalpine types described in the project area.

Age Classes

Forest stands in the project area and BCL are predominantly 90 to 120 years old with occasional old, scattered trees approaching 180 years. Recent harvest units logged during the last several decades are typically 0 to 39 years old.

DNRC has adopted the Green et al. (1992) criteria for determining old growth stands on state lands (ARM 36.11.403). Stands of sufficient old age and number of large trees to meet these criteria were not found on the project area.

Environmental Effects

Direct and Indirect Effects of the No-Action Alternative

In areas where lodgepole pine is the dominant species, mortality due to the mountain pine beetle could create temporary openings varying in size that would be expected over time to regenerate with lodgepole pine or Douglas-fir. The age class in those areas would likely shift from 90-plus year old mature stands to 0 to 39 year old seedling and sapling stands. In areas of the project area where other cover types (Douglas-fir, hardwoods, subalpine, mixed conifer, and non-forest) are dominant, no changes in cover type or age class would be expected.

Direct and Indirect Effects of the Action Alternative

Within the project area, the proposed harvesting activities would change 4 acres of the mixed conifer cover type to the Douglas-fir cover type. With the exception of the 4 acres of mixed conifer converted to Douglas-fir, post-harvest stands are expected to have the same species composition and cover type classification as the pre-harvest stands (Table V-1). Regeneration of new trees would be expected to initiate immediately following harvesting, with seedling and sapling components fully established in harvested areas within 15 years following harvesting; however, in areas where prescribed burning is used for site preparation, the development of regeneration could be accelerated. Planting may also be used to augment natural regeneration in some harvested areas. In areas of the project area where harvest is not proposed and lodgepole pine is the dominant species, mortality due to the mountain pine beetle could create temporary openings varying in size that would be expected over time to regenerate with lodgepole pine or Douglas-fir.

Harvesting activities would alter the age class distribution in the project area by increasing the amount of younger forests. In cutting units 4, 5, and 6, each of which has a significant component of lodgepole pine that would be removed during harvesting, up to 286 acres would be expected to shift from the 90-plus year age class to the 0 to 39 year age class. Age classes in the remaining 448 harvested acres would not be expected to change due the number of trees left on site following harvesting. In areas of the project area where harvest is not proposed and lodgepole pine is the dominant species, mortality due to the mountain pine beetle could shift stands from the 90-plus year age class to the 0 to 39 year age class.

Cumulative Effects of the No-Action Alternative

In areas where lodgepole pine is the dominant species, mortality due to the mountain pine beetle could create temporary openings varying in size that would be expected over time to regenerate with lodgepole pine or Douglas-fir. The age class in those areas would likely shift from 90-plus years to 0 to 39 years. In areas of the BCL where other cover types (Douglas-fir, hardwoods, spruce-fir, limber pine, and non-forest) are dominant, no changes in cover type or age class would be expected. Treatments occurring under the proposed USFS BMW project also may alter the distribution of forest cover types and age classes on up to 4,269 acres (12 percent) of the BCL. Silvicultural treatments implemented under the BMW project may shift acres from the 90-plus year age class to the 0 to 39 year age class, resulting in a higher proportion of younger forests than currently exists in the BCL.

Cumulative Effects of the Action Alternative

Within the BCL, the proposed harvesting activities would change 4 acres of the spruce-fir cover type to the Douglas-fir cover type. With the exception of the 4 acres of spruce-fir converted to Douglas-fir, post-harvest stands are expected to have the same species composition and cover type classification as the pre-harvest stands. In areas of the BCL where harvest is not proposed and lodgepole pine is the dominant species, mortality due to the mountain pine beetle could create temporary openings varying in size that would be expected over time to regenerate with lodgepole pine or Douglas-fir.

Harvesting activities would alter the age class distribution in the BCL by increasing the amount of younger forests. The proposed project would increase acreage in the 0 to 39 age class as a result of harvesting in areas dominated by lodgepole pine, and treatments occurring under the BMW project may also increase the amount of younger forests. Additionally, in areas of the BCL where harvest is not proposed and lodgepole pine is the dominant species, mortality due to the mountain pine beetle could shift stands from the 90-plus year age class to the 0 to 39 year age class.

Forest Insects

Analysis Methods

USFS Aerial Detection Survey (ADS) data from 2010 was used to estimate the distribution and type of insect activity in the BCL. Pre-timber sale cruise data collected by DNRC foresters during the summer of 2010 was used to estimate the amount of mortality due to insects in the project area.

Affected Environment

Two insects are currently active and causing varying amounts of damage to forests within the project area and BCL: mountain pine beetle and western spruce budworm (*Figure V-3*).

ADS identified mortality caused by mountain pine beetle on 1,131 acres (32 percent) of the project area and 15,339 acres (46 percent) of the BCL. However, these surveys capture only

the previous year's mortality, and for that reason may underestimate the amount of mortality while the infestation is still growing. Beetle-hit trees that are still green are unlikely to be identified by the ADS (the needles of beetle-hit trees do not turn red until the year following attack). Pre-timber sale cruise data identified both green-hit trees and red-hit trees and indicated varying levels of mortality, from 50 percent of the lodgepole pine in some stands to 100 percent in others. In proposed cutting units 4, 5, and 6, which have the highest proportions of lodgepole pine, mortality ranged from 61 to 82 percent.

ADS surveys identified 175 acres (less than one percent) of the BCL affected by western spruce budworm. DNRC foresters also observed and recorded minor amounts of damage from western spruce budworm in the project area. Spruce budworm is a defoliator that targets spruces, true firs, and Douglas-fir, but it generally does not cause mortality except in severe cases of defoliation over multiple years.

Environmental Effects

Direct, Indirect, and Cumulative Effects of the No-Action Alternative

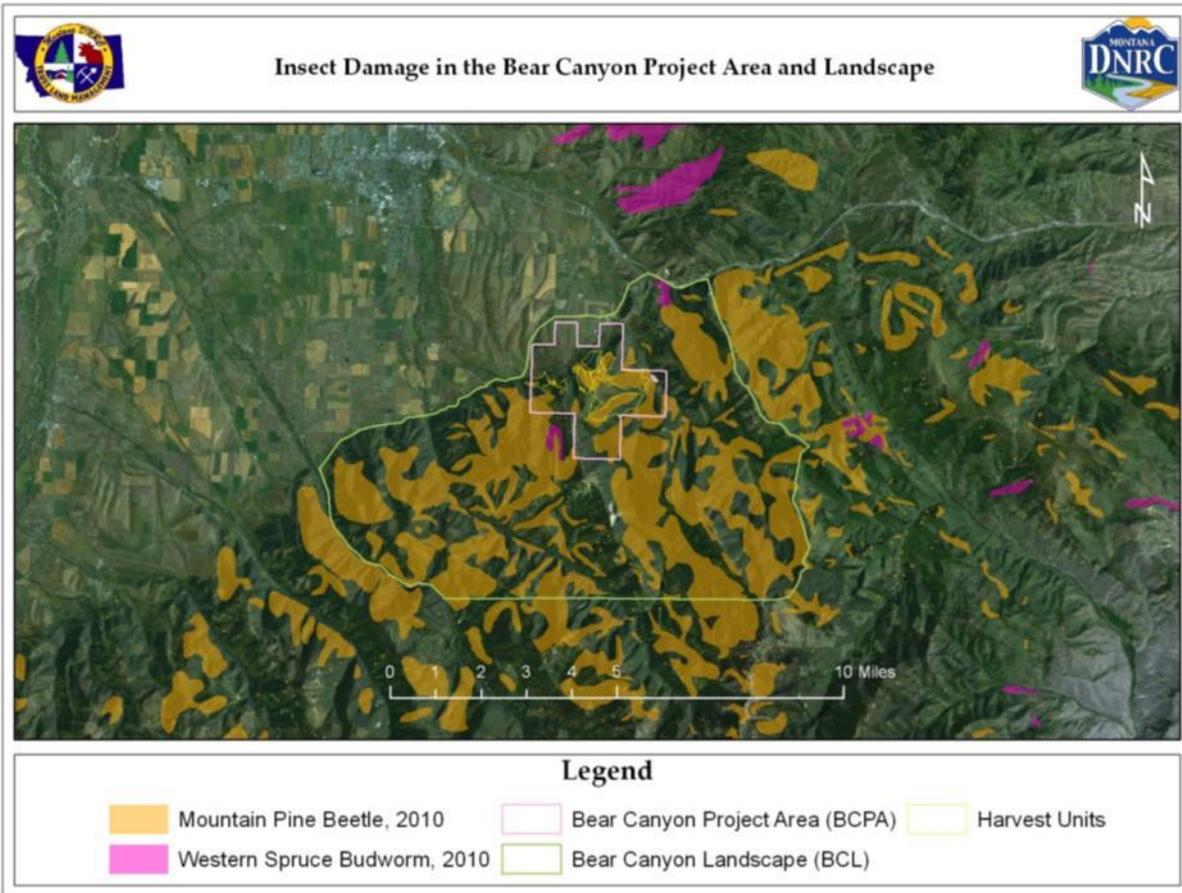
The mountain pine beetle outbreak would continue to impact forests in the project area and BCL until it naturally subsides. Based on the extent of beetle activity in the BCL and levels of mortality observed in the project area, the majority of mature lodgepole pine stands and scattered individuals of lodgepole pine occurring in other forest types are likely to die and be replaced by a new cohort of trees. Beetle populations are likely to return to endemic levels in the project area and landscape as the available host trees are killed. Future widespread outbreaks of mountain pine beetle would not be likely to occur for several decades.

Western spruce budworm would continue to impact forests in the project area and BCL to varying degrees. Areas where overstocked conditions and/or multi-storied tree canopies exist in stands of the preferred tree host species are more susceptible to damage from spruce budworm than stands that lack those characteristics. Treatments occurring under the BMW project could reduce the risk of impact from spruce budworm in those areas.

Direct, Indirect, and Cumulative Effects of the Action Alternative

Salvage harvesting of lodgepole pine in the project area is unlikely to appreciably affect beetle populations in the project area and BCL, and the mountain pine beetle outbreak would continue to impact forests in the project area and BCL until it naturally subsides. Based on the extent of beetle activity in the BCL and levels of mortality observed in the project area, the majority of mature lodgepole pine stands and scattered individuals of lodgepole pine occurring in other forest types are likely to die and be replaced by a new cohort of trees. Beetle populations are likely to return to endemic levels in the project area and landscape as the available host trees are killed. Future widespread outbreaks of mountain pine beetle would not be likely to occur for several decades. Salvage harvesting in the project area is expected to accelerate the process of regeneration in lodgepole pine stands.

Figure V - 3. Forest insect damage in the project area and Bear Canyon Landscape.



Western spruce budworm would continue to impact forests in the project area and BCL to varying degrees. Areas where overstocked conditions and/or multi-storied tree canopies exist in stands of the preferred tree host species are more susceptible to damage from spruce budworm than stands that lack those characteristics. Silvicultural treatments in Douglas-fir stands within the project area would be expected to reduce susceptibility to budworm damage by reducing stocking levels. Treatments occurring under the BMW project could reduce the risk of impact from spruce budworm in those areas. Susceptibility of untreated stands in the project area and BCL would not be expected to change.

Fire Behavior and Ecology

Analysis Methods

Potential fire behavior was determined by examining existing forest stand structure, canopy cover, and potential fuel loading. Forest stand structure was determined using pre-timber sale cruise data collected by DNRC foresters during the summer of 2010, Stand Visualization System software, and aerial photographs.

Affected Environment

Stands in the project area and BCL are predominantly single- or two-storied stands; meaning that they have one or two well-defined canopy layers. Single-storied stands have one overstory canopy layer composed of mature trees, and there may be scattered individuals, usually Douglas-fir seedlings or saplings, present below the mature canopy. In two-storied stands, there is an overstory canopy with well-established seedling or sapling regeneration, usually Douglas-fir, beneath the mature overstory. Multi-storied stands, those with three or more well-defined canopy layers, exist but are not common in the project area and BCL. Multi-storied stands typically have a greater development of “ladder fuels” that allow ground fires to climb into the overstory tree canopy than single- and two-storied stands.

Aerial photographs show that in most forested areas of the BCL, forest canopy cover is continuous with few breaks in mature stands, indicating that fires have the potential to readily move through the overstory once they have reached the main canopy. In young, harvested stands currently in the 0 to 39 age class, fire would most likely burn along the ground given sufficient fuel.

The fire ecology of the project area and BCL is characterized by 4 fire groups as described by Fischer and Clayton (1983). Fire groups 6 and 8 are most common, and fire groups 5 and 7 are also found. *Table V-3* describes the characteristics of these fire groups. The current amount of fuel loading in the project area and BCL is variable but approximates the averages given in *Table V-3* for the fire groups listed.

Table V - 3. Characteristics of fire groups occurring in the project area and BCL (summarized from Fischer and Clayton, 1983).

	<i>FIRE GROUP</i>			
	5	6	7	8
Habitat type group	Cool, dry Douglas-fir habitat types	Moist Douglas-fir habitat types	Cool types dominated by lodgepole pine	Dry lower subalpine habitat types
Mean Fire return interval/ Severity	35-40 years/ Low	42 years/ Mixed	50 years/ High	50-90 years/ Mixed
Average fuel loading (tons/ac.)	10	13	15	20

Environmental Effects

Direct, Indirect, and Cumulative Effects of the No-Action Alternative

Stand structure of Douglas-fir stands in the project area is not expected to change in the foreseeable future; however, over time and in the absence of disturbance, stands may develop from single- and two-storied structures into multi-storied structures. Lodgepole

pine stands in the project area would be expected to remain as single- or two-storied stands, although live canopy cover would be reduced due to mortality from mountain pine beetle. Amounts of large woody debris may increase as dead lodgepole pine falls over, resulting in an increase in the amount of ground fuels compared to present conditions. Treatments implemented under other proposed projects in the BCL would not be expected to appreciably alter stand structure. Those treatments may reduce tree canopy continuity, and may also reduce amounts of coarse woody debris, particularly in areas treated with broadcast burning.

Direct, Indirect, and Cumulative Effects of the Action Alternative

In the project area, harvesting treatments would emulate the types of disturbances that have historically occurred in the area. Research by Fiedler et al. (2004) has shown that ecologically-based silvicultural treatments similar to those proposed effectively reduce crowning index (the wind speed necessary to sustain a crown fire once the fire has reached the main canopy), and maintain low-hazard conditions for up to 30 years. Silvicultural treatments in Douglas-fir stands including group selection and selection cutting would create a mosaic of openings and forest cover containing variably-spaced groups or individual trees, similar to the effects and burn patterns created by mixed severity fire. Tree distribution in these areas would be irregular and patchy, including small clumps of trees and irregularly shaped openings, resulting in decreased continuity of canopy fuels. Stand structure in these areas would remain single- or two-storied, and over time as existing trees grow and new trees regenerate, the characteristics of a multi-storied stand would be expected to develop. In areas dominated by lodgepole pine, silvicultural treatments including clearcutting and group selection would create openings of varying size with reduced tree cover, similar to the effects of a stand-replacing fire. Canopy fuel continuity in these areas would be reduced, and stand structure would be expected to remain single- or two-storied. The removal of lodgepole pine during harvesting operations would result in fewer dead and dying trees that over time would fall and accumulate as coarse woody debris; however, amounts of coarse woody debris left after harvesting would meet or exceed recommended amounts (10 to 20 tons/acre) by Graham et al. (1994). Areas that are broadcast burned would be expected to have less coarse woody debris than unburned areas. Effects of the Action Alternative in untreated stands within the project area and BCL would be expected to be similar to those of No-Action.

Threatened, Endangered, and Sensitive Plants

Analysis Methods

The Montana Natural Heritage Program tracker (MNHP) was used to identify the presence of species of concern, including threatened, endangered, or sensitive plant species, in the project area and BCL.

Affected Environment

MNHP data shows no species of concern occurring with the project area and BCL. Meadow communities containing wildflowers are described above as non-forest cover types and do not contain any species of concern.

Environmental Effects

Direct, Indirect, and Cumulative Effects of the No-Action Alternative

Because no species of concern were identified in the project area and BCL, there are no anticipated impacts on threatened, endangered, or sensitive plant species.

Direct, Indirect, and Cumulative Effects of the Action Alternative

Because no species of concern were identified in the project area and BCL, there are no anticipated effects on threatened, endangered or sensitive plant species. If any such species are encountered, mitigations to avoid impacting the area would be implemented. These mitigations would include establishing a no-entry buffer around the population or individuals.

Harvesting operations would take place in forested cover types and are not expected to impact non-forested areas containing wildflower meadows. Road reconstruction of Section A (*Figure T-2*) would result in minor and temporary impacts to non-forested areas immediately adjacent to the existing road.

Noxious Weeds

Analysis Methods

The presence of noxious weeds in the project area was determined through field observation.

Affected Environment

Canada thistle and hound's tongue have been observed near existing roads in the project area, and sulfur cinquefoil is present in the meadow area of Section 34. The population of sulfur cinquefoil has been mapped and is currently the subject of a Montana State University study.

Environmental Effects

Direct, Indirect, and Cumulative Effects of the No-Action Alternative

In the absence of disturbance, existing noxious weed populations would be expected to remain at or near current levels; however, recreational use could introduce new species or aid in the spread of existing species in the project area and BCL. Continued monitoring and management of existing populations would continue.

Direct, Indirect, and Cumulative Effects of the Action Alternative

Harvesting operations have the potential to facilitate the spread of existing species or introduce new species to the project area and BCL due to soil disturbance and reduction of canopy cover. Recreational use could also introduce new species or aid in the spread of existing noxious weeds. The following mitigations will be implemented in order to minimize the potential spread and introduction of noxious weeds:

1. Required washing of equipment before entering the site
2. Sowing grass seed on roads after harvesting has been completed
3. Spot application of herbicide along roadsides and other identified areas with noxious weeds.

Continued monitoring and management of noxious weed populations outside of areas receiving silvicultural treatments would continue to occur.

Watershed and Fisheries

Introduction

The following effects analysis will describe the dominant controls on runoff generation, the patterns and processes observed during runoff and how these physical watershed characteristics help to support downstream aquatic ecosystems. By further understanding these watershed attributes and associated connections, potential effects of specific forest management activities can be forecasted with higher degree of certainty and communicated more effectively.

Two alternatives will be analyzed for potential effects as outlined in Chapter 2 – Alternatives. The Action Alternative proposes activities such as road construction and maintenance, road-stream crossing construction, timber harvesting, log skidding and processing, and log hauling. All of the actions mentioned above have been shown to result in a range of impacts to watershed resources in magnitude, duration, and spatial extent. The following analysis will analyze each alternative with respect to issues and concerns that were raised internally at DNRC and through public comment and public meetings as described in *Table I-1*.

Analysis Area

The gross Bear Canyon project area consists of approximately 3,500 acres of state owned lands where actions have been proposed (*Figure WF-1*). Four watersheds containing these lands have been identified and potential direct, indirect and cumulative effects to watershed and fisheries resources as a result of implementing either the No-Action or Action Alternative will be described at this scale.

The scale chosen for watershed analysis areas was determined by considering the proposed actions in each watershed, existing watershed conditions and the beneficial uses the watershed supports. The choice of scale balances the need to be small enough to accurately communicate watershed condition and potential measureable effects with the inherent problems of large scale analysis. In large scale analysis, potential effects may not be measurable or potentially masked by impacts such as urban development or agricultural practices that are scale dependant and outside the scope of analysis.

Each watershed analysis area varies in size but generally are forested, 2nd order watersheds similar to the location where actions are proposed. Physical attributes of individual watersheds can be found below in *Figure WF-1*.

Figure WF - 1. Bear Canyon Project Area and watershed analysis areas.

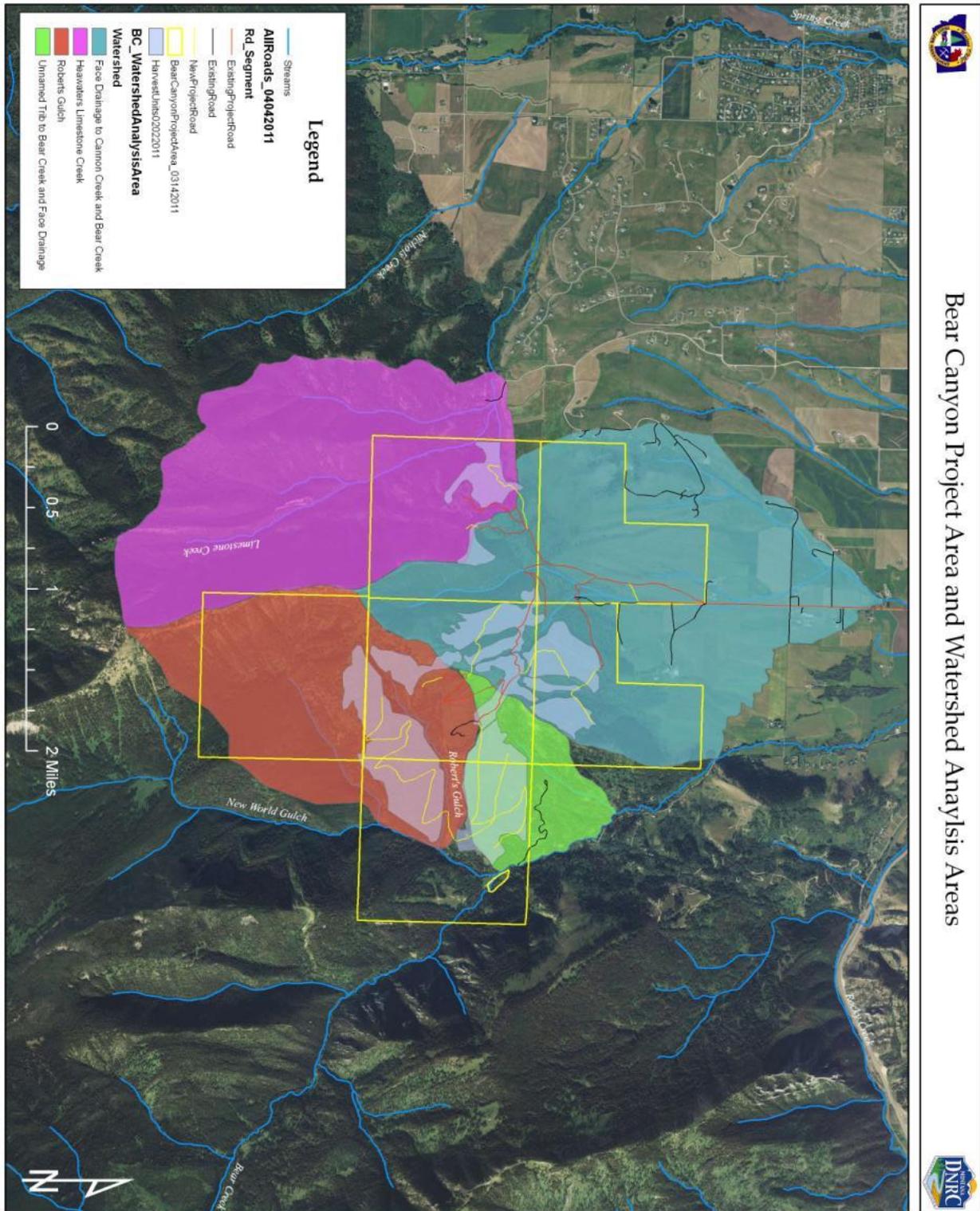


Table WF - 1. Physical attributes of watershed analysis areas.

Physical Attribute	Watershed Analysis Area			
	Face drainage to Bear Creek	Robert's Gulch	Limestone Creek headwaters	Canon Creek and face drainage
Area (Acres)	419	1260	1775	2384
Proposed Harvest (Acres)	168	270	62	250
Mean Precipitation (inches)	27.8	34.3	30.6	24.8
Mean Watershed Slope (%)	24	36	43	18
Mean Watershed Aspect	69	120	207	154
Relief (feet)	1,420	2,831	2,911	2,611
Geology	Shales, sandstones and mudstones	Shales, limestone, sandstone and mudstones	Igneous Rocks, sandstone, limestone and shales	Alluvium/Colluvium, limestones and sandstones
Weight Average Canopy Cover (%)	68%	68%	72%	30%
General Soil Erosion Hazard	Moderate	Moderate	Low-Moderate	Low-Moderate
Channel Stability	Fair-Good	Poor - Fair	Good - Excellent	Fair
Stream Order	1 st	2 nd	2 nd	2 nd
Fisheries	No	Yes	Yes	No
Mean Basin Runoff (inches)	9.8	13.2	12.0	9.9
Road Density (mi/mi ²)	1.9	0.4	0.2	3.0
Water-yield Increase Threshold (%)	20%	10%	20%	20%

Analysis Methods

Methods for disclosing impacts to watershed and fisheries resources relied on information from numerous data sources. These sources included internal DNRC data and reports, professionally published surveys on soil and water resources, and fisheries data from FWP. All of these data sources assisted in field evaluation and verification of the project area during the summer of 2010. Professional training and judgment was intricate in synthesizing the information from these various sources to describe watershed processes and connections within the project area and to ultimately forecast potential impacts from forest management activities.

Evaluating potential direct, indirect and cumulative water quality effects included a field review of potential sediment sources from haul routes within the project area. Stream crossings and roads, both existing and proposed, were evaluated to determine existing and potential sources of introduced sediment. Potential sediment delivery from harvest units will be evaluated from a risk assessment of potential upland soil disturbance. This risk assessment will use the soil information provided in the *Chapter 3 – Geology and Soils* and the results from soil monitoring on past DNRC timber sales (DNRC 2009).

Annual water yield will be disclosed as a cumulative effect in the *Affected Environment* portion of this report because the existing condition is a result of all past harvesting and

associated activities. Annual water yield refers to the gross volume of water in a watershed that is contributed to a stream or other surface water features. In the *Environmental Consequences* portion of this report, water-yield increases as a result of this project will be disclosed as a direct effect. The cumulative water-yield increase as predicted to include each alternative will be disclosed as a cumulative effect.

The annual water-yield increase for watersheds in the project area was estimated using the Equivalent Clearcut Area (ECA) method as outlined in *Forest Hydrology, Part II* (Haupt et al, 1976).

ECA is a function of total area roaded, harvested, or burned; percent of crown removed during harvesting or wildfire; and amount of vegetative recovery that has occurred in the harvested or burned areas. As live trees are removed, the water that would have evaporated and transpired either saturates the soil or is translated to runoff. This method also estimates the recovery of these increases as new trees revegetate the site and move toward preharvest water use.

In order to evaluate the potential effects of water-yield increases, a threshold of concern for each watershed was established per *ARM 36.11.423*. Thresholds were established based on evaluating the acceptable risk level, resources value, stream channel stability and watershed sensitivity. Increased annual water yields above the threshold of concern result in an increased risk of in-channel erosion and degradation of fisheries habitat.

Potential effects to fisheries habitat compiles all of the above methods and information and compares the results to the existing extend and quality of fisheries habitat in the project area. Based on the current condition and extend of habitat, potential impacts to water quality, water quantity, and riparian habitats will be used to qualitatively forecast potential modifications or impacts to fish habitat from anthropogenic sources.

Effective risk management requires assessment of inherently uncertain events and circumstances, typically addressing two dimensions: how likely the uncertainty is to occur (probability), and the magnitude the effect would be if it happened (impact) (Hillson and Hulett, 2004). This method of risk management and communication is employed for all issues throughout this document.

Issues and Measurement Criteria

The following bulleted issue statements listed below summarizes both internal and public concerns that will be analyzed in this effects analysis.

- Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams.
- Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed.
- Project activities may affect fish habitat by modifying channel form and function.
- Project activities may affect fish habitat by modifying stream temperature.

- Project activities may affect fish habitat by modifying riparian function.
- Project activities may affect fish habitat by accelerating natural sediments delivery processes.
- Cumulative effects associated with the proposed actions in conjunction with past or proposed further projects may accelerate natural sediment delivery rates within the project analysis area.
- Cumulative effects associated with the proposed actions in conjunction with past or proposed future projects may adversely affect fisheries habitat parameters within the project analysis area.

Some of these above listed issues are typically relevant during many timber harvest projects; some issues can be dismissed based on the operational plan within the proposed actions. Specially, no streamside management zone (SMZ) or riparian management zone (RMZ) harvest is being proposed within any harvest unit under the Action Alternative. As riparian vegetation tends to be a primary regulator of stream temperature and no modifications to riparian habitats are proposed, issues regarding riparian function and stream temperature will be dismissed from further analysis in this document and remaining issues will generally be referred to as fisheries habitat.

The measurement criteria that will be used to assess the direct, indirect and cumulative effects regarding the remaining issues are listed in *Table WF-2*.

Table WF - 2. Watershed and fisheries analysis measurement criteria.

Generalized Issue	Measurement Criteria	Units
Water Quality	Equivilant Clearcut Area (ECA), Water Yield Increase	Acres, % increase
Water Quality	Length of road construction within 100' of a stream, upland soil distrubance, new stream crossing sites, stream restoration sites	Feet, % of area, # of sites
Channel Form and Function	Channel stability (modified Pfankuch procedure), water yield increase	Stability rating, % increase

Water Uses and Regulatory Framework

Water Quality Standards

This portion of the East Gallatin River Basin, including Bear Creek, Limestone Creek and its tributaries (Canon Creek), is classified as B-1 by the DEQ, as stated in *ARM 17.30.609*. The water-quality standards for protecting beneficial uses in B-1 classified watersheds are located in *ARM 17.30.623*. Water in B-1 classified waterways is suitable for drinking, culinary and food processing purposes after conventional treatment, bathing, swimming and recreation, growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply. State water-quality regulations limit any increase in sediment above the naturally occurring concentration in water classified B-1. Naturally occurring means condition or materials present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied (*ARM 17.30.602 [17]*).

Reasonable land, soil, and water conservation practices include “methods, measures or practices that protect present and reasonably anticipated beneficial uses...” (*ARM 17.30.602 [21]*). The State of Montana has adopted BMPs through its non-point source management plan as the principle means of meeting the *Water Quality Standards*.

Water Quality Limited Bodies

Robert’s Gulch, Canon Creek and Limestone Creek are not listed as a water-quality limited water body in the 2010 303(d) list (DEQ, 2010). However, Bear Creek, which is the receiving waters from Robert’s Gulch, is listed on the 2010 303(d) list for partial support of aquatic life, cold-water fishery, industry and primary contact recreation. The listed probable causes for not fully supporting these uses include alternation of streamside or littoral vegetative covers, excessive algal growth, phosphorus (total), sedimentation/siltation, and solids (suspended/bedload). Grazing in riparian areas and unpaved roads or trails adjacent to streams are listed as probable sources. The 303(d) list is compiled by DEQ as required by Section 303(d) of the *Federal Clean Water Act* and the *Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (40 CFR, Part 130)*. Under these laws, DEQ is required to identify water bodies that do not fully meet water-quality standards, or where beneficial uses are threatened or impaired.

Streamside Management Zone Law

All rules and regulations pertaining to the SMZ Law will be followed. An SMZ width of 100 feet is required on Class I and II streams when the slope is greater than 35 percent. An SMZ width of 50 feet is required when the slope is less than 35 percent.

Riparian Management Zone

All class I streams, regardless of fisheries status, will have a RMZ applied. Under this commitment the total width of the combined SMZ and RMZ will equal one site potential tree height (SPTH). This zone comprises of a 50 foot no-cut buffer from the ordinary high water mark to 50 feet and then 50 percent retention of trees ≥ 8 inches in diameter from 50 feet out to the end of the RMZ. The SPTH within the Bear Canyon Project Area was assessed at 80 feet.

Water Rights and Beneficial Uses

Numerous surface water rights from Bear Creek and Canon Creek exist within and downstream of the project area for irrigation and stock watering. Currently the Wolverton irrigation ditch diverts surface flow from Bear Creek and also captures both subsurface and any potential surface flow from a large portion of the Canon Creek watershed analysis area for both flood and sprinkler irrigation around the Mt. Ellis Lane area.

Affected Environment

Face Drainage to Bear Creek

This watershed analysis area contains one Class III channel draining a relatively small portion of both the analysis area and project area directly to Bear Creek. Approximately 40 percent of the analysis area is drained by the Class III channel while the remaining 60 percent drains to Bear Creek through lateral subsurface flow on moderate to steep hillslopes. Due to the lower elevation of this watershed, runoff generation is typically earlier in the spring season as low elevation snowpacks melt out first. The melt is typically slow due to the north to east aspect of the watershed. Riparian buffers that receive this lateral flow are intact and functional despite low to moderate levels residential development. Riparian soils become saturated for very short time periods and support surface flows of low volumes and for short durations at the watershed outlet. This watershed analysis area does not contain a fishery and fisheries issues will be dismissed from further analysis in this watershed.

One current stream crossing structure is present within this watershed on private land and road densities are low with a majority of the road system constructed on and servicing private lands. No current sources of sediment delivery were noted during field review and no new stream crossings are proposed within this analysis area. No roads currently exist or are proposed within 100 feet of a stream.

Approximately 12 acres of regeneration harvest was conducted in the highest elevations of the analysis area in 1981. Vegetative recovery within this portion of the harvest unit was successful and is currently on-going. Current water yield increases for this watershed was modeled at less than one percent with no sign of historic channel instability resulting from this action. Recent increases in water yield are speculated to currently be occurring due to the magnitude and extent of mortality within lodgepole pine stands. Due to the intermittent nature of the flow regime, stable channel conditions, and low watershed sensitivity, water yield increase thresholds were set at 20 percent for this analysis area.

A very small portion of this analysis area is licensed for grazing. Much of the terrain is steep and provides little forage or browse potential for cattle. Slight trailing is the only evident effect of grazing in this watershed. No current grazing license exists within this watershed.

Robert's Gulch

This watershed analysis area contains two Class I streams that drain the highest portions of the project area and continue to convey water to Bear Creek via New World Gulch. Upper elevations consist of subalpine vegetation and accumulate relatively deep snowpacks that remain late into spring months. Melt water is transferred by saturation excess overland flow to Class I stream channels via first-order, moderately dissected draw. Numerous solar aspects exist within this watershed with an average aspect of east-southeast. Meltwater runoff to stream channels can be rapid due to high elevation, shallow soils. Coupled with large vertical relief and steep hillslopes and channels, this watershed can be considered a

transport portion of the larger Bear Creek Watershed. Channels consist of large substrates and due to the high transport capacity, these channels exhibit poor to fair stability. Riparian areas surrounding Robert's Gulch are functional, providing adequate shading, filtration, and recruitment of large woody debris. Due to the steep nature of channels and hillslopes as well as only fair channel stability, water yield thresholds for this watershed were reduced due to the potential sensitivity and conservatively set at 10 percent over fully forested conditions.

Flow regime within Robert's gulch consist of a typical snowmelt pattern with peak flows experienced in late April thru May with recession limbs extending well into July months until base flows are achieved. Flow in late summer and fall months becomes spatially discontinuous though is highly dependent on precipitation inputs from winter snowpack and spring rains. Because of high seasonal and spatial variability of base flows in Robert's Gulch, a conservative designation of Class I stream protection under the SMZ law was applied to the main stem of Robert's Gulch in its entirety.

The road network within Robert's Gulch is limited, reflected by a road density of 0.4 mi/mi². Currently no road-stream crossings have been constructed in Robert's Gulch though one is proposed under the Action Alternative. No roads currently exist within 100 feet of a stream. No introduced sources of sediment were noted during field review though an unstable hiking trail delivering sediment was noted adjacent to New World Gulch just outside the watershed boundary. No upland sources of sediment from road segments were observed.

Approximately 58 acres of regeneration harvest has occurred within the mid elevations of the watershed in 1981. This area of forest management has since had thirty years of vegetative recovery and regeneration to where water yield increases are less than one percent over fully forested conditions. No historic signs of channel instability from this forest management project were observed during field review. The water yield within Robert's Gulch is currently assumed to be increasing naturally due to the magnitude and extent of lodgepole pine mortality within the watershed though no sign of channel response from this increase is currently evident.

Only a small portion of this analysis area has historically been licensed for grazing. Much of the terrain is steep and provides little forage or browse potential for cattle. Slight trailing is the only evident effect of grazing in this watershed. No current grazing license exists within this watershed.

Fisheries presence has only been documented in the main stem of Bear Creek though fisheries habitat, while limited and poor, potentially exists both upstream of Bear Creek in New World Gulch and Robert's Gulch. Fish species documented within Bear Creek include brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), longnose dace (*Rhinichthys cataractae*), and Rocky Mountain sculpin (*Cottus bondi*). Potential fisheries habitat in Robert's Gulch is poor due to, steep stream channels with limited pool habitat, and consequently, very limited seasonal connectivity.

Headwaters of Limestone Creek

The Limestone Creek analysis area contains two Class I streams, of which only one short segment is within proximity of a harvest unit to designate a SMZ and RMZ. Under the proposed action, harvesting would also occur adjacent to a class III tributary to the main stem Limestone Creek. This tributary displays intermittent and discontinuous signs of channel scour and likely contributes flow to Limestone Creek only during long duration, intense rainfall or snowmelt events. Large relief, steep slopes, and numerous solar aspects create a runoff condition that can be quite responsive during runoff events within Limestone Creek. Despite these physical attributes, channel stability was observed to be good to excellent with highly functional riparian habitats adjacent to the stream network.

Currently one road stream crossing exists within the analysis area and provides access to private residences within the Triple Tree subdivision. This crossing structure on private land currently meets BMPs and is not delivering sediment to Limestone Creek. Two hundred feet of road exists within 100 feet of Limestone Creek due to this crossing structure. No new road-stream crossing sites are proposed in this watershed. Road densities within the analysis area are also very low at 0.2 mi/mi² and no road segments within this analysis area are currently delivering sediment to any portion of the stream network.

Approximately 29 acres of shelterwood harvest was completed in the mid 1990's within this analysis area resulting in unmeasurable water yield increases and likely had no effect or has recovered completely. The water yield within Limestone Creek is currently assumed to be increasing naturally due to the magnitude and extent of lodgepole pine mortality within the watershed, though no sign of channel response from this increase is currently evident and would likely be a poor response indicator due to excellent channel stability. Due to limited historical harvest and the extent and location of proposed harvest (59 acres), issues associated with water yield increases will be dismissed within this watershed analysis area.

Only a small portion of this analysis area is licensed for grazing. Much of the terrain is steep and provides little forage or browse potential for cattle. No grazing related impacts were noted during field review. No current grazing license exists within this watershed.

Brook Trout (*Salvelinus fontinalis*) is the only fishery that is supported by the waters of Limestone Creek. Due to the limited amount of historic and proposed harvest, low existing road density and low amount of proposed road construction including no new stream crossing, as well as no proposed SMZ/RMZ harvest, fisheries issues will be dismissed within this watershed analysis area.

Canon Creek and Face Drainage

Canon Creek and the associated face drainage from the area comprise the largest watershed analysis area for the project but responds much differently than the other forested watersheds previously described. At only 30 percent forested, the forest canopy is not a dominant control on runoff generation within this watershed. Runoff characteristics are dominantly controlled by local geologic deposits of colluvium and alluvium in the lower elevations. The only expression of surface flows are displayed at slope breaks where near

surface ground and hillslope waters begin surface expressions for short periods before losing stream reaches infiltrate most all surface flow into local groundwater sources within deep colluvium, alluvium and gravel deposits in the valley. Much of the range land in this watershed is sub irrigated. Due to the spring fed nature of surface waters, flows are typically perennial until valley fill deposits are reached. Above this point, two Class I and one Class III stream segments have been identified adjacent to proposed activities, none of which support a fishery.

The majority of the road network for the Bear Canyon area exists within this watershed as well as numerous private and county roads accessing private lands. This moderate level of road construction is reflected by a road density of 3.0 mi/mi². The main point of administrative access to the Bear Canyon block begins at the end of Mt. Ellis Lane and continues on a steep, historic ranch road that was never designed to forest road specifications. Due to this road location and design, the road surface has chronically eroded and rutted with only minimal maintenance over its lifespan but no sediment delivery to stream features is occurring. This road segment would have BMP's applied in the Action Alternative is selected. Approximately 2,200 feet of road is currently constructed within 100 feet of a stream on state lands in this watershed.

A couple points of chronic erosion were noted in this watershed during a road inventory of the project area. Two spur roads off this main access road were constructed at various points in time for forest management activities. The northern most spur crosses two Class III and one Class I channels with road-stream crossing sites not currently meeting BMPs due to deferred road maintenance and inadequate culvert installation at the time of construction. Currently, BMP issues with these culverts include inadequate rock armoring, culvert not on stream grade, and compromised culvert capacity. The second spur road off the main haul route heading east crosses a Class I, spring feed stream via an old log stringer /earth fill crossing that is actively failing and contributing small amounts of fine sediments to this stream. All other existing road segments within the watershed are largely meeting BMP's with a few relief culverts needing maintenance and short segments of road surfaces needing surface drainage reinforcement through blading.

Approximately 159 acres of historic harvest has been completed in this watershed by both regeneration (~20 acres) and shelterwood (~139 acres) prescriptions. As previously mentioned, forest canopy cover has little control on runoff generation processes in this watershed. Considering this in conjunction with low annual precipitation (24.8 inches), lack of surface water connectivity to beneficial uses and very high levels of natural mortality in lodgepole pine stands, traditional ECA methods of predicting water yield increases are ineffective, possess minimal practicality and are unwarranted thus water yield increases will be dismissed from further analysis in this watershed.

Other historic and current management actions within this watershed include the lease and license of the land for cattle grazing as well as agriculture leases for the production of hay. Four grazing leases and one agricultural and grazing lease are currently issued for grazing and hay in T2S R6E S34 and S35. These actions has resulted in moderate levels of

streambank trampling, sediment delivery and associated channel instability in localized areas adjacent to road-stream crossings and slightly distal both upstream and downstream of crossing sites until vegetation and/or terrain limits cattle accessibility. Although localized areas of stream have been impacted by grazing, when observed at the stream reach scale, grazing impacts are within DNRC's numerical standards for riparian grazing assessments.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative no timber harvesting or road construction activities would be implemented in any watershed analysis area. One non-functional culvert would be replaced to meet BMPs and a failing native log stringer crossing would be removed and the site restored to improve water quality. The nature of these activities fall under categorical exclusions as defined by *ARM 36.11.447* and would be funded and carried out as a standard road maintenance activity.

Water yield would continue to increase in the project area as infected stands of lodgepole pine continue to lose canopy cover and hydrologic control on runoff generation. This natural rate of water yield increase is not expected to destabilize channels or effect downstream beneficial uses but would be measureable nonetheless.

Grazing practices would continue in Sections 34 and 35. Localized watering sites would continue to experience bank trampling but would likely remain within numerical standards for riparian grazing assessments.

Direct and Indirect Effects of the Action Alternative

Face Drainage to Bear Creek

Under the Action Alternative, approximately 168 acres would be harvested and 2.3 miles of road constructed in this watershed analysis area. No road-stream crossings or roads within 100 feet of a stream would be constructed. BMPs would be applied to all new road segments and existing road drainage BMPs would be maintained on existing roads. After project completion, all but approximately one mile of road would be debris closed with slash and grass seeded. Upland ground disturbance would be limited to 15 percent or less of a unit and all harvest BMPs would be applied concurrently with felling and skidding operations to reduce the potential of water quality impacts (Rashin et al., 2006). Due to the above listed factors and mitigations; there is a low probability of low direct and indirect impacts to water quality within this analysis area from the proposed action.

Forest canopy removal related to timber harvesting and road construction would increase water yield within this watershed analysis area by 16.8 percent over fully-forested conditions. This water yield increase would be under the threshold of concern set for this watershed. Silvicultural prescriptions would target dead and dying lodgepole pine and to a much lesser degree, overstocked green Douglas-fir. No SMZ or RMZ harvest would be conducted. Due to the very high rate of natural mortality in lodgepole pine stands,

forecasted annual water yield increase would likely be similar to the No-Action Alternative within this watershed regardless of forest management activities. Hydrograph features that would be altered include runoff response (time to peak), peak flows (increased), and rate of decrease in the recession limb of the hydrograph. When considering these potential changes in the hydrograph in concert with the location of harvest units, distance to stream channels, functional riparian buffers and stream channel stability a high degree of certainty can be assumed that there is a moderate probability of long-term, low level impacts to water quantity in this watershed analysis area. These low level impacts to hydrograph response would be expected to continuously decline until vegetative recovery has occurred, which would be much quicker than similar, naturally occurring impacts expected under the No-Action Alternative.

Robert's Gulch

Under the Action Alternative, approximately 270 acres would be harvested and 2.3 miles of road constructed in this watershed analysis area. All 2.3 miles of the new road construction would be permanently closed to administrative access by debris closing with slash and hydrologically stabilizing the road surface with drainage features and grass seed. One new road-stream crossing site and a little more than 200 feet of road within 100 feet of Robert's Gulch would be constructed. Field review of this crossing location reveals low grade approaches to the site, minimal clearing necessity as well as minimal fill requirements. This crossing structure would be designed for a 25-year flow event and would remain in-stream during only one spring runoff event. This crossing structure would be permanently removed upon project completion to eliminate any long-term sedimentation or failure risk. Activities associated with culvert installation and removal would present a high probability of low level and short-term impacts to water quality but the risk of long-term adverse direct or indirect effects to water quality or beneficial uses would be low. All other road construction activities would have BMPs applied and maintained during hauling periods to minimize any risk of water quality impacts. Upland ground disturbance would be limited to 15 percent or less of a unit and all harvest BMPs would be applied concurrently with felling and skidding operations to reduce the potential of water quality impacts (Rashin et al., 2006). Considering all of the above factors, the proposed actions present a moderate risk of low level impacts to water quality.

Forest canopy removal related to timber harvesting and road construction will increase water yield within this watershed analysis area by 7.4 percent over fully-forested conditions. This water yield increase is under the threshold of concern set for this watershed. Silvicultural prescriptions will target dead and dying lodgepole pine and to a much lesser degree, overstocked green Douglas fir. No SMZ or RMZ timber harvest would be conducted. Due to the very high rate of natural mortality in lodgepole pine stands, forecasted annual water yield increase would likely be similar to the No-Action Alternative within this watershed regardless of forest management activities. Hydrograph features that would be altered include runoff response (time to peak), peak flows (increased), and rate of decrease in the recession limb of the hydrograph. When considering these potential changes

in the hydrograph in concert with the location of harvest units (aspect), distance to stream channels, riparian buffers and stream channel stability a high degree of certainty can be assumed that there is a moderate probability of long-term, low level impacts to water quantity in this watershed analysis area.

Considering the risk and potential impacts to water quality and water quantity as stated above in conjunction with the poor habitat quality within Robert's Gulch, it is forecasted that there is a low probability of low level impacts to fisheries habitat as a result of implementing the proposed action. Because no SMZ or RMZ harvest is proposed, no modification to riparian habitats are foreseen resulting in no net change in large woody debris (LWD) recruitment, stream shading, or stream temperature, all of which are contributing factors to fisheries habitat.

Headwaters of Limestone Creek

Under the Action Alternative, approximately 62 acres would be harvested and 0.4 miles of road constructed in this watershed analysis area. All but approximately 450 feet of road would be closed to administrative access by debris closing the road with slash and hydrologically stabilizing the road surface with drainage features and grass seed. No new road-stream crossing structures or road within 100 feet of a stream would be constructed in this watershed analysis area. BMPs would be applied to all new road segments and existing road drainage BMPs would be maintained on existing roads. Upland ground disturbance would be limited to 15 percent or less of a unit and all harvest BMPs would be applied concurrently with felling and skidding operations to reduce the potential of water quality impacts (Rashin et al., 2006). Due to the above listed factors and mitigations, there is a low probability of low level impacts to water quality as a result of implementing the proposed action within this watershed analysis area.

Canon Creek and face drainage

Under the Action Alternative, approximately 250 acres would be harvested and 1.9 miles of road constructed including two new road-stream crossings within this watershed analysis area. Two culverts currently not meeting BMPs would be replaced and one native log crossing would be removed and restored to improve water quality. On the same note, two temporary road-stream crossings would be installed. One would be on a Class I stream and the other on a Class III stream. Both of these crossing sites would be fully reclaimed and restored to original topography after project completion. All of these above mentioned actions would have short-term water quality impacts resulting from culvert installation and removal. These activities are short-term in duration and small in magnitude and present a low risk of long-term adverse direct or indirect effects to water quality or beneficial uses. Trends in long-term water quality would be expected to improve considering BMP applications, maintenance and road stream crossing restoration.

All other road construction activities would have BMPs applied and maintained during hauling periods to minimize any risk of water quality impacts. This would include approximately 400 feet of road constructed within 100 feet of a stream and would

exclusively be associated with stream crossings. All of these road segments would be recontoured, debris closed with slash, grass seeded and closed to all administrative motorized use. Upland ground disturbance would be limited to 15 percent or less of a unit and all harvest BMPs would be applied concurrently with felling and skidding operations to reduce the potential of water quality impacts (Rashin et al., 2006). Considering all of the above factors, the proposed action presents a moderate risk of low level impacts to water quality for short durations in this watershed analysis area. Long-term water quality would be expected to improve over existing conditions.

Cumulative Effects of the No-Action Alternative – All Analysis Areas

Because no timber harvesting or associated activities would occur under this alternative, cumulative effects would be limited to the natural progression of the existing condition. Two deficient stream crossing sites would be addressed under No-Action Alternative and trends in long-term water quality would be stable or improve. Grazing practices would continue within Canon Creek and localized watering sites would continue to experience bank trampling but would likely remain within numerical standards for riparian grazing assessments.

Water yield increase would be expected to increase as tree mortality increased and progressed throughout all watershed analysis areas. These increases would be natural and progress and recover slowly. Expected natural water yield increase would not impact current stream channel stability or function.

Under this alternative, fisheries habitat quality would be maintained at its current level with a low degree of risk of change due to anthropogenic sources.

Cumulative Effects of the Action Alternative

Face Drainage to Bear Creek

Considering the low risk to water quality from the proposed action as described in the direct and indirect effects section as well as excellent water quality conditions currently in this watershed, cumulative effects to water quality have a low risk of occurring from the proposed actions.

Existing conditions and direct impacts to water yield from the proposed action in this watershed would result in a cumulative water yield increase of 17.4 percent. This increase is under the threshold of concern of 20 percent set for this watershed. This increase is likely within the natural range of variability considering historic insect and disease outbreaks and wildfire disturbances. No cumulative effects from water yield increases are expected in this analysis area.

Robert's Gulch

Factors considered for cumulative effects to water quality within the Robert's Gulch analysis area included the low risk of direct and indirect effects to water quality from the proposed

actions, no prior water quality degradations in the watershed, very low existing road densities and minimal length of new road constructed within 100 feet of a stream. These variables were considered in conjunction with the moderate probability of moderate to high level impacts resulting from mass failures in the project area as disclosed in *Chapter 3 – Geology and Soils*. Because a majority of these potentially unstable slopes are located far from stream networks and historic failures are rotational in nature rather than debris flows traveling long distances, potential impacts to water quality from slope instability are limited. Considering all these variables, a moderate probability of low level cumulative effects to water quality exists in this watershed.

Existing conditions and direct impacts to water yield from the proposed actions in this watershed would result in a cumulative water yield increase of 7.7 percent. This increase is under the threshold of concern of 10 percent set for this watershed. This increase is likely within the natural range of variability considering historic insect and disease outbreaks and wildfire disturbances. No cumulative effects from water yield increases are expected in this analysis area.

Furthermore, conditions would continue to support fish-habitat parameters and provide adequate levels of LWD and shade to maintain channel form and function and also support a natural range of water temperatures. Under this alternative, fisheries habitat quality would also be maintained at its current level, with a low degree of risk of change due to anthropogenic sources.

Headwaters of Limestone Creek

No cumulative effects to water quality from sediment delivery are expected in this watershed analysis area due to the low risk of direct and indirect effects and lack of any existing water quality degradations.

Canon Creek and Face Drainage

Grazing practices would continue to occur under this alternative as well as direct bank trampling and the associated sediment delivery. These impacts are localized and not impacting beneficial uses. When grazing impacts are considered in conjunction with, timber harvesting, road-stream crossing installation and removals as well as road-stream crossing restoration projects planned under the Action Alternative, several small scale, short duration and small magnitude disturbances are forecasted. While each activity is expected to result in short-term and temporary water quality impacts, cumulatively they present a moderate level of short term impacts but are ultimately expected to improve long-term water quality within the watershed. Because of these factors, no long-term cumulative effects to water quality are expected to occur in the watershed as a result of the proposed action.

Cumulative Effects Summary

Because all timber-harvesting activities would follow recommended mitigations and BMPs as required by ARM 36.11.422 and the direct and indirect effects would have a low risk of

impacts, a low risk of additional adverse cumulative effects would be expected to occur under the Action Alternative in all watershed analysis areas. This expectation considers (1) a short-term impact during construction activities with minor reduction in direct sediment delivery to streams from BMP upgrades, road maintenance and road-stream crossing site restoration in the long-term; (2) no riparian habitat modification within all established SMZ and RMZ areas; and (3) increases in modeled annual water-yield estimates under the threshold values set for individual watersheds.

Geology and Soils

Introduction

The following effects analysis will describe the geologic setting of the project area in concert with the dominate processes controlling landscape evolution, geomorphology, and soil properties of the area. These physical attributes ultimately control the many ecological processes we readily observe as well as the productive capacity of the area. By better understanding these processes and connections, a more accurate forecast of potential effects from a proposed action can be described and effective mitigation strategies can be designed to minimize potential effects.

Two alternatives will be analyzed for potential effects as outlined in Chapter 2 – Alternatives. The Action Alternative proposes activities such as road construction and maintenance, rock source development, timber harvesting, and log skidding and processing burning slash, and site preparation activities. All of the actions mentioned above have been shown to result in a range of impacts to soil resources in both magnitude and spatial extent (DNRC 2009). The following analysis will analyze each alternative with respect to issues and concerns that were raised internally at DNRC and through public comment and public meetings as described in *Table I-1*.

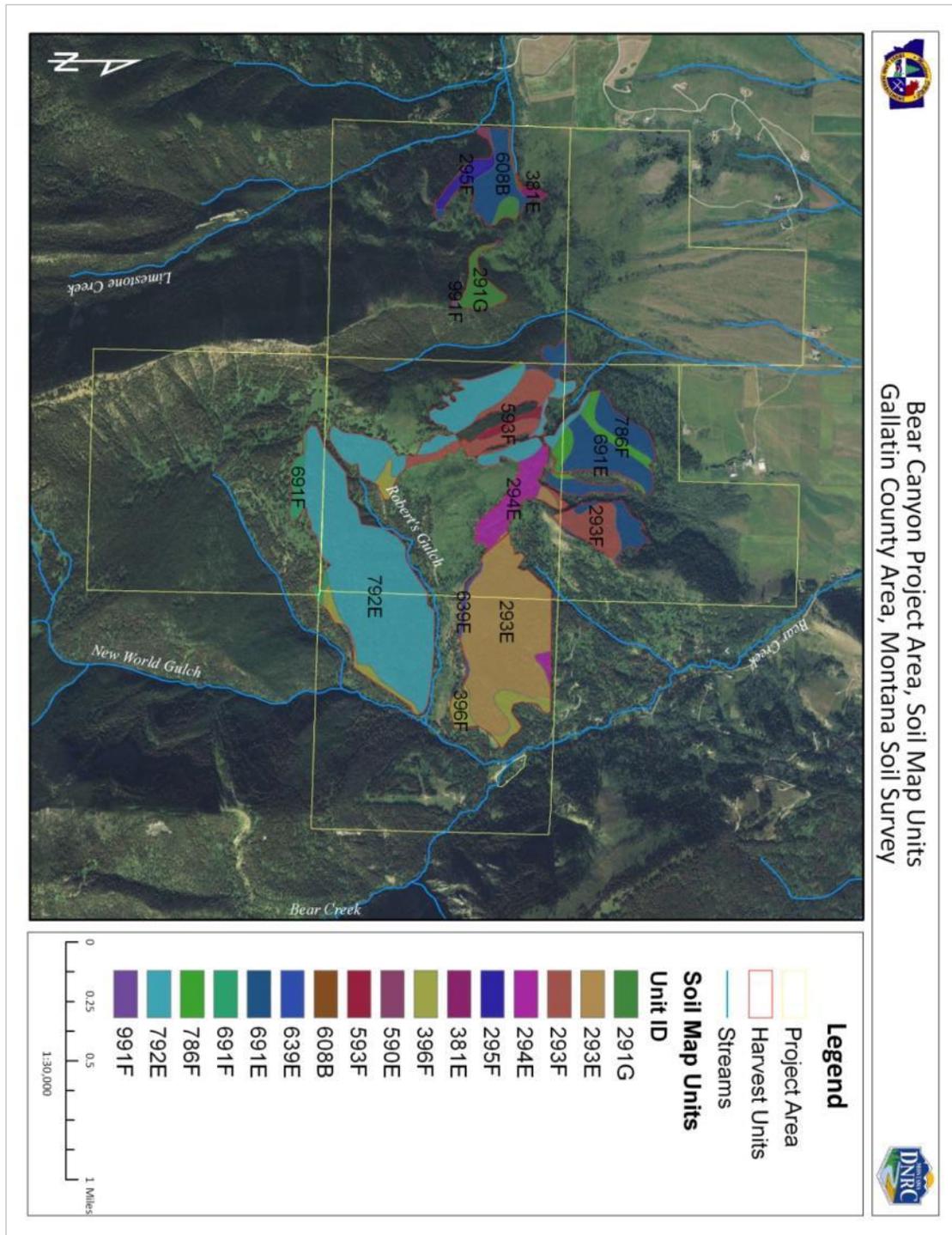
Analysis Area

The gross project area consists of 3,500 acres of state owned lands (*Figure GS-1*). The analysis area for direct and indirect effects to soil physical properties, nutrient cycling, and site productivity will be a subset of the gross project area of approximately 750 acres and will include all harvest units, landings, the clearing limits of new and temporary road construction and areas of developed gravel sources.

The Action Alternative has the potential to affect slope stability and erosion on different spatial scales than the analysis area described above. Recognizing this, the analysis areas for issues concerning slope stability and erosion will include the gross project area.

Cumulative effects by definition are the collective impacts on the human environment of the proposed action(s) when considered in conjunction with other past, present and future actions related to the proposed action by location or association. For an impact to soil resources to be cumulative they must overlap a least twice in both time and space. Considering this constraint, the cumulative effects analysis area for all proposed alternatives will be the same as that described for direct and indirect impacts above except for issues relating to slope stability and erosion, in which case the project area will be the unit of analysis.

Figure GS - 1. Bear Canyon Project Area, soil map units, Gallatin County area, Montana soil survey.



Analysis Methods

Methods for disclosing impacts to geologic and soil resources relied on information from numerous data sources. These data sources ranged from field evaluation, verification and measurement to professional published surveys including the soil survey of the Gallatin County, Montana (USDA, 2006) and the Geologic Map of the Mystic Lake Quadrangle, Montana (Roberts, 1964). Professional training and judgment was intricate in synthesizing the information from these various sources to describe the geologic structure and physical soil properties within the project area to forecast potential forest management limitations. Soil variables gained from field interpretations and professional surveys used to forecast risk include soil texture, soil depth, percent coarse fragments, plasticity index, liquid limit, permeability, infiltration capacity and Unified classification.

It has been shown through DNRC soil monitoring (DNRC 2009) that past performance in timber sale contract administration, BMP design and implementation, and harvest design are good indicators of expected future results regarding impacts to soil resources from timber harvest. The following soil analysis was designed around this assumption which has been validated through 22 years of quantitative soil monitoring conducted by DNRC. The risk of adverse effects to soils resources resulting from the proposed action was qualitatively assessed using the above listed data sources as well as soil monitoring data collected on over 90 monitoring sites spanning 22 years of DNRC timber sales projects.

Effective risk management requires assessment of inherently uncertain events and circumstances, typically addressing two dimensions: how likely the uncertainty is to occur (probability), and the magnitude the effect would be if it happened (impact) (Hillson and Hulett, 2004). This method of risk management and communication is employed for all issues throughout this document.

Issues and Measurement Criteria

The following bulleted issue statements listed below summarizes both internal and public concerns that will be analyzed in this effects analysis.

- Traditional ground based harvest operations have the potential to compact and displace surface soils which can reduce hydrologic function, macro-porosity, and/or soil function.
- Areas of impacted soil function have the potential to increase rates of offsite erosion which may affect productive surface soils.
- Harvest activities associated with the proposed actions may cumulatively affect long term soil productivity
- Activities associated with the proposed actions such as timber harvest and road construction have the potential to affect slope stability through increased water yields and road surface drainage concentration resulting in the exceedence of resisting forces.

- The removal of large volumes of both coarse and fine woody material through timber harvest reduces the amount of organic matter and nutrients available for nutrient cycling possible affecting the long-term productivity of the site.

The measurement criteria that will be used to assess the direct, indirect and cumulative effects regarding the issues listed above are listed below in *Table GS-1*.

Table GS - 1. Geology and soils analysis measurement criteria.

Generalized Issue	Measurement Criteria	Units
Slope stability	Length of existing and proposed new road construction on potentially unstable landtypes.	Miles
Soil Physical Properties	Bulk Density, Infiltration Capacity, Displacement, and Compaction (<i>Howes et al. 1983</i>)	g/cm ³ , cm s ⁻¹ , % of area
Erosion	Magnitude of current chronic upland erosional and mass wasting sites	# of sites
Site Nutrients	Volume of coarse and fine woody debris	Tons/Acre
Long Term Productivity	Amount of acres proposed for re-entry, detrimental Soil Disturbance, coarse and fine woody debris	Acres, % of area, Tons/Acre

Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations

Developed in 1996, the SFLMP is a programmatic plan that outlines the approach and philosophy guiding land management activities on forested school trust lands throughout the State of Montana (DNRC 1996). Within this plan, detrimental soil disturbance is defined and recommends that projects implemented by DNRC should strive to maintain the long-term soil productivity of a site by limiting detrimental soil impacts to 15 percent or less of a harvest unit and retain adequate levels of both coarse and fine woody material to facilitate nutrient retention and cycling.

To accomplish these goals and objectives contract stipulations and site specific BMPs are developed by resource specialist to provide protection for soil resources in a project area. The Forest Management Rules [*ARM 36.11.422(2)(2)(a)*] state that appropriate BMPs shall be determined during project design and incorporated into implementation. *ARM 36.11.414* mandates that adequate coarse woody debris shall be left on site to facilitate nutrient conservation and cycling guided the findings of Graham et al. (1994). To ensure the incorporated BMPs are implemented and site productivity maintained, specific requirements are incorporated into the DNRC timber sale contracts. The following are some general BMPs and mitigations that would be incorporated into the proposed action to ensure adequate soil protection and long-term productivity of the site.

- Limit equipment operations to periods when soils are relatively dry, (less than 20% soil moisture), frozen or snow covered (12 inches packed or 18 inches unconsolidated) to minimize soil compaction and rutting, and maintain drainage features.
- Ground-based logging equipment (tractors, skidders, and mechanical harvesters) is limited to slopes less than 45 percent on ridges, convex slopes; and 40 percent or less on concave slopes without winter conditions.
- The Forest Officer shall approve a plan for felling, yarding and landings in each harvest unit prior to the start of operations in the unit. The locations and spacing of skid trails and landings shall be designated and approved by the Forest Officer prior to construction.
- Levels of coarse and fine woody material will be retained on site as prescribed by the forest officer and recommended by the project soil scientist using guidance from the best available science (Graham et al. 1994). 15 to 20 tons/acre of material greater than 3 inches is recommended for the Bear Canyon project area with as many needles and fine material as possible which are typically retained during skidding operations.

These general BMPs along with site specific mitigations designed during contract development have been monitored for effectiveness by DNRC since 1988 and have repeatedly been shown to be an effective measure to achieve objectives described in the SFLMP (DNRC 2009).

Affected Environment

Climate

The climate of the Bear Canyon project area is highly seasonal. The average annual precipitation of 23 to 37 inches in the project area is directly correlated to elevation which ranges from 5,200 to 7,800 feet. Approximately 53 percent of this precipitation is received as snow in winter months from late November to early April although spring rains during May and June also comprise a large portion of annual precipitation. *Table GS-2* below provides storm recurrence intervals for the project area along with the associated 24-hour precipitation totals and the probability of such a storm happening in any given calendar year. Intensive precipitation in short durations can be an analog to erosive events and can help highlight the limitation of BMP effectiveness during such events. It is assumed here that BMP effectiveness would be compromised to varying degrees during a storm with a 5 to 10 percent event probability.

Table GS - 2. Precipitation intensity and recurrence.

Recurrence Interval (years)	24hr Precipitation (inches)	Event Probability of Occurrence per Year (%)
1	1.1	100%
2	1.3	50%
4	1.5	25%
5	1.6	20%
10	1.9	10%
20	2.2	5%
25	2.2	4%
50	2.3	2%

Geology

The project area is an interesting area geologically because it presents a wide range of rock types and ages in a small area. This is due to the complex geologic structure of the area. Land use limitations in the Bear Canyon area are closely tied to this complex sedimentary bedrock geology.

Folding, faulting, tilting and subsequent stream dissection and erosion exposed in some places and buried in others these sedimentary outcrops. Structurally, there are numerous of anticlines, synclines and thrust faults within the project area. During field review it was noted that all faults showed very little motion during the Holocene and were presumed to be inactive.

Limestones, sandstones, mudstones, and shales of various thickness and mixed orders are most common within the project area and range from Cambrian to Tertiary in age. Shale beds, and in particular those weathering to montmorillonitic clays are the most limiting for forest management due to the low bearing strength and moisture content.

Landscape Morphology

Historic mass failure has shaped the geomorphology of only a small portion of hillslopes within the project area and most could be characterized as planer to slightly concave with moderate to steep slopes. *Table GS-3* below shows both the acreage and percent of the area within various slope categories. Tables such as this further help to describe hillslopes as well as many other physical attributes such as erosion potential, runoff response, terrain complexity and slope stability hazard within the project area. Drainage density is low to moderate due to the modest precipitation levels with most channels showing only slight to moderate incision. The northern portion of the project area in sections 34 and 35 consist of alluvium and colluvium deposits in large alluvial fans.

Table GS - 3. Slope class distribution.

Slope Category	Project Area			Analysis Area		
	Acres	% of Project Area	Cumulative Total	Acres	% of Analysis Area	Cumulative Total
0-10%	257.2	7.3%	7.3%	4.9	0.7%	0.7%
11-20%	777.1	22.1%	29.5%	131.1	17.9%	18.5%
21-30%	808.9	23.0%	52.5%	308.8	42.1%	60.6%
31-40%	690.2	19.7%	72.2%	196.4	26.7%	87.3%
41-50%	493.7	14.1%	86.2%	85.9	11.7%	99.0%
51-60%	302.4	8.6%	94.8%	7.2	1.0%	100.0%
>60%	181.1	5.2%	100.0%	0.0	0.0%	100.0%

Slope Stability

Slope stability is the ability of material on a slope to remain in equilibrium (stable) and therefore represents some balance between driving forces (shear stress) and resisting forces (shear strength). Many variables, both natural and/or anthropogenic, may affect either driving or resisting forces. For a slope to be considered unstable driving forces and resisting forces must be close to unity.

Structural weaknesses and poor permeability will limit many forest management activities on clay rich materials, particularly road construction activities. More specifically, mass failure has been associated with a number of site factors in this area of Gallatin Range (Montagne, 1975). These factors typically include 1) excessive saturation, 2) steep slopes, 3) certain bedrock formations (shales, mudstones and sandstones) 4) dipslopes in harmony with hillslopes, 5) history of mass failure.

Numerous historic scarps and rotational failures have been documented within the Bear Canyon project area during project review and were exclusively isolated to the landscape variables listed above. While mass failure hazard may be the most important limitation to road construction and harvest activities in the project area simple mitigations such as avoidance and adequate drainage can reduce the likelihood of failure.

Soils

Soil development within the project area can be directly correlated to bedrock geology, slope position and aspect. The Gallatin Valley, Montana soil survey (NRCS, 2008) has identified 16 individual soil map units where actions have been proposed (road construction and timber harvest). A description of these map units along with the risk of impacts associated with forest management activities is listed in *Table GS-4*.

The soils within the Bear Canyon project area have many similarities with local variations in aspect, slope position, and depth to bedrock creating slight differences in physical properties that limit forest management activities. In general, soil depth is typically greater than 60 inches before encountering impervious bedrock with loam to clay loam surface textures. Deep soils with elevated clay contents, particularly on north aspects, typically remain moist well into summer months. Due to the fine texture of these soils, pore spaces are small and matrix water is bound tightly by capillary forces resulting in slow infiltration

Table GS - 4. Soil map unit descriptions.

Map Unit	Description	Acres	Percent of Analysis Area	Landtype Description	Compaction Hazard	Erosion Hazard	Displacement Hazard
291G	Whitire cobbly clay loam, 40 to 70 percent slopes, stony	21.6	2.9%	Structural Control - colluvial-alluvial, mixed sedimentary	Moderate/High	Moderate	Moderate/High
293E	Stemple cobbly sandy loam, 15 to 35 percent slopes, stony	139.8	19.0%	Dip Slopes - pluvial, mixed sedimentary	Moderate/High	Moderate	Moderate
293F	Stemple cobbly sandy loam, 35 to 60 percent slopes, stony	57.4	7.8%	Dip Slopes - pluvial, mixed sedimentary	Moderate/High	Moderate	High
294E	Yellowmule-Lonniebe, stony complex, 15 to 45 percent slopes	31.1	4.2%	Dip Slopes - pluvial, mixed sedimentary	Moderate	Low/Moderate	Moderate
295F	Shadow very cobbly coarse sandy loam, moist, 35 to 60 percent slopes, stony	10.7	1.5%	Structural Control - colluvial-alluvial, mixed sedimentary	Moderate	Moderate	Moderate
381E	Hanson, bouldery-Bridger, complex, 8 to 25 percent slopes	2.8	0.4%	Structural Control - colluvial-alluvial, mixed sedimentary	Low/Moderate	Low	Low/Moderate
396F	Loberg very flaggy loam, 35 to 60 percent slopes, very stony	34.8	4.7%	Dip Slopes - mass wasting, mixed sedimentary	Moderate	Moderate	Moderate
590E	Jaegle-Shadow, stony complex, 15 to 45 percent slopes	1.5	0.2%	Pluvial Dissection - pluvial, mixed sedimentary	Moderate	Low/Moderate	Moderate
593F	Lonniebe-Cowood complex, 35 to 60 percent slopes	5.3	0.7%	Dip Slopes - pluvial, mixed sedimentary	Moderate/High	Moderate	Moderate/High
608B	Behive-Mooseflat complex, 0 to 4 percent slopes	2.7	0.4%	Structural Control - colluvial-alluvial, mixed sedimentary	Low/Moderate	Moderate	Low/Moderate
639E	Shawmut-Tolbert complex, 15 to 45 percent slopes, very stony	4.1	0.6%	Structural Breakland - weak mass wasting	Moderate	Moderate	Moderate
691E	Whitire-Sicklesteets complex, 15 to 40 percent slopes, stony	113.4	15.4%	Structural Control - colluvial-alluvial, mixed sedimentary	High	Moderate	Moderate
691F	Whitire-Sicklesteets complex, 40 to 60 percent slopes, stony	12.0	1.6%	Structural Control - pluvial	High	Moderate/High	Moderate/High
786F	Whitecow, stony-lap, very stony-Rock outcrop complex, 35 to 60 percent slopes	18.7	2.5%	Structural Control - colluvial-alluvial, mixed sedimentary	Moderate/High	Moderate	Moderate
792E	Danaher, stony-Loberg, very stony complex, 15 to 45 percent slopes	279.5	37.9%	Dip Slopes - pluvial, mixed sedimentary	Moderate/High	Moderate	Moderate
991F	Whitere-Rock outcrop complex, 35 to 70 percent slopes	1.3	0.2%	Structural Control - colluvial-alluvial, mixed sedimentary	Low	Moderate	Moderate

capacities and moderate to poor drainage attributes. The amount of coarse rock fragments within the soil profile varies throughout the project area but typically is within the range of 5 to 30 percent by volume. With increasing coarse rock fragments, the bearing strength of the material increases thus decreasing the limitation of road construction and risk of compaction. The risk of compaction from forest management activities for each soil map unit can be found in *Table GS-4*.

Surface layers of organic matter form from needles and leaves from forest canopies, decomposition of plant material and roots as well as coarse and fine woody material. This organic layer is critical in providing habitat for microbial activity, regulating soil respiration, aeration and soil temperature. Throughout the project area surface organic layers or duff depths range from a few centimeters to several inches dependent upon habitat type, aspect and fire history.

In many portions of the project area surface ash deposits from the Holocene eruption of Mt. Mazama can be found under this duff layer, particularly on sheltered, high elevation, north to northeast facing terrain. Local ash depths range from 2 to 6 inches and provide significant water holding capacity to surface vegetation, particularly in late summer months and are typically associated with highly productive sites.

While both organic duff layers and ash caps, where present, are critical to soil function, they are also the most susceptible to surface displacement from equipment operations and log skidding. Factors affecting the risk of displacement from forest management activities include slope, amount of downed coarse woody material, equipment type, and operator skill. The risk of surface soil displacement for each soil map unit in the analysis area can be found in *Table GS-4*.

When surface soils become displaced and protective organic layers removed, bare mineral soil is exposed to surface processes, most notably erosion. Erosion of productive surface soils can entrain and transport nutrients offsite and expose more infertile subsoils. Factors effecting offsite erosion include the amount and magnitude of exposed surface soils, vegetative cover, intensity of precipitation (*Table GS-2*), and local slope. Elevated clay contents within a majority of the Bear Canyon soils provide significant bonds between clay particles due to Van der Waal forces. These attractive forces limit particle detachment and transport resulting in moderately erosive soil properties in the majority of the project area. Erosion on these materials can commonly be overcome with standard drainage practices, providing temporary vegetative cover with slash mats and limiting the areal extent of soil disturbance. The risk of soil erosion for particular soil map units can be found in *Table GS-4*.

No rill, gully or sheet erosion was observed on any locations outside of road prisms within the project area. All disturbed soils from past management activities, excluding road surfaces, have naturally revegetated and are erosively stable.

Nutrient Cycling and Soil Productivity

Coarse (CWD) and fine (FWD) woody debris provides many necessary functions to sustain soil productive and includes site moisture retention, soil temperature modification, soil

protection, nutrient cycling as well as providing a long-term supply of soil wood which is paramount to soil microbial activity (Harmon et al. 1986). Amounts of CWD and FWD throughout the Bear Canyon project area are highly variable and range from as little as 5 tons per acre to upwards of 35 to 40 tons per acre. This variability is dependent on habitat type, magnitude of insect and disease mortality, and management history. Due to the increased level of mortality through most stands proposed for treatment, CWD and FWD is accumulating in trend as needles fall and lodgepole pine stands collapse. Due to the moderate levels of precipitation and high seasonality of the project area, soils are only moderately productive when compared to other regions in Montana. Forest management activities have the potential to modify both amounts and trends of recruitable material and in turn the long-term productivity of the soil.

Past Management Activities

Two large forest management projects have been implemented in the past within the project area. The first was in 1981 and included approximately 90 acres of regeneration harvest of lodgepole pine and as well as 66 acres of select harvest of Douglas fir. Others projects were completed in the early and mid 1990's that treated approximately 102 acres by shelterwood and group selection prescriptions. While these projects were implemented prior to the developed many forest practices and regulations, they still provide insight into how potential soil impacts will ameliorate if the current proposed action are implemented.

Physical soil properties were measured within skid trail areas within the 1981 regeneration harvest unit and compared to control locations sampled on similar soils, though unaffected, adjacent to impacted areas. *Table GS-5* below displays the data from physical measurements that were made with a minidisk infiltrometer as well as lab analysis of bulk soil samples collected from five individual locations.

Table GS - 5. Soil properties from historic harvest.

Stratum	Infiltration (cm s ⁻¹)	Hydrologic Conductivity (cm s ⁻¹)	Bulk Density (g/cm ³)	Porosity (%)
Control (n=5)	0.00220	0.00027	0.87	58.8
Skid Trail (n=5)	0.00231	0.00029	1.09	48.0

Results from this sampling effort show that skid trail locations still show measureable levels of increased bulk density from actions implemented over 30 years prior, but these increases are well below root limiting values and hydrologic function, as measured by infiltration, has completely recovered. This data is critical when forecasting the temporal scale of potential impacts for the proposed actions.

Other forest management actions that have been implemented within the project area include numerous firewood gathering permits. These permits have exclusively employed hand felling and processing on site with chainsaws and resulted in no measureable soil impacts.

Four grazing leases and one agricultural and grazing lease have also been issued for grazing and hay in T2S R6E S34/35. During field review no detrimental soil impacts from these grazing related activities within the project area besides minor cow trail development. For further information regarding these licenses and leases, refer to the *Chapter 3 – Watershed and Fisheries*.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under the No-Action Alternative, none of the proposed actions outlined in *Chapter 2 – Alternatives* would be implemented. Soil physical properties would continue on a stable trend though the productivity, or ability of the land to produce biomass, would potentially decrease in the short-term as insect and disease mortality continued to increase and forest stand further collapsed. Without any site disturbance, most lodgepole pine stands would remain stagnant until historic fire regimes were restored.

Areas of margin slope stability would continue rotational movements with large failures possible under convergent conditions and seismic activity. Base erosion rates would remain constant.

Amounts of CWD and FWD would continue to increase as stands collapse and fall to the forest floor. Nutrient pools would also potentially increase due to the massive additions of CWD and FWD available as organic sources of carbon as well as macro and micro nutrients.

Direct and Indirect Effects of the Action Alternative

Soil Physical Properties and Long-term Productivity

DNRC has been conducting quantitative soil monitoring studies on timber harvest projects since 1988 that cover a wide range of soil and equipment types, climates, geologies, and silvicultural prescriptions throughout the state. This data, in concert with data presented in *Table GS-5*, allows the forecast of potential impacts to soil resources to be more informed and thus more accurate. Only a portion of the 90-plus soil monitoring sites DNRC has observed are applicable to the Bear Canyon Project in terms of equipment type, soil texture, and slope class. When this dataset is filtered by these attributes for similarities with the proposed actions, a more representative dataset for the project area is defined. *Table GS-6* below represents data from DNRC soil monitoring database for projects employing ground-based equipment on clay loam soils with slopes similar to those within the project area (*Table GS-3*).

Table GS - 6. Measured soil disturbance rates.

Stratum	Sites (n)	Sample Area (acres)	Displacement (%)	Slight Compaction (%)	Severe Compaction (%)	Erosion (%)	Total Detrimental Disturbance (%)
Ground Based Equipment	72	3,911	8.5	5.4	4.5	0.1	13.1
Clay Loam Soil Textures	17	572	5.4	3.9	3.5	0.0	8.9
Slope Class (20-40%)	41	1,625	9.8	5.0	3.7	0.1	13.6

*Slight compaction is considered non-detrimental and maintains physical, chemical and biological attributes within 15 percent of native soil conditions.

The equipment used to harvest timber and the slopes that the equipment operates on typically are the best indicators for potential soil impacts with increased levels of impacts as slopes increase with traditional ground based equipment. Understanding these controls on soil disturbance, a weighted average can be calculated to estimate a potential rate of soil disturbance within the Bear Canyon analysis area. This weighted rate, expressed as a percentage of area disturbed, was calculated at 12.9 percent (Equipment: 0.5, Slope: 0.4 and Soil Texture: 0.1). Applying this soil disturbance rate to the acres proposed for timber harvest and road construction shows that approximately 117.7 acres of land will have varying ranges of detrimental soil disturbance if the Action Alternative is selected. When this data is paired with measurements collected on historic skid trails within the project area, it can confidently be forecasted that harvest related impacts will remain for approximately 10-30 years dependent upon the magnitude of impacts. The land use within the road prism of new road construction (20.9 acres) will permanently be converted from forest products to transportation and will facilitate administrative access to these lands in the future. The level of soil disturbance forecasted from harvest activities are below that recommended within the SFLMP (DNRC, 1996) and presents a high probability of low to moderate level impacts to soil physical properties within the analysis area and the long-term soil productivity is expected to be maintained at levels described in the existing conditions.

Table GS - 7. Detrimental soil disturbance for the Action Alternative.

Area of Analysis	Total Area (Acres)	Disturbance Rate (%)	Affected Area (acres)
Harvest Units (including landings)	750	12.9%	96.8
Roads *	20.9	100.0%	20.9

*The area estimated for roads was based on 6.9 miles of road and an average clearing limit of 25 feet.

Nutrient Cycling

The amount of CWD and FWD retention within the Bear Canyon analysis area is recommended at 10 to 20 tons per acre dependent upon habitat type and aspect (Graham et al., 1994). This can be achieved by cut-to-length harvest systems or return skidding slash to harvest units. Due to the high level of dead and dying trees that will be harvested and the brittle nature of dead trees, breakage during felling and skidding operations will be high and retention should be easily achievable. Coupling this retention with the natural rate of organic accumulation given the high levels of mortality in pine stands will result in a low risk of low level impacts to site nutrient pools if the Action Alternative is selected.

Erosion

In addition to distributing slash within all harvest units for nutrient cycling and soil resource protection, slash will also be heavily scattered on primary skid trails and log landing sites to provide temporary vegetative cover. This cover will help to limit soil particle detachment and transport during intense rain events and minimize the erosion potential of disturbed areas (Wynn et al., 2000). This mitigation measure is designed to be temporary until grass seed takes and provides more permanent cover. Due to this mitigation, the low to moderate erosion risk of project area soils, and BMPs/mitigations that will be implemented to limit the extent and magnitude of soil disturbance, there is a moderate probability of low level impacts from erosion to soil productivity.

Slope Stability

Up to 1.6 miles of new road would be constructed on landtypes that are potential prone to mass failure. Though these landtypes are generally mapped as higher risk of mass failure, it can be thought of a broad brush approach. The length of new road construction noted above are on materials with low bearing strengths and require properly located and functional drainage features to eliminate localized concentration of water and potential mass failure. Mass failure within the Bear Canyon project area as well as in the northern Rockies in general, can typically be more confined to slopes that exceed 50 percent. When a fine filter approach is employed to examine locations of new road construction on potentially unstable landtypes with slopes exceeding a conservative 40 percent is completed, 0.4 miles of road would be constructed on potentially unstable landtypes. This area is exclusively located to the northern approach to the road stream crossing within Robert's Gulch. This segment of proposed new road construction is not forested and on a dry southern aspect. While not your typical area of slope instability, overlying hillslope soils are in harmony with the underlying bedrock dip slope. It is paramount in these areas that road surface drainage is tightly space to avoid hyper-concentrated runoff and subsequent slope instability. If such mitigations are achieved, slope stability issues can largely be avoided in such areas.

Notwithstanding, the proposed actions under the Action Alternative present a moderate probability of moderate to high level impacts to soil resources as a result of mass failure. If road construction activities and to a lesser extent, harvest activities, destabilize local slopes resulting in mass failure infertile subsoils will be exposed. These areas typically take long periods of time to re-vegetate and can remain unstable until re-vegetation occurs.

Cumulative Effects of the No-Action Alternative

Under the No-Action Alternative, none of the proposed actions outlined in *Chapter 2 – Alternatives* would be implemented. A low risk of low level cumulative effects to soil resources resulting from continued fire wood permits and grazing leases and licenses would be expected. Trends of soil physical properties, nutrient cycling, long-term productivity, erosion, and slope stability would continue as described within *Direct and Indirect Effects of No-Action Alternative*.

Cumulative Effects of the Action Alternative

Cumulative effects as defined in the *Analysis Area* section require multiple entries into a harvest unit for an impact to be cumulative. Under the Action Alternative, no previously harvest area is proposed for reentry. Because of this constraint, no cumulative effects are expected to soil physical properties, nutrient cycling or long-term soil productivity.

No chronic upland erosion was noted during field review of the project area. Small slumps and rotational failures that were noted have revegetated and are both hydrologically and erosional stable. Due to these observations, lack of current erosion and a moderate probability of low level impacts from erosion resulting from direct and indirect effects of the proposed action, no cumulative effects to soil resources from erosion are expected within project area.

There is no sign of mass failure within the project area directly attributed to past management actions such as road construction, timber harvest, and/or grazing practices. Observed slumps and rotational failures in the project area are natural for the particular landtypes and occur on geologic timescales typically triggered by seismic activity common to the Greater Yellowstone ecosystem. All existing roads are currently constructed on moderately stable landtypes and show no signs of instabilities. Historic harvest on landtypes prone to mass failure also shows no sign of instability and has re-vegetated to a point at which stability has been reinforced through hydrologic recovery and root developed. Additional timber harvest on landtypes prone to mass failure can potential result in water yield increases and thus cumulatively affect existing instabilities, but water yield analysis cited in the *Chapter 3 – Watershed and Fisheries* section suggests potential increases are under those of concern for detrimental watershed effects including mass failure. Due to these factors in conjunction with the potential direct and indirect effects, there is a moderate probability of low to moderate level cumulative effects to slope stability within the project area.

Wildlife

Introduction

The following sections disclose the anticipated direct, indirect, and cumulative effects to wildlife resources from the proposed action in the project area and cumulative-effects analysis areas described for each resource category. Past and ongoing activities on all ownerships, as well as planned future agency actions, have been taken into account in each cumulative-effects analysis for each resource topic.

Analysis Areas

The discussions of existing conditions and environmental effects within each subsection pertain to land areas of 2 different scales. The first scale of analysis is the project area (3,511 acres), which is comprised of the relevant subset of DNRC lands where activities are being proposed. The project area is located approximately 5 miles southeast of Bozeman, Montana on state trust lands in the Bear Canyon area (*Figure I-1*).

The second scale is the cumulative-effects analysis area, which refers to a broader surrounding landscape useful for assessing cumulative effects to wildlife and habitat. For this proposed project, two distinct cumulative-effects analysis areas were identified. One, for assessing cumulative impacts to smaller species of wildlife surrounds the project area and is 33,442 acres. This area was identified as an appropriate adjacent land area of similar vegetation and topography where potential cumulative impacts would be most likely to be realized and detectable in relation to proposed activities and most of the issues raised pertaining to wildlife and habitat. The second larger area for analyzing cumulative effects is 93,551 acres and was delineated as an approximation of a fall elk herd home range for elk that use the Bear Canyon Project Area vicinity. The area identified extends roughly in an 8 mile radius from the project area (J. Cunningham, R-3, FWP Biologist, pers. comm., 4/13/11). This area coincides closely with forested lands contained within the National Forest Boundary as well as state trust lands in, or near the project area. This area was identified as the most appropriate area to consider cumulative impacts associated with road densities and forest cover on elk.

Issues and Measurement Criteria

Several issues regarding wildlife species and their habitat were identified through public and internal scoping. These issues are listed in *Table I-1* and are reiterated at the beginning of the following sections. Different measurement criteria were used to evaluate the effects of the alternatives on wildlife resources, depending on the resource or habitat need specified. The measurement criteria used for evaluation of impacts are described under each issue below.

Analysis Methods

For each species or habitat issue, existing conditions of wildlife habitats are described and compared to the anticipated effects of the No-Action Alternative and the proposed Action

Alternative to determine the foreseeable effects to associated wildlife habitats.

To assess the existing condition of the project area and surrounding landscape and related impacts associated with the proposed Action Alternative, a variety of techniques were used. Field visits, scientific literature, SLI data, review of aerial photographs, review of MNHP data, and consultations with other professionals provided information for the following discussion and effects analysis. Specialized methodologies, where applicable, are discussed under the species or issue in which they occur. Species were dismissed from further analysis if habitat did not exist in the project area or if the habitat would not be appreciably modified by any alternative.

Past management activities in the vicinity of the project area that could result in cumulative effects were also considered in the following analyses. Those activities are listed in *Chapter I – Relevant Past, Present, and Related Future Actions*.

Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations

Various legal documents dictate or recommend management direction for terrestrial wildlife species and their habitats on state trust lands. The documents most pertinent to this project include DNRC Forest Management Rules, the ESA, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act.

Coarse Filter – Cover Types, Age Classes, Old Growth, Stand Structure, Snags and Coarse Woody Debris, Patch Characteristics, Connectivity of Forest Cover, and Habitat Linkage

DNRC's principal means of managing for biodiversity is by taking a 'coarse-filter approach', which favors an appropriate mix of stand structures and compositions on state lands (ARM 36.11.404). Appropriate stand structures are based on ecological characteristics (e.g., landtype, habitat type, disturbance regime, unique characteristics). A coarse-filter approach assumes that if landscape patterns and processes are maintained similar to those endemic species evolved with, the full complement of species will persist and biodiversity will be maintained. This coarse-filter approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate historic conditions across the landscape. DNRC cannot assure that the coarse-filter approach will adequately address the full range of biodiversity; therefore, DNRC also employs a 'fine-filter' approach for threatened, endangered, and sensitive species (ARM 36.11.406). The fine-filter approach focuses on a single species' habitat requirements and helps ensure that special habitat needs of these rare or sensitive species are not overlooked.

Issue

There is concern that activities that would occur under the proposed action could affect important habitat attributes at a landscape scale that could adversely wildlife species and maintenance of biodiversity.

Measurement Criteria

The management criteria used to evaluate impacts related to the following issues included: the timing of proposed activities, location of proposed activities, scale of activities, quantified cover amounts, quantified road amounts, stand level inventory summaries of stand age classes and cover types, visual field assessments of the abundance of snags and coarse woody debris, visual assessments of aerial photography for visual evaluation of cover and topography as related to potential linkage areas and movement corridors.

Affected Environment

Introduction

The project area is situated along the northerly foothills portion of the Gallatin Mountain Range and is comprised of cool, dry forest types interspersed with open grass and shrub communities. Elevations range from 5,200 to 7,600 feet. Slopes range from 0 to 20 percent along fringe agricultural lands and pastures up to 65 percent on steeper mountainous terrain. The project area provides forested and non-forested habitats used by many terrestrial wildlife species, and it is used to varying degrees by moose, elk, mule deer and black bears. Occasional observations of mountain lions, bobcats, wolves, wolverines and grizzly bears have been noted in the vicinity of the project area (K. Frey, R-3, FWP Biologist, pers. comm. May 2011; J. Cunningham, R-3, FWP Biologist, pers. comm. 4/13/11).

Cover Types

Forest cover types in the project area are dominated by Douglas-fir, followed by non-forest grass/shrub openings and meadows, lodgepole pine, subalpine fir, and localized stands of aspen. Fire has historically played an important role in shaping vegetation community types in the Bear Canyon area (Gruell 1983). Habitat types (Pfister et al. 1977) characteristic of the project area are consistent with those found in Fire Groups 5 (cool, dry Douglas-fir), 6 (moist Douglas-fir dominated), 7 (lodgepole pine dominated), and 8 (dry subalpine fir dominated) (Fischer and Clayton 1983). The role of fire in Group 5 is not well defined and fire probably occurred less frequently in these types than in those in ponderosa pine habitat types found elsewhere (Fischer and Clayton 1983). Fire in Group 6 was important as a thinning agent and as a stand-replacement agent. Mean fire intervals in Fire Groups 5 and 6 have been estimated at about 40 years and downed, dead fuel loads average about 10 to 13 tons/acre respectively. Mean fire intervals in forests within Fire Groups 7 and 8 can vary from about 50 years to well over 100 years. Often, large scale stand-replacing fires were the predominant disturbance type in Groups 7 and 8. Lodgepole pine stands in these types generally regenerate back into young lodgepole stands and may occupy very large acreages due to large catastrophic events. Downed, dead fuel loads average 15 to 20 tons/acre respectively in these types, but can often greatly exceed these amounts (Fischer and Clayton 1983). Since the turn of the century, conifer encroachment has made dramatic advances across previously non-forested openings in the Bozeman Pass area (Gruell 1983). Currently, beetle infestations are reducing considerably the amount of standing live lodgepole pine on DNRC ownership.

Age Classes, Old Growth, and Stand Structure

Different ages of forest stands can provide a variety of habitats for wildlife species. Since 1980, approximately 258 acres of timber harvest and thinning have occurred on DNRC lands in the project area, which have resulted in open forest stands or young sapling stands ranging in age from 0 to 39 years. Most stands within the project area and nearby lands fall within the 40 to 99 year and 100 to 149 year age classes, with most mature stands ranging in age from 90 to 120 years. Old growth stands that meet the classification criteria of Green et al. (1992) do not occur on the project area (see Chapter 3 – Vegetation for details). Existing stand structures in mature forest stands range from open Douglas-fir/limber pine parks on exposed dry sites with shrub/grass understory vegetation to dense Douglas-fir/lodgepole stands with high amounts of ninebark and coarse woody debris. Sight distances range from several hundred feet in old harvest units and dry site parks to less than 200 feet in dense, mature Douglas-fir/lodgepole stands and lush riparian areas, which provide suitable hiding cover for wildlife. Overstory canopy cover in older partial-harvest logging units on the project area ranges from approximately 15 percent to 40 percent. Whereas, overstory canopy cover in existing unharvested mature stands ranges from about 66 percent to 87 percent and averages approximately 79 percent. Sites within lodgepole pine stands where mountain pine beetle has killed a high proportion of trees are variable and lower than the 79 percent average for the project area. In areas heavily affected by mountain pine beetle, high accumulations of coarse woody debris are likely to increase on affected sites -- potentially inhibiting movements of some animals in localized areas.

Snags and Coarse Woody Debris

Snags, downed logs and defective trees (eg. partially dead, spiked top, broken top etc.) are used by a wide variety of terrestrial species for nesting, denning, roosting, feeding, and cover. Amounts of snags and coarse woody debris vary considerably across the project area and few large old trees and snags greater than 20 inches dbh occur on the project area (<1 per acre). Those that exist are primarily Douglas-fir, and a few scattered spruce in cool, moist areas. Coarse woody debris in Douglas-fir stands and mixed Douglas-fir/lodgepole pine stands is highly variable and ranges from about 5 to 40 tons per acre. Some localized sites have very heavy downed log concentrations with >50 tons per acre. In portions of some stands that have large quantities of beetle-infested lodgepole pine (8 to 12 inches dbh), snag amounts range from approximately 50 to 100 snags per acre. Snags in old harvest units are relatively uncommon and occur at densities of 0 to 1 per acre -- the majority being less than 20 inches dbh. Coarse woody debris amounts in old logging units generally range from 1 to 5 tons per acre and the material is comprised of 3 to 10 inch diameter logs.

Patch Characteristics and Connectivity of Forest Cover

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross nonforested expanses. Generally, the more effective corridors are those that are relatively wide, unfragmented, diverse, and associated with riparian areas (Fischer and Fischenich 2000). Dense patches of mature forest are abundant in the project area and cumulative effects analysis area. Approximately 2,532 acres of the 3,511-acre project area (72 percent) currently possess greater than 40 percent

overstory canopy cover in mature forest patches. Approximately 27,036 acres (81 percent) of the 33,442-acres cumulative effects analysis area currently possess greater than 40 percent overstory canopy cover in mature forest patches. Existing patches have variable tree density and comprise a diverse mosaic of habitat conditions. Existing patch shapes and sizes in the project area have been influenced by past logging, roads, and natural disturbances that have likely occurred during the past 150 years. Mature forest stands in the project area and cumulative effects analysis area are generally well connected and provide a suitable network of cover capable of facilitating movements of many terrestrial species across the local landscape. Mature forest patches of several hundred acres to those over 1,000 acres are present in the project area. Due to past timber harvest design and natural disturbance types, hard forest/non-forest edges that would pose greater risk to wildlife species sensitive to edge effect and associated predation are not abundant in the project area or cumulative effects analysis area.

Habitat Linkage

Linkage zones are defined as “the area between larger blocks of habitat where animals can live at certain seasons and where they can find the security they need to successfully move between these larger habitat blocks” (Servheen et al. 2003). Linkage zones differ from corridors in that the area is not just used for travel. Areas appropriate for linkage zones can occur at different spatial scales, particularly when considering the species of concern. The project area lies just to the west of Bear Canyon and the Bozeman Pass area and is approximately 1.3 miles south of possible wildlife crossing sites across U.S. Interstate 90. This general vicinity in relation to U.S. Interstate 90 has been recognized by various agencies and interest groups as an area important for maintaining and promoting wildlife linkage and movement corridors between the Gallatin and Absaroka mountain ranges to the south and the Bridger and Bangtail mountains to the north (MDT 2010). The USFS has also recognized this area as potentially important for maintaining habitat connectivity for Canada lynx (USFS 2007). Agricultural lands, a number of homes, and several subdivisions occur within one mile of the project area. The Bear Canyon area is a popular recreation destination for people from the city of Bozeman and local area during all seasons of the year. Popular activities include hiking, biking, skiing, horseback riding, and hunting.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative – All Coarse Filter Issue Topics

Under this alternative, there would be no short-term changes to cover types, age classes, stand structures, old growth, snags and coarse woody debris, patch characteristics, connectivity of forest cover, or habitat linkage associated with proposed activities. Over time and in the absence of natural disturbance events, the abundance of dense mature forest would be expected to increase. Forest cover types would likely remain similar to the existing condition, but over several decades a greater representation of Douglas-fir types and subalpine fir types would be expected -- often replacing lodgepole pine stands. Stand age classes would gradually shift to older types in the absence of disturbance, and old growth stands would have greater representation as stands continue to age. Stand structure diversity would decrease over time and forest openings would infill with mature forest,

resulting in a relatively homogenous and continuous blanket of mature forest across the landscape. Snags and coarse woody debris would likely increase (particularly in dead and dying lodgepole pine stands) and, in the absence of fire or other broad scale disturbance, mature forest patches and connectivity of mature forest cover would tend to expand through forest succession. Habitat linkage would not be influenced under this alternative. Terrestrial wildlife species that prefer habitat conditions resulting from these described changes would presumably benefit (eg. American marten), whereas those preferring open forest conditions (eg. mountain bluebird), and young forest stands (eg. olive-sided flycatcher) would not.

Direct and Indirect Effects of the Action Alternative

Cover Types

Under the proposed action appreciable cover type changes affecting wildlife habitat and species use and/or diversity on the 3,511-acre project area would not be expected given the 734 acres proposed for harvest. Harvested stands with high amounts of Douglas-fir would likely develop back into similar stands in the future, and those areas with large amounts of lodgepole pine would likely mature again back to lodgepole pine (Fisher and Clayton 1983:49). Where affected, aspen exposed to potential logging and burning disturbance would be expected to increase in abundance, particularly where it is currently surrounded and overgrown by conifer forest.

Age Classes and Old Growth

Following proposed timber harvesting, approximately 286 acres of the 3,511-acre project area (8 percent) would have age classes altered from the 90 to 120-year age class to the 0 to 39-year age class due to the extensive removal of older lodgepole pine trees from these acres. The 448 acres containing greater amounts of Douglas-fir that would be harvested less intensively would remain in the 90-120 year age class. Old growth stands that meet the minimum requirements of Green et al. (1992) do not occur within the project area, thus, old growth and closely associated wildlife species would not be affected. The alteration of age classes on 8 percent of the project area would result in a minor increase in age class diversity that would benefit some species that use young-aged conifer forest and forest openings for nesting and foraging. Conversely, there would be minor adverse effects associated with species highly associated with older, mature interior forest conditions.

Stand Structure

Dense forest structural types comprised of mature forest currently represent the most abundant condition on the project area. Comparison of three structural classes by alternative based on mature forest canopy are provided in *Table W-1* below. Forest structure would be altered on 734 acres within proposed harvest units and approximately 20 additional acres associated with tree removal along the 6.8 miles of proposed temporary roads. Following harvest activities, the Non-Forest/Sparse Forest class would increase by 502 acres. Including the additional acreage for road clearing, a total of 522 acres would be converted to the Non-Forest/Sparse Forest class. The Moderate Dense class would increase by 231 acres and the Dense Forest Class would be reduced by 734 acres (i.e., the total harvest amount). Under the Action Alternative the Dense Forest structural type would remain the

most abundant (albeit at a reduced level), closely followed by the Non-Forest/Sparse Forest class (*Table W-1*). Under the Action Alternative, there would be an increase in structural diversity related to stand density (i.e., a broader range of stands with differing densities of trees and attributes), which would benefit species that prefer a mosaic of dense forest and open forest stand conditions. Within all harvest units, stand structure complexity associated with multiple tree canopy levels would decrease as a result of tree removal and logging disturbance, which could cause minor adverse effects for species that prefer dense undergrowth. Following harvest, 1,362 acres of dense forest conditions would remain on the project area (*Table W-1*).

Table W - 1. Acreages by alternative of sparse forest, moderately dense forest, and dense forest structural classes based on overstory forest canopy cover classes on the DNRC Bear Canyon Timber Sale Project Area.

Forest Structural Classes	No Action Alternative Acres (%)	Action Alternative Acres Post Harvest (%)
Non-Forest/Sparse Forest (0 to 30% Canopy Cover)	810 (23%)	1,312 (37%)
Moderately Dense Forest (31 to 60% Canopy Cover)	607 (17%)	838 (24%)
Dense Forest (61 to 100% Canopy Cover)	2,095 (60%)	1,362 (39%)
Total	3,511	3,511

Data source USGS 2003

Snags and Coarse Woody Debris

Under the proposed action, existing numbers of snags would be reduced from existing levels on the 750 acres (21 percent) proposed for harvest on the 3,511 acre project area due to timber felling operations and removal of dead and dying beetle-infested trees. Additional snags may also be lost in the short term following treatments due to wind throw. Given operability and human safety constraints, existing non-merchantable snags would be left standing where possible. Additionally, across the project area, at least 2 large snags and 2 large recruitment trees per acre (both >21 inches dbh) would be retained. In cases where snags and recruitment trees meeting this minimum size are not present, the largest available snags and trees would be retained. Available snag habitat would be reduced on all treated acres in the project area, which would be expected to reduce the abundance of species that require snags as a life requisite. However, snags and future recruitment trees would be retained in a well distributed manner across the project area, which could maintain habitat for fewer individuals. Existing snag amounts would not be influenced on the 2,777 acres of

the project area that would not receive harvest. Effects on the abundance and distribution of coarse woody debris would be variable, however, post-harvest monitoring on DNRC projects from 2001 to 2011 has indicated that ample amounts have been attained in most logging units (DNRC 2005, DNRC 2011). Areas with currently high concentrations of coarse woody debris (i.e., >50 tons per acre) would likely have amounts reduced due to operability needs and harvest operations. Whereas, the amounts of material in areas where down woody material is relatively sparse would likely increase following harvest (DNRC 2005, DNRC 2011). Post harvest coarse woody debris levels would range from 5 to 20 tons/acre and average approximately 10 tons/acre across harvest units. While some changes in the amount and distribution of woody material would occur across the project area, ample amounts would be expected to remain, which would provide for soil structure, habitat structure and feeding substrate for many species that utilize woody material to meet life requisites (Graham et al. 1994). Retained snags and recruitment trees would further ensure the presence of downed woody material across the project area over time.

Patch Characteristics and Connectivity of Forest Cover

Under the proposed action, habitat connectivity associated with riparian areas would not be appreciable altered as no riparian timber harvesting would occur in the project. Across the project area, dense patches of mature forest cover would also remain abundant and well connected. Of the 3,511-acre project area, 1,893 acres (54 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 1,362 would possess >60 percent overstory cover (39 percent). Following logging, forest patches on the project area would continue to have variable tree density and would continue to provide a mosaic of habitat conditions. Overall, stand density would be reduced on 734 acres of mature forest. Mature forest stands in the project area would generally remain well connected and provide a suitable network of cover capable of facilitating movements of terrestrial species across the local landscape. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide a reduced amount of escape cover and visual screening. Tree density would be reduced most within harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse on this affected 286 acres. The amount of hard forest edge that could adversely affect some species of wildlife would increase approximately 4,382 feet on the project area due to removal of lodgepole pine in harvest unit 4. Overall, timber harvesting associated with the proposed action would have a minor adverse impact on species that prefer interior forest conditions and well-connected mature forest cover. Tree density in harvested patches would be reduced, which would improve habitat conditions for species that prefer open forest conditions, but would reduce security and habitat quality for species that benefit from large expanses of mature forest cover.

Habitat Linkage

The project area lies just to the west of Bear Canyon and the Bozeman Pass area. The area has been recognized as being important for maintaining and promoting wildlife linkage and movement corridors between the Gallatin and Absaroka mountain ranges to the south and the Bridger and Bangtail Mountains to the north (MDT 2010). Under the proposed action, stand density would be reduced on 734 acres of mature forest and sparsely forested

openings would be created on approximately 286 acres (8 percent) of the 3,511-acre project area. Following timber harvest, large species such as elk, deer, bears and moose may alter the way they move through and use habitat and individual forested stands in the project area. However, given: 1) the sizable amounts of moderate to dense mature stands that would remain following harvest (1,893 acres with >40 percent canopy cover), 2) the mosaic of habitat conditions that would remain following harvest, 3) that there would be no long-term increases in motorized or non-motorized human access routes associated with the project, and 4) that there would be no permanent human development associated with the project, there would be minimal risk of adverse affects to wildlife linkage or future linkage potential in the Bear Canyon and Bozeman Pass areas associated with this project.

Cumulative Effects of the No-Action Alternative – All Coarse Filter Issue Topics

Cumulative effects associated with the No-Action Alternative would be the same as those described above under "Direct and Indirect Effects" for no action. Under this alternative, no action at the scale of the 734-acre proposed harvest area of the 33,422 cumulative effects analysis area would result in minimal successional changes on 2.2 percent of the land area in the absence of disturbance. Thus, cumulative effects associated with any successional changes over time pertaining to cover types, stand age classes, old growth, stand structure, coarse woody debris, forest patch characteristics, connectivity of mature forest cover, or habitat linkage would be minor.

Cumulative Effects of the Action Alternative

Cover Types

Under the Action Alternative no appreciable changes in cover types that would contribute to adverse cumulative effects to wildlife habitat, species use, or diversity within the 33,422-acre cumulative effects analysis area would be expected given the 734 acres (2 percent) proposed for harvest. As harvested stands would regenerate and grow following harvest, tree species composition would likely remain very similar to what is present under the existing condition given the site conditions and species that are present (Fisher and Clayton 1983:49). The proposed USFS Bozeman Municipal Watershed Project (BMW project) would potentially alter vegetation type and density on approximately 4,269 acres within the DNRC 33,422-acre cumulative effects analysis area. If both projects were to occur over the next 5 years, approximately 5,003 acres (15 percent) of vegetation within the 33,422-acre cumulative effects analysis area could be altered. Of the 5,003 acres involved in the projects of both DNRC and USFS, intensive treatments that would have greatest potential to alter cover types (primarily in the short term) would only occur on approximately 2,117 acres (6 percent). As cover types in both project areas are similar, tree species composition would likely remain very similar to what is present under the existing condition given the site conditions and species that are present.

Age Classes and Old Growth

Following proposed timber harvesting, approximately 286 acres (0.8 percent) of the 33,422-acre cumulative effects analysis area would have age classes altered from the 90 to 120-year age class to the 0 to 39-year age class due to the removal of older lodgepole pine trees from

these acres. Old growth stands that meet the minimum requirements of Green et al. (1992) do not occur within the project area, thus, there would be no potential for cumulative impacts to closely associated wildlife species at the scale of the project area or cumulative effects analysis area. The conversion and increased representation of the 0 to 39-year age class on 286 acres (0.8 percent) within the cumulative effects analysis area would result in a minor increase in age class diversity that would benefit some species that use young-aged conifer forest and forest openings for nesting and foraging. Due to these slight potential changes in vegetation, there would be very minor added risk of adverse cumulative effects to species associated with mature interior forest conditions. The proposed USFS BMW project would potentially alter age classes on approximately 1,831 acres (5 percent) of the DNRC 33,422-acre cumulative effects analysis area. Combined with the acreage of DNRC lands that would have age class altered (286 acres), approximately 2,117 cumulative acres (6 percent) could be affected. This potential change in age classes could result in a minor cumulative increase in age class diversity that would benefit some species that use young-aged conifer forest and forest openings for nesting and foraging. Considering changes proposed under both projects, there would be potential for minor adverse cumulative effects to species associated with mature interior forest conditions and older, mature age classes.

Stand Structure

Dense forest structural types comprised of mature forest currently represent the most abundant condition on the cumulative effects analysis area. Comparison of three structural classes by alternative based on mature forest canopy is provided in *Table W-2* below. Forest structure would be altered on 734 acres within proposed DNRC harvest units and approximately 20 additional acres associated with tree removal along the 6.8 miles of proposed temporary roads. Following harvest activities, the Non-Forest/Sparse Forest class would increase by 502 acres. Including the additional acreage for road clearing, a total of 522 acres would be converted to the Non-Forest/Sparse Forest class. The Moderate Dense class would increase by 231 acres and the Dense Forest Class would be reduced by 734 acres (i.e., the total harvest amount). Under the Action Alternative the Dense Forest structural type would remain the most abundant, followed by the Moderately Dense-Forest and Non-Forest/Sparse classes (*Table W-2*). Under the Action Alternative, there would be an increase in structural diversity related to stand density (i.e., a broader range of stands with differing densities of trees and attributes), which would benefit species that prefer a mosaic of dense forest and more open forest stand conditions. Within all harvest units, stand structure complexity associated with multiple tree canopy levels would decrease as a result of tree removal and logging disturbance, which could cause minor adverse effects for species that prefer dense undergrowth and forests with multiple canopies. Following proposed harvest on DNRC lands, approximately 21,769 acres (65 percent) of dense forest conditions would remain in the cumulative effects analysis area (*Table W-2*). Should the USFS BMW project also be implemented as proposed, vegetation changes associated with both projects would cumulatively alter structural attributes within the cumulative effects analysis area (*Table W-2*). Given proposed treatment types for each project, the acreage of dense forest could be reduced in the cumulative effects analysis area over the next 5 years by approximately 5,003

acres (15 percent reduction). The Moderately Dense Forest class could increase by approximately 2,902 acres (9 percent increase), and the Non-Forest/Sparse Class could increase by approximately 2,099 acres (6 percent increase). The potential adverse and beneficial cumulative effects to wildlife species described above in this paragraph would likely be proportional to the relative size of the areas undergoing disturbance associated with proposed logging and prescribed burns.

Table W - 2. Acreages by alternative of sparse forest, moderately dense forest, and dense forest structural classes based on overstory forest canopy cover classes on the DNRC Bear Canyon Timber Sale Cumulative Effects Analysis Area.

Forest Structural Classes	No Action Alternative Acres (%)	Action Alternative Acres Post Harvest DNRC Project Only (%)	Action Alternative Estimated Acres Post Harvest DNRC Project and USFS BMW project Alt. 6 (%)
Non-Forest/Sparse Forest (0 to 30% Canopy Cover)	4,827 (14%)	5,328 (16%)	6,926 (21%)
Moderately Dense Forest (31 to 60% Canopy Cover)	6,094 (18%)	6,325 (19%)	8,996 (27%)
Dense Forest (61 to 100% Canopy Cover)	22,501 (67%)	21,769 (65%)	17,498 (52%)
Total	33,422	33,422	33,422

Data source USGS 2003, USFS 2011

Snags and Coarse Woody Debris

Under the proposed action, existing numbers of snags would be reduced from existing levels on the 734 acres (2 percent) proposed for treatment within the 33,422-acre cumulative effects analysis area due to timber felling operations and removal of dead and dying beetle-infested trees. Additional recruitment trees and snags may also be lost in the short term following treatments due to wind throw. Given operability and human safety constraints, existing non-merchantable snags would be left standing where possible on DNRC lands. Additionally, across the project area, at least 2 large snags and 2 large recruitment trees per acre (both >21 inches dbh) would be retained on DNRC harvest units. If such large trees and snags are absent, the largest available snags and trees would be retained. Available snag habitat would be reduced on all treated acres in the project area, which would be expected to reduce habitat quality and the abundance of species that require snags as a life requisite. However, snags and future recruitment trees would be retained in a well

distributed manner across the project area, which would maintain habitat, albeit possibly for fewer individuals. Over the next 5 years, amounts of snags and coarse woody debris could also be influenced by the USFS BMW project which would alter vegetation on approximately 4,269 acres (13 percent) within the DNRC cumulative effects analysis area. Logging and burning of vegetation undertaken by both agencies under these proposals would result in approximately 5,003 acres (15 percent) of total treatment area within the DNRC 33,422-acre cumulative effects analysis area. Treatments planned by the USFS would require retention of at least 3 snags per acre >10 inches dbh, and 6 live replacement trees per acre (USFS 2010). Of the 5,003-acre total treatment area, at least 3,405 acres would have many additional potential live replacement trees retained due to the proposed partial harvest treatment types, which would ensure the ample presence of snags and recruitment trees into the future. None of the DNRC proposed harvest units would be expected to possess an average of less than 31 live trees per acre following logging. Effects on the abundance and distribution of coarse woody debris would be variable on DNRC lands, however, ample amounts have not been difficult to retain in most logging units during the last decade (DNRC 2005, DNRC 2011). Areas with currently high concentrations of coarse woody debris (i.e., >50 tons per acre) would likely have amounts reduced due to operability needs and harvest operations. Whereas, the amounts of material in areas where down woody material is relatively sparse would likely increase following harvest. Post harvest coarse woody debris levels would range from 5 to 20 tons/acre and average approximately 10 tons/acre across DNRC harvest units. While some changes in the amount and distribution of woody material would occur across the project area, ample amounts would be expected to remain, which would provide for soil structure, habitat structure and feeding substrate for many species that utilize woody material to meet life requisites (Graham et al. 1994). Retained snags and recruitment trees would further ensure the presence of downed woody material across the project area and cumulative effects analysis area over time. Under the USFS BMW project proposal, an average of 15 tons/acre of woody material >3 inches diameter would be retained in harvest units, and two additional 10-inch diameter logs at least 20 feet long would be retained. Residual woody material on USFS lands proposed for prescribed burning (~1,430 acres) would likely be variable, depending upon individual site fuel loads and burning conditions at the time of ignitions.

Patch Characteristics and Connectivity of Forest Cover

Under the proposed action, habitat connectivity associated with riparian areas would not be altered as no riparian timber harvesting would occur in the project. Across the DNRC cumulative effects analysis area, large dense patches of mature forest cover (>200 acres) would remain abundant and well connected, which would provide a suitable network of cover capable of facilitating movements of terrestrial species across the local landscape. Of the 33,422-acre cumulative effects analysis area, approximately 26,378 acres (79 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Following logging, forest patches on the project area would have variable tree density, but would maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Tree density would be reduced from existing levels most within

harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse on this 286 acres. The 286 acres represents 0.8 percent of the DNRC 33,422 acre cumulative effects analysis area. The amount of hard forest edge that could adversely affect some species of wildlife would increase approximately 4,382 linear feet on the project area due to removal of lodgepole pine in harvest unit 4. If this DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover with >40 percent crown closure could be reduced to approximately 24,547 (73 percent) of the 33,422-acre cumulative effects analysis area. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies. However, habitat connectivity would not likely be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Also, of the 5,003 acres of vegetation that both agencies have proposed for treatment, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance due to the partial harvest treatment prescriptions being proposed. Within treated stands on both the DNRC and USFS projects, individual trees and patchy tree retention would remain, which would continue to provide appreciable amounts (albeit at reduced levels) of escape cover and visual screening within treatment areas. Minor increases in hard forest edge could occur as a result of fuel break treatments on the 168 acres proposed for management in the USFS BMW project, which represent a cumulative increase in addition to hard edge that could be created within a 79-acre unit (unit 6) in the DNRC proposal. Additional hard edge would likely not be increased to any appreciable degree on proposed management units in the USFS BMW project due to the partial and variable nature of the treatment types being proposed (i.e., partial timber harvesting, pre-commercial thinning, and prescribed burning).

Under both the DNRC project and USFS project, short-term (3 to 5 years) cumulative disturbance to wildlife associated with roads and logging activities could occur, which could influence movement patterns and habitat use while projects are active. The combined road amount that would be used under both combined proposals would total approximately 21.2 miles. DNRC operations would include temporary use of 12.4 miles of road (5.3 miles restricted road, 7.1 miles of temporary road). Proposed USFS operations would include approximately 8.8 miles (1.7 miles of existing road, 7.1 miles of temporary road). All temporary roads would be quickly and effectively closed after project completion. Additional short-term disturbance associated with forest management activities proposed under both projects would be cumulative to existing high levels of motorized and non-motorized public recreational use, which occurs within the cumulative effects analysis area. Such disturbance could increase the potential for temporary displacement of wildlife species that may be sensitive to the increased presence of humans and motorized activities. Species such as elk, moose, and black bears could be displaced from normal home range areas into places with lower quality habitat, and/or be pressed into nearby areas possessing greater inherent risk of conflict with humans (eg. areas with high hunter density, subdivisions, home sites, and agricultural lands). During periods of active

management associated with both projects, an elevated likelihood of black bear displacement and conflicts could occur, which could require additional effort by FWP bear managers to resolve problems in the local area (K. Frey, R-3, FWP Biologist, pers. comm. May 2011). Overall, forest management activities associated with the proposed DNRC action would have a minor adverse cumulative impact on species that prefer interior forest conditions and well-connected mature forest cover, and minor, temporary impacts associated with logging disturbance and displacement of wildlife. Tree density in harvested patches would be reduced, which would improve habitat conditions for species that prefer open forest conditions, but would reduce security and habitat quality for species that benefit from large expanses of mature forest cover.

Habitat Linkage

The project area lies immediately to the west of the Bear Canyon/Bozeman Pass area. The Bozeman Pass area has been recognized as being important for maintaining and promoting wildlife linkage and movement corridors between the Gallatin and Absaroka mountain ranges to the south and the Bridger and Bangtail Mountains to the north (MDT 2010). Under the proposed DNRC action, stand density would be reduced on 734 acres of mature forest, and sparsely forested openings would be created on approximately 286 acres (0.8 percent) of the 33,422-acre cumulative effects analysis area. Following timber harvest, large species such as elk, deer, bears and moose may alter the way they move through and use habitat and individual forested stands in the project area, but continued year-round use would be expected at the scale of the cumulative effects analysis area. Under the USFS BMW project, an additional 1,598 acres could be converted to sparsely forested openings, thus, under both projects combined, 1,884 acres could be converted to such a condition. Given: 1) the sizable amounts of moderate to dense mature stands that would remain in the cumulative effects analysis area following harvest [24,547 acres (73 percent) with >40 percent canopy cover], 2) the mosaic of habitat conditions that would remain following harvest, 3) that there would be no long-term increases in motorized or non-motorized human access routes associated with the project, and 4) that there would be no permanent human development associated with the project, there would be minor risk of adverse cumulative effects to wildlife linkage or future linkage potential in the Bear Canyon/Bozeman Pass area in association with this project.

Fine Filter

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species federally listed under the ESA, species listed as sensitive by DNRC, and species managed as big game by FWP. In western Montana, 3 terrestrial species are federally classified as threatened or endangered. The grizzly bear and Canada lynx are classified as threatened. The gray wolf has been classified as endangered in northwest Montana and until recently has been managed under the experimental population classification in southwest Montana. The listing status of gray wolves has been in flux for the last several years due to multiple legal challenges and court rulings. Wolves were delisted on May 5, 2011 through a Congressional budget action (April 14, 2011). On May 6,

2011 four environmental groups again filed suit charging that the action was unconstitutional and that wolves should remain listed. Given the numerous fluctuations in status and potential for future changes that could occur, wolves were considered as endangered for this analysis.

Endangered, Threatened, and Sensitive Species

Issue

There is concern that activities proposed in this project may adversely affect federally listed threatened and endangered species, and/or sensitive species.

The potential for direct, indirect and cumulative effects was considered for the endangered, threatened and sensitive species included in the table below. For Canada lynx and grizzly bears potential for adverse impacts was present, therefore, detailed analyses are included below for both species. For each of the remaining species listed in the checklist below, the likelihood of adverse impacts was considered to be minimal. The assessment rationale for each species is presented in each corresponding description cell in the table.

Measurement Criteria

The management criteria used to evaluate impacts related to the following issues and species included: MNHP species occurrence record search (4/1/11), Species specific assessments of distribution and habitat suitability, field reviews, assessment of anecdotal information obtained from local biologists on species occurrence, assessment of risk factors for each species, timing of proposed activities, location of proposed activities, scale of activities, cover amounts, road amounts as applicable.

Checklist for Endangered, Threatened and Sensitive Species – Central Land Office

Threatened and Endangered Species	Potential for Impacts and Rationale [Y/N] Potential Impacts and Mitigation Measures N = Not Present or No Impact is Likely to Occur Y = Impacts May Occur (Explain Below)
Canada Lynx (<i>Lynx canadensis</i>) Habitat: dense spruce/fir forest supporting snowshoe hares.	[Y] Detailed analysis provided below.
Gray Wolf (<i>Canis lupus</i>) Habitat: ample big game pops., security from human activity	[N] No known denning or rendezvous sites occur within 1 mile of the project area. However, wolves may occasionally use the project area and occasional sightings have been noted in the area (J. Cunningham, R-3 FWP Biologist, pers. comm. 4/13/11). Minimal risk of direct, indirect or cumulative effects that would result in harm to wolves would be anticipated under either of the alternatives considered. If wolves or an active den site were detected in the immediate area, operations

	would cease, and a DNRC biologist would be consulted. Appropriate mitigations would be developed and applied prior to resuming activities.
Grizzly Bear (<i>Ursus arctos</i>) Habitat: recovery areas, security from human activity	[Y] Detailed analysis provided below.
DNRC Sensitive Species	[Y/N] Potential Impacts and Mitigation Measures N = Not Present or No Impact is Likely to Occur Y = Impacts May Occur (Explain Below)
Bald Eagle (<i>Haliaeetus leucocephalus</i>) Habitat: late-successional forest <1 mile from open water	[N] No bald eagle nests, feeding areas, roosting areas or suitable nesting habitat occur within 1 mile of the project area. Thus, no direct, indirect or cumulative effects to bald eagles would be anticipated under either of the alternatives considered.
Black-Backed Woodpecker (<i>Picoides arcticus</i>) Habitat: mature to old burned forest	[N] No recent burns within the last 5 years occur on the project area or within 1 mile of the project area. Thus, no direct, indirect or cumulative effects to black-backed woodpeckers would be anticipated under either of the alternatives considered.
Black-tailed Prairie Dog (<i>Cynomys ludovicianus</i>) Habitat: Prairie, shortgrass prairie, badlands	[N] Black-tailed prairie dogs have not been documented in the project area or surrounding vicinity (MNHP/FWP Montana Field Guide -- search 5/19/11). No grassland habitat suitable for use by black-tailed prairie dogs occurs in or near the project area. Thus, no direct, indirect or cumulative effects to prairie dogs would be anticipated under either of the alternatives considered.
Flammulated Owl (<i>Otus flammeolus</i>) Habitat: late-successional ponderosa pine and Doug.-fir forest	[N] The project area occurs on the fringe of the distribution of flammulated owls in Montana, and warm forest types suitable for use by flammulated owls do not occur in or near the project area. Thus, no direct, indirect or cumulative effects to flammulated owls would be anticipated under either of the alternatives considered.
Greater Sage-grouse (<i>Centrocercus urophasianus</i>) Habitat: sagebrush semi-desert	[N] No occurrence records for greater sage grouse exist for the quarter-latitude containing the project area since 1991 (Skaar 2003, MNHP/FWP Montana Field Guide -- search 5/19/11, and MNHP 2011). Also, extensive stands of sagebrush community types do not occur within or near the project area. Thus, no direct, indirect or cumulative effects to greater sage grouse would be anticipated under either of the alternatives considered.

<p>Harlequin Duck (<i>Histrionicus histrionicus</i>) Habitat: white-water streams, boulder and cobble substrates</p>	<p>[N] No known streams supporting harlequin ducks occur within or near the project area, and no recent observations (within the last 15 years) have been reported for the general area (MNHP/FWP Montana Field Guide -- search 5/19/11, and MNHP 2011). Thus, no direct, indirect or cumulative effects to harlequin ducks would be anticipated for either of the alternatives considered.</p>
<p>Mountain Plover (<i>Charadrius montanus</i>) Habitat: short-grass prairie, alkaline flats, prairie dog towns</p>	<p>[N] No grassland habitat suitable for use by mountain plovers occurs within or near the project area. Thus, no direct, indirect or cumulative effects to mountain plovers would be anticipated under either of the alternatives considered.</p>
<p>Northern Bog Lemming (<i>Synaptomys borealis</i>) Habitat: sphagnum meadows, bogs, fens with thick moss mats</p>	<p>[N] No sphagnum meadows, bogs or fens occur within or near the project area, and the project area occurs outside of the known distribution of northern bog lemmings in Montana (MNHP/FWP Montana Field Guide -- search 5/19/11). Thus, no direct, indirect or cumulative effects to bog lemmings would be anticipated for either of the alternatives considered.</p>
<p>Peregrine Falcon (<i>Falco peregrinus</i>) Habitat: cliff features near open foraging areas and/or wetlands</p>	<p>[N] No cliff features or suitable foraging areas occur within 0.75 miles of the project area, and no known nest sites occur within or near the project area. Thus, no direct, indirect or cumulative effects to peregrine falcons would be anticipated for either of the alternatives considered.</p>
<p>Pileated Woodpecker (<i>Dryocopus pileatus</i>) Habitat: late-successional ponderosa pine and larch-fir forest</p>	<p>[N] The project area occurs outside of the normal distribution of pileated woodpeckers in Montana. Thus, no direct, indirect or cumulative effects to pileated woodpeckers would be anticipated for either of the alternatives considered.</p>
<p>Townsend's Big-Eared Bat (<i>Plecotus townsendii</i>) Habitat: caves, caverns, old mines</p>	<p>[N] No caves, caverns, or old mines suitable for use by bats occur within 1 mile of the project area. Thus, no direct, indirect or cumulative effects to Townsend's big-eared bats would be anticipated for either of the alternatives considered.</p>

Canada Lynx

Issue

Timber harvesting and associated activities could remove canopy closure, alter stand conditions, and/or cause motorized disturbance, which could alter lynx habitat, rendering it unsuitable for supporting lynx.

Measurement Criteria

Assess suitable lynx habitat and potential reductions and effects related to the proposed action using DNRC SLI habitat data (2010) and model for direct and indirect effects at the project area scale (3,511 acres). Estimate potential lynx habitat at elevations >6,000 feet using USGS cover layer (2003) and evaluate anticipated reductions and effects from the proposed action to assess cumulative effects within the 33,422-acre cumulative effects analysis area.

Affected Environment

Canada lynx are currently federally listed as a threatened species in Montana. Canada lynx prey primarily on snowshoe hares (Squires and Ruggiero 2007) and live in subalpine fir/spruce forests, generally between 4,000 to 7,000 feet in elevation in western Montana (Ruediger et al. 2000). The proposed project area ranges from approximately 5,200 to 7,600 feet in elevation. DNRC lands within the project area are dominated by mature stands containing Douglas-fir and lodgepole pine. Relatively pure stands of both tree species are present, as well as mixed species stands of varying composition. Trace amounts of Engelmann spruce and subalpine fir are present on cool, moist sites, and trace amounts of limber pine are present on drier, exposed sites. In western Montana, lynx prefer stands dominated by spruce and subalpine fir that possess high horizontal cover and provide habitat for snowshoe hares (Squires et al. 2010). Lynx home range sizes vary from approximately 16,000 to 25,000 acres (Ruediger et al. 2000). Dense, mature stands are preferred by lynx in winter, whereas younger dense, stands with high horizontal cover are preferred in summer (Squires et al. 2010). Mature subalpine fir stands containing abundant coarse woody debris are valuable for denning and provide cover for kittens, and they provide forested cover for travel and security (Squires et al. 2008). Historically, high intensity, stand-replacing fires of long fire intervals (150 to 300 years) occurred in continuous dense forests comprised of lodgepole pine, subalpine fir, and Engelmann spruce. These fires created extensive even-aged patches of regenerating forest intermixed with old stands that maintained a mosaic of snowshoe hare and lynx habitat on the landscape. While many of the current forest cover types within the project area are considered suitable for use by lynx (Ruediger et al. 2000), most typically do not contain high horizontal cover comprised of subalpine and spruce bows described by Squires et al. (2010). Thus, even considering the common presence of several habitat attributes within the project area that are known to be important for lynx and snowshoe hares (eg. dense overstory canopy, dense shrubs and downed logs), habitat in this area is likely best suited as travel habitat or matrix habitat (USFWS 2009) that would facilitate movement, linkage, and provide habitat for secondary prey species such as red squirrels. For this analysis the three habitat classes that will be considered are: 1) non-habitat (i.e., rocks, ice, water and cover types that will never be habitat), 2) suitable habitat (i.e., habitat that provides structure and cover that facilitate occupancy and travel), and 3) temporary non-suitable habitat (i.e., habitat that temporarily does not have structural attributes necessary for suitable habitat, but will acquire them back over time as stands re-grow and age.). Currently in the 3,511-acre project area there are

approximately 1,426 acres of suitable habitat (41 percent), 213 acres of temporarily non-suitable habitat (6 percent), and 1,872 acres of non-habitat (53 percent).

Under requirements of the federal listing of lynx as a threatened species, a draft recovery plan outline was written (USFWS 2005), and federally designated Critical Habitat has been described for in the Greater Yellowstone Area in Unit 5 (USFWS 2009). However, the project area occurs outside of the Critical Habitat boundary and no federal funding or permitting would be required for the proposed project. Thus, federal measures required under the Critical Habitat designation would not be applicable to this project.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to lynx or lynx habitat would be anticipated. In areas heavily affected by mountain pine beetle, coarse woody debris amounts would likely increase, thus improving the availability of den site attributes in some areas.

Direct and Indirect Effects of the Action Alternative

Currently on the 3,511-acre project area there are 1,426 acres of suitable lynx habitat (41 percent), 213 acres of temporary non-lynx habitat (6 percent), and 1,872 acres of non-habitat (53 percent) (*Table W-3*). Under the Action Alternative, approximately 192 acres (13 percent) of the 1,426 acres of existing suitable lynx habitat would be removed within the 3,511-acre project area and converted to temporary non-habitat. The 192 treated acres would be sparsely forested following harvest and would likely take 20 to 30 years to regenerate into a suitable habitat condition comprised of lodgepole pine and Douglas-fir sapling stands. Given the high percentage of the existing suitable lynx habitat with high levels of attributes, which would be retained in the project area post-treatment [i.e., 1,234 acres (86 percent) retained of 1,426 existing acres], harvest under this alternative would exceed retention measures required under *ARM 36.11.435*. Should any individual lynx be present in the project area at the time logging activities were initiated, there would be increased risk of their displacement due to the increased level of noise and disturbance for the duration of the project (potentially 2 to 3 years). Risk of any displacement attributable to motorized project activities beyond 3 years would not be expected. Given the relatively small size and location of the patches of lynx habitat affected, habitat connectivity would not be appreciably altered. Similarly, maintenance of linkage potential associated with the Bear Canyon/Bozeman Pass Area would be minimally influenced as considerable amounts of forest cover and lynx habitat would remain after timber harvest, and no additional open roads or human developments would occur as a part of this proposal (*See above Coarse Filter subsections regarding patch characteristics and connectivity of forest cover and habitat linkage for additional details*). In summary, given that: 1) the 192 acres (~1 percent) of habitat that would be affected is a relatively small amount in the context of an average lynx home range size, 2) that any associated habitat effects would be temporary, 3) appreciable amounts of habitat would remain in the project area following harvest, 4) risk of displacement due to motorized activities would be temporary and short-term at 2 to 3 years, 5) habitat connectivity and

linkage would not be appreciably altered by project activities, minor adverse direct and indirect effects to lynx would be expected.

Table W - 3. Acreages by alternative of lynx habitat on the DNRC Bear Canyon Timber Sale Project Area.

Lynx Habitat Element	No Action Alternative Acres (%)	Action Alternative Acres Post Harvest (%)
Suitable Habitat	1,426 (41%)	1,234 (35%)
Temporary Non-suitable Habitat	213 (6%)	405 (12%)
Non-Habitat	1,872 (53%)	1,872 (53%)
Total	3,511	3,511

Data source DNRC SLI 2010

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects to lynx or lynx habitat would be anticipated. In areas heavily affected by mountain pine beetle, coarse woody debris amounts would likely increase, thus improving the availability of den site attributes in some areas.

Cumulative Effects of the Action Alternative

Due to data limitations, lynx habitat was modeled at the 33,422 cumulative effects analysis scale by considering stands most likely to be lynx habitat as those moderate to well-stocked stands existing above 6,000 elevation. The 33,422-acre scale was used as an approximation for the home range size of a lynx in a landscape likely possessing relatively low densities of snowshoe hares. For this analysis, DNRC's current SLI data were used to identify lynx habitat and the applicable harvest units proposed on the project area, and the USGS National Land Cover Database (2003) and digital elevation model to define the likely amounts of lynx habitat in the large geographic area. Also, due to data limitations, modeled habitat conditions could only be identified down to the level of "suitable" and "non-lynx habitat" types. Potential "temporary non-lynx habitat" could not be differentiated. The non-habitat component also includes acres at low elevations and elsewhere in non-lynx habitat types that would likely never be habitat. Currently on the 33,422-acre cumulative effects analysis area there are approximately 21,468 acres of suitable lynx habitat (64.2 percent) and 11,954 acres of non-habitat (35.8 percent) (Table W-4). Under the Action Alternative, approximately 192 acres (0.9 percent) of the 21,468 acres of existing suitable lynx habitat would be removed within the 33,422-acre cumulative effects analysis area and converted to temporary non-habitat. The 192 treated acres would be sparsely forested following harvest and would likely take 20 to 30 years to regenerate into a suitable habitat condition comprised of lodgepole pine and Douglas-fir sapling stands. A high percentage of existing suitable lynx habitat with high levels of attributes would be retained in the cumulative

effects analysis area post-treatment (i.e., 21,276 acres (99 percent) retained of 21,468 existing acres). However, in addition to the DNRC project, the USFS BMW project could occur concurrently within several miles. Under the USFS proposal, approximately 2,673 acres of lynx habitat could be affected in some way, of which 646 of the acres could be converted temporarily to unsuitable habitat (USFS, BMW project FEIS Ch. 3, Alternative 6, 2010) leaving 20,630 acres remaining (*Table W-4*). Considering the BMW project area and lynx analysis unit (LAU) habitat requirements, retained habitat amounts would meet requirements of the Northern Rockies Lynx Management Direction (USFS 2007). Within the 33,422-acre DNRC cumulative effects analysis area both projects combined could result in 2,955 acres (8 percent) affected in some way and 838 acres (2 percent) temporarily converted to non-suitable habitat. Should any individual lynx be present in the cumulative effects analysis area at the time logging activities were initiated by both agencies, there would be increased risk of their displacement due to the increased level of noise and disturbance for the duration of the project (potentially 3 to 5 years). Should lynx be present in the vicinity, such disturbance could render habitat temporarily unavailable for denning or foraging in the local areas where project activities would take place. Risk of any displacement attributable to motorized project activities beyond 5 years would not be expected. Disturbance associated with motorized and non-motorized human activities conducted in conjunction with both projects would be in addition to existing levels of human disturbance attributable to dispersed recreational activities during all seasons of the year. Given the proposed treatment types and relatively small size and location of the patches of lynx habitat affected, habitat connectivity would not be appreciably altered by either project. Similarly, maintenance of linkage potential associated with the Bear Canyon/Bozeman Pass Area would be minimally influenced as considerable amounts of forest cover and lynx habitat would remain after timber harvest, and no additional open roads or human developments would occur as a part of either proposal (See above Coarse Filter subsections regarding patch characteristics and connectivity of forest cover and habitat linkage for additional details). In summary, given that: 1) the 2,955 acres (~8 percent) of habitat that would be affected is a relatively small amount in the context of an average lynx home range size, 2) that any associated habitat effects would be temporary, 3) appreciable amounts of suitable habitat would remain in the project area and cumulative effects analysis area following harvest (20,630 acres), 4) risk of displacement due to motorized activities would be temporary and short-term at 2 to 3 years, 5) habitat connectivity and linkage would not be appreciably altered by project activities -- the BMW project and DNRC Bear Canyon Timber Sale projects would result in a low level of adverse cumulative effects to lynx.

Table W - 4. Acreages by alternative of lynx habitat on the 33,422-acre DNRC Bear Canyon Timber Sale Cumulative Effects Analysis Area.

Lynx Habitat Element	No Action Alternative Acres (%)	Action Alternative Acres Post Harvest DNRC Bear Canyon Project Only (%)	Action Alternative Acres Post Harvest DNRC Project and USFS BMW project Alt. 6 (%)
Suitable Lynx Habitat*	21,468 (64.2%)	21,276 (63.7%)	20,630 (61.7%)
Non-Lynx Habitat**	11,954 (35.8%)	12,146 (36.3%)	12,792 (38.3%)
Total	33,422	33,422	33,422

Data sources DNRC SLI 2010, and USGS cover layer 2003

*Suitable lynx habitat is defined as areas >6,000 elevation possessing forest cover with >40 percent canopy.

**Non-lynx habitat includes all forest and non-forest <40 percent canopy cover and forested habitat below 6,000 feet.

Grizzly Bear

Issue

There is concern that timber harvesting activities could remove security cover, cause displacement of bears, increase roads, and increase presence of unnatural attractants and bear foods, which could adversely affect grizzly bears.

Measurement Criteria

Assessment of extent of cover removal [data sources DNRC SLI habitat data (2010) and USGS land cover layer (2003)]; type, season and duration of proposed activities; and assessment of changes in road types and amounts.

Affected Environment

In April 2007, the USFWS delisted grizzly bears in the Greater Yellowstone Ecosystem (GYE). In September 2009, the US District Court vacated the delisting rule, placing bears in that ecosystem back to listed status as a threatened species. The ruling is currently under appeal by the USFWS.

Forest-management activities may affect grizzly bears by altering cover and/or by increasing access to humans into otherwise secure areas by creating roads (Mace et al. 1996). Forest management operations can reduce the ability of vegetation and cover to conceal grizzly bears, which can lower effective bear use of habitat and render bears more vulnerable to human-caused mortality (Servheen et al. 1999). These actions could lead to the displacement of grizzly bears from preferred areas and/or result in an increased risk of human-caused mortality by bringing humans and bears closer together, which can increase

their risk of being killed. Displacing bears from preferred areas may increase their energetic costs, which may in turn lower their ability to survive and/or reproduce successfully. The greatest sources of grizzly bear mortality in both the GYE and Northern Continental Divide Ecosystem in Montana are attributable to human-related causes -- particularly associated with the acquisition of unnatural foods (Schwartz et al. 2006, Haroldson et al. 2006, Servheen 2009). If people implementing forest management activities on the project area were to possess bear attractants that were stored in a non-secure manner, the risk of creating bear management situations could be elevated -- resulting in the prompt of future removal of a problem bear(s).

The project area lies approximately 21 miles due north of the GYE grizzly bear recovery zone, and occurs at the northerly edge of the occupied habitat boundary described by Wittinger (2002). There have been a number of confirmed grizzly bear sightings in the Bear Canyon/Mount Ellis area during the last 34 years, 4 of which have occurred during the last 10 years (Kevin Frey, R-3, FWP Biologist, pers. comm., 5/02/11). Given the frequency and types of observations, it is possible that a few grizzly bears may periodically use the general area as part of their home ranges during the non-denning seasons (Kevin Frey, R-3, FWP Biologist, pers. comm., 5/02/11). There are currently high levels of recreational use that occur within the project area and 33,422-acre cumulative effects analysis area during all seasons, which may influence use of the area by grizzly bears.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to grizzly bears would be anticipated.

Direct and Indirect Effects of the Action Alternative

Under the Action Alternative, cover and habitat connectivity associated with riparian areas would not be appreciable altered as no riparian timber harvesting would occur in the project. Across the project area, dense patches of mature forest cover would also remain abundant and well connected. Of the 3,511-acre project area, 1,893 acres (54 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 1,362 would possess >60 percent overstory cover (39 percent). Following logging, forest patches on the project area would continue to have variable tree density and would continue to provide a mosaic of habitat conditions. Overall, stand density would be reduced on 734 acres of mature forest. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some escape cover and visual screening. Tree density would be reduced most within harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse on this affected 286 acres. Opening sizes would be restricted for these intensively harvested stands, such that hiding cover would remain nearby (within 600 feet) from any point within each unit. Although there would be some minor reductions in the acreage of cover following timber harvest, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain suitable cover conditions for grizzly bears, should they

occasionally use the area. However, on 734 of the acres proposed for treatment, existing tree density would be reduced and bears that may wander into such areas would be more detectable by humans, which would result in minor added risk for bears, particularly in fall during the big game general hunting season.

Under the Action Alternative, 6.9 miles of new road would be constructed to access logging units and 5.5 miles of existing road would be used and brought up to BMP standards. In total, 12.4 miles of road would be operational and used in conjunction with logging activities for the duration of the project (2 to 3 years). This would result in a temporary increase in road density from an existing level of 1.0 miles/square mile, to 2.3 miles/square mile that would be subject to active operations on the 5.5 square mile project area. Immediately following project completion, 7.1 miles of the total 12.4 miles would be made impassible with slash and debris, resulting in an overall 0.2 mile reduction on the total DNRC road system that would occur in the project area. Following harvest activities, the remaining total road density consisting entirely of restricted roads (allowable uses foot travel and periodic DNRC administrative uses only) would be 0.96 miles/square mile. During harvest operations disturbance from motorized equipment could disturb and displace bears, and habitat in the project area and nearby vicinity may temporarily be unusable due to the level of noise and human activity. No public motorized access would be allowed in the project area while harvest activities are underway, thus no added risk due to this cause would be present. After project completion, a very minor overall improvement associated with the closing of 0.2 miles of road would occur, resulting in essentially no long-term net change from the current condition regarding either total or open road density. There would be short-term added risk of disturbance and displacement of grizzly bears that could result in minor adverse effects associated with logging operations, short term road construction, and road use. However, no long-term measurable impact to grizzly bears attributable to either open or total road density would be expected.

Under the Action Alternative DNRC field staff and contractors would be required to keep any unnatural bear foods or attractants (such as garbage) in a bear resistant manner. It is unlikely that contractors would request to camp on or near the project area, however, should they choose to do so, they would be required by the operating contract to store any unnatural bear foods and attractants in a bear resistant manner. Compliance with contract terms would frequently be evaluated and would be enforced by a DNRC contract administrator. Any added risk to grizzly bears associated with unnatural bear foods or attractants would be minimal.

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects to grizzly bears would be anticipated.

Cumulative Effects of the Action Alternative

Under the Action Alternative, cover and habitat connectivity associated with riparian areas would not be altered as no riparian timber harvesting would occur in the project. Across the 33,422-acre DNRC cumulative effects analysis area, large dense patches of mature forest cover (>200 acres) would be well represented and well connected, which would provide a

suitable network of cover capable of facilitating movements of grizzly bears across the local landscape. Of the 33,422-acre cumulative effects analysis area, approximately 26,378 acres (79 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Following logging, forest patches on the project area would have variable tree density, but would maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. On DNRC lands, tree density would be reduced from existing levels most within harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse on this 286 acres. The 286 acres represents 0.8 percent of the DNRC 33,422 acre cumulative effects analysis area. Opening sizes would be restricted for intensively harvested stands on the DNRC project area, such that hiding cover would remain nearby (within 600 feet) from any point within each unit. If this DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover with >40 percent crown closure could be reduced to approximately 24,547 (73 percent) of the 33,422-acre cumulative effects analysis area. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies, which could reduce cover amount and quality for grizzly bears. However, habitat connectivity would not likely be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Also, of the 5,003 acres of vegetation that both agencies have proposed for treatment, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance due to the partial harvest treatment prescriptions being proposed. Within treated stands on both the DNRC and USFS projects, individual trees and patchy tree retention would remain, which would continue to provide some lesser amounts of escape cover and visual screening within treatment areas. Although there would be some minor reductions in the acreage of cover following timber harvest, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain suitable cover conditions for grizzly bears, should they occasionally use the area.

Under both the DNRC project and USFS project, short-term (3 to 5 years) cumulative disturbance to grizzly bears associated with roads and logging activities could occur, which could influence their movement patterns and habitat use while projects are active. The combined road amount that would be used under both proposals would total approximately 21.2 miles and result in a cumulative increase in temporary open road density (for agency use only) of 0.4 miles/square mile. DNRC operations would include temporary use of 12.4 miles of road (5.3 miles restricted road, 7.1 miles of temporary road). Proposed USFS operations would include approximately 8.8 miles (1.7 miles of existing road, 7.1 miles of temporary road) (USFS 2011). Existing open road density in the cumulative effects analysis area is approximately 1.2 miles per square mile and total road density is approximately 1.6 miles per square mile. Should projects of both agencies occur, open density would increase to 1.6 miles/square mile and total density would increase to 2.0

miles/square mile for a period of about 3 to 5 years. Following project activities of both agencies, both open and total road density amounts would revert back to their existing levels, as all temporary roads would be quickly and effectively closed after project completion. Additional short-term disturbance associated with forest management activities proposed under both projects would be cumulative to existing high levels of motorized and non-motorized public recreational use, which occurs within the cumulative effects analysis area. Such disturbance could increase the potential for temporary displacement of grizzly bears sensitive to the increased presence of humans and motorized activities. If present in the area, some bears could be displaced from normal home range areas into places with lower quality habitat, and/or be pressed into nearby areas possessing greater inherent risk of conflict with humans (eg. areas with high hunter density, subdivisions, home sites, and agricultural lands). Overall, forest management activities associated with the proposed DNRC action would have a minor adverse cumulative impact on forest conditions and well-connected mature forest cover, and minor, temporary impacts associated with logging disturbance and displacement of grizzly bears.

Under the Action Alternative DNRC field staff and contractors would be required to keep any unnatural bear foods or attractants (such as garbage) in a bear resistant manner. It is unlikely that contractors would request to camp on or near the project area, however, should they choose to do so, they would be required by a contract stipulation to store any unnatural bear foods and attractants in a bear resistant manner. Terms of the contract would frequently be evaluated and would be enforced by a DNRC contract administrator. Any added cumulative risk to grizzly bears associated with unnatural bear foods or attractants would be minimal.

Big Game Species

Measurement Criteria

The management criteria used to evaluate impacts related to the all the big game issues pertaining to big game species included: the timing of proposed activities, location of proposed activities, scale of activities, quantified cover amounts [data sources DNRC SLI habitat data (2010), and USGS land cover layer (2003)], road amounts, visual assessments of aerial photography and visual evaluation of cover and topography as related to linkage areas. Pre harvest canopy cover estimates were obtained from the USGS land cover layer (2003) and post harvest estimates were derived by multiplying residual trees/acre values by estimated crown diameters for each tree species in a harvest unit.

Issue – Elk Habitat Security

There are concerns that potential increases in road density, motorized disturbance, and removal of forest cover through logging may adversely affect security habitat for elk, thereby increasing the potential to reduce hunter opportunity, and/or increase displacement of elk resulting in subsequent game damage and conflicts on neighboring agricultural lands.

Affected Environment

The project area is located just within the northerly boundary of FWP Hunting District 301, and lands within the project area are part of the home range of a growing elk herd of 300 to 400 animals (J. Cunningham, R-3, FWP Biologist, pers. comm., 7/29/10). Private agricultural lands to the north and west of the project area nearer the city of Bozeman are within Hunting District 309, which is restricted to primitive means of take only, to maintain safety near private homes and neighborhoods. Elk within this herd periodically frequent private lands and agricultural fields located in Hunting District 309, and crop depredation has been a problem (J. Cunningham, R-3, FWP Biologist, pers. comm., 7/29/10). Hunting regulations for the general season in Hunting District 301 allow harvest of brow-tined bull elk or antlerless elk from October 22 to November 6, 2011 and then become more restrictive thereafter to allow harvest of brow-tined bulls only for the remainder of the season from November 7 to November 27, 2011. For Hunting District 309, hunting with primitive weapons is allowed for either sex elk from September 3 to November 27, 2011. Then from November 28 until January 15, 2012, harvest of antlerless elk only is allowed (FWP 2011).

Timber harvest can increase elk vulnerability by changing the size, structure, juxtaposition and accessibility of areas that provide security during hunting season (Hillis et al. 1991). As visibility and accessibility increase within forested landscapes, elk have a greater probability of being observed and subsequently harvested by hunters. Because the cow segment of the harvest is normally regulated carefully, primary concerns are related to substantial reduction of the bull segment and subsequent decrease in hunter opportunity. The presence of fewer mature bulls at the beginning of the hunting season, reduces the odds of any given hunter to see or harvest such an animal throughout the remainder of the hunting season. In the current situation involving lands in the project area vicinity and neighboring agricultural lands in Hunting District 309, both cow and bull elk may become unavailable to rifle hunters in Hunting District 301 if security is reduced, because groups of elk could be displaced and seek refuge and forage on nearby agricultural lands serving as refuges. In either situation, elk may become less available to hunters for harvest during the general season.

To evaluate the potential for adverse impacts to elk security associated with the proposed action, existing elk security in the project area and cumulative effects analysis area was evaluated following the methods of Hillis et al. (1991). Only moderately dense to closed canopy mature forested stands with patch size >250 acres were considered to contribute to elk security. All forested patches that met these criteria also had to be >0.5 miles from any open road or intensively traveled trail in order to be counted towards security. Hillis et al. (1991) recommended that at least 30 percent of an elk herd's home range during hunting season should be comprised of large forested patches meeting this acreage and road-distance criteria to provide reasonable security for bull elk throughout hunting season.

A larger cumulative effects analysis area was delineated to evaluate elk security for this project. The size of this area is 93,551 acres and it was delineated to approximate the fall elk herd home range for elk that use the Bear Canyon Project Area vicinity. The area identified

extends roughly in an 8 mile radius from the project area (J. Cunningham, R-3, FWP Biologist, pers. comm., 4/13/11). This area coincides closely with forested lands contained within the National Forest Boundary as well as state trust lands in, or near the project area. This area was identified as the most appropriate to consider cumulative impacts associated with road densities, disturbance, and potential reductions in forest cover on elk. The USFS manages the majority of lands within the elk security analysis area, followed by private landowners, and DNRC (*Table W-5*). DNRC manages approximately 7 percent of the elk security cumulative effects analysis area.

Table W - 5. Approximate land ownership within the DNRC Bear Canyon Timber Sale elk security cumulative effects analysis area.

Landowner	Acres (%)
DNRC	6,400 (7%)
Private	21,120 (23%)
USFS	66,031 (71%)
Total	93,551 (100%)

Currently within the project area 626 acres of mature forest with >40 percent canopy cover exist in habitat patches that are >250 acres and >0.5 miles from open roads. Following the concepts described by Hillis et al. (1991), these large cover blocks are most likely to provide adequate security for elk and provide areas of relative sanctuary when pressured by hunters in the fall. Similarly, within the cumulative effects analysis area, there are currently 21,822 acres of mature forest with >40 percent canopy cover that exist in habitat patches that are >250 acres and >0.5 miles from open roads. This represents 23 percent of the 93,551-acre cumulative effects analysis area -- 7 percent below the minimum amount recommended by Hillis et al. (1991).

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to elk or elk security habitat would be anticipated.

Direct and Indirect Effects of the Action Alternative

Under the Action Alternative, tree density within harvested stands would be reduced on 734 acres of mature forest. Of the existing 626 acres of security habitat patches on the project area that are >250 acres with >40 percent mature canopy cover and that are >0.5 miles from an open road, 138 would be removed leaving 488 acres (78 percent) after logging. Across the project area other dense patches of mature forest cover would be present and remain

well connected. Of the 3,511-acre project area, 1,893 total acres (54 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 1,362 would possess >60 percent overstory cover (39 percent). Following logging, forest patches on the project area would continue to have variable tree density and would continue to provide a mosaic of habitat conditions. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some amount of escape cover and visual screening for elk. Tree density would be reduced within harvest units 4, 5, and 6 by approximately 80 percent, thus remaining cover would be sparse on this affected 286 acres. Although there would be 138 less acres of security cover following timber harvest, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain suitable cover conditions for elk, which would be expected to continue to use the project area.

Under the Action Alternative, 6.9 miles of new road would be constructed in the project area to access logging units and 5.5 miles of existing road would be brought up to BMP standards and used. In total, 12.4 miles of road would be operational and used in conjunction with logging activities for the duration of the project (2 to 3 years). This would result in a temporary increase in road density from an existing level of 1.0 miles/square mile, to 2.3 miles/square mile that would be subject to active operations on the 5.5 square mile project area. Immediately following project completion, 7.1 miles of the total 12.4 miles would be made impassible with slash and debris, resulting in an overall 0.2 mile reduction on the total DNRC road system that would occur in the project area. Following harvest activities, the remaining total road density consisting entirely of restricted roads (allowable uses foot and non-motorized travel and DNRC administrative uses only) would be 0.96 miles/square mile. During harvest operations disturbance from motorized equipment could disturb and displace elk, and habitat in the project area and nearby vicinity may temporarily be unusable by elk due to the level of noise and human activity. During the period that management activities would be occurring, elevated risk of elk displacement onto neighboring private lands would be present. Thus, some additional game damage situations could arise as a result of DNRC project activities; however, long-term displacement of elk onto private lands would not be expected as a result of proposed project activities. Further, several new forest openings would be created by logging and prescribed burning that could provide minor benefits for elk and other ungulates for foraging, which could encourage their continued general use of the forest area away from private lands. Given the highly palatable and preferred forage species grown on nearby agricultural lands in the area (eg. winter wheat and alfalfa etc.), it is unlikely that elk would easily be discouraged from using such areas, regardless of whether or not any habitat changes or disturbance occurred on the project area or other neighboring forest lands. No public motorized access would be allowed in the project area while harvest activities are underway, thus no added risk of displacement or increased elk vulnerability due to this cause would be present. After project completion, a very minor overall improvement associated with the closing of 0.2 miles of road would occur, resulting in essentially no long-term net change from the current condition regarding either total or open road density. There would be short-term added risk of disturbance and displacement of elk that could

result in minor adverse effects associated with logging operations, short term road construction, and road use. However, no long-term measurable impact to elk or crops on neighboring private lands attributable to temporary increases in either open or total road density would be expected.

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects related to elk or elk security would be anticipated.

Cumulative Effects of the Action Alternative

Under the Action Alternative, tree density within harvested stands would be reduced on 734 acres of mature forest. Of the existing 21,822 acres of security habitat patches (i.e., >250-acre stands with >40 percent canopy cover, >0.5 miles from open roads), 21,684 acres (99 percent) would remain after logging on the 93,551-acre cumulative effects analysis area. Across the cumulative effects analysis area, other dense patches of mature forest cover would also be present and remain well-connected. Of the 93,551-acre cumulative effects analysis area, approximately 73,625 total acres (79 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 61,379 (66 percent of the 93,551-acre area) would possess >60 percent overstory cover. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some limited escape cover and visual screening for elk. Tree density would be reduced most within DNRC harvest units 4, 5, and 6 by approximately 80 percent, thus remaining cover would be sparse on this affected 286 acres. Although there would be 138 less acres of security cover following timber harvest on DNRC lands, ample amounts of hiding cover and connected mature forest patches would remain elsewhere in the project area, which would maintain suitable cover conditions for elk, which would be expected to continue to use the cumulative effects analysis area.

If the DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover with >40 percent crown closure could be reduced from 21,822 acres to approximately 17,796 acres (19 percent) of the 93,551-acre cumulative effects analysis area (combined reduction 4,026 acres). The result would be a 4 percent reduction from existing levels in the elk security cumulative effects analysis area. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies, which could reduce cover amount and quality for elk. However, habitat connectivity would not be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Also, of the 5,409 acres of vegetation that both agencies have proposed for treatment within this cumulative effects analysis area, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance due to the partial harvest treatment

prescriptions being proposed. Within treated stands on both the DNRC and USFS projects, individual trees and patchy tree retention would remain, which would continue to provide appreciable amounts of escape cover and visual screening within some treatment areas. Further, several new forest openings would be created by logging and prescribed burning that may provide minor benefits for elk and other ungulates for foraging, which could encourage their continued general use of the forest area away from private lands. Given the highly palatable and preferred forage species grown on nearby agricultural lands in the area (eg. winter wheat and alfalfa), it is unlikely that elk would easily be discouraged from using such areas, regardless of whether or not any habitat changes or disturbance occurred on the project area or other neighboring forest lands. Although there would be a 4 percent cumulative reduction in the acreage of secure habitat following timber harvest, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain considerable amounts of forest cover. In this defined area, the factor with the greatest impact to elk security is the existing network of open roads and heavily used trail systems.

Under both the DNRC project and USFS BMW project, short-term (3 to 5 years) cumulative disturbance to elk associated with roads and logging activities could occur, which could influence their movement patterns and habitat use while projects are active. Existing open road density in the DNRC elk security cumulative effects analysis area is approximately 1.04 miles/square mile and would increase if both projects were active to approximately 1.19 miles per square mile. The combined road amount that would be used for management operations under both proposals would total approximately 21.2 miles and would result in a cumulative increase in temporary open road density (for agency use only) of 0.15 miles/square mile for a period of 3 to 5 years. The DNRC proposal would include temporary use of 12.4 miles of road (5.3 miles restricted road, 7.1 miles of temporary road). Proposed USFS operations would include approximately 8.8 miles (1.7 miles of existing road, 7.1 miles of temporary road) (USFS 2011). Following project activities of both agencies, open road density amounts would revert back to their existing levels, as all roads would be used temporarily and they would be quickly and effectively closed after project completion. Additional short-term disturbance associated with forest management activities proposed under both projects would be cumulative to existing high levels of motorized and non-motorized public recreational use, which occurs within the cumulative effects analysis area. Such disturbance could increase the potential for temporary displacement of elk into more secure areas or potentially onto neighboring private agricultural lands, where greater risk of game damage could occur. Long-term displacement of elk onto private lands would not be expected as a result of proposed project activities. Overall, forest management activities associated with the proposed DNRC action would have a minor adverse cumulative impact on forest conditions and well-connected mature forest cover, and minor, temporary impacts associated with logging disturbance and displacement of elk. Should the DNRC and USFS projects occur simultaneously, the risk of lowered hunter opportunity in the northern portion of Hunting District 301 and the risk of increased game damage conflicts in Hunting District 309, would be elevated. Given this circumstance, some greater compensatory hunter opportunity could be realized in Hunting

District 309, should additional elk temporarily displace to private lands in that area during the primitive hunting season, and should hunter access be obtainable.

Issue – Big Game Movement

There is concern that the construction of additional roads and removal of forest cover through logging may affect big game movements and use of the area, which would result in decreased hunting opportunities (particularly in proposed harvest in sections 1, 2 and 11).

Affected Environment

The project area provides forested and non-forested habitats used to varying degrees by moose, elk, mule deer and black bears. Lands in the project area are highly valued by some recreationists for the purpose of hunting, and several individuals voiced concerns during public scoping about several specific areas known to have important habitat values. Specifically, concerns were expressed about the proposed treatments and road construction that would occur within harvest units 1 (40.7 acres) and 3 (217.9 acres). These areas were noted anecdotally as providing important bedding and loafing sites, providing transition areas with hiding cover facilitating movements to feeding sites, and providing security from predators and recreational human traffic. Combined, these two harvest units total 258.6 acres. Proposed treatments for these units would target most lodgepole pine trees for removal and would remove approximately 60 percent of the Douglas-fir trees. Specific concerns were expressed that if these stands were intensively harvested, wildlife species frequently observed there would likely: 1) change their habits and behavioral patterns, 2) be displaced indefinitely from the area, and/or 3) be forced onto nearby private lands where increased game damage could occur (see elk security analysis above regarding this concern for more detail). Specific concern was also voiced regarding the road that would be constructed to access trees in unit 3, which could provide a more direct access route up to Mount Ellis. Creating such a route could increase human traffic to that area from bikers and hikers using the New World Gulch access site.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to wildlife habitat or hunting opportunity would be anticipated.

Direct and Indirect Effects of the Action Alternative

Under the Action Alternative, harvest units 1 and 3 would be treated (258.6 acres). In these units, most lodgepole pine would be removed and approximately 60 percent of the existing Douglas-fir trees would be removed. Specifically, about 75 trees/acre would be retained in unit 1 following harvest (~46 percent of existing trees retained), and 46 trees/acre would be retained in unit 3 following harvest (~24 percent of existing trees retained). Resulting overstory canopy cover estimates for units 1 and 3 following harvest at these levels are provided in *Table W-6* below. The amount of new temporary road that would be

constructed to harvest unit 3 would total approximately 2.1 miles.

Table W - 6. Pre- and post-harvest overstory canopy cover estimates for proposed harvest units on the DNRC Bear Canyon Timber Sale.

Harvest Unit Number	Pre-Harvest Canopy Cover %	Post-Harvest Canopy Cover %	Difference %
1	61	44	17
2	63	38	25
3	57	27	30
4	54	15	39
5	55	11	44
6	60	16	44
7	65	34	31
8	61	32	29
9	72	59	13
10	61	32	29

For the duration that motorized activities would take place on the project area, big game species that frequently or periodically use these (and other) harvest units on the project area would likely be temporarily displaced to other habitat in the general geographic area for up to 3 years. Given the type and duration of the disturbance it would be reasonable to expect large game species to be displaced >1 mile from activity centers, however, it is possible that some nighttime use of the project area could occur. While logging operations are active, it is possible that some elk could be displaced to nearby private lands, resulting in greater risk of crop damage and reduced hunter opportunity. The degree to which this could occur is uncertain and is buffered by the fact that considerable amounts of dense forest cover occur on lands adjacent to the project area. Risk of black bears being displaced to private lands is possible, however, for moose and mule deer, it would be less likely due to their inherent differences in habitat preferences and behaviors.

Harvest of the 258.6 acres in the two units could also contribute to short term displacement, and would likely very likely cause alteration of the local habits and patterns of individual big game animals that use the area during the short term (2-3 years) and potentially the longer term (several decades). However, given the presence of similar cover attributes and stand conditions that would remain on approximately 1,200 acres immediately to the south on sections 11 and 12, it is unlikely that any of the big game species mentioned would be displaced indefinitely from the area. Areas previously used as secure bedding areas, however, may revert to being used as foraging areas used primarily at night etc. As discussed above in the elk security analysis subsection above, it is unlikely that elk would be displaced as a result of forest cover removal at this scale to private agricultural lands over

the long term (>3 years).

The 2.1 miles of temporary road that would be constructed to access harvest unit 3 would be decommissioned immediately following use to limit its potential use as a newly evolved high use recreational route. Thus, any related concerns regarding wildlife associated with a new high-use recreational route in this area would not be expected.

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects to big game habitat, movements or associated hunting opportunities would be anticipated.

Cumulative Effects of the Action Alternative

For this analysis, the smaller general 33,422-acre cumulative effects analysis area was used to describe impacts at a more localized scale consistent with the particular issue raised. Under the Action Alternative, harvest units 1 and 3 would be treated (258.6 acres). For the duration that motorized activities would take place on the project area, big game species that frequently or periodically use these (and other) harvest units on the project area would likely be temporarily displaced to other habitat in the 33,422-acre cumulative effects analysis area for up to 3 years. Given the type and duration of the disturbance it would be reasonable to expect large game species to be displaced >1 mile from activity centers, however, it is possible that some nighttime use could occur in treatment areas. While logging operations are active, it is possible that some elk could be displaced to nearby private lands, resulting in greater risk of crop damage and reduced hunter opportunity. The degree to which this could occur is uncertain and is buffered by the fact that considerable amounts of moderate to dense forest cover would occur on lands within the 33,422-acre cumulative effects analysis area (26,378 acres -- 79 percent). Risk of black bears being displaced to private lands is possible, however, for moose and mule deer, it would be less likely to occur as a result of logging, due to their inherent differences in habitat preferences and behaviors.

If this DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover with >40 percent crown closure could be reduced to approximately 24,547 (73 percent) of the 33,422-acre cumulative effects analysis area. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies. However, habitat connectivity would not likely be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Also, of the 5,003 acres of vegetation that both agencies have proposed for treatment, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance

due to the partial harvest treatment prescriptions being proposed. The proposed activities of both DNRC and USFS BMW project could cause cumulative disturbance and changes in habitat conditions that could change habits and behavioral patterns of big game species in the area. This could also result in increased risk of displacement of elk onto neighboring private lands resulting in increased game damage incidents in the short term (3 to 5 years). Longer term (>5 years) displacement associated with forest management activities following completion, would not be expected. The USFS BMW project, if implemented, would not contribute additionally to cumulative impacts or risk associated with the 2.1 miles of temporary road constructed for access to unit 3.

See also Cumulative Effects sections under the *Patch Characteristics and Connectivity of Forest Cover* subsection and *Elk Security* issue analyzed above for further details and discussion.

Issue – Wintering Moose, Elk, and Mule Deer

There is concern that activities proposed in this project may create disturbance, increase road amounts, and reduce forest cover, which could adversely affect wintering moose, elk, and mule deer.

Affected Environment

Relatively disturbance-free areas with low snow accumulation and ample cover and forage are important in winter for moose, elk and deer herds in western Montana. Areas where these species winter are typically found at low to mid elevations (~3,000 to 6,000 ft.) and possess moderate to steep slopes – particularly associated with southerly or westerly exposures. Densely stocked thickets of conifer regeneration and densely forested mature stands provide thermal protection and hiding cover, which can reduce energy expenditures and stress associated with cold temperatures, wind, and human-caused disturbance. Areas with mature forest cover are also important for snow interception, which makes travel and foraging less stressful for elk and deer during periods when snow is deep. Because of their larger size, moose are better adapted to withstand deeper snow conditions and cold temperatures (Jenkins and Wright 1988). Dense stands that are well connected provide for animal movements across wintering areas during periods with deep snow, which improves their ability to find forage and shelter under varied environmental conditions. Thus, removing cover that is important for wintering moose, elk, and deer through forest management activities can increase their energy expenditures and stress in winter. Reductions in cover could ultimately result in a reduction in winter range carrying capacity and subsequent increases in winter mortality within local herds. High recreational use and existing open roads present in the project area and cumulative effects analysis area reduce the effectiveness and suitability of this area to provide high quality winter range.

For this analysis FWP winter habitat GIS data layers were obtained for moose, elk, and mule deer. Winter cover was evaluated for pre harvest and post harvest conditions using USGS Land Cover Data (USGS 2003) for both the project area and 93,551-acre elk security cumulative effects analysis area. The FWP habitat map for moose did not depict winter habitat areas associated with the project area, however, the map information is documented at a coarse scale and frequent observations of wintering elk and moose have been noted on

the project area (J. Cunningham, R-3, FWP Biologist, pers. comm., 7/29/10), and moose have been a species of interest in this general area for a number of years (Schladweiler 1974).

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to big game winter range or wintering animals would be anticipated. In areas heavily affected by mountain pine beetle, coarse woody debris amounts would likely increase, potentially inhibiting movements of some animals in localized areas.

Direct and Indirect Effects of the Action Alternative

Under the Action Alternative, stand density and winter cover would be reduced on 734 acres of mature forest in the project area. Of the 3,511-acre project area, 1,893 acres (54 percent of project area) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 1,362 would possess >60 percent overstory cover (39 percent of project area), which would provide quality thermal cover and snow intercept cover for wintering moose, elk, and deer. Following logging, forest patches on the project area would continue to have variable tree density and would continue to provide a mosaic of habitat conditions. Mature forest stands in the project area would generally remain well connected and provide a suitable network of cover capable of facilitating movements of wintering animals across the local landscape. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide limited escape cover and visual screening. Tree density would be reduced most within harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse and compromised on this affected 286 acres.

Of the wintering areas identified using FWP habitat layers (FWP 2008), no moose habitat would be affected, however, moose have frequently been observed using the project area in winter months (J. Cunningham, R-3, FWP Biologist, pers. comm., 7/29/10). Cover on approximately 509 acres of elk winter range would be affected, and 734 acres of mule deer winter range would be affected (*Table W-7*).

Table W - 7. Acreage of big game winter range by species and alternative on the DNRC Bear Canyon Timber Sale Project Area. .

Species	No Action Alternative Winter Range Acres (% of Project Area)	Action Alternative Winter Range Acres (% of Project Area)	Difference in Acres (% Change)
Moose	0 (0%)	0 (0%)	0 (0%)
Elk	1,966 (56%)	1,457 (41%)	509 (14%)
Mule Deer	2,550 (73%)	1,816 (52%)	734 (21%)

Data sources DNRC SLI (2010), and FWP (2008)

Under the Action Alternative, 6.9 miles of new road would be constructed in the project area to access logging units and 5.5 miles of existing road would be brought up to BMP standards and used. In total, 12.4 miles of road would be operational and used in conjunction with logging activities for the duration of the project (2 to 3 years). This would result in a temporary increase in road density from an existing level of 1.0 miles/square mile, to 2.3 miles/square mile that would be subject to active operations on the 5.5 square mile project area. Immediately following project completion, 7.1 miles of the total 12.4 miles would be made impassible with slash and debris, resulting in an overall 0.2 mile reduction on the total DNRC road system that would occur in the project area. Following harvest activities, the remaining total road density consisting entirely of restricted roads (allowable uses foot and non-motorized travel and DNRC administrative uses only) would be 0.96 miles/square mile. During winter harvest operations, disturbance from motorized equipment would likely disturb and displace moose, elk, and mule deer, and habitat in the project area and nearby vicinity may temporarily be unusable due to the level of noise and human activity. During the winter periods when management activities would be occurring, elevated risk of displacement of wintering animals onto neighboring private lands would be present. Thus, some additional game damage situations could arise as a result of DNRC project activities; however, long-term displacement of onto private lands would not be expected as a result of proposed project activities in winter. Further, several new forest openings would be created by logging and prescribed burning that could provide minor benefits for elk and other ungulates for foraging during mild winters, and early and late portions of each winter, which could encourage their continued general use of the forest area away from private lands. Given the highly palatable and preferred forage species grown on nearby agricultural lands in the area (eg. winter wheat and alfalfa etc.), it is unlikely that elk would easily be discouraged from using such areas, regardless of whether or not any habitat changes or disturbance occurred on the project area or other neighboring

forest lands. No public motorized access would be allowed in the project area while harvest activities are underway, thus no added risk of displacement or increased elk vulnerability due to this cause would be present. After project completion, a very minor overall improvement associated with the closing of 0.2 miles of road would occur, resulting in essentially no long-term net change from the current condition regarding either total or open road density. There would be short-term added risk of disturbance and displacement of wintering animals that could result in minor adverse effects associated with logging operations, short term road construction, and road use. However, no long-term appreciable impact to winter range carrying capacity or crops on neighboring private lands attributable to temporary increases in either open or total road density would be expected.

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects to big game winter range or wintering animals would be anticipated. In areas heavily affected by mountain pine beetle, coarse woody debris amounts would likely increase, potentially inhibiting movements of some animals in localized areas.

Cumulative Effects of the Action Alternative

Under the Action Alternative, tree density within harvested stands would be reduced on 734 acres of mature forest. Across the cumulative effects analysis area, other dense patches of mature forest cover would also be present and remain well-connected. Of the 93,551-acre cumulative effects analysis area, approximately 73,625 total acres (79 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 61,379 (66 percent of the 93,551-acre area) would possess >60 percent overstory cover which would provide quality thermal cover and snow interception capability. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some escape cover and visual screening for elk. Tree density would be reduced most within DNRC harvest units 4, 5, and 6 by approximately 80 percent, thus remaining cover would be sparse on this affected 286 acres. Following timber harvest on DNRC lands, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain suitable cover conditions (albeit, potentially at slightly reduced carrying capacity) for wintering animals, which would be expected to continue to use the project area and cumulative effects analysis area.

If the DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover could be reduced on as much as 5,409 acres. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies, which could reduce cover amount and quality for elk. However, habitat connectivity would not be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Such

treatments could improve the availability, quality, and quantity of grass and browse forage for approximately 20 years. New forest openings created by logging and prescribed burning could encourage general use of the forest area by wintering animals, away from private lands. Also, of the 5,409 acres of vegetation that both agencies have proposed for treatment within this cumulative effects analysis area, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance due to the partial harvest treatment prescriptions being proposed. Within treated stands on both the DNRC and USFS projects, individual trees and patchy tree retention would remain, which would continue to provide appreciable amounts of escape cover and visual screening within treatment areas. Given the highly palatable and preferred forage species grown on nearby agricultural lands in the area (eg. winter wheat and alfalfa etc.), it is unlikely that elk would easily be discouraged from using such areas, regardless of whether or not any habitat changes or disturbance occurred on the project area or other neighboring forest lands. In this defined area, a factor with appreciable potential to impact wintering moose, elk, and mule deer is the existing network of open roads and heavily used trail systems.

Of the wintering areas identified using FWP habitat layers (FWP 2008) for the DNRC project only, no moose habitat would be affected, however, moose have frequently been observed using the project area in winter months (J. Cunningham, R-3, FWP Biologist, pers. comm., 7/29/10). Cover on approximately 509 acres of elk winter range would be affected, and 734 acres of mule deer winter range would be affected (*Table W-8*). If both the DNRC and USFS projects were to occur within the next 3 to 5 years, a greater reduction in thermal cover and snow intercept cover would be expected for these species. Reductions calculated using wintering areas identified using FWP habitat layers (FWP 2008) are presented below in *Table W-8*. Compensatory effects associated with new forest openings created by logging and prescribed burning could benefit wintering animals by improving the abundance, quality and availability of winter forage.

Table W - 8. Acreage of big game winter range by species and alternative, and for combined activities of USFS BMW project and DNRC Bear Canyon Timber Sale on the DNRC Bear Canyon Timber Sale Elk Security Cumulative Effects Analysis Area (93,511 acres).

Species	No Action Alternative Winter Range Acres (% of CE Area)	DNRC Action Alternative Winter Range Acres Post Harvest (% of CE Area)	*Action Alternative Winter Range Acres if Both DNRC Project and USFS BMW project Occurred (% CE Area)
Moose	12,596 (0%)	12,596 (0%)	10,517 (0%)
Elk	13,777 (15%)	13,268 (14%)	8,084 (9%)
Mule Deer	22,621 (24%)	21,887 (23%)	17,193 (18%)

Data sources DNRC SLI (2010), and FWP (2008)

* Values represented in this column would be worst case. Approximately 50 percent of the acres treated could continue to provide some amount of winter thermal and snow intercept cover.

Under both the DNRC project and USFS project, short-term (3 to 5 years) cumulative disturbance associated with roads and logging activities could occur, which could elevate winter stress, and influence movement patterns and habitat use by wintering animals while projects are active. Existing open road density in the DNRC elk security cumulative effects analysis area is approximately 1.04 miles/square mile and would increase if both projects were active to 1.19 miles per square mile. The combined road amount that would be used for management operations under both proposals would total approximately 21.2 miles and would result in a cumulative increase in temporary open road density (for agency use only) of 0.15 miles/square mile for a period of 3 to 5 years. The DNRC proposal would include temporary use of 12.4 miles of road (5.3 miles restricted road, 7.1 miles of temporary road). Proposed USFS operations would include approximately 8.8 miles (1.7 miles of existing road, 7.1 miles of temporary road) (USFS 2011). Following project activities of both agencies, open road density amounts would revert back to their existing levels, as all roads would be used temporarily and they would be quickly and effectively closed after project completion. Additional short-term disturbance associated with forest management activities proposed under both projects would be cumulative to existing high levels of public recreational use, which occurs within the cumulative effects analysis area. Such disturbance could increase the potential for temporary displacement of wintering animals into more secure areas or potentially onto neighboring private agricultural lands, where greater risk of game damage could occur. Long-term displacement of wintering animals onto private lands would not be expected as a result of proposed project activities. Due to the: 1) relatively small scale of the activity, 2) type of treatments proposed, 3) duration of the project, 4) abundance of other available habitat in the cumulative effects analysis area, activities associated with the proposed DNRC action would contribute minor adverse cumulative impacts related to forest cover conditions, disturbance, and winter carrying capacity for moose, elk, and mule deer.

Issue – Ungulate Rearing of Young

There is concern that disturbance associated with active logging in spring, may disturb elk and other ungulates that may be rearing young.

Affected Environment

Elk and other ungulates seek out secluded areas to have their young that are safe from disturbance and predators in May and June. In northwest Montana, elk have been documented moving to specific secure sites within 2 days of having calves, and 4 out of 5 cows gave birth within 100 meters of where they had previously (Vore and Schmidt 2001). Immediately following the birth of calves, individual cows remained isolated near their selected locations for several days before returning to mingle with other elk in local herds (Vore and Schmidt 2001). Such areas are often located along spring migration routes. While specific areas may have importance for calf recruitment, it would be very difficult to identify precise sites that individual cow may select year after year. Thus, managing for broad, diverse and well-connected dense cover patches across the landscape is a logical approach to maintaining a suitable range of sites over time for elk as well as moose and mule deer.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no direct or indirect effects to calving areas would be anticipated.

Direct and Indirect Effects of the Action Alternative

As previously discussed in other sections, under the Action Alternative, stand density and cover would be reduced on 734 acres of mature forest in the project area. Of the 3,511-acre project area, 1,893 acres (54 percent of project area) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 1,362 would possess >60 percent overstory cover (39 percent of project area), which would provide quality hiding and security cover for elk and other ungulates in the spring season when calves and fawns are most vulnerable. Following logging, forest patches on the project area would continue to have variable tree density and would continue to provide a mosaic of habitat conditions. Mature forest stands in the project area would generally remain well connected and provide a network of cover suitable for providing calving sites. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some escape cover and visual screening. Tree density would be reduced most within harvest units 4, 5, and 6 by approximately 80 percent, so remaining cover would be sparse and compromised on this affected 286 acres.

Under the Action Alternative, 6.9 miles of new road would be constructed in the project area to access logging units and 5.5 miles of existing road would be brought up to BMP standards and used. In total, 12.4 miles of road would be operational and used in conjunction with logging activities for the duration of the project (2 to 3 years). This would result in a temporary increase in road density from an existing level of 1.0 miles/square mile, to 2.3 miles/square mile that would be subject to active operations on the 5.5 square mile project area. Immediately following project completion, 7.1 miles of the total 12.4 miles would be made impassible with slash and debris, resulting in an overall 0.2 mile reduction of the total DNRC road system that would occur in the project area. Following harvest activities, the remaining total road density consisting entirely of restricted roads (allowable uses foot travel and DNRC administrative uses only) would be 0.96 miles/square mile. No public motorized access would be allowed in the project area while harvest activities are underway, thus no added risk of disturbance or displacement due to this cause would be present in spring. Disturbance risk associated with project activities would be relatively low as motorized logging activity would be restricted from March 15 to June 15 each during each year of operations. After project completion, a very minor overall improvement associated with the closing of 0.2 miles of road would occur, resulting in essentially no long-term net change from the current condition regarding either total or open road density. There would be minor short-term added risk of disturbance and displacement of animals in late spring that could result in minor adverse effects associated with logging operations, short term road construction, and road use that could occur after the June 15 activity restriction date when some individuals with young could still be in the area. However, no

long-term additional impact to spring habitat or calving areas due to open or total road amounts would be expected.

Cumulative Effects of the No-Action Alternative

Under this alternative none of the proposed forest management activities would occur, thus no cumulative effects to spring calving areas would be anticipated.

Cumulative Effects of the Action Alternative

Under the Action Alternative, tree density within harvested stands would be reduced on 734 acres of mature forest. Across the cumulative effects analysis area, other dense patches of mature forest cover would also be present and remain well-connected. Of the 93,551-acre cumulative effects analysis area, approximately 73,625 total acres (79 percent) would remain in mature forest cover with >40 percent overstory canopy closure. Of these acres, approximately 61,379 (66 percent of the 93,551-acre area) would possess >60 percent overstory cover which would provide quality hiding and security cover in spring for female moose, elk and mule deer. Within harvested stands, individual trees and patchy tree retention would remain, which would continue to provide some escape cover and visual screening for elk and other ungulates in spring. Tree density would be reduced most within DNRC harvest units 4, 5, and 6 by approximately 80 percent, thus remaining cover would be sparse on this affected 286 acres. Following timber harvest on DNRC lands, ample amounts of hiding cover and connected mature forest patches would remain in the project area, which would maintain suitable cover conditions (albeit, at reduced levels) for animals in spring, which would be expected to continue to use the project area and cumulative effects analysis area over time.

If the DNRC project and the USFS BMW project were occur simultaneously, the acreage of mature forest cover could be reduced on as much as 5,409 acres. Under this cumulative scenario, forest patches on the project area would have variable tree density following logging, but would also maintain connectivity of mature forest cover patches across numerous ridges, drainages, saddles and riparian areas. Openings reducing connectivity of mature forest would be created under the proposals of both agencies, which could reduce cover amount and quality for elk and other species in spring. However, habitat connectivity would not be substantially altered where the DNRC and USFS projects would occur, as the majority of acres proposed for prescribed burning under the USFS BMW project (1,430 acres) would occur on exposed south-facing slopes where dense stands of mature forest currently do not exist. Also, of the 5,409 acres of vegetation that both agencies have proposed for treatment within this cumulative effects analysis area, approximately 2,902 (58 percent) would continue to possess moderately to well stocked forest conditions post disturbance due to the partial harvest treatment prescriptions being proposed. Within treated stands on both the DNRC and USFS projects, individual trees and patchy tree retention would remain, which would continue to provide appreciable amounts of escape cover and visual screening within treatment areas across the cumulative effects analysis area.

Under both the DNRC project and USFS project, short-term (3 to 5 years) cumulative disturbance associated with roads and logging activities could occur, which could elevate

stress, and influence use of calving areas in spring while projects are active. However, this concern would be mitigated considerably by activity restrictions that would limit motorized operations on the DNRC project area from March 15 to June 15. Existing open road density in the DNRC elk security cumulative effects analysis area is approximately 1.04 miles/square mile and would increase if both projects were active to 1.19 miles per square mile. The combined road amount that would be used for management operations under both proposals would total approximately 21.2 miles and would result in a cumulative increase in temporary open road density (for agency use only) of 0.15 miles/square mile for a period of 3 to 5 years. The DNRC proposal would include temporary use of 12.4 miles of road (5.3 miles restricted road, 7.1 miles of temporary road). Proposed USFS operations would include approximately 8.8 miles (1.7 miles of existing road, 7.1 miles of temporary road) (USFS 2011). Following project activities of both agencies, open road density amounts would revert back to their existing levels, as all roads would be used temporarily and they would be quickly and effectively closed after project completion. Additional short-term disturbance associated with forest management activities that could occur in late June under both projects would be cumulative to existing high levels of public recreational use, which occurs within the cumulative effects analysis area during all seasons. Such disturbance could increase the potential for temporary displacement of animals in spring into more remote and secure areas, or areas less secure where risk of predation on young may be greater. Due to the: 1) relatively small scale of the activity, 2) type of treatments proposed, 3) duration of the project, 4) March 15 to June 15 spring seasonal activity restriction that would be incorporated as mitigation, and 5) abundance of other available habitat and dense cover in the cumulative effects analysis area, activities associated with the proposed DNRC action would contribute minor adverse cumulative impacts related to spring habitat used during parturition for moose, elk, and mule deer.

Recreation

Introduction

The 5,500 acres of blocked state trust land in the Bear Canyon area provide the public opportunities to hunt, hike, mountain bike, run, bird watch, ski and generally enjoy the flora and fauna of the Gallatin Front. This analysis describes the existing environment of recreational uses and infrastructure in the project area and surrounding areas, and discloses the potential environmental effects the proposed action (*see Chapter 1 – Purpose and Need*) may have on those.

Analysis Areas

The analysis area used to determine direct and indirect environmental effects of the proposed action on the recreation resource will be the project area (*see description in Chapter 1 – Purpose and Need*).

The analysis area used to determine cumulative environmental effects of the proposed action will include all legally accessible blocked state trust lands in the Bear Canyon area and the roads used to access those lands. This analysis area will herein be referred to as the cumulative effects analysis area.

Analysis Methods

The methodologies used to portray the existing environment and determine the environmental effects of the proposed action on recreational uses within the project and cumulative effects analysis areas include: determining amounts and types of existing recreational uses; determining the existing condition of each of the measurement criteria; and estimating any changes to the measurement criteria that may result under each alternative. Cumulative effects include consideration of other actions indicated in *Chapter I – Relevant Past, Present, and Related Future Actions*.

Issues and Measurement Criteria

Issues

A number of concerns were raised during the scoping period regarding potential impacts the proposed action may have on recreation throughout the area. The following issue statements were crafted to account for those concerns and to ultimately guide the analysis of this section.

- Harvest activities may affect the amount, location, use and condition of many of the existing trails and other developed facilities within the project area.
- Harvest activities may adversely affect recreational experiences within the project area including hiking, skiing, hunting, horseback riding, birding, mountain biking, and the general enjoyment of the area.

- Harvest activities may occur at times of the year that are especially important to recreational users.
- Increase in road densities may result in motorized use of the area which may adversely affect current recreational users within the project area.

Measurement Criteria

Quantitative and qualitative changes to the following measurement criteria are intended to ‘measure’ the extent of the potential direct, indirect, and cumulative environmental effects the proposed action may have on existing recreational uses in the area:

- amount, location, use, and condition of developed recreational facilities
- general recreational use of the area
- amount, duration, time of year and location of forest-management activities in the area
- amount of roads in the area

Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations

DNRC Recreational Use Rules

DNRC Recreational Use Rules (*ARM 36.25.146 through 162*) regulate and provide for the reasonable recreational use of legally accessible school trust lands. Recreational use is divided into two categories and, subsequently, requires two different types of recreational licenses for those wishing to engage in recreational activities on school trust lands.

General Recreational Use License

General recreational use refers to recreational activities that are non-concentrated and noncommercial. Examples of these activities include snowmobiling, hiking, bicycling, hunting, motorized use, horseback riding, and berry picking. Any person over the age of 12 who wishes to engage in activities that pertain to general recreational uses is required to obtain a 12-month General Recreational Use License from state license providers (i.e. FWP). For recreationists younger than 17 or older than 60, the license is \$5. For recreationists between the ages of 17 and 60, the license is \$10. All license holders are required to abide by current restrictions, closures, and regulations.

Special Recreational Use License

Special recreational use refers to recreational commercial activities in which an entity charges a participant a fee, specific non-commercial organized group activities, and overnight activities using non-designated campground areas. Specific examples of such activities include outfitting, non-commercial recreational lodges or retreats, and overnight horse camping. Any person who wishes to engage in activities that pertain to special recreational uses is required to obtain a Special Recreational Use License from DNRC. The

cost of the license is determined by DNRC and assessed at what DNRC considers to be the full market value of that use.

Memorandum of Agreement Affecting Recreational Use of State Trust Lands

This agreement entered into by FWP and DNRC requires FWP to reimburse DNRC 2 dollars for every wildlife conservation license and certain game animal licenses sold in accordance with MCA 87-2-202, 505, 510, and 511.

Land Use License

DNRC Surface Management Rules [ARM 36.25.102(14)] define and allow for the use of State lands for uses other than for which the land is classified. Such uses are allowed for a specific fee and a term not to exceed 10 years [ARM 36.25.106(2)].

Affected Environment

The state trust lands in the Bear Canyon area are located about 5 miles southeast of Bozeman and are blocked together in a 5,500 acre unit. Due to their size and location as well as being adjacent to USFS lands, these lands provide a convenient and popular access to outdoor recreational opportunities within a few miles of Bozeman. Public access to these lands is located at a parking area at the end of Mt. Ellis Lane and at a trailhead at the end of Bear Canyon Road. State trust lands within the Bear Canyon block can also be accessed from the trail system on adjacent USFS lands.

Recreational use is facilitated by the use of developed facilities such as trailheads, trails and parking areas; use of existing infrastructure developed for previous land management projects such as roads; trails pioneered by users; and backcountry use (off-trail/road use). The recreational activities generally associated with these lands include hiking, skiing, running, birding, mountain biking, horseback riding, hunting, rock climbing and general enjoyment of flora and fauna. With the exception of Bear Canyon Road/Trail which is managed by Gallatin County and the USFS, motorized use is not allowed as a recreational activity by the public on these state trust lands.

Developed Recreational Facilities

Developed recreational facilities within the project area and the cumulative effects area include parking areas, trailheads and trails. Within the project area the only developed facility is the parking area at the end of Mt. Ellis Lane. Facilities located in the cumulative effects analysis area include a trailhead and parking area at the end of Bear Canyon Road and 4 developed trails: New World Gulch, Moonshine Gulch, Bear Canyon and Triple Tree Trails.

The parking area at the end of Mt. Ellis Lane was developed by Gallatin County to provide parking for users of the state trust lands. This area is used year-round. During daylight hours it will usually have one to 3 cars parked and at times of high use there have been up to 10 which is about all it can hold without encroaching onto the road. The lands accessed by this location are primarily those of state ownership.

The parking and trailhead area at the end of Bear Canyon Road was improved by the DNRC in 2005 with fencing and signage. This area is more popular than the Mt. Ellis Lane Parking area and generally has a 2 to 3 parked vehicles during daylight hours, and on summer and winter weekends it can be over flowing with users. This area provides easy access to other ownerships by use of the New World Gulch, Moonshine Gulch and Bear Canyon Trails; and destinations of Mt. Ellis and the rock bands that are used for climbing up the Bear Canyon Trail.

Of the 4 developed trails, 3 are accessed from the parking area and trailhead at the end of Bear Canyon road: New World Gulch, Moonshine Gulch, and Bear Canyon Trail. All 3 of these trails access USFS ownership and are included as part of the USFS Trails System. The Bear Canyon Trail is managed by both Gallatin County and the USFS.

The Triple Tree Bench Trail is located at the west end of the cumulative effects analysis area and is accessed by the Triple Tree Trail from Sourdough Road. This trail was established in the mid-1990s as part of the development of the Triple Tree Subdivision and is used heavily in the summer and fall. DNRC currently has a proposal by the Gallatin Valley Land Trust to attain an easement on this trail for recreational management.

General Recreational Use

In addition to developed recreational facilities, the general recreational use within the area depends on the use of existing infrastructure not specifically developed by the DNRC for recreation. This infrastructure includes state trust land management roads and trails pioneered by users. Currently there are approximately 5.5 miles of road within the project area designated as “Motorized Use Restricted Year-Round” (see Table T-1). The state trust land management roads within the project area were developed to support the 1981 and 1991 timber sales and for the use of a grazing lessee. These roads in addition to trails pioneered by users are used for recreation throughout the project area and to access lands located in the cumulative effects analysis area with the exception of Section 11 T3S R6E.

Recreational use of the road system is present throughout the year, but the types of use change seasonally. During winter and early spring the road system provides a base for cross-country skiing and snow shoeing. Spring breakup typically has the least use due to the wet and muddy conditions but still supports occasional hikers. During late spring and summer the area sees the heaviest and most diverse recreational use which includes; hiking, mountain biking, birding, running, horseback riding, dog walking and wildflower viewing. In the fall the primary use transitions to hunting activities, though most of the summer uses are still present to a lesser degree.

There are numerous trails pioneered by users or game trails that facilitate access to areas away from the road system within the state trust lands. Most pioneered trails receive only occasional use by a limited number of recreationists during summer and fall. The exception to this is the “Charlie’s Face Trail” which originates as a spur off of the existing road system and creates a loop to the New World Gulch trail. The “Charlie’s Face Trail” is a well-known technical mountain biking trail and receives regular use in the summer and fall. It also forms the only complete loop between the Mt. Ellis Lane parking area and the trailhead at the end of Bear Canyon Road.

Backcountry use (off-trail/road use) is mostly concentrated in the summer and fall and primarily associated with hunting hiking and birding. This use also relies on the road system, the user established trails and the game trails to facilitate access. Some backcountry use also occurs during the winter during which time skiers travel through the cumulative effects analysis area to reach Mt. Ellis, a popular local backcountry ski area.

Big game hunting is another popular recreational activity in the area and is focused on bear in the spring and deer, moose and elk in the fall. Hunting in the area is by both archery and firearm, there are no restrictions with the exception that firearms cannot be discharged within ¼ mile of occupied structures without permission of the occupant (*ARM 36.25.149c*). Specifics on the existing condition of big game populations and other wildlife are detailed in *Chapter 3 – Wildlife*.

Forest Management Activities

Forest management activities have been part of the management of the state trust lands in the Bear Canyon area since 1981. These activities have included; timber harvest, road building, firewood permits, regeneration surveys and pre-commercial forest treatments, such as thinning. The last major forest management activity that would have been noticeable by recreationists at the Mt. Ellis Parking area would have been the multi-product sale that began in 1993 and ended in 1997. In the last 14 years recreationists would have encountered no major sale activity. Firewood permits have been consistently active between July and September each summer during which time recreationists would have encountered their sawing and hauling activities.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

No appreciable changes to access for the developed areas or existing infrastructure would occur. Backcountry, user-pioneered trail and game trail access would become more difficult in the stands that are primarily lodgepole pine due to collapse of these stands through pine beetle mortality. Hunting patterns of use may also be affected by these changes. The use of these lands would continue to increase as a product of population pressure in the Gallatin Valley.

Direct and Indirect Effects of the Action Alternative

The Action Alternative would result in a temporary displacement of recreationists and a reduced quality of recreational experience within the project area during harvest activities. Recreationist could expect industrial activity (road construction and timber harvest activities), increase in traffic (timber hauling, sale administration and harvest crews), a change in the character of the ground within the harvest units (*see Chapter 3 – Vegetation*), alterations in animal movements and use (*see Chapter 3- Wildlife*) and harvest activities during the summer, fall and winter. These disturbances could be expected over a 2 to 3 year period from the start of the sale.

Developed Recreational Facilities

The only developed recreational facility in the project area would be the parking area at the end of Mt. Ellis Lane. Traffic would be expected to increase through the parking area during the summer, fall and winter during harvest and administration activities. Use of the area by personnel involved in the sale would be unnecessary and shouldn't result in a reduction of availability of space.

General Recreational Use and Forest Management Activities

According to *Table II-2* and *Table T-3*, harvest activities and harvest-related traffic would occur up to 9 months per year (June 15th through March 15th) over a 2 to 3 year operating period. Harvest activities within designated harvest units may take place up to 7 days per week over the operating season. Log hauling and other large equipment traffic in and out of the project area would mostly occur during the typical business workweek (Monday through Friday). Although entry into the project area and harvest activities within the designated harvest units may begin in the early morning, operations are expected to cease by early evening each day of operation. Harvest-related traffic is expected to be considerable, resulting in 14 to 33 trips per day during the workweek and 4 to 8 trips per day during the weekend throughout the operating period. For more information regarding the timing of harvest activities and harvest-related traffic, please refer to *Table II-2* and *Table T-3*.

Under the Action Alternative, approximately 6.9 miles of new road would be constructed. During the 2 to 3 year operating period, these roads would be closed to public motorized access yet open for non-motorized recreational purposes. However, after the project ends, approximately 7.1 miles of road within the project area would be 'abandoned' (closed with slash and debris: see *Table T-2*). Those who choose to recreate along the road system may find it difficult to travel along these abandoned roadways. Compared to existing conditions, the amount of road managed as Motorized Use Restricted Year-Round would decrease by 0.2 miles. Similar to existing conditions, no roads would be managed for motorized public use.

Within the project area the general recreational use would likely be temporarily displaced on occasion. Harvest activities that would affect these uses would occur during the summer, fall and winter and would include; road construction, timber harvest, traffic and vegetative change within designated harvest units.

During the operating season (June 15th to March 15th), recreationists could expect the road system to be used by log hauling and support activities from early in the morning to late in the evening. Recreationists would thus be expected to experience an increase in noise and dust along the road system and near active harvest units. Most of the road system throughout the project would not be closed to recreational use during harvest, but notification of potential log hauling and other associated traffic would be posted at the parking area and the trailhead. However, for safety reasons, portions of the "Charlie's Face Trail" that run alongside harvest unit 4 may be closed while harvest is taking place on that unit. During times of active harvesting operations, the actual harvest units would also be closed to recreationists for safety considerations. These closures would be well-posted at locations surrounding the harvest units and at the parking area and trailheads.

Prescribed burning operations may also temporarily displace recreationists. Slash pile burning would likely take place during appropriate conditions in the fall following harvest. If conditions were appropriate in the year following harvest, a broadcast burn operation may take place during the summer and/or fall which may also interfere with recreation. If this kind of operation were to take place the vicinity would be closed for recreation while the operation was conducted, which could take approximately a week. Burning operations may also be carried out in multiple stages potentially creating conflicts for a greater amount of time across the project area. Appropriate signage would be posted surrounding the burn units as well as at the parking areas and trailheads.

Activities in the winter that would create conflicts would be similar to those in the summer and fall. Winter use is significantly less than summer or fall use so the conflicts would be expected to be less.

Hunting, a primary fall activity, would see the most conflict along the travel route and in the area of the harvest units. Human activity in and around the active harvest units would likely lead to temporary displacement of game during the activity. The removal of vegetative cover would potentially affect the way hunters ultimately use the area in the future (*see Chapter 3 – Wildlife for details*).

Cumulative Effects of the No-Action Alternative

No appreciable changes to access for the developed areas or existing infrastructure would occur. Backcountry, user pioneered trail and game trail access would become more difficult in the stands that are primarily lodge pole pine due to collapse of these stands through pine beetle mortality, hunting patterns of use may also be affected by these changes. The use of these lands would continue to increase as a product of population pressure in the Gallatin Valley.

Cumulative Effects of the Action Alternative

Although recreationists may experience temporary displacement and / or increased noise and activity within the project area during harvest operations, areas outside of the project area would continue to offer recreational opportunities to those who may wish to experience more solitude. Those effects could potentially be noticed at the Bear Canyon Trailhead (more cars) or on the trails and in the backcountry (more recreationists avoiding land management roads). Recreationists may also choose to legally enter state land via USFS ownership. The proposal by the Gallatin Valley Land Trust to attain an easement on the Triple Tree Trail for recreational management would continue, potentially expanding recreational opportunities throughout state trust land ownership.

Once harvest operations have completed administrative use of the road system and activities within the harvest units would be reduced to near pre-sale levels. Continuing invasive plant monitoring and management would be necessary mostly along the road system. Some areas may be opened to firewood gathering in the summer months, similar to current use. Where accessible and where the forest would benefit from it, the improved access may allow for small permits to continue addressing forest management issues on a small scale.

After the project ends, approximately 7.1 miles of road within the project area would be 'abandoned' (closed with slash and debris: *see Table T-2*). Those who choose to recreate along the road system may find it difficult to travel along these abandoned roadways. Compared to existing conditions, the amount of road managed as Motorized Use Restricted Year-Round would decrease by 0.2 miles. Similar to existing conditions, no roads would be managed for motorized public use. Portions of Charlie's Face that were closed during the operating period would be opened back up.

The existing infrastructure would continue to be available to support the recreational uses of hiking, mountain biking, running, skiing, horseback riding and access to the backcountry. Hunting patterns would be expected to change over time, but not be eliminated.

Aesthetics

Introduction

This analysis describes the existing visual quality and noise levels throughout the area and discloses the potential environmental effects the proposed action may have on those attributes.

Analysis Area

The analysis area used to determine the direct and indirect effects of the proposed action on the visual quality and noise levels will be the project area.

The analysis area used to determine cumulative environmental effects of the proposed action on the visual quality and noise levels will include state, private, city, and federal lands within a 37,500 acre area surrounding the project area. The USFS is the largest landowner within the cumulative effects analysis area, owning nearly 66 percent of the land, while 17 percent is in state trust land ownership, 14 percent in private ownership, and 3 percent in city of Bozeman ownership. This analysis area will herein be referred to as the cumulative-effects analysis area.

Analysis Methods

Visual Amount and Quality

The methodologies used to portray the existing environment and determine the environmental effects of the proposed action on the visual quality in the project area and cumulative effects analysis area include using GIS, photo-points, Adobe Photoshop, and methods adapted from the Landscape Visibility section of the USFS Scenery Management System (USFS 1995).

Using a GIS viewshed analysis and historical harvest data, DNRC calculated past, present, and future DNRC acres of harvest units and miles of road visible and not visible from various observation points for both the existing environment and the environmental effects section of this analysis.

The following observation points were determined to be important areas of concentrated public-viewing use:

- **Observation Point 1** refers to the northeast corner of the parking lot at the Museum of the Rockies.
- **Observation Point 2** refers to the intersection of Tayabeshockup Road and Star Ridge Road
- **Observation Point 3** refers to the intersection of Bozeman Trail Road and Mt. Ellis Lane.
- **Observation Point 4** refers to the bend in the road in front of 7595 Bear Claw Lane.

Acres and road miles visible and not visible from these observation points do not account for existing or potential obstructions in the following visibility ranges: foreground (0 to 0.5 miles), middle ground (0.5 to 4.0 miles) and background (4 miles and beyond). Therefore, reported visible acres and road miles are likely to be overestimations of what would be currently or potentially visible from each observation point.

Methods adapted from the USFS Scenery Management System were used to account for obstructions in the visibility ranges and describe existing form, lines, textures, and colors and potential changes to those attributes as proposed under the Action Alternative. Harvest units associated with the action alternative were displayed by stand type to more accurately disclose the potential visual quality of the harvested unit.

Photo images are displayed throughout the analysis to provide the reader with a visual aid in understanding the potential visual impacts associated with the proposed action. Harvest unit layers were placed on these images using Adobe Photoshop. These images are estimations of the placement of harvest units and should only be interpreted as such. If the Action Alternative is selected, harvest units may not fit these images exactly.

Noise Levels

The methodologies used to portray the existing environment and determine the environmental effects of the proposed action on the noise levels in the project area and the cumulative effects analysis area include estimating the magnitude, timing, and type of activities that produce noise.

Cumulative effects analysis for both visual amount and quality and noise levels include consideration of other actions indicated in *Chapter 1 – Relevant Past, Present, and Related Future Actions*.

Issues and Measurement Criteria

The following issues concerning visual quality and noise levels were raised during internal and external scoping and will be analyzed in further detail.

- Harvest activities, such as road construction, slash/debris piles and harvest design, may adversely affect the visual quality of the landscape as seen from within the proposed project area, neighboring properties and the City of Bozeman.
- Activities associated with this project may increase local noise levels.

Quantitative and qualitative changes to the following measurement criteria are intended to “measure” the extent of the potential direct, indirect and cumulative environmental effects the proposed action may have on existing visual amount and quality and noise levels in the area. The quality of views from specific observation points are expressed in terms of texture, form, line and color.

- The number and quality of harvest-unit acres and road miles visible from specific observation points.
- The magnitude, timing and type of activities that produce noise within the area.

Affected Environment

The project area involves the landscape visible to the southeast of Bozeman, sometimes referred to as the Gallatin Face. The view consists of foothills rising from the alluvial plain bisected by drainages at each end, predominantly timbered north slopes transitioning to generally open west slopes and meadows with brushy draws in the alluvial plain. The current visible landscape has been influenced by timber harvest, agricultural activities, development, fire suppression and insect and disease issues. The lodgepole pine stands affected by the insects are mostly in the red stages (70 percent mortality across the Face) of the Mountain Pine Beetle epidemic, with a few occurrences of the grey stage.

Harvest Units

Forest management activities on the state trust lands in the Bear Canyon area began in 1981 (see Chapter 1 – *Relevant Past, Present, and Related Future Actions*). These acres of harvest resulted in a visible change in the viewshed. Approximately 7 to 11 percent of the project area as seen from each observation point has been altered due to forest management over the last 30 years (Table A-1).

Table A - 1. Visible acres of historic harvest within the project area as seen from each observation point.

Observation Point	Project Area Visible Acres	Historic Harvest Visible Acres	Percent of Historic Harvest Visible within Project Area
OP-1	1,000	96	10%
OP-2	1,057	118	11%
OP-3	1,316	116	9%
OP-4	1,298	96	7%

Harvest on neighboring private and USFS lands that are visible within the cumulative effects analysis area include a harvest on private land in Section 5 T3S R6E and harvest on USFS ownership in Sourdough and Leverach canyons. Previous harvests on USFS ownership have mostly re-vegetated and in some cases, have been treated with smaller logging projects to mitigate the harsh lines of the harvests thereby creating a more natural appearance.

The visual effects of a harvest are the most noticeable during and just after the harvest, when the disturbance is at greatest contrast with the surrounding environment. As the land starts to re-vegetate the colors and textures return to a more natural state reducing the contrast to the adjacent environment. The most recent of the forest management projects in the area is the 2007 Eagle Rock Fuels Reduction harvest which has re-vegetated and is not very noticeable due to harvest design and topographic considerations. The most noticeable historic harvest on state trust land from the valley is the 1981 harvest located in Section 35 T2S R6E. The harvest has re-vegetated but the harvest design is more geometric than the

other harvests on the state trust land and remains less natural looking, therefore more distinct.

Roads

Within the project area there are 5.5 miles of road managed as Motorized Use Restricted Year-Round (*see Chapter 3 – Transportation*). This road system was developed to support the 1981 and 1991 harvests and grazing lessee’s activities. Approximately 56 to 82 percent of the existing road system is visible from each observation point (*Table A-2*). Most of these roads are re-vegetated and are not very discernable and therefore have little effect on the viewshed with the exception of the road that leads from the end of Mt. Ellis Lane to the forested edge. This portion of the road system wasn’t adequately designed as a road when the harvest activities were taking place, and has since eroded with large ruts in the wheel tracks creating a very visible line through the meadow to the forested edge, illustrated in *Figure A-1*.

Table A - 2. Existing road miles visible within the project area as seen from each observation point.

Observation Point	Existing Road Miles Visible within the Project Area	Percent of Total Existing Road Miles
OP-1	3.3	60 %
OP-2	3.2	58 %
OP-3	4.5	82 %
OP-4	3.1	56 %

Figure A - 1. Rutted access road.



Roads within the cumulative effects area include county roads, private driveways and USFS system roads. With the exception of the USFS, most visible roads are in the foreground of the viewshed of each observation point. The USFS roads in the middle ground or background are predominantly hidden by topography or have re-vegetated to the extent they are not very noticeable.

Noise Levels

Current activities that generate noise within the project area and cumulative effects analysis area include:

Project area

- traffic associated with administrative use, firewood permits and grazing management;
- firewood harvesting; and
- recreational use such as biking, dog walking, hiking and hunting.

Cumulative effects analysis area

- traffic associated with trail use, residential access and commercial use and
- construction activities, agricultural activities and recreational activities.

Within the project area firewood harvesting is the most significant contributor to noise. This activity occurs at a moderate level with only 8 permits issued last year totaling 40 cords. The activity is limited by season from June 15 till September 15 of a given year and rarely are there multiple firewood collectors operating at the same time.

The cumulative effects analysis area encompasses a greater variety of activities not uncommon to any part of the Gallatin Valley, and no single activity contributes at a level that is unusual. The highest noise levels would be produced in the summer and fall in association with the construction and agricultural industries.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

No harvest activities would occur. The viewshed would continue to noticeably change due to the effect of the mountain pine beetle, and no change in noise levels would be expected.

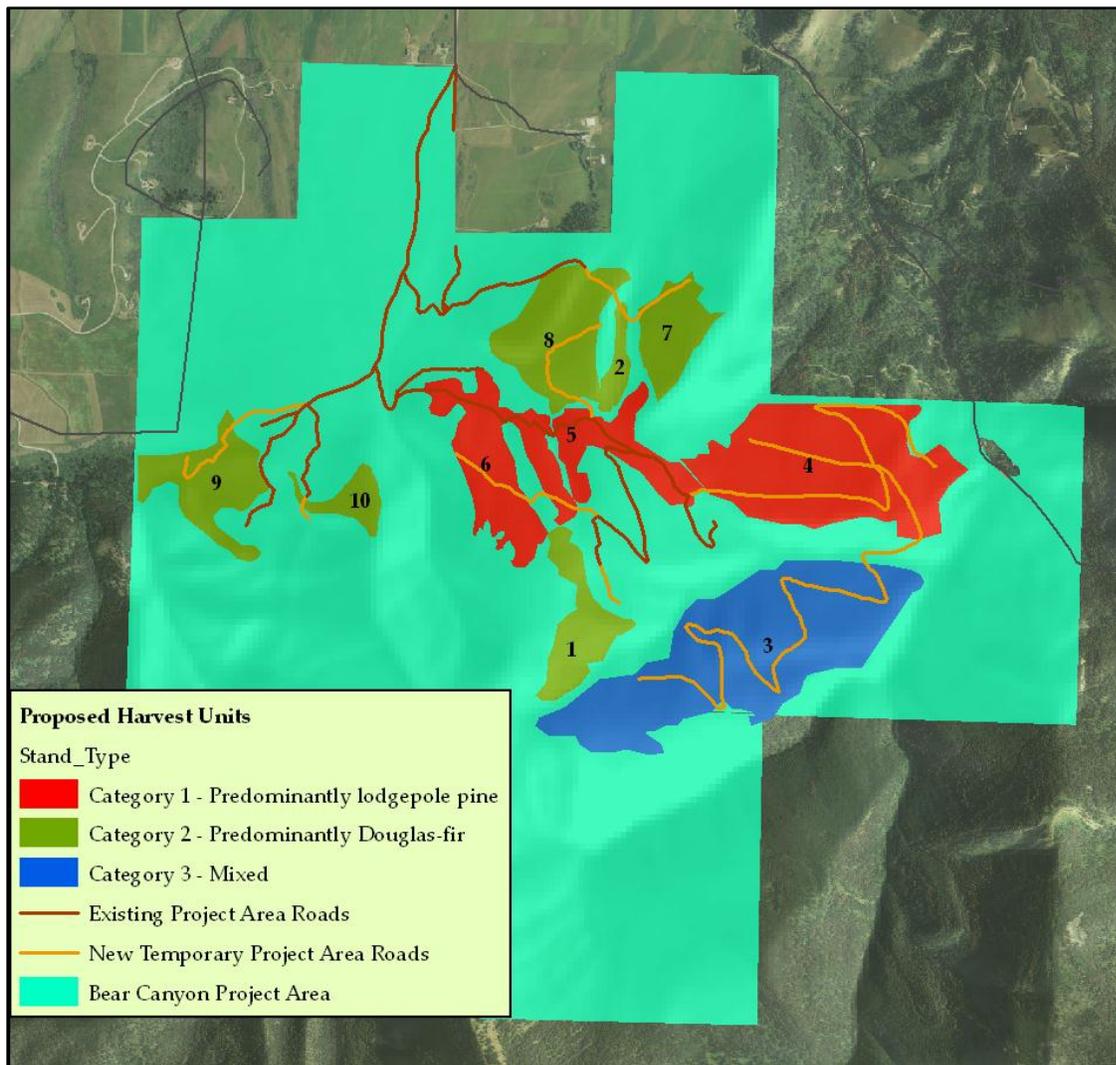
Direct and Indirect Effects of the Action Alternative

Under the Action Alternative, portions of the viewshed would be altered as seen from each observation point. The magnitude of alteration would depend on the species harvested, harvest design, viewing perspective and the rate of recovery from harvest activities.

Amount and Quality of Visible Harvest Unit Acres

The harvest prescription for lodgepole pine and the other merchantable species (Douglas-fir, Engelmann spruce and subalpine fir) would be different due to different silvicultural needs: thus, each prescription would affect the viewshed differently (*see Table II-1 and Figure II-1 for prescription details*). For the purpose of illustrating the future visual character of the area, stands can be placed into 3 categories; Category 1, predominantly lodgepole pine (>70% BA); Category 2, predominantly Douglas-fir (>70% BA); and Category 3, mixed stands with lodgepole pine and Douglas-fir at similar proportions with other species intermixed. Representation of the makeup of the units based on each of these 3 categories is illustrated in *Figure A-2*. According to the silvicultural prescriptions outlined in the *Table II-1*, DNRC would remove all the merchantable lodgepole pine and up to 60 percent of the Douglas-fir and other mixed species within the harvest units.

Figure A - 2. Proposed harvest unit by stand type.



Harvest prescriptions applied to these 3 categories of stand types would thus result in various types of textures, forms, lines, and colors.

Category 1: According to *Chapter 2*, stands that are predominantly lodgepole pine would be clearcut with reserves. These stands would appear very light in color, distinctive in form, and have hard perimeter lines where the stand meets adjacent regenerating or un-harvested stands. Patches of Douglas-fir may be retained where they occur; however, retention of these patches would not be expected to be very noticeable from the observation points.

Category 2: According to *Chapter 2*, stands that are predominantly Douglas-fir would be treated using group selection and selection cutting leaving patches of Douglas-fir where available. These stands are expected to retain the most canopy cover out of all 3 categories of stands. Stands are expected to be darker in color, less distinctive in form, and have softer perimeter lines than stands in the other 2 categories. Due to the distribution of species throughout the harvest unit, these stands may appear patchy in nature, likely retaining groups of Douglas-fir where they exist.

Category 3: According to *Chapter 2*, stands that contain similar proportions of lodgepole pine and Douglas-fir would also be treated using group selection and selection cutting. These stands are expected to have a blend of qualities from the two categories described above. Since these stands have a greater component of lodgepole pine, Douglas-fir retention patches are expected to be fewer and more infrequent than seen in Category 2 stands while group-selected areas are expected to be larger and more frequent. Similar to Category 1 stands, these areas are expected to appear very light in color, distinctive in form, and have hard perimeter lines where the stand meets adjacent regenerating or un-harvested stands.

For all categories of stands, where the opportunities exist, the edges of the cutting units would be feathered into the surrounding trees to soften the edges and to create a more natural looking transition between stands. In addition, topography would be used to reduce the acres of harvest visible from a specific observation point; opportunities to apply this would be most prevalent where Douglas-fir exists. The quantity of the viewshed disturbed by harvest activities from any particular view point is directly related to how it affects the viewshed. Depending on the observation point the amount of harvest visible within the project area ranges from 17 percent of the visible project area (OP- 3 at the end of Mt. Ellis Lane) to 29 percent of the visible project area (OP- 4 on Bear Claw Lane). A breakdown of the viewshed data by Observation Point is included in *Table A-3*.

Table A - 3. Acres of harvest area visible from each observation point.

Observation Points	Analysis Area				Percent of Visible Harvest Unit within Total Acres Visible
	Project Area Total Acreage = 3500		Harvest Units Total Acreage = 750		
	Visible Acres	Not Visible Acres	Visible Acres	Not Visible Acres	
OP-1	1,000	2,500	243	507	24%
OP-2	1,057	2,443	212	538	20%
OP-3	1,316	2,184	222	528	17%
OP-4	1,298	2,202	381	369	29%

Figures A-3 through A-6 depict the visual representation of the visible harvest area from each observation point. Photos were taken from each point and were overlaid with the proposed harvest units visible from the location. Category 1 stands (predominantly lodgepole pine) are represented in red, Category 2 stands (predominantly Douglas-fir) are represented in green, and Category 3 stands (mixed) are represented in blue.

Figure A - 3. View from Museum of the Rockies (OP-1).



Figure A - 4. View from Tayabeshockup and Star Ridge Roads (OP-2).



Figure A - 5. View from Mt. Ellis Land and Bozeman Trail Road (OP-3).

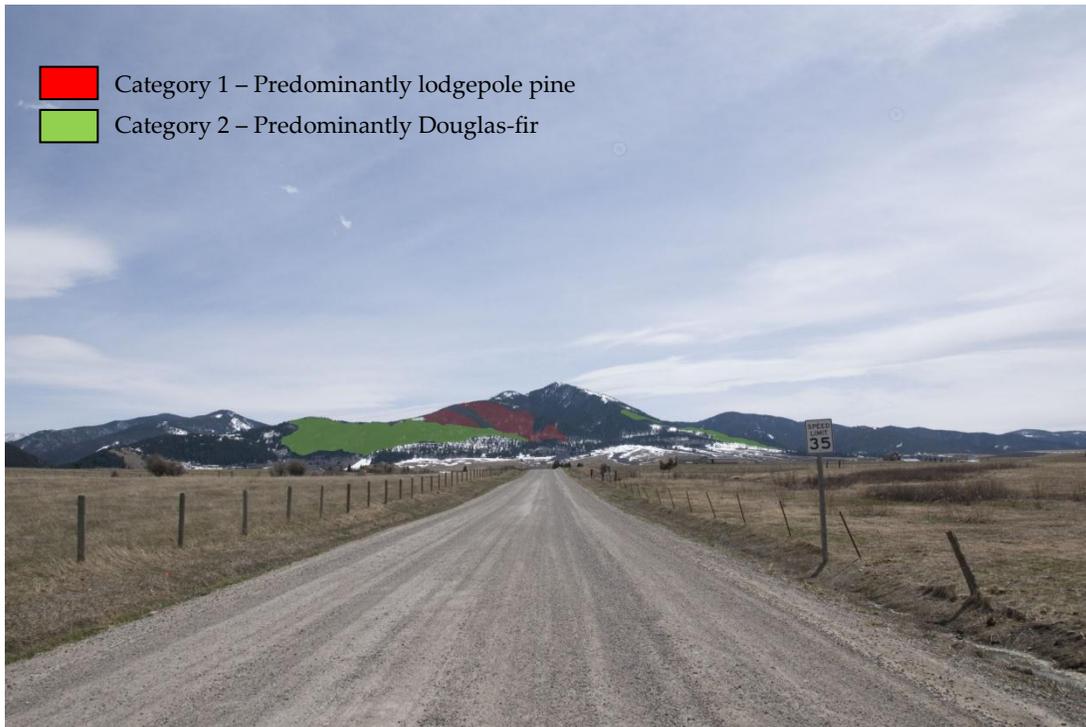


Figure A - 6. View from Bear Claw Lane (OP-4).



According to the earlier discussion on the quality of the 3 categories of stands, Category 1 stands (red) are expected to be most noticeable in contrast to the surrounding area, followed

by Category 3 stands (blue), and lastly Category 2 stands (green). The amounts of visible acres by stand category as seen from each observation point are illustrated in *Table A-4*.

Table A - 4. Amount of visible harvest unit acres by stand category as seen from each observation point.

Harvest Unit	Visible Harvest Unit Acres*							
	OP-1	Percent of Total Visible Project Area	OP-2	Percent of Total Visible Project Area	OP-3	Percent of Total Visible Project Area	OP-4	Percent of Total Visible Project Area
Category 1 Stands (Predominantly lodgepole pine)								
4	0	0%	0	0%	0	0%	153	12%
5	18	2%	14	1%	20	2%	14	1%
6	77	8%	68	6%	74	6%	45	3%
Subtotals	95	10%	82	7%	94	8%	212	16%
Category 2 Stands (Predominantly Douglas-fir)								
1	0	0%	0	0%	7	1%	30	2%
2	0	0%	0	0%	7	1%	4	0%
7	31	3%	24	2%	36	3%	11	1%
8	54	5%	46	4%	52	4%	37	3%
9	45	5%	42	4%	10	1%	0	0%
10	17	2%	17	2%	16	1%	6	0%
Subtotals	147	15%	129	12%	128	11%	88	6%
Category 3 Stands (Mixed)								
3	0	0%	0	0%	0	0%	82	6%
Totals	242	25%	211	19%	222	19%	381	28%

*Reported visible acres are likely to be overestimations of what would be currently or potentially visible from each observation point.

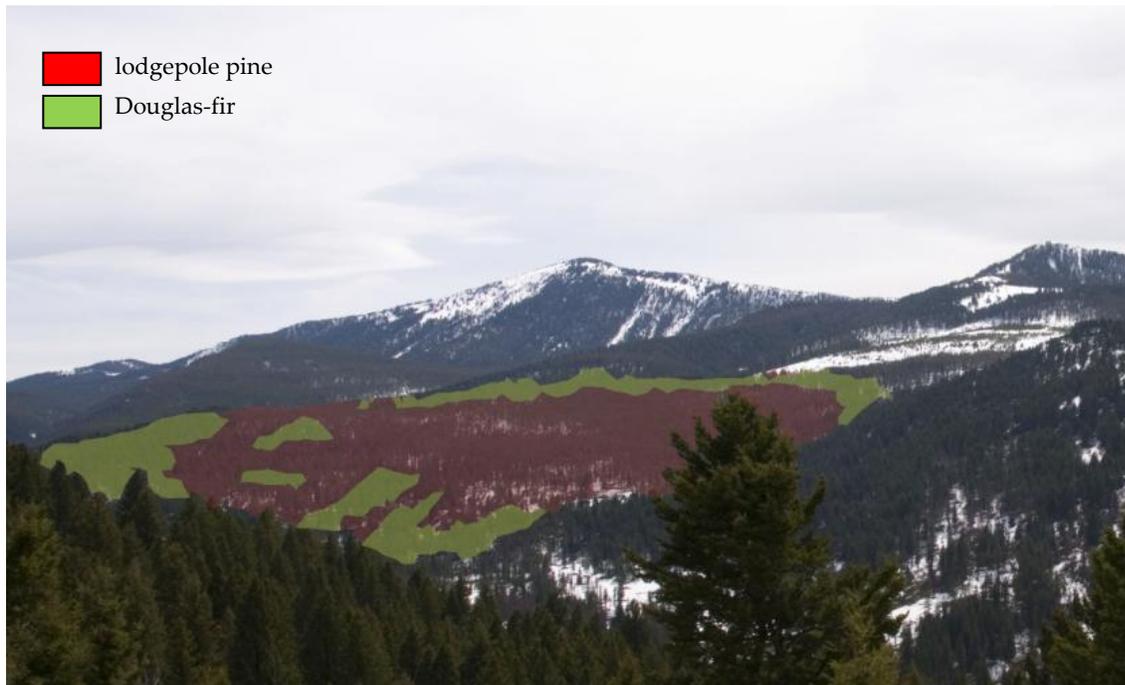
As indicated above, the Category 1 stands (Harvest Units 4, 5, and 6) are expected to present the greatest impact to the viewshed from each observation point. None of these units are exclusively lodgepole pine: Douglas-fir, while infrequent throughout these stands, does exist and could present opportunities to minimize the sharp effects of these clearcut units. Harvest designs within these units may allow for some naturalization of the harvest boundaries.

Figures A-7 and A-8 depict the approximate locations of Douglas-fir and lodgepole pine within the Category 1 stands (Harvest Units 4, 5 and 6). The red represents areas of the stand that are almost exclusively lodgepole pine while the green color represents areas of the stand that contain some Douglas-fir. Where Douglas-fir is available on the borders of the stand, opportunities may exist to ‘soften’ the edges by feathering the harvest up to adjacent stands. Where Douglas-fir occurs within the stand of lodgepole pine, healthy trees could be left as leave trees to break up the unit.

Figure A - 7. Harvest Units 5 and 6 species composition as seen from Mt. Ellis Lane.



Figure A - 8. Harvest Unit 4 species composition as seen from Bear Claw Lane.



Immediately following the harvest the visual effect will be dramatic, especially in the Category 1 stands (predominantly lodgepole pine) that are clearcut. The rapid reduction in vegetative cover and ground disturbance associated with the harvest will contrast starkly to the previous forest condition and surrounding vegetation. Within 2 to 3 years the new vegetation will become established allowing the harvest design mitigations to be a more effective buffer to the visual quality of the harvest.

Roads

According to *Table A-5*, new road construction would account for 24 to 56 percent of the total road miles visible from each observation point, resulting in a 31 to 120 percent increase from existing conditions. Because of maintenance activities, existing roads within the project area are expected to become more visible particularly the road that leads from the end of Mt. Ellis Lane to the forested edge which would require a major amount of reconstruction to meet BMPs. Likewise, new construction throughout the project area would be apparent particularly along steeper terrain where the cut and fill slopes would be more exaggerated. Where possible, trees would be retained along roads in attempts to minimize the impacts to the viewshed as seen from the observation points.

Table A - 5. Existing and new road miles visible in the project area from each observation point.

Road Type	Visible Road Miles*							
	OP-1	Percent of Total Visible Road Miles	OP-2	Percent of Total Visible Road Miles	OP-3	Percent of Total Visible Road Miles	OP-4	Percent of Total Visible Road Miles
Existing Roads	3.3	66%	3.2	70%	4.5	76%	3.1	44%
New Road Construction	1.7	34%	1.4	30%	1.4	24%	3.9	56%
Totals	5		4.6		5.9		7	

*Reported visible road miles are likely to be overestimations of what would be currently or potentially visible from each observation point.

Noise

Noise would be generated by harvest operations, harvest related traffic, road construction and administrative oversight. This could be expected to be present for the entire season of harvest, June 15th through March 15th of the following year, for the duration of the harvest of 2 to 3 years.

Activities would mostly occur during the typical business work week (Monday through Friday) and cease each day by evening except for occasional operations. Road construction, harvesting operations and timber hauling are expected to be louder than other harvest-related traffic. This louder traffic would constitute 75 to 80 percent of traffic trips expected. For more information on type and duration of harvest activities, see *Table II-2* and *Table T-2*.

Cumulative Effects of the No-Action Alternative

Under the No-Action Alternative, no harvest-related activities would occur. Therefore, no cumulative effects to visual quality and noise levels as a result of the No-Action Alternative would be expected.

Cumulative Effects of the Action Alternative

As stated in the Affected Environment portion of this analysis, timber harvest has been a regularly occurring activity throughout the Gallatin Face particularly on USFS land. Harvesting activities and road building on both City of Bozeman and USFS land are expected to continue into the future with projects concentrated within the western portion of the cumulative effects analysis area (USFS BMW Timber Sale Project and City of Bozeman thinning project). Likewise, thinning of forested stands on private ownerships along the Face may occur in the future. These activities, in conjunction with those proposed under the

Action Alternative would result in an increase of total harvested acres and road miles visible from each observation point and an increase in noise levels.

According to *Table A-6*, the Action Alternative would account for 4 to 12 percent of total acreage within the cumulative effects analysis visible from each of the observation points. Managed acres on all ownerships throughout the cumulative effects analysis area are the most visible from observation points 1, 2, and 3. Therefore, the increase in visible managed acres associated with the proposed action and as seen from these points is expected to be consistent with the trend of the surrounding landscape. Since managed acres on adjacent properties are not very visible from observation point 4 (Bear View Lane), harvest units associated with the Action Alternative are expected to constitute most of the managed acres that would be seen from this point.

Table A - 6. Action Alternative harvest unit acres visible within the cumulative effects analysis area as seen from each observation point.

Observation Point	Cumulative Effects Analysis Area Visible Acres	Harvest Unit Acres Visible within Cumulative Effects Analysis Area	Percent of Visible Acres within the Cumulative Effects Analysis Area affected by Harvest Units
OP-1	6194	243	4%
OP-2	3602	212	6%
OP-3	4490	222	5%
OP-4	3265	381	12%

Following harvest, the increase in the amount of managed acres visible from each observation points is expected to be very noticeable within the range of the cumulative effects analysis area especially from observation point 4. Over time, the harvest units are expected to blend in with the surrounding landscape, appearing more consistent with other managed areas throughout the area. All the new roads would be closed with slash and debris thereby blending in with the surrounding landscape. Roads left open for management purposes would likely become overgrown with grass and other vegetation.

Depending on type and amount of forest management planned on adjacent ownerships, lands throughout the cumulative-effects analysis area would likely continue to experience similar forms, lines, textures, and colors as they do currently. Older harvest units would continue to regenerate, blending in line, texture, form, and color while newer harvest units would continue to introduce new attributes in sharper contrast to regenerating stands.

Cumulative effects to noise during the daytime and on weekends would be expected to increase beyond current levels found within the cumulative-effects analysis area. Noise emanating from the harvest activities associated with the proposed action would be concentrated in the areas surrounding the proposed harvest units and roads. Cumulative

effects to noise during the evenings would not be expected to increase beyond current levels found within the area.

Economics

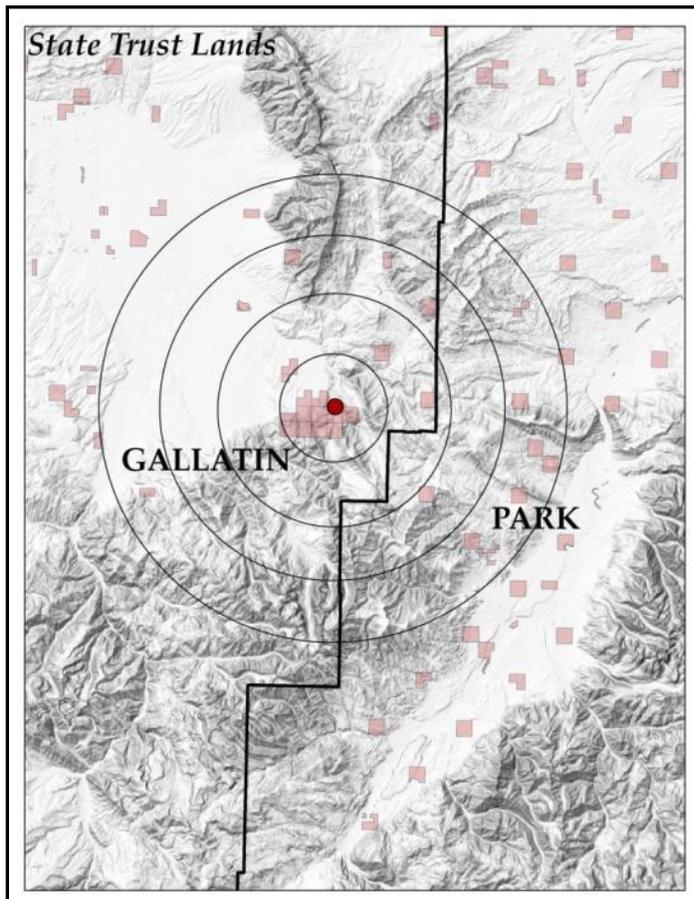
Introduction

This analysis describes existing economic conditions associated with the Bear Canyon Timber Sale and identifies the potential direct, indirect, and cumulative economic effects of the proposed action.

Analysis Area

The geographic scope of the economic analysis is primarily confined within two counties, Gallatin and Park County, shown in relation to the project area in *Figure E-1*. These two counties are economically relevant to the proposed action and represent the general area where the direct, indirect, and cumulative effects are expected to occur.

Figure E - 1. Gallatin and Park County Analysis Area.



Analysis Methods

The economic analysis of proposed timber sales is limited to the estimation of income and employment opportunities occurring as a result of the proposed action.

Total income, defined as income earned in all stages of the forest products economy up to the point of industrial processing, is estimated by multiplying reported regional gate prices² (the delivered log price paid by industrial wood processors), by the total harvest volume expected in the proposed timber sale. Stumpage prices, the contractual price paid for standing timber, are analyzed to determine the portion of total income earned by the trust beneficiaries. Stumpage prices are estimated through transaction evidence from comparable timber sales, highlighting unique characteristics of the proposed sale (i.e. species mix, wood quality, density and diameter, terrain, development requirements, and proximity to markets). State trust management expenses are estimated from annual cash-flow records from DNRC TLMD forest management program.

Direct employment opportunities are estimated using employment multipliers published by the University of Montana’s Bureau of Business and Economic Research (BBER). Additionally, data sources for the economic analysis include the DNRC’s TLMD, the Department of Labor and Industry, Research and Analysis Bureau, the Western Wood Products Association (WWPA) and Random Lengths (RL).

Issues and Measurement Criteria

The following issue statement is a guide for the economic analysis.

- The proposed action may directly affect income in the regional forest products economy. This includes revenue for state trust beneficiaries, infrastructure development, and other forest improvements on forested state trust lands. The proposed action may also directly affect employment opportunities in the regional forest products economy.

The following measurement criteria are used to ‘measure’ the potential direct, indirect, and cumulative economic effects under each alternative.

- For all income, revenues, and prices the measurement criterion is current U.S. dollars.
- For employment, the measurement criterion is full-time jobs sustained for one year.

² Surveyed gate prices are reported quarterly by the Bureau of Business and Economic Research (BBER), an industry research organization at the University of Montana.

Affected Environment

Gallatin and Park County

The proposed action would take place on forested state trust lands managed by the Central Land Office and Bozeman Unit Office of Montana’s DNRC. Timber sales in this region supply raw materials for nearby and statewide forest products firms producing framing lumber, boards and beams, posts and poles, house logs, home improvement products, furniture, fuels and paper products.

Gallatin and Park Counties contain parts of the statewide forest products economy. Current labor market data for these two counties appears in *Table E-1*. Basic information is provided on industry firms present in each county. Industry employment data is largely unavailable at the county level. It is expected that available employment data accounts for only a portion of the total employment in the economy due to missing data on smaller or informal businesses. Gallatin County has many small wood products licensed businesses and Park County contains one significantly sized sawmill.

Table E - 1. Existing forestry and wood products industry by county.¹

Statistic (American Industry Classification Code)	Montana	Gallatin County	Park County
Population	974,989	90,343	15,941
Total Employment	457,386	43,728	7,089
Forestry and Logging Firms/Jobs (1133)	215/686	3/	2/
Wood Products Firms/Jobs (321)	117/2,743	N/A	N/A
Sawmills and Wood Preservation Firms (3211)	30	N/A	1
Veneer and Engineered Wood Firms (3212)	11	N/A	N/A
Other Wood Products Firms (3219)	216	32	5
Pulp, Paper, and Paperboard Mills (3221)	1	0	0
Forestry Support Firms/Organizations (1153)	110	10	2

¹ Data from the Montana Department of Labor and Industry, Research and Analysis Bureau

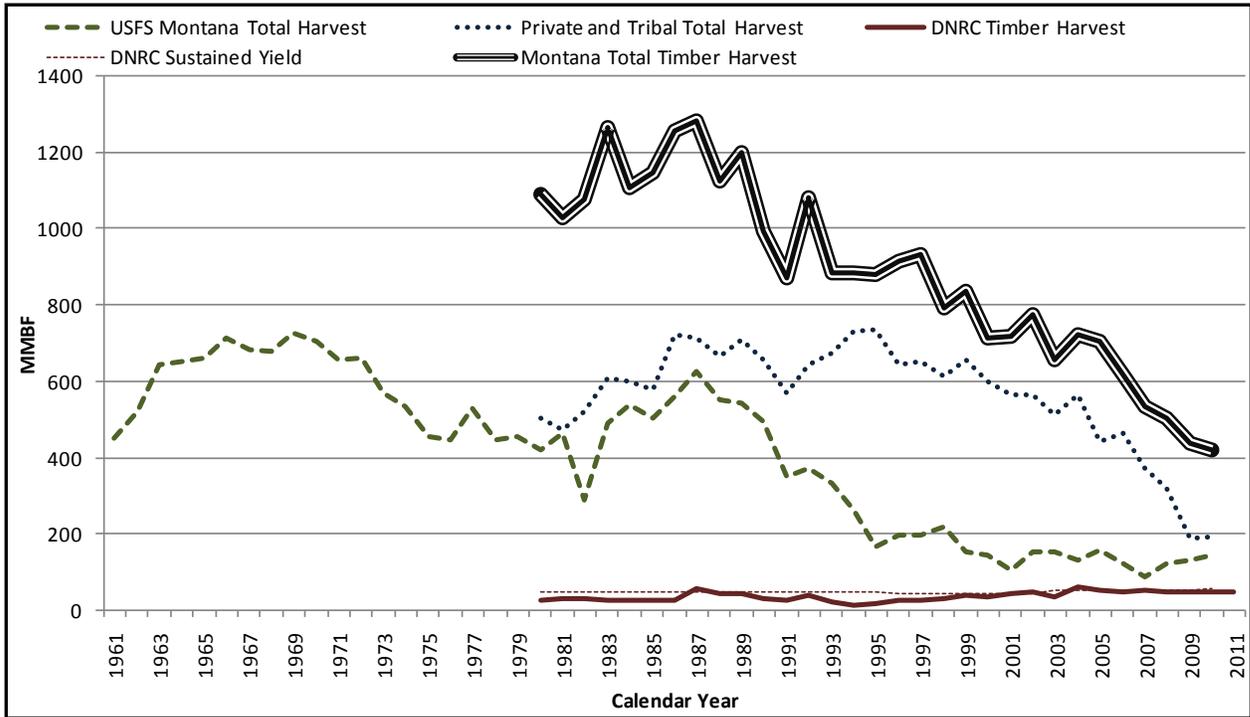
Montana’s Working Forests

Timber harvest in Montana varies year to year, responding to industry, government and market trends. *Figure E-2* shows total timber harvest in Montana over 50 years. Total harvest declined over the past two decades due to declining sale volumes from USFS land followed in recent years by declining harvest on private lands. Currently, DNRC maintains an annual statewide sustainable yield of 53.2 MMbf contributing higher percentages of the total log supply in more recent years.

Estimating the number of jobs sustained by DNRC’s annual sustainable yield can be approximated using a job multiplier from BBER industry survey research. BBER estimates

that for every one MMbf of harvest, 9 direct and indirect industry jobs are sustained for a one year period across all related sectors from logging, milling, and other value adding stages. This multiplier can be interpreted to mean that DNRC’s state forest management helps sustain in the range of 500 industry jobs.

Figure E - 2. Montana working forests timber harvest 1961 to 2011.



In addition to jobs, state-owned forests generate direct and indirect income including revenues distributed to state trust beneficiaries. Timber sale revenue distributed to trust beneficiaries varies depending on the harvest volume and stumpage prices established through sealed bidding on timber sale contracts. *Table E-2* shows gross revenues from DNRC timber sales and the forest improvement (FI) revenues collected from sale purchasers over the last 6 years.

Table E - 2. DNRC timber sale and forest improvement revenues by fiscal year.

Fiscal Year	Timber Sale Revenue	Forest Improvement Revenue	Gross Forest Management Revenue
2010	\$8,044,850	\$1,196,307	\$9,241,157
2009	\$7,584,555	\$866,122	\$8,450,677
2008	\$10,000,724	\$1,098,577	\$11,099,302
2007	\$7,482,894	\$1,316,404	\$8,799,298
2006	\$13,000,348	\$2,875,277	\$15,875,626
2005	\$13,651,632	\$1,850,022	\$16,585,882

FI fees are collected on non-Morrill Grant lands and used to finance projects that improve the health, productivity, and value of forested trust lands. FI activities may include the piling and disposal of logging slash, reforestation, thinning, prescribed burning, site preparation, noxious weed control, seed collection, acquiring access and maintaining roads necessary for timber harvesting, and monitoring.

Environmental Consequences

Direct economic effects are those that alter the direct forest product economy income and employment, including the State of Montana. Indirect economic effects are those that alter other economic sectors within the two-county area. Cumulative economic effects are typically seen as those that contribute to long-term changes in any part of the economy.

Direct and Indirect Effects of the No-Action Alternative

Information organized in *Table E-3* shows that under the No-Action Alternative income effects from the project area would not be realized at this time. However, if timber from this project is not sold, equivalent volumes would need to come from sales on other trust forestlands in the state, lending to income and employment effects of an unknown scale to occur elsewhere. Local mills may not be able to substitute the potential loss of delivered logs from their regional resource supply chain.

Negative economic effects could also occur from a No-Action Alternative concerning salvage condition trees where a particular forest stand is left unmanaged in a dead or dying state. Leaving beetle-infested pine unmanaged would represent a significant economic loss to the trust beneficiaries because instead of appreciation in value by growing, dead and dying stands depreciate rapidly as the wood rots losing its structural and therefore marketable qualities. Additionally, unmanaged dead stands could produce negative externalities and extend economic losses by promoting unwanted silvicultural conditions and slowing down the rate at which a replacement stand matures. These effects are not

quantified in this analysis, but do represent an increase in the total economic opportunity costs for a No-Action Alternative decision concerning salvage stands.

Direct and Indirect Effects of the Action Alternative

Direct income effects are estimated with current regional BBER log price data and state revenues are estimated using the transaction evidence appraisal approach discussed earlier. Information organized in *Table E-3* shows an estimated total direct income of \$1,561,840 would be generated in the harvest and delivery of logs from the Bear Canyon Timber Sale. Much of this income represents the margin for operators to harvest, load and haul the logs to mill locations. The other portion includes revenue for state trust beneficiaries, and infrastructure development and other forest improvements on state forested trust lands. This subtotal income to the state is estimated at \$469,834, and represents the total revenue received by the state plus additional capitalized value to trust land as a result of the proposed action. Of this, \$345,334 is estimated to be received as actual revenue, \$211,226 of which would be directly earned for trust beneficiaries. The rest would cover the expenses from the state to provide sale preparation and management associated with the proposed action as well as forest improvement activities. Management expenses are estimated using an average program revenue/cost ratio from annual accounting records highlighted in the *formula* column of *Table E-3*.

Direct and indirect employment effects include an estimated 50 full time annual jobs in the logging and forest products industry, as well as other supporting sectors of the economy. Again, the level of employment sustained by this project is estimated using BBER industry research.

Indirect income effects are not quantified in this analysis, but they represent additional benefits to the economy as income earned from the proposed action is recycled within the two-county area, buying other goods and services. Assuming a regionally average leakage rate (the rate at which money escapes the local economy and is spent elsewhere) the indirect income effects would be represented by some additional sum of money in the proximity to the direct income effects experienced within the two-county area.

Table E - 3. Estimated direct and indirect economic effects.

Measurable Effect	Formula	No-Action Alternative	Action Alternative
Total harvest volume (MBF)	[a]	0	5,578 MBF
Delivered Log Price (\$/MBF) ¹	[b]	\$0	\$280/MBF
Total Delivered Log Value (\$)	[a] * [b]	\$0	\$1,561,840
Timber Sale Revenues (\$/MBF)	[c]	\$0	\$45.44/MBF
FI Revenue (\$/MBF)	[d]	\$0	\$16.47/MBF
Development Costs (\$/MBF)	[e]	\$0	\$22.32/MBF
Total Value to the State (\$)	[a] * ([c] + [d] + [e])	\$0	\$469,834
Total State Revenues	[a] * ([c] + [d])	\$0	\$345,334
Total Trust Revenues ²	[a] * ([c] + [d]) – [a] * ([d] * 0.53)	\$0	\$211,226
Direct Industry Jobs Supported ³	[a] * (.009)	0	50 Jobs

¹ Current BBER market price for delivered sawlogs in Central and Eastern Montana region.

² State management expenses estimated with the revenue and cost summary in the 2010 SFLMP Monitoring Report

³ Direct full time logging and forest products jobs per MBF annually; not including indirect jobs, or forestry and forest management jobs. (Keegan et. al. 2004)

Cumulative Effects of the No-Action Alternative

DNRC has a statewide sustainable-yield annual harvest goal of 53.2 MMbf. If this project were not sold, this volume could come from sales elsewhere. The substituting timber sale may be from other areas and not benefit this region of the state.

Cumulative Effects of the Action Alternative

The Action Alternative would contribute volume to the annual sustainable yield of 53.2 MMbf. This yield establishes a relatively stable supply of state trust land timber for regional and statewide markets. In the past decade, the state's timber market share in terms of log supply has grown from five percent up to nearly twenty percent. This substantial increase in market share is indicative of the greater reliance regional forest product firms are placing on state supplied timber. Maintaining a stable timber supply is even more critical in

recessed markets where other forest land owners have reduced their respective harvest levels.

Overall, the business relationship between state trust land forests and forest products industries is mutually beneficial. Without timber demand from industries forest land assets would be nearly valueless, failing to provide revenue for the trust beneficiaries, and would remain a fiscal liability to the trusts in terms of maintaining forest health. Similarly, forest product manufacturing sites, which are scaled and financed according to the assessment of available timber supply within an economical operating distance, require a steady supply of timber to remain open and competitive in their respective markets.

Additionally, the proposed action would also contribute proportionally to public school funding. Funds distributed by state trusts partially offset tax dollars needed to fund public education. The cumulative effect of this proposed action in conjunction with revenue-generating activities of other trust land is the continued financial contribution to public education in Montana. Effectively, these revenue contributions represent tax dollar offsets and either work to reduce the overall tax burden for Montanans, or expand the available tax revenue for other public services.

The proposed action would also contribute to the overall size of the FI fund. In the long term, FI funding represents an investment in forest health, future income-generating opportunities, fire protection, and other associated benefits. The economic benefits of work conducted with FI funds cannot be directly measured, but they represent an additional cumulative effect related to the proposed action.

Air Quality

Introduction

This analysis describes the existing air quality and discloses the potential direct, indirect, and cumulative environmental effects the proposed action (*see Chapter I – Purpose and Need*) may have on air quality throughout the area.

Analysis Areas

The analysis area used to determine direct, indirect, and cumulative environmental effects to air quality includes airsheds within a 25-mile radius of the proposed project area. This area encompasses airsheds associated with the following major towns within the area: Bozeman, Belgrade, Livingston, and Four Corners.

Analysis Methods

The methodologies used to determine the environmental effects of the proposed action on air quality within the project and cumulative-effects analysis area include estimating the amount, location, timing, and duration of smoke and dust generated by activities associated with the proposed action. Cumulative effects include consideration of other actions indicated in *Chapter I – Relevant Past, Present, and Related Future Actions*.

Issues and Measurement Criteria

The following issues concerning air quality were raised during internal and external scoping and will be analyzed in further detail in this analysis:

- Dust produced from harvest activities, road building and maintenance, and hauling associated with this project may adversely affect local air quality.
- Smoke produced from logging slash pile and broadcast burning associated with this project may adversely affect local air quality.

Quantitative and qualitative changes to the following measurement criteria are intended to ‘measure’ the extent of the potential direct, indirect, and cumulative environmental effects the proposed action may have on existing air quality in the area.

- Amount/Intensity, location, timing (week, month, season), and duration (weeks, months, years) of road construction, road maintenance, and harvest-related traffic.
- Amount/Intensity (piles, acres), location, timing (week, month, season), and duration (weeks, months, years) of prescribed burning (broadcast and slash pile)

Relevant Agreements, Laws, Plans, Permits, Licenses, and Other Authorizations

Congress passed the Clean Air Act in 1963. The purpose of the act is to protect and enhance air quality while ensuring the protection of public health and welfare. *MCA 75-2-101* through *429* is known as the Clean Air Act of Montana and requires the State of Montana to

provide for a coordinated statewide program to prevent, abate, and control air pollution while balancing the interest of the public.

DNRC is a member of the Montana/Idaho Airshed Group which was formed to minimize or prevent smoke impacts while using fire to accomplish land-management objectives and/or fuel hazard reduction (Montana/Idaho Airshed Group 2010). As a member, DNRC must submit a list of planned burns to the smoke-monitoring unit that describe the type of burn to be conducted, the size of the burn in total acres, the estimated fuel loading in tons/acre, and the location and elevation of each burn site. The smoke-monitoring unit provides timely restriction messages by airshed. DNRC and other cooperators are required to abide by those restrictions and burn only when conditions are conducive to good smoke dispersion.

The DEQ issues permits to entities that are classified as major open burners (*ARM 17.8.610*). DNRC is permitted to conduct prescribed wildland open-burning activities that are either deliberately or naturally ignited. Planned prescribed burn descriptions must be submitted to DEQ and the smoke-monitoring unit of the Montana/Idaho Airshed Group. All burns must be conducted in accordance with the major open-burning permit.

Affected Environment

The analysis area is within the central part of Montana Airshed 8A (Montana DSL, 1988, p D-15). The entire area is considered to be in attainment (an area considered to have air quality as good as or better than the National Ambient Air Quality Standards as defined in the Clean Air Act) by the Montana DEQ. The nearest non-attainment (an area that has been designated by the EPA and the appropriate state air quality agency as exceeding one or more National Ambient Air Quality Standards) area is Butte for Particulate Matter (PM-10) (85 miles to the west). All of the area and the entire Gallatin National Forest is a Class II Airshed (areas can accommodate normal, well-managed industrial growth). The nearest Class I Airshed (areas allow the smallest incremental growth and accommodate only a small degree of air quality deterioration) area is Yellowstone National Park with is 33 miles to the south.

Air quality within the analysis areas is excellent with very limited local emission sources and consistent wind dispersion. Existing sources of emissions include occasional construction equipment, vehicles, road dust, residential wood burning, wood fires, and smoke from logging slash disposal.

Environmental Consequences

Direct and Indirect Effects of the No-Action Alternative

Under the No-Action Alternative, there would be no harvest-related activities and traffic, or road construction and maintenance. Therefore direct and indirect effects to air quality as a result of the No-Action Alternative would not be expected.

Direct and Indirect Effects of the Action Alternative

Prescribed Burning

DNRC may conduct prescribed burning following harvest activities in order to remove residual logging waste and fine fuels. These burning activities would subsequently reduce fire risk within the area and prepare site conditions conducive to tree regeneration.

The total harvest over two years may produce approximately 2,700 tons of Douglas-fir slash and 6,000 to 7,200 tons of lodgepole pine slash. Burning would be conducted by harvest unit and start approximately one year after a harvest unit has been completed. Due to airshed restrictions, burning could be expected to last one to 3 years after completion of a harvest unit.

Burning would most likely occur during the months of July through November and March through April during conditions that are conducive to good smoke dispersion. Actual burning days would be controlled and monitored by DEQ and the smoke monitoring unit of the Montana/Idaho Airshed Group and would meet EPA standards, which would further minimize the direct and indirect effects of burning activities.

Road Construction and Maintenance

Road construction and Maintenance would be expected to produce particulate matter. According to *Table T-1*, approximately 5.5 miles of road would be reconstructed and maintained and there would be approximately 6.9 miles of new road construction. A ½ acre borrow pit in Section 3 of Township 3S Range 6E *Chapter 3 – Geology and Soils*, would provide rock armoring for roads and culverts.

Direct and indirect effects to air quality as a result of road construction, maintenance, and a ½ acre borrow pit are expected to be localized to the roadways and areas directly adjacent to the roadways. Vegetative barriers along the roadside and dust abatement mitigations are expected to greatly limit the dispersion of particulate matter beyond these areas. Thus direct and indirect effects to air quality throughout the analysis area as a result of road construction and maintenance are expected to be minor.

Harvest-Related Traffic

Harvest-related traffic on gravel/dirt roads would be expected to produce particulate matter. According to the analysis conducted for *Chapter 3 – Transportation*, approximately 1,120 to 3,040 trips for log hauling and loader operator transportation would be expected to occur per year over the 2 to 3 year operating period. Log hauling is based off 160 days per year of potential operations with no hauling on weekends or major holidays. Harvest Crew transportation could be expected 7 days a week from June 15 through March 15 of the following year. Approximately 1,872 to 5,760 total harvest-related trips could be expected per year over the 2 to 3 year operation period (*see Table T-2*).

Dust production on roads during the dry summer and fall months would likely be higher than during the late fall, winter, and early spring months when frozen ground conditions and/or higher levels of moisture are expected to abate particulate production. During the

dry months, log and equipment hauling traffic would be expected to produce more particulate matter than the other harvest-related traffic due to the size and weight of the vehicles.

Direct and indirect effects to air quality as a result of harvest-related traffic are expected to be localized to the roadways and areas directly adjacent to the roadways. Vegetative barriers along the roadside and dust abatement mitigations are expected to greatly limit the dispersion of particulate matter beyond these areas. Thus direct and indirect effects to air quality throughout the analysis area as a result of harvest-related traffic are expected to be minor.

Cumulative Effects of the No-Action Alternative

Cumulative effects to air quality as a result of this alternative would not be expected.

Cumulative Effects of the Action Alternative

Cumulative Effects of burning, road construction, road maintenance, and gravel crushing and hauling associated with ongoing and foreseeable actions on DNRC, federal, and private, lands would produce particulate matter. Existing emission sources from occasional construction equipment, vehicles, road dust, residential wood burning, wood fires, and smoke from logging slash disposal would continue. Nearby residential areas and the City of Bozeman could experience reductions in air quality during peak burning periods. All burning activities by major burners would continue to comply with emission levels authorized by the DEQ, Montana/Idaho Airshed Group, and the EPA.

All above mentioned emissions in conjunction with expected particulate production from the proposed action would occur at higher levels than currently expected. Providing that dust abatement would be used during dry conditions and gravel operations, half of the harvest operations would occur during frozen and/or wetter conditions, construction activities would be short in duration, and emissions produced from burning would be appropriately controlled and monitored, the cumulative effects to air quality are not expected to exceed EPA and DEQ standards.

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Appendix A

List of Preparers

May 2010 Scoping Letter

October 2010 Scoping Letter

Scoping List

List of Respondents

List of Preparers

Chuck Barone — Dillon Unit, Management Forester

Craig Campbell — Bozeman Unit, Unit Manager

Jeff Schmalenberg — Forest Management Bureau (FMB), Hydrologist / Soils Scientist

Katie Svoboda — Bozeman Unit, Office Manager

Ross Baty — FMB, Wildlife Biologist

Sonya Germann — FMB, Forest Management Planner

Tim Spoelma — FMB, Silviculturist/Forest Ecologist

May 2010 Scoping Letter

Proposed Bear Canyon Timber Sale Scoping Notice

Montana Department of Natural Resources & Conservation
Central Land Office
Bozeman Unit



May 24th, 2010

Dear Bozeman Area Resident,

The Montana Department of Natural Resources and Conservation (DNRC) Trust Land Management Division (TLMD), Bozeman Unit, is currently evaluating state trust lands within the Bear Canyon Area near Bozeman, Montana for potential timber harvest activities. Specifically, DNRC TLMD is considering harvest activities in an area encompassing up to 1,300 acres within sections 1, 2, 3 and 4 T3S R6E and sections 34 and 35 T2S R6E (*see Proposed Project Area map*).

Currently a majority of the lodgepole pine trees within the Bear Canyon area are experiencing or are facing mortality due to the serious infestation of Mountain Pine Beetle. The Douglas-fir stands within the area are confronted with health and vigor issues due to the overstocked conditions and would benefit from selective harvesting practices.

We recognize that this is an important area to our neighbors and many community members throughout Bozeman and its surroundings. We want to provide you with every opportunity to ask us questions about the proposed project, provide input, share your concerns, and stay updated on and involved in each step of the process. Please read on to learn more about this proposed project.

What are state trust lands?

Upon ratification of the Montana State Constitution in 1889, the U.S. Congress granted certain lands to the State of Montana for support of common schools and other public institutions. To this day, these lands are held in trust for the specific trust beneficiaries to which they were assigned and ultimately for the people of the State of Montana (*1972 Montana Constitution [Article X, Section 11](#)*). The Board of Land Commissioners (Land Board) and the DNRC TLMD are required by law to manage these state trust lands to produce reasonable and legitimate return for the trust beneficiary institutions while considering environmental factors and protecting the future income-generating capacity of the land (*1972 Montana Constitution, Article X, Section 11; Montana Code Annotated [\[MCA\] 77-1-202](#)*).

State trust lands within the proposed project area are currently held in trust for the benefit of the State Normal School, State Industrial School and Public Buildings.

What are DNRC's objectives with this proposed project?

DNRC's mission is to manage the state forest resource for its health and long term sustainability and to protect and enhance the future income-generating capacity of state trust land. The [State Forest Land Management Plan \(SFLMP\)](#) is the plan under which DNRC manages forested state trust lands. The SFLMP is premised on the philosophy that the best way to produce long-term income for the trust beneficiaries is to manage intensively for healthy and biologically diverse forests. In the foreseeable future, timber management will continue to be the primary source of revenue and primary tool for achieving biodiversity objectives on forested state trust lands.

DNRC TLMD is proposing the following objectives for this proposed project:

1. Manage the forest resource to promote improved health, productivity, and diversity.
2. Capture the value of dead, dying, and decadent lodgepole pine.
3. Generate revenue for the trust beneficiaries.
4. Minimize fire and safety risks imposed by these conditions.
5. Enhance and expand the existing transportation system to provide improved access for long-term future management of the area and fire suppression needs.

What activities would be involved with the proposed project?

In order to achieve these project objectives, we anticipate conducting the following activities:

- Timber harvest
- Road building
- Road improvement

How can I participate?

We are currently in the beginning stages of project development and would like your help in identifying potential issues associated with our proposed activities. Although we encourage you to submit comments *any time* during the MEPA process, we are asking the public to contact us with initial issues and concerns by **June 25th, 2010**. Identifying issues early on in project development will help us develop alternatives under which we can reasonably address concerns through proper project design.

Please send comments:

Via Mail: Curt Tesmer, Project Leader
ATTN: BEAR CANYON
PROPOSED TIMBER SALE
Montana DNRC
2273 Boot Hill Court, Ste. 110
Bozeman, MT 59715

Via Email: DNRCBearCanyon@mt.gov

Or Submit Comments Online at:

www.dnrc.mt.gov/trust/timber/information/BearCanyon/Comments

For more information on the proposed Bear Canyon Timber Sale Project, please visit our project website at www.dnrc.mt.gov/trust/timber/information/BearCanyon/. If you have other questions regarding the MEPA process, contact Craig Campbell or Curt Tesmer at the Bozeman Unit Office at 586-5243.

Sincerely,

Craig Campbell
Bozeman Unit Manager

ENCLOSED!

Please fill out the enclosed postcard to let us know how we can keep you informed, if you would like to attend field trips and/or meetings, and if you would like to receive a copy of the draft environmental analysis this fall. If we do not hear from you, we will continue to contact you via this address.

October 2010 Scoping Letter

Scoping Notice Proposed Bear Canyon Timber Sale & Public Meeting

**Thursday, October 28th, 2010, at 7:00 P.M. at the Bozeman Unit Office Conference room
Montana Department of Natural Resources & Conservation, Central Land Office,
Bozeman Unit**

The Montana Department of Natural Resources and Conservation (DNRC) Trust Land Management Division (TLMD), Bozeman Unit, is continuing the evaluation of state trust lands within the Bear Canyon Area near Bozeman, Montana, for potential timber harvest activities. Specifically, DNRC TLMD is considering harvest activities in an area encompassing up to 800 acres within sections 1, 2, 3, 4 and 11 T3S R6E and sections 34 and 35 T2S R6E (*see Bear Canyon Proposed Timber Sale map*).

Currently a majority of the lodgepole pine trees within the Bear Canyon area are experiencing or are facing mortality due to a Mountain Pine Beetle infestation. The Douglas-fir stands within the area are confronted with health and vigor issues due to overstocked conditions. The proposed harvest would provide revenue to the trust, recover value from damaged and overstocked timber and improve the health and productivity of the forest stands.

Since we began our initial scoping process in May of this year, we have been in the field collecting data to refine our proposal. Our work has resulted in the identification of 13 potential harvest units consisting of approximately 830 acres that would yield approximately 6,500 Thousand Board Feet (MBF) of harvested timber.

The proposed project would incorporate group selection, selection and regeneration harvest methods utilizing conventional/tractor harvest systems. Overstocked stands of Douglas-fir, spruce, and subalpine fir would have the basal area reduced by up to 60%. All merchantable lodgepole pine would be salvaged.

Access to the proposed harvest units would require the construction of up to 8.7 miles of new road, up to 2.5 miles of which would be long-term road and the remainder temporary road. The long-term road would be left in place to accommodate future management activities, while the temporary road would be used only for timber harvest for this sale, then physically closed with slash/debris and seeded with grass.

We recognize that this is an important area to our neighbors and many community members throughout Bozeman and its surroundings. We want to provide you with every opportunity to ask us questions about the proposed project, provide input, share your concerns, and stay updated on and involved in each step of the process. To facilitate more

complete communication we will be holding a **Public Meeting on Thursday, October 28th, 2010, at 7:00 P.M. at the Bozeman Unit Office Conference room.** At this meeting we will present an overview of the proposed project and answer questions on our proposal.

Although we encourage you to submit comments *any time* during the MEPA process, we are asking the public to contact us with issues and concerns by **November 18th, 2010.**

Identifying issues early on in project development will help us develop alternatives under which we can reasonably address concerns through proper project design.

Please send comments:

***Via Mail:* Craig Campbell, Bozeman Unit Manager**

**ATTN: BEAR CANYON
PROPOSED TIMBER SALE
Montana DNRC
2273 Boot Hill Court, Ste. 110
Bozeman, MT 59715**

***Via Email:* DNRCBearCanyon@mt.gov**

Or Submit Comments Online at:

www.dnrc.mt.gov/trust/timber/information/BearCanyon/Comments

For more information on the proposed Bear Canyon Timber Sale Project, please visit our project website at www.dnrc.mt.gov/trust/timber/information/BearCanyon/. If you have other questions regarding the MEPA process, contact Craig Campbell at the Bozeman Unit Office at 586-5243.

Sincerely,

Craig Campbell
Bozeman Unit Manager

Scoping List

Local Government

- Ft Ellis FSA, Sourdough Fire District
- Gallatin County Commissioners
- Harold Blattie , Montana Association of Counties
- Jeff Krauss, Mayor, The City of Bozeman

State and Federal Agencies

- Janel Favero, DNRC
- Jeanne Holmgren, DNRC
- John Grassy, DNRC
- Kevin Chappell, DNRC
- Patrick Rennie, DNRC
- Sonya Germann, DNRC
- Gallatin National Forest
- Pat Flowers, Montana Department of Fish, Wildlife, and Parks
- Julie Cunningham, Wildlife Biologist, MTFWP - Region 3
- Park Planning , Yellowstone National Park

Tribal Government

- Joe Rivera, Blackfeet Tribe
- John Murray, Blackfeet Tribe
- Joyce Spoonhunter, Blackfeet Tribe
- Francis Auld, Confederated Salish & Kootenai Tribes
- Stephen McDonald, Confederated Salish & Kootenai Tribes
- Rose Leach, Confederated Salish & Kootenai Tribes
- Tribal Historic Preservation Office, Confederated Salish & Kootenai Tribes

Organizations and Associations

- Michael Garrity, Director, Alliance for the Wild Rockies
- Lisa Lenard, Director, American Wildlands
- Linda Johnson, Bear Mountain Homeowners Association
- Patti Steinmuller, Bozeman Women's Activity Groups (BWAGs)
- Bridger Ski Foundation
- Citizens for Balanced Use
- Andrew Dana , Conservation Law Associates
- David Gaillard, Defenders of Wildlife
- John Parker, Dirt Concern of the Gallatin Valley Bicycle Club
- Steve Bretson, Dirt Concern of the Gallatin Valley Bicycle Club
- Aimee and David Devlin, Eagle Rock Reserve Owners Association
- Bill Ogden, Eagle Rock Reserve Owners Association
- Fed and Barbara Stockwell, General Managers, Eagle Rock Reserve Owners Association

-
- Arlene Montgomery, Friends of the Wild Swan
 - Gallatin Valley Back Country Horsemen
 - Amy Chiuchiolo, Director, Gallatin Valley Bicycle Club(GRR)
 - Gary Vodehnal, Trails Coordinator, Gallatin Valley Land Trust
 - Kelly Pohl, Managing Director, Gallatin Valley Land Trust
 - Stephen Johnson, Director, Gallatin Valley Land Trust
 - Ted Lange, Gallatin Valley Land Trust
 - Glenn Hockett President, Gallatin Wildlife Association
 - Greater Gallatin Watershed Council
 - Hannah Stauts, Greater Yellowstone Coalition
 - Mike Clark, Director, Greater Yellowstone Coalition
 - Mike Jongeling, Montana 4x4 Association, Bozeman Mountaineers
 - Steve Kelly, Montana Ecosystem Defense Council
 - Anne Hedges, Montana Environmental Information Center
 - Bob Allen, Co-president, Montana Mountain Bike Alliance (MMBA)
 - Greg Beardslee, Montana Mountain Bike Alliance (MMBA)
 - Liz Harrison, Director, Montana Outdoor Science School
 - Bonnie Secor, Montana Trail Vehicle Riders Association, Gallatin Motor Sports Club
 - Ellen Engstedt-Simpson, Montana Wood Products Association
 - Sara Jane Johnson, Native Ecosystem Council
 - Phil Knight, Native Forest Network Last Refuge Campaign
 - Property and Environment Research Center (PERC)
 - Al Christophersen, Rocky Mountain Elk Foundation
 - Sierra Club Headwaters Group
 - Ben Donatelle, The Wilderness Society
 - Bob Ekey, Regional Director, The Wilderness Society
 - Peter Aengst, The Wilderness Society
 - Cameron Nacify, Staff Ecologist, Wild West Institute
 - MT Conference of Seventh-day Adventists

Businesses

- Bozeman Chamber of Commerce-for Bozeman citizens
- DeWin Madill, President, Covenant Investments, Inc.
- Paul McKenzie, Land and Resource Manager, FH Stoltze Land and Lumber
- Michael Atwood, Montana Land Consultancs, LLC
- Jim Kranz, Plum Creek Timber Co.
- Ed Regan, R-Y Timber, Inc.
- Sherman Anderson, Sun Mountain Lumber, Inc.
- Steve Flynn, Sun Mountain Lumber, Inc.
- Lisa Grossi, Thunderball Ranch
- Triple Tree Ranch Owners Center

Private Citizens

- Andrew Dana
- Anne Banks
- Ben Donatelle
- Ben Lloyd
- Beth MacConnell
- Bethany Letiecq
- Bill Cochran
- Bill Cochran
- Blake and Anna Norsworthy
- Bob and Judy Wilkes
- Brenda Davis
- Brian Cooke
- Bruce and Rebecca Ruefer
- Bruce Granger
- Bryan Walthall
- Bundy Phillips
- Carol Metcalf
- Casey Seibert
- Casper and Jan Offutt
- Catherine Cooper
- Chris Newman
- Craig Coles
- Dan Porter
- Dave Kascht
- Deb Berglund
- Debbie Sierra
- Don Bachman
- Don Beadle
- Doug Hanson
- Doug Williams
- Dr. Carol & Timothy Roark
- Dr. Ellen Macfarland
- Erin Hamilton
- Frank and Nancy Morgan
- Gary and Moe Dewalt
- Gary and Susan Skaar
- George and Nancy Wood
- Gerry and Cindy Graff
- Gordon Julian
- Helen Davis
- Henry Glenn

-
- Holly Fretwell
 - James & Nanette Conley
 - James O'Neill
 - Janice Cartwright
 - Joel Walthall
 - John Lambert
 - John Parker
 - Joseph and Sherry Faber
 - Josh Gage
 - Kara Miller
 - Kate Dolan
 - Kathleen Williams
 - Kim Kotur
 - Kristian and Stacey Hansen
 - Larry Jent
 - Leon Liebman
 - Lisa Grossi
 - Mark and Pamela Duffy
 - Mary Keefer
 - Mary Wilson
 - Mike Conley
 - Mike Phillips
 - Mike Sand
 - Miss Ashea Mills
 - MJ Kearns
 - Mr. Bob Seibert
 - Mr. Bobby Crowe & Marlene Moran
 - Mr. Connie & Richard Hilsted
 - Mr. David Ellenberger
 - Mr. Gregory Vallor
 - Mr. Hans & Beverly Villinger
 - Mr. Hugh & Connie McFadden
 - Mr. Jim & Marion Kraus
 - Mr. Mike O'Connell
 - Mr. Norman A. Bishop
 - Mr. Peter Murry & Ms. Mary Swanson
 - Mr. Robert Keith & Ms. Marisa Bueno
 - Mr. Steve Garcia
 - Mrs. Amy Frykman
 - Mrs. Kenneth Pierce
 - Mrs. Renee Evanoff
 - Ms. Anne Rockhold
 - Ms. Gail & John Richardson

- Ms. Jeanette Goodwin
- Ms. June Safford
- Ms. Katherine Looney & Mr. Brett Gustafson
- Ms. Linda Barnsley
- Ms. Nancy Kessler
- Ms. Patricia Simmons & Mr. Edward Verry
- Ms. Susan Mavor
- Nancy Creel
- Nicholas Davis
- Nick Mahan
- Nona Chambers
- Noreen and Roger Breeding
- Patty & Jamie Walton
- Paul Gaffney
- Paul Griffin
- Peter Fischer
- Randy Walthall
- Remi Metcalf
- Representative Brady Wiseman
- Representative JP Pomnichowski
- Robert Earley
- Robert Kasmer
- Rodelle Madill
- Roger Creel
- Sara Johnson
- Schaplow Farms
- Senator Bob Hawks
- Shalon Osler
- Shelley Watters and Steve Malmberg
- Stephen and Elisa Eshbaugh
- Steve and Shari Sutherland
- Steven and Jane Shaneyfelt
- Stuart Lewin
- Susan Barbisan
- Susie Mathre
- Ted Chervin
- Terry Johnson
- Tim Border
- Tim Kearns
- Tim Wilkes
- Tom Burnett
- Tom Greason

- Valorie Drake
- Verne House
- Wendy Wilson
- William Kearns

List of Respondents

State and Federal Agencies

- Pat Flowers, Montana Department of Fish, Wildlife, and Parks

Organizations and Associations

- Michael Garrity, Director, Alliance for the Wild Rockies
- Steve Kelly, Montana Ecosystem Defense Council
- John Parker, Dirt Concern of the Gallatin Valley Bicycle Club
- Steve Bretson, Dirt Concern of the Gallatin Valley Bicycle Club
- Kelly Pohl, Managing Director, Gallatin Valley Land Trust
- Bob Allen, Co-president, Montana Mountain Bike Alliance (MMBA)
- Greg Beardslee, Montana Mountain Bike Alliance (MMBA)
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- David Gaillard, Defenders of Wildlife
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- Ed Regan, R-Y Timber, Inc.
- DeWin Madill, President, Covenant Investments, Inc.

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- Joel Walthall
- Kate Dolan
- Tim Wilkes
- Mike Sand
- Roger Creel
- Kim Kotur
- Beth MacConnell
- Don Beadle
- Bundy Phillips
- Tim Kearns
- Brian Cooke
- Bruce and Rebecca Ruefer

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- Nancy Creel
 - Helen Davis
 - Nicholas Davis
 - Casey Seibert
 - Don Bachman
 - Paul Gaffney
 - Bruce Granger
 - Josh Gage
 - Gary and Susan Skaar
 - Henry Glenn
 - James O'Neill
 - Janice Cartwright
 - Tom Greason
 - Verne House
 - Bill Cochran
 - Bob and Judy Wilkes
 - Craig Coles
 - Shelley Watters and Steve Malmberg
 - Peter Fischer
 - Randy Walthall
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 - Ms. Katherine Looney
 - Mr. Brett Gustafson
 - Dan Porter
 - Noreen and Roger Breeding
 - John Lambert
 - Gerry and Cindy Graff

Montana Department of Natural Resources and Conservation
Bozeman Unit
2273 Boot Hill Court, Suite 110
Bozeman, MT 59715
406-586-3136

Persons with disabilities who need an alternative, accessible format of this document should contact the DNRC at the above address or phone number.

