Chapter 4

Affected Environment and Environmental Consequences

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4 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter describes the affected environment and analyzes the direct and indirect environmental effects associated with the alternatives described in EIS Chapter 3 (Alternatives). Table E3-4 in Appendix E, EIS Tables, provides a summary of effects presented in this chapter. Cumulative effects are presented in EIS Chapter 5 (Cumulative Effects). For resources that could potentially be affected by implementation of the alternatives, affected environment discussions describe the relevant regulatory framework and present technical background information. These discussions identify the current conditions against which the anticipated environmental effects of the alternatives are evaluated. The remaining sections of this chapter present the physical environment first, followed by the biological environment, and then the social environment. The specific order of the sections is as follows:

- Forest Vegetation (Section 4.2)
- Air Quality (Section 4.3)
- Transportation (Section 4.4)
- Geology and Soils (Section 4.5)
- Water Resources (Section 4.6)
- Plant Species of Concern, Noxious Weeds, and Wetlands (Section 4.7)
- Fish and Fish Habitat (Section 4.8)
- Wildlife and Wildlife Habitat (Section 4.9)
- Recreation (Section 4.10)
- Visual Resources (Section 4.11)
- Archaeological, Historical, Cultural, and Trust Resources (Section 4.12)
- Socioeconomics (Section 4.13).

Sections 4.14 and 4.15 at the end of this chapter address irreversible and irretrievable commitments of resources and the relationship between short-term uses and long-term productivity. Unavoidable adverse impacts are identified within the individual resource sections in this chapter.

4.1.1 ANALYSIS AREAS

EIS Chapter 1, Sections 1.3.2 (EIS Planning Area) and 1.3.3.1 (HCP Project Area), describe the EIS planning area and HCP project area, respectively (see also Figures D-1 and D-3 in Appendix D, EIS Figures). These areas are used to define the analysis areas for which the affected environment,

environmental consequences, and cumulative effects will be described. The HCP project area is composed of 548,500 acres of trust lands occurring on both blocked and scattered parcels. The blocked lands are mostly contiguous blocks of DNRC ownership in the Stillwater and Coal Creek State Forests (Stillwater Block) and the Swan River State Forest. The EIS planning area encompasses a geographic area potentially influenced by implementation of the HCP and totals 39 million acres. It includes the HCP project area and all other lands in the NWLO, SWLO, and CLO. The EIS planning area also defines the cumulative effects analysis area for many of the resource areas (see EIS Chapter 5, Cumulative Effects, for additional discussion of cumulative effects). The remainder of this section describes the current climatic conditions within the EIS planning area, as well as potential effects of global climate change.

4.1.1.1 Climate and Precipitation in the EIS Planning Area

Montana's northern and mountainous interior location results in climate conditions that vary considerably. The Continental Divide exerts a marked influence on climate and precipitation regimes within the planning area. West of the Continental Divide, the climate of the NWLO and SWLO is strongly influenced by moisture-laden air masses from the Pacific Ocean (NCDC 2003). Rainfall and snow melt water are usually plentiful in the mountainous areas of the NWLO, especially at higher elevations (Woods et al. 2002). Compared to areas east of the mountain barrier, summers in the NWLO and SWLO are cooler in general, winters are milder, and precipitation is more evenly distributed throughout the year (NCDC 2003).

East of the Continental Divide, the climate of the CLO is continental, characterized by warm summers and wintertime invasions of sub-zero air followed by warm, dry Chinook winds (Caprio and Farnes 2004). Compared to the two western land offices, a greater proportion of annual precipitation falls between May and September in the CLO. In Helena, 62 percent of the average annual precipitation occurs in those 5 months, versus 48 percent in Kalispell (NWLO) and 50 percent in Missoula (SWLO) (WRCC 2005). On average, less precipitation falls in areas east of the Continental Divide compared to areas on the west side: 11.9 inches in Helena, versus 15.2 in Kalispell and 13.5 in Missoula (WRCC 2005).

Throughout the planning area, the wet season occurs during late spring and early summer, except in narrow strips along the Bitterroot Mountains and the Continental Divide, where a large portion of the precipitation occurs during the winter months (Caprio and Farnes 2004). May and June are the wettest months at weather stations in Kalispell, Missoula, and Helena (WRCC 2005). A secondary peak in precipitation occurs during November, December, and January in Kalispell and Missoula; however, no such wintertime peak occurs in Helena (WRCC 2005). East and west of the Continental Divide, precipitation varies widely and depends largely on topographic influences. Areas adjacent to mountain ranges in general are the wettest, although there are a few exceptions in valleys where the rain shadow effect appears (NCDC 2003).

Precipitation is a primary factor influencing vegetation conditions, runoff, sediment yield, and water quality. Annual precipitation varies by geographic location and largely depends on topographic influence. The western mountainous areas of the state are the wettest and the north-central area is the driest. Some of the wetter mountainous areas, such as the peaks in the Whitefish Range and Mission Mountains Wilderness in the NWLO and the Bitterroot Range in the SWLO, average more than 85 inches of precipitation per year (Caprio and Farnes 2004). Sheltered mountain valleys are

some of the driest areas in the state because of rain-shadow effects. Such areas include Missoula and Deer Lodge in the SWLO and Lonepine in the NWLO, where annual precipitation averages are only 11 to 14 inches (Caprio and Farnes 2004; WRCC 2005).

Occasional thunderstorms occur during the summer months in Montana. Particularly over mountainous areas, these thunderstorms result in limited rainfall but often large amounts of lightning. However, they can also be highly variable spatially and can form very intense short-duration rainfalls. Localized flash flooding and large erosion events are often caused by these localized convective storms. These dry thunderstorms are quite common in Montana during the summer, and they are a primary cause of most wildfires in the state.

Based on precipitation data from 1961 thru 1990 (Oregon Climate Service 2005; WRCC 2005), average annual precipitation in the vicinity of the NWLO ranges from 16 to 22 inches in the Lake County area, increasing to between 34 to 85 inches per year in the mountains. Annual average precipitation on the SWLO ranges from 12 to 14 inches in the Bitterroot Valley, 8 to 14 inches in the upper Swan River Valley, 16 to 34 inches in the surrounding mountains, and 34 to 85 inches along the western and southwest highlands and Mount Powell area. For the CLO, average annual precipitation in the lowlands around the Dillon and Townsend areas and in the northwest portion ranges from 8 to 14 inches, and along the western edge and southwest mountains, it averages from 22 to 60 inches per year.

Nearly half the annual long-term average total precipitation falls in Montana from May through July (WRCC 2005). The state's snowfall varies dramatically from year to year. Annual snowfall ranges from about 20 inches in the dryer northern areas east of the Continental Divide to 300 inches in the western mountains (NRCC 2003). Most snow falls between November and March, but heavy snowstorms can occur as early as mid-September or as late as May 1 in the higher-elevation southwestern half of the state (WRCC 2005). Mountain snow pack in the wetter areas can often exceed 100 inches in depth as the annual snow season approaches its end around April 1 to 15.

The highest volume of stream flow in Montana rivers occurs during the spring and early summer months with the melting of the winter snow pack. Heavy rains falling during the spring thaw occasionally constitute a serious flood threat (WRCC 2005). Ice jams, which occur during the spring breakup (usually in March), can cause backwater flooding. Flash floods, although restricted in scope, are probably the most common form of flooding and result from locally heavy rainstorms in the spring and summer.

Currently, Montana is experiencing a prolonged period of drought. For the past 10 years, precipitation levels have been below average, and while fluctuations in average annual precipitation are natural, the historical record suggests that such prolonged drought is rare (MNRIS 2005a).

4.1.1.2 Global Climate Change

One factor that makes the earth's surface suitable for life is the presence of greenhouse gases in the atmosphere. Emissions of these gases, which include carbon dioxide (CO_2), methane, and nitrous oxide, decrease the amount of the sun's heat energy radiated back into space, resulting in increased warming of the earth's surface.

There is growing scientific consensus that global greenhouse gas levels are rising. It is widely accepted that increased use of fossil fuels, worldwide reduction of forests, and other human activities are contributing to atmospheric levels of greenhouse gases, especially CO_2, which far surpass historical norms. Carbon dioxide is being produced at a rate faster than the rate at which the biosphere can sequester or fix it, therefore raising the concentration of CO_2 in the earth's atmosphere. Although the degree of temperature change and the extent to which climate will be affected are under debate, the consensus among scientists on the Intergovernmental Panel on Climate Change (IPCC) is that this rise in greenhouse gas levels will cause gradual warming and global climate change (IPCC 2007).

The rise in global temperature is already apparent; in the past century, mean global surface temperatures have risen between 0.5 and 1.0 degree Fahrenheit (° F) (EPA 2002). While this increase may seem minor, the effects of this warming trend could be significant, especially in light of widely accepted predictions regarding the rate at which warming will continue. In its 2007 assessment report, the IPCC modeled scenarios using various levels of CO_2 mitigation to predict the temperature rise associated with each one, and determined that mean global surface temperature will rise between 1.1 and 6.4 degrees Celsius (° C) (2 to 11.5° F) by the year 2099, with a mid-range prediction of 3° C (5.4° F) (IPCC 2007).

Impacts of global climate change will occur over decades and include altered precipitation patterns and an increase in frequency and severity of extreme weather events, such as storms, floods, and drought. Climate change will also likely impact natural ecosystems and associated biodiversity; socioeconomics, especially in areas that rely on resource extraction and agriculture; and human health and activities (RUS and MDEQ 2007).

Global climate change will affect various regions of the world differently. Montana will most likely be affected by changes in precipitation, as weather patterns shift and warmer temperatures influence the frequency and duration of storms. Biodiversity and natural ecosystems will likely display the evidence of subtle climatic differences. These impacts will vary depending on the sensitivities of different habitat types and different species. Montana will also potentially see a socioeconomic impact, as climate change will likely influence timber harvests, agriculture, and recreation. EPA Region 8, which includes Montana, predicts the following changes due to climate change (EPA 2008):

- The region will experience warmer temperatures overall, with less snowfall.
- Temperatures are expected to increase more in winter than in summer, more at night than in the day, and more in the mountains than at lower elevations. These changes will lead to less snow.
- Earlier snowmelt means peak streamflows will be earlier, weeks before the peak needs of farmers, ranchers, rafters, and others. In late summer, rivers, lakes, and reservoirs will be drier.
- More frequent, more severe, and possibly longer-lasting droughts will occur.

- Crop and livestock production patterns could shift northward, and less soil moisture due to increased evaporation may increase irrigation needs.
- Drier conditions will reduce the range and health of ponderosa and lodgepole pine forests, and increase susceptibility to fire. Grasslands and rangeland could expand into previously forested areas.

The proposed HCP under each action alternative identifies climate change as an event or process that may be addressed as a changed circumstance. Potential effects on the HCP species from DNRC's implementation of its changed circumstances process for climate change are discussed in EIS Chapter 4, Sections 4.8 (Fish and Fish Habitat) and 4.9 (Wildlife and Wildlife Habitat). Alternatively, given the global nature of climate change and the primarily industrial sources of greenhouse gas increases, the variations in forest management policies among the four alternatives analyzed in this EIS are not expected to result in any differences in effects of these alternatives on the global climate or climate change in Montana.

4.1.2 Evaluation Criteria and Effects Evaluations

Evaluation criteria for resource effects are defined for each of the resource topic areas within their individual subsections in this chapter. The criteria are briefly described immediately before the detailed discussion of environmental consequences for each resource topic.

The scientists who conducted the analysis for this EIS based the effects analysis on best professional judgment after weighing all of the quantitative and qualitative evaluation criteria that were developed, as well as their review of applicable literature. They also accounted for the fact that, under the adaptive management program, each action alternative allows for change in the conservation commitments over time based on feedback from research and monitoring activities.

The HCP is a programmatic plan for managing the habitats of HCP species on forested trust lands in western Montana. The commitments that define the four alternatives represent a programmatic planning effort for forest management activities that take place over the term of the Permit within the HCP project area. Consequently, the analysis for each resource area focuses specifically on evaluating the impacts of the policies and procedures that are being proposed for modification under the alternatives. Conclusions are based on reasonably available data and generally qualitative analyses, supported by quantitative data where available and appropriate.

Under Alternative 2, grizzly bears in the Swan River State Forest would be managed in accordance with the Swan Agreement (current ARMs). In the event the agreement is terminated, the HCP would be in effect and grizzly bears would be managed in accordance with the HCP conservation commitments. Therefore, the analysis of effects on grizzly bears under Alternative 2 represents implementation of the proposed HCP conservation commitments. For lynx and bull trout conservation under Alternative 2, the HCP would be followed on all HCP project area lands.

The affected environment sections describe existing conditions for resources within the analysis area that would potentially be affected by implementing the proposed conservation commitments. Discussions focus on those resources that would be most affected, or have a high likelihood of being affected, by the commitments and that would, in turn, have a high likelihood of affecting fish and wildlife, particularly the species proposed for coverage under the HCP.

Discussions of environmental consequences focus on substantive beneficial and adverse effects on resources that would result from implementing the proposed conservation commitments. For the no-action alternative, potential effects are discussed in terms of trends and future conditions. The potential effects of the proposed HCP and the two other action alternatives are compared to the effects of the no-action alternative. Emphasis is placed on analyzing potential impacts on species and habitat proposed for coverage under the HCP, as well as pertinent issues raised during internal and public scoping. Mitigation measures that would reduce or avoid the potential occurrence of certain adverse impacts are described for each resource. Any remaining unavoidable adverse impacts are identified. Irreversible and irretrievable commitments of resources, as well as the relationship between short-term uses and long-term productivity, are described in the final two sections of this chapter.

As described in EIS Chapter 3 (Alternatives), the HCP and associated Permit would have a proposed permit duration of 50 years. Consequently, the analysis in the EIS generally considers long-term effects to be those occurring over the course of the 50-year Permit term. Short-term effects are considered to occur over a period of less than 10 years.

4.2 FOREST VEGETATION

This section describes the affected environment and environmental consequences of the no-action and action alternatives on forest vegetation.

The State of Montana includes more than 94 million acres, of which approximately 5.2 million surface acres are designated trust lands owned by the State of Montana and managed to provide income for the trust beneficiaries (see Chapter 2, Environmental and Procedural Setting). Approximately 730,000 acres of all trust lands are managed under DNRC's forest management program, which generates revenues for the trust through timber harvest and other timber-related activities. The HCP project area encompasses 548,500 acres, representing less than 1 percent of the total acres in the State of Montana. The HCP project area is located within the NWLO, SWLO, and CLO of DNRC, which, including all land ownerships, comprise more than 39 million acres. Approximately 17 million acres of this total are managed for timber production, recreation, wildlife, grazing, and other uses by the State of Montana, USFS, Native American Tribes, or private entities including timber companies. The HCP project area represents less than 1 percent of the forestlands managed in the planning area.

Section 4.2.1 (Affected Environment) presents a discussion of the policies and regulations that shape the forests on trust lands, and the current conditions that are mostly likely to change or differ among the proposed alternatives. Section 4.2.2 (Environmental Consequences) addresses issues raised during public scoping and describes the conditions that would be likely to change under the proposed action alternatives.

4.2.1 AFFECTED ENVIRONMENT

This section describes the rules and regulations under which DNRC operates its forest management program; describes the management of forested trust lands; and describes the existing forest vegetation conditions found on trust lands in the HCP project area.

4.2.1.1 Regulatory Framework

DNRC's forest management actions are governed by a variety of policies, rules, regulations, and multi-party management agreements. Specifically, the policies, rules, regulations, and agreements that have the greatest influence on how the forest management program and timber harvest practices are implemented include the SFLMP, the Forest Management ARMs (36.11.401 through 450), statutes pertaining to state lands (MCA Title 77, Chapter 5), and the Swan Agreement, as summarized in Table 4.2-1. The application of these rules, regulations, and agreements ultimately shapes the forests found on trust lands. Chapter 2 (Environmental and Procedural Setting) provides a more detailed description of DNRC's management philosophy, the SFLMP, and the statutes pertaining to trust lands.

TABLE 4.2-1. RULES, REGULATIONS, AND AGREEMENTS GOVERNING DNRC'S FOREST MANAGEMENT PROGRAM

Rules, Regulations, and Agreements	Purpose (Summarized)
State Forest Land Management Plan (SFLMP)	Provides the management philosophy and direction for the program.
Forest Management ARMs (36.11.401 through 450)	Provides specific legal resource management standards and establishes desired future condition objectives for stand management.
Statutes. State Lands (MCA Title 77, Chapter 5)	Defines the administration and designation of state lands, their purpose, classification, uses, and obligations to the trust beneficiaries. Chapter 5 contains provisions related to the management of state forest lands.
Determination of Annual Sustainable Yield (MCA 77-5-222 through 223)	Requires DNRC to determine the annual sustainable yield on forested trust lands under the direction of the board at least once every 10 years.
Timber Salvage Program (MCA 77-5-207)	Provides for the timely salvage logging on state forests of dead or dying timber or timber that is threatened by insects, disease, fire, or windthrow.
State forest lands - deferral of management prohibited (MCA 77-5-116)	Prohibits the designation, treatment, or disposal of any interest in state forest lands for the preservation or nonuse of these lands prior to obtaining funds for the affected beneficiary.
Swan Agreement	Provides grizzly bear conservation through coordinated forest management activities on USFS, state trust, and Plum Creek Timber Company lands in the Swan Valley (Swan River State Forest).

Within the Forest Management ARMs, there are regulations pertaining to specific resources that have the potential to influence forest vegetation across the DNRC landscape. These ARMs are identified below, along with the respective sections where they are discussed.

Rule	Section Where it is Addressed
Road Management (ARM 36.11.421)	Section 4.4 Transportation
Old Growth (ARM 36.11.418)	Discussed below under Current Conditions, Age Class.
Listed Terrestrial Species (ARMs 36.11.431 through 435, Grizzly bears and Canada lynx)	Section 4.9 Wildlife and Wildlife Habitat
Snag Retention and Course Woody Debris (ARMs 36.11.411 and 414)	Section 4.9 Wildlife and Wildlife Habitat
Weed Management (ARM 36.11.445)	Section 4.7 Plant Species of Concern, Noxious Weeds, and Wetlands
SMZ Rules (ARMs 36.11.301 through 313)	Section 4.8 Fish and Fish Habitat

4.2.1.2 Forest Vegetation Management

The SFLMP provides the philosophical basis for DNRC's forest management program. The SFLMP (codified in ARM 36.11.404) takes a coarse-filter approach to biodiversity. This approach operates at a landscape scale and focuses on maintaining an appropriate mix of forest stand structures and compositions on trust lands. Maintaining a diversity of stand structures and compositions also provides a range of current and prospective trust revenue opportunities, including a sustainable yield of timber and maintenance of forest health and biodiversity, while reducing risks of catastrophic fires and insect or disease attacks.

Because the coarse-filter approach may not adequately address the full range of needs required to support biodiversity, a fine-filter approach, as provided for in ARM 36.11.406, is employed to address the needs of threatened, endangered, or sensitive species.

To achieve its biodiversity objectives, DNRC manages large, blocked ownerships for a DFC characterized by the proportion and distribution of forest cover types and structures (snags, coarse woody debris, large live trees) historically present on the landscape. Across its ownership, on scattered or smaller parcels, DNRC strives to create and maintain a semblance of historical conditions (cover type and structure) to the extent feasible.

<u>Annual Sustainable Yield</u>

DNRC is required to review and re-determine the annual sustainable yield for forested trust lands at least every 10 years, as specified by MCA 77-5-221 through 223. Montana law defines the annual sustainable yield 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 current annual sustainable yield is calculated using a forest management model that considers the acres available for management and capable of growing timber, and finds an optimal solution, given a mathematical representation of management objectives and constraints (DNRC 2004b). The DNRC forest model seeks to optimize the present net value (PNV) and maximize harvest across the planning horizon (in order to meet its trust mandate. that the use of trust lands result in income for the intended beneficiary) while meeting management policies and constraints. PNV is the difference between the present value of cash inflows and the present value of cash outflows. PNV is used in capital budgeting to analyze the profitability of an investment or project. The economics associated with PNV are further discussed in Section 4.13 (Socioeconomics).

When the sustainable yield was last calculated in 2004, it incorporated all applicable laws and environmental commitments by DNRC as described in the Forest Management ARMs. Biodiversity, forest health, endangered species considerations, and DFCs are important aspects of

state forest land management. These factors were modeled in the SYC and were reflected in the various constraints applied to the model. These constraints included

- ARMs constraints that require certain treatments in certain types of stands such as within old-growth stands and riparian areas
- Allocation constraints that force certain areas to be managed under specific management regimes
- Forest condition constraints that limit the number of acres in a certain condition or require a minimum number of acres in a certain condition
- Old-growth constraints that require the model to have a minimum of 55,700 acres (about 8 percent of DNRC's forested acres) that meet the Green et al. (1992) old-growth definition at year 100, and then maintain at least 55,700 acres of old growth through the remainder of the planning horizon (years 101 to 175)
- Implementation and operational constraints that establish the number of acres DNRC can reasonably treat each year across the various land offices.

Harvest Allocation

After the sustainable yield is determined, a proportion of the yield is distributed to each of the land offices. Each administrative unit also has a specific annual yield to contribute to the overall sustainable yield for the land office. However, the amount contributed by each unit can vary from year to year based on a number of factors, such as emergency salvage priorities due to large fires, insects, or disease, and timing and coordination challenges that come with planning projects across thousands of acres.

Timber Stand Management

DNRC manages forestlands intensively for healthy and biologically diverse forests to generate revenue for trust beneficiaries. To accomplish this, stands are selected for management and assigned timber treatments (described below) to meet one or more management objectives, including

- Regenerate stands
- Improve stand productivity
- Move stands toward DFC
- Address insect and disease issues
- Reduce fire hazards
- Address wildlife habitat and aquatic considerations.

Above all, treatments are required to maintain the long-term productivity of the site in order to ensure the long-term capability to produce trust revenue (ARM 36.11.420). On blocked lands, ARM 36.11.407 directs DNRC to manage for a DFC that can be characterized by the distribution and proportion of those forest types and structures historically present on the landscape. For scattered parcels, management is based on restoring a semblance of historical conditions within the state ownership (ARM 36.11.416).

To implement the DFC ARM, DNRC assigns each stand in the SLI database (described in Chapter 2, Environmental and Procedural Setting, and below in the Data Sources discussion under Section 4.2.1.3 Current Conditions) to a DFC classification. The DFC classification system provides an estimate of what forest conditions would have been like prior to European settlement in Montana under natural disturbance regimes. This classification system was constructed to systematically assign a particular cover type given the presence of key tree species or evidence that the species was present in a stand at least in low to moderate amounts.

DNRC then applies timber treatments to achieve DFC objectives with the intent to promote long-term, landscape-level diversity through an appropriate representation of forest conditions across the landscape. For example, on a warm, dry site, a stand currently dominated by Douglas-fir (*Pseudotsuga menziesii*) would typically be managed to increase the abundance of ponderosa pine (*Pinus ponderosa*). In some cases, the current cover type matches the DFC cover type. Where this occurs, silviculture prescriptions and harvest treatments are designed to maintain the current cover type. Where the current cover type does not match the DFC cover type, silviculture prescriptions and harvest treatments are designed to move stands toward DFC cover types by generally removing shade-tolerant species and retaining species associated with early seral stages (usually shade-intolerant species) during partial harvest treatments or through natural regeneration and/or planting the desired species after an even-aged treatment.

Interim treatments or alternative treatments that do not fully meet DFC objectives but are critical for addressing more immediate needs within a stand (i.e., fire hazard reduction, insect/disease infestations, or habitat considerations) may also be applied.

Harvest Treatments

Once the DFC for a stand has been identified, DNRC selects a harvest treatment that emulates the natural disturbance regimes that historically occurred in that cover type, most commonly: stand-replacement fire, mixed-severity fire, or non-lethal fire (ARM 36.11.408). DNRC also considers other natural disturbances such as insects, disease, and wind when selecting treatments.

A treatment is then applied to emulate the natural disturbance (primarily fire) acting on the forest. Treatments that are designed to emulate stand-replacement fire include clearcut, and seed tree harvests. Shelterwood treatments typically emulate mixed-severity fires. Commercial thinning and selection harvests emulate mixed-severity and non-lethal fire or gap-replacement disturbances. DNRC also uses timber harvesting to maintain forest health, increase tree growth, reduce wildfire severity and mortality, and promote desired forest cover types or DFCs. Emulating fire disturbances and managing for DFCs is guided by the coarse-filter approach described in the SFLMP.

DNRC's timber harvests can be grouped into two categories of silvicultural treatments: regeneration treatments and intermediate treatments. Regeneration treatments aim to initiate or assist the development of a new age class in a stand, and can be accomplished by using even-aged methods or uneven-aged methods. Even-aged methods regenerate or maintain a stand with a single age class; such methods include clearcutting, seed tree, and shelterwood. Uneven-aged or selection methods regenerate or maintain a multi-aged stand by removing trees throughout the range of age and size

classes present in a stand. Selection cutting can be done by removing single trees or small groups of trees within a stand.

Intermediate treatments are used to enhance the growth, quality, vigor, and composition of a stand after establishment and prior to final harvest. Two common intermediate treatments are commercial thinning and sanitation cutting.

These treatments are defined below.

- **Clearcut.** The cutting of essentially all trees, producing a fully exposed microclimate for the development of a new age class. Regeneration is typically accomplished by planting or seeding or using seedlings established in advance of the treatment (Helms 1998). DNRC always retains some structural elements when clearcutting, such as small reserve patches and large snags and snag recruits.
- **Seed tree.** The cutting of all trees except for a small number of widely dispersed trees retained for seed production and to produce a new age class in a fully exposed microenvironment. Seed trees are often removed after regeneration is established, unless they are required to attain goals other than regeneration (i.e., live large tree or snag requirements) (Helms 1998).
- **Shelterwood.** The cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment. Shelterwood trees may be removed after regeneration is established, unless they are required to attain goals other than regeneration (i.e., live large tree or snag requirements) (Helms 1998).
- **Selection.** A cutting method applied in uneven-aged forests to regenerate and maintain a multi-aged structure by removing some trees in all size classes either singly, in small groups, or in strips (Helms 1998).
- **Commercial thinning.** Any type of thinning that produces merchantable material at least equal to the value of the direct costs of harvesting (Helms 1998).
- **Sanitation cutting.** The removal of trees to improve stand health by stopping or reducing the actual or anticipated spread of insects and disease (Helms 1998).

Most of the recent harvests completed on DNRC land have employed either selection or commercial thinning prescriptions (Table 4.2-2).

Salvage Harvest

The term salvage is defined under ARM 36.11.403(71) as "the removal of dead trees or trees being damaged or killed by injurious agents other than competition, to recover value that would be otherwise lost." Injurious agents include wildfires and major outbreaks of insects and diseases that ultimately inflict high tree mortality rates throughout forested stands. Wind events can also be considered injurious; however, such events typically result in far less mortality than wildfires or insect and disease outbreaks on trust lands.

TABLE 4.2-2. PERCENT OF THE TOTAL TIMBER HARVESTED ON DNRC-MANAGED LANDS STATEWIDE BY SILVICULTURAL METHOD FOR FISCAL YEARS 1998 THROUGH 2005

Silvicultural Treatment Method	Percent of Total Harvest[1]	
	Fiscal Years 1998–2000[2]	Fiscal Years 2001–2005[3]
Clearcut	4	5
Seed tree	8	18
Shelterwood	2	8
Selection	55	47
Commercial thinning	31	22

[1] Total harvest for fiscal years 1998 to 2000 was 27,141 acres; total harvest for fiscal years 2001 to 2005 was 31,492 acres.
[2] Source: DNRC (2000a).
[3] Source: DNRC (2005b). Percentages do not include fire-salvaged acres.

Salvage is not considered a timber treatment but comprises a substantial proportion of the value harvested on trust lands in some years. A considerable portion of recent DNRC harvest volume has been derived from salvage harvest resulting from fires and insect and disease outbreaks. For fiscal years 2001 to 2005, fire salvage comprised 26 percent of the total harvest acreage on forested trust lands (DNRC 2005b). This harvest occurred primarily in areas affected by large wildfires, including the fires in the Sula State Forest in 2000 and the Coal Creek State Forest in 2001, as well as the Maxey Ridge and Wilson Creek fires in the Bozeman area in 2001. Fire and insect and disease salvage volume sold for fiscal years 2006, 2007, and 2008 and the percentage of the total volume sold those years as salvage harvest are presented in Table 4.2-3. The high fire salvage volume associated with fiscal year 2008 is attributed to large wildfires, including the Chippy Creek, Jocko Lakes, Blackcat, and Mile-marker 124 fires.

TABLE 4.2-3. SALVAGE HARVEST VOLUME SOLD AND PERCENTAGE OF TOTAL VOLUME SOLD COMPRISING SALVAGE HARVEST FOR FISCAL YEARS 2006, 2007, AND 2008

Fiscal Year	Salvage Type	Salvage Harvest Volume Sold (million board feet)[1]	Percent of Total Volume Sold as Salvage Harvest
2006	Insect and Disease	16.5	31
	Fire	1.0	1.9
2007	Insect and Disease	27.2	51
	Fire	6.5	12.2
2008	Insect and Disease	2.5	4.8
	Fire	19.9	37.8

[1] Salvage harvest volume sold does not include volume sold as timber permits.
Source: DNRC (2008b).

Forest Improvements

DNRC strives to maintain forested trust lands in a healthy condition in order to protect the future income-generating capacity of the land. The forest improvement program uses fees from harvested

timber to improve the health, productivity, and value of forested trust lands. Uses of these fees as authorized by statute include disposal of logging slash; reforestation including seed collection, seedling production, and tree planting; acquisition of, access to, and maintenance of roads necessary for timber harvest; other treatments necessary to improve the condition and income potential of state forests; and compliance with other legal requirements associated with timber harvest. Specific activities include piling of logging slash, prescribed burning, site preparation, reforestation, fertilization, thinning, and forest inventory.

Slash Disposal and Prescribed Burning

Slash is the woody debris that is dropped to the forest floor during forest practices. Slash disposal refers to the treatment of woody residue generated from forest management activities. Guidelines for slash disposal to meet fire hazard reduction requirements and to meet the nutrient and CWD retention requirements are included in the ARMs (36.11.410 and 414). Slash disposal is also an element of site preparation to facilitate stand regeneration. Slash disposal may include brush piling, pile burning, and broadcast burning. The annual average acres of slash disposal and prescribed burning from fiscal years 1995 through 2005 and the total acres treated in 2006 are presented in Table 4.2-4. In fiscal year 2006, pile burning was the most common type of slash disposal employed by DNRC (Table 4.2-4).

TABLE 4.2-4. AVERAGE ANNUAL ACRES OF SLASH DISPOSAL AND BROADCAST BURNING ON TRUST LANDS DURING FISCAL YEARS 1996 THROUGH 2005, COMPARED TO 2006

Method	Annual Average, 1996–2005[1]	Fiscal Year 2006[1]
Brush piling	817	1,654
Pile burning	1,677	3,792
Broadcast burning	285	417

[1] The acres in the table represent the stand area where these treatments occurred, but do not necessarily reflect the actual area treated. The amount of area actually treated is typically much smaller than the stand area. For example, during the process of pile burning, slash from throughout a harvest unit is gathered into a small area before being burned.

Source: DNRC (2005b, 2006a).

Prescribed burns are those set "to deliberately burn wild land fuels in either their natural or their modified state and under specific environmental conditions, which allows the fire to be confined to a predetermined area and produces the fire intensity and rate of spread required to attain planned resource management objectives" (Helms 1998). DNRC currently employs broadcast burning and pile burning as prescribed fire methods. These methods are used primarily to control the fire hazard associated with slash generated from forest management activities and for site preparation to meet reforestation objectives. DNRC rarely uses broadcast burning as a management tool for slash disposal due to liability issues and the prohibitively high costs to conduct such projects. Using the data presented in Table 4.2-4, an average of 1,962 acres are treated through prescribed burning (pile and broadcast burning) each year, and 4,209 acres were burned in fiscal year 2006.

Site Preparation

The Society of American Foresters defines site preparation as "hand or mechanized manipulation of a site, designed to enhance the success of regeneration" (Helms 1998). DNRC uses burning, herbicides, and mechanical scarification to create conditions conducive to the establishment and

growth of desired tree species. Many of the activities conducted under slash disposal also accomplish site preparation goals, such as slash piling and burning.

Reforestation

Reforestation is "the reestablishment of forest cover either naturally or artificially by direct seeding or planting" (Helms 1998). DNRC regularly engages in reforestation activities, primarily by planting in burned areas or areas where regeneration harvest treatments have occurred, and by interplanting in open areas following partial harvests. DNRC reforestation is primarily limited to shade-intolerant species (ponderosa pine, western larch [*Larix occidentalis*], and western white pine [*Pinus monticola*]), often with seedlings selected from genetically superior seed sources. DNRC also monitors regeneration survival using surveys to assess survival of planted acres and inventory surveys to assess natural regeneration.

Between fiscal years 2001 and 2005, DNRC planted trees on approximately 5,103 acres (average of 1,020 acres per year). Between 2001 and 2005, regeneration surveys occurred on approximately 7,421 acres or an average of 1,484 acres per year. Planting and regeneration surveys may increase or decrease within a monitoring period, depending on the number and severity of fires requiring planting treatments.

Fertilization

Fertilization associated with forest management on trust lands consists of occasional applications of small amounts of fertilizers to individual planted trees. DNRC applies a few thousand doses of fertilizer annually on lands designated for tree planting. A dose is typically about 1 ounce, and there may be 200 to 300 doses per acre when trees are planted. These applications are designed to increase growth rates or to overcome nutrient deficiencies in the soil. When warranted, DNRC also uses fertilizer on newly constructed road cuts and fills to promote establishment of grass. The type of fertilizer applied varies based on the soil deficiency at the site, but is generally some combination of nitrogen, phosphorous, and/or potassium.

Pre-commercial Thinning

Pre-commercial thinning is defined under ARM 36.11.403(59) as "the removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees." From fiscal years 1998 and 2004, DNRC conducted pre-commercial thinning on approximately 12,466 acres of forested trust lands statewide with an annual average of 1,781 acres (DNRC 2005b). Most recently, pre-commercial thinning occurred on 1,537 acres in fiscal year 2006 (DNRC 2006a).

Forest Inventory

Funding from timber receipts is used to collect and analyze forest resource inventory data, including a comprehensive inventory of all timber resources on forested trust lands. This data is housed in a GIS inventory, including the SLI database used to support forest management planning, which is coordinated through the Technical Services Section of the FMB.

Forest inventory field activities consist primarily of accessing inventory areas from forest road systems with motorized vehicles, conducting walk-through stand examinations, conducting cruise plots, and collecting other field data. Inventories are completed by both DNRC field staff and

contracted employees. From 1997 through 2002, an average of 47,450 acres of SLI data were collected each year. Most of the inventory field data were collected from within the NWLO and SWLO by DNRC contractors (and their employees). In 2004, the inventory program collected 14,200 acres of SLI data. To date, approximately 1,206,000 acres of forested and non-forested trust lands statewide have been inventoried and mapped.

Wildfire Prevention and Suppression

The state fire policy is contained in MCA 76-13-115. In general, the policy prioritizes the safety of the public and firefighters during wildfire suppression activities. The policy states that the state's priority is to minimize property and resources loss from wildfires and minimize expense to taxpayers through aggressive and rapid initial attack. The policy acknowledges that all property in Montana has wildfire protection from a recognized fire protection entity and that all federal, state, or local agencies must cooperate and coordinate fire fighting activities, including cooperation, when restricting activity or closing areas to access becomes necessary. The policy further states that fire prevention, hazard reduction, and loss mitigation are important components of the fire policy. It encourages all private, federal, and state landowners to responsibly manage lands to mitigate fire hazards and prevent fires on their properties, and acknowledges that sound forest management activities can reduce fire risk and improve the diversity and vigor of forested landscapes. Lastly, it encourages the development of fire protection guidelines for wildland-urban interface to improve safety and reduce the risk and loss in these areas.

The state policy influences forest management on trust lands. Fires on trust lands are addressed through rapid initial attack, and the majority of fires are put out before they cost major losses to the trust beneficiaries. DNRC's forest program also embraces the philosophy that sound forest management activities can reduce fire risk and improve the diversity and vigor on forested landscapes, while recognizing the natural role fire plays in forest ecosystems in Montana. This is demonstrated in the two previous sections (Timber Stand Management and Harvest Treatments).

When a fire does cause losses of timber resources, MCA 77-5-207 provides for "timely salvage logging on state forests of dead or dying timber or timber that is threatened by insects, disease, fire . . ." The MCA states that DNRC should consider (1) the economic value of the timber to be salvaged; (2) the cost of salvage efforts; and (3) the long-term costs to all forest resources from insects, disease, or fire that otherwise might be controlled through salvage operations. The MCA also states that the DNRC should, to the extent practicable, harvest dead and dying timber before there is substantial wood decay and value loss.

Insects and Diseases

There are no specific regulations or policies pertaining to threats to timber resources attributed to insects and diseases. As described above in two previous sections (Timber Stand Management and Harvest Treatments), insect and disease infestations are important considerations in selecting stands for management and selecting appropriate timber treatments to prevent, limit, or control outbreaks.

Even healthy, well-managed forests exhibit certain endemic levels of insects and disease. However, insect and disease outbreaks appear to be increasing. Aerial detection flights indicate that the

amount of forest acres infested by various insects is generally increasing, and the amount of the annual change in acres infested is also increasing (Meyer 2006).

When an outbreak occurs on trust lands, DNRC pursues timber salvage in accordance with MCA 77-5-207 described under Wildfire Prevention and Suppression.

Monitoring and BMP Audits

DNRC conducts contract compliance monitoring as well as post-harvest monitoring for compliance with the SFLMP and ARMs for all major resource areas. Monitoring activities, including BMP audits, are described in Chapter 2 (Environmental and Procedural Setting).

DNRC inspects all active timber sales for contract compliance. For the last monitoring period reported (fiscal years 2001 through 2005), 2,224 timber sales inspections were completed and 16,429 items were documented as satisfactory, whereas 405 items required direction for improvement and 47 violations were documented (DNRC 2005b).

For the last monitoring period reported (fiscal years 2001 through 2005), of 111 wildlife mitigation measures applied on five timber sales, only 5 percent were considered inadequate. The results of the monitoring were used to adjust future mitigation measures related to snag retention and road closures (DNRC 2005b).

Statewide and internal BMP audits consistently demonstrate that BMP applications meet or exceed standards. For the last monitoring period reported (fiscal years 2001 through 2005), internal BMP audits found 97 percent of the 3,141 practices evaluated were appropriately applied and 98 percent of the practices were effective at protecting soil and water resources (DNRC 2005b). Statewide BMP audits on DNRC sites in 2004 also found 97 percent of the practices were appropriately applied and 98 percent were effective (DNRC 2004c).

4.2.1.3 Current Conditions

In applied forest science, many terms are used to describe forest conditions or forest attributes. For the purposes of this analysis, this section focuses on those conditions most likely to change or differ among the proposed alternatives or those conditions that are important to HCP species. This section identifies the current SYC for forested trust lands and includes a discussion of the following forest attributes: cover type and DFCs; size and age class distribution, including old growth; stocking levels; and disturbance processes, such as wildfire and forest insects and diseases.

Other forest attributes, such as connectivity, snags, and CWD are important features in the landscape and provide essential habitat components for numerous wildlife species. These attributes are discussed in Section 4.9 (Wildlife and Wildlife Habitat). Additionally, forest management in riparian areas also has the potential to influence forest vegetation. Forested riparian areas contribute important habitat components to fish-bearing streams, including shade, woody debris that creates habitat, and stream channel stability. Therefore, timber management in riparian areas is discussed in detail in Section 4.8 (Fish and Fish Habitat).

Data Sources

The forest attribute information contained in this section and the next (Section 4.2.2, Environmental Consequences) section was derived from two sources. The primary source of data was DNRC's SLI database, which contains field data collected on timber stands managed by DNRC. The second source of data was the output data from the forest management model used to calculate the annual sustainable yield for DNRC forested trust lands (DNRC 2004b).

Sustainable Yield

The 2004 SYC serves as the baseline for the no-action alternative and represents more than just an annual volume goal or target. It also represents the management level that is needed to maintain healthy and diverse forests and meet other important ecological goals and commitments. The harvest level and the associated income earned by the trust beneficiaries are also tempered by access and operability constraints as well as DNRC's environmental and legal commitments, which are specified in the SFLMP and ARMs. This is clearly seen when comparing the various model runs in the *2004 Sustained Yield Calculation* (DNRC 2004b), as highlighted in Table 4.2-5. Without the environmental commitments and legal constraints placed on DNRC's forest management program, the annual sustainable harvest level could be as high as 94.6 million board feet with a PNV of $346 million over the model period. The model run adopted by the Land Board incorporated all environmental and legal commitments and resulted in a sustainable yield of 53.2 million board feet and a PNV of $146 million. The current annual sustainable yield represents 56 percent of the potential volume and 42 percent of the potential revenue of the unconstrained biological capability of DNRC's forested trust lands.

TABLE 4.2-5. FOREST MANAGEMENT MODEL RESULTS FOR BENCHMARK RUN 001 (BM001) AND ADOPTED SUSTAINABLE YIELD CALCULATION 008 (SYC008) FROM THE 2004 SUSTAINED YIELD CALCULATION

	BM001 (Biological Potential)	SYC0081	Difference
Acres Managed	668,168	430,784	237,384 (64.5% of BM001)
Volume Harvested (million board feet)	94.6	53.2	41.4 (56.2% of BM001)
Present Net Value (PNV)	$346 million	$146 million	$200 million (42% of BM001)

[1] SYC008 was adopted by the Land Board in November 2004.
Source: DNRC (2004b).

Table 4.2-6 shows the current sustainable yield allocation by land or administrative unit office. The three land offices with lands included in the HCP project area (CLO, NWLO, and SWLO) are responsible for harvesting 95.5 percent of the total statewide DNRC harvest. The sustainable yield for the Stillwater and Swan Units in the NWLO are separated from the other NWLO administrative units (Kalispell, Plains, and Libby), because these are large, consolidated blocks of state ownership with unique management opportunities and a high level of public interest.

TABLE 4.2-6. CURRENT ANNUAL SUSTAINABLE YIELD BY LAND OFFICE AND NWLO ADMINISTRATIVE UNIT

Land Office and Administrative Unit	Annual Sustainable Yield (million board feet)	Percent of Total Sustainable Yield[1]
Northwest Land Office (NWLO)		
Stillwater Unit	10.1	19.0
Swan Unit	6.7	12.6
Other Units (Kalispell, Plains, Libby)	16.4	30.8
Total NWLO	33.2	62.4
Southwest Land Office (SWLO)	13.6	25.6
Central Land Office (CLO)	3.9	7.3
Eastern Land Offices (NELO, ELO, and SLO)	2.5	4.7
Total All Land Offices	**53.2**	**100.0**

[1] Percentages may not add up due to rounding.
Source: DNRC (2008a).

Current Forest Cover Types and Desired Future Conditions

While many forest stands contain multiple tree species, cover type classifications are routinely used to describe and categorize stands based on the dominant tree species present. For the purposes of this analysis, stands were classified into distinct cover types based on the dominant species in the stand as shown in Table 4.2-7 and Figure 4.2-1.

TABLE 4.2-7. HCP PROJECT AREA LANDS BY CURRENT COVER TYPE AND LAND OFFICE

	CLO		NWLO		SWLO		TOTAL	
Cover Type	Forest Acres	Percent of Forest Acres in Cover Type	Forest Acres	Percent of Forest Acres in Cover Type	Forest Acres	Percent of Forest Acres in Cover Type	Forest Acres	Percent of Forest Acres in Cover Type
Mixed conifer	390	0.7	65,536	25.4	4,523	3.4	70,450	15.8
Hardwoods	656	1.2	816	0.3	569	0.4	2,041	0.5
Western larch/ Douglas-fir	0	0.0	65,402	25.4	20,857	15.9	86,260	19.3
Douglas-fir	35,620	62.9	7,046	2.7	29,242	22.2	71,908	16.1
Ponderosa pine	6,045	10.7	47,552	18.4	48,640	37.0	102,237	22.9
Lodgepole pine	7,413	13.1	20,363	7.9	12,432	9.5	40,208	9.0
Subalpine fir	5,385	9.5	37,470	14.5	5,117	3.9	47,972	10.8
Western white pine	0	0.0	7,790	3.0	207	0.2	7,997	1.8
Non-commercial	64	0.1	96	0.0	293	0.2	452	0.1
Non-stocked	1,083	1.9	5,830	2.3	9,657	7.3	16,570	3.7
Total	**56,657**	**100.0**	**257,901**	**100.0**	**131,537**	**100.0**	**446,095**	**100.0**

Note: Totals may not sum due to rounding.
Source: DNRC (2008a).

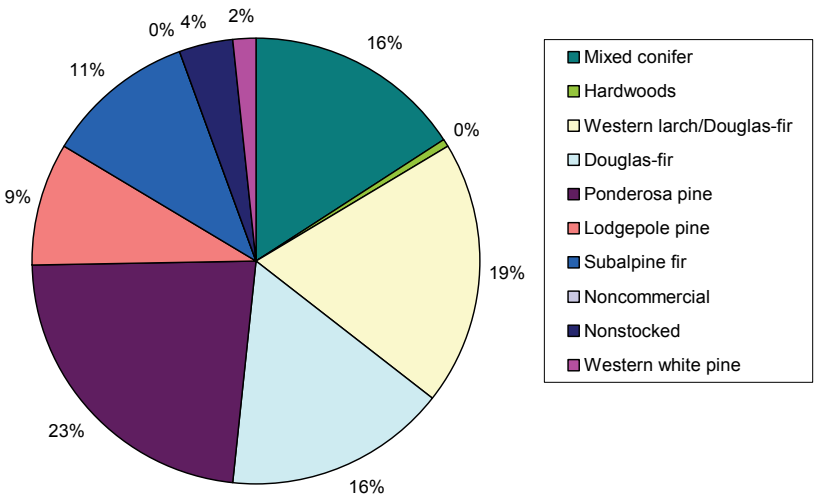

FIGURE 4.2-1. CURRENT COVER TYPES IN THE HCP PROJECT AREA

The current species composition of a stand reflects site variables, management history, and natural processes. As shown in Table 4.2-7, the CLO and SWLO have a higher proportion of the Douglas-fir cover type, which is typically found on the warmer, drier sites more common in the eastern and southern parts of the state. In contrast, the mixed conifer and western larch/Douglas-fir cover types are more prevalent on the cooler, moist sites found in the northwest part of the state.

While Table 4.2-7 reflects current cover type conditions, DNRC's forest management activities are designed to move stands toward DFC cover types. The acreage in each land office by current cover type and DFC type is summarized in Table E4-1 in Appendix E, EIS Tables.

The comparison of current cover type acres with DFC cover types for the CLO in Table E4-1 in Appendix E, EIS Tables, shows little differences because the SLI data for the CLO is predominantly based on aerial photo interpretation and not on field data. Therefore, comparisons between current and DFC cover types cannot be made on a programmatic scale at this time for the CLO. In the CLO, the current cover type is converted to DFC following analysis conducted at the project level. This is achieved by selecting silvicultural treatments that emulate the stand development and tree species expected to occur based on the project area's disturbance regime(s).

On the NWLO and SWLO, detailed stand and site information is available to make comparisons between current and DFC cover types. For example, the mixed conifer cover type on the NWLO is currently over-represented when compared to historical amounts as represented by target DFC acres (Table E4-1 in Appendix E, EIS Tables). Even though there is an overabundance of the mixed conifer cover type (65,536 acres) across the NWLO as compared to the DFC target (17,141 acres), only 14,360 acres currently contain the mixed conifer cover type and appropriately match the DFC. This implies that much of the mixed conifer cover type (51,176 acres) currently occupies sites where other cover types are desired, and this "surplus" acreage should be converted to other cover types to more accurately reflect historical conditions. Conversely, some sites where mixed conifer cover types are desired (2,781 acres) are currently occupied by a different cover type.

Size Class

Forest stands are commonly grouped into size classes for forest management purposes, for describing habitat suitability for wildlife, and as an indication of biodiversity. DNRC uses three size classes, seedling/sapling (less than 5 inches diameter at breast height [dbh]), poletimber (5 to 9 inches dbh), and sawtimber (greater than 9 inches dbh), to describe or group forest stands.

Grouping forest stands by size class is helpful for describing habitat suitability for certain wildlife species. For example, young foraging habitat for lynx includes densely stocked forest stands in the seedling/sapling class where the trees are predominantly less than 5 inches dbh and the crowns are between 3 and 20 feet high. These are typically young conifer stands with high stem densities that provide potential habitat for snowshoe hares, the predominant prey species for lynx. Size class and its relevance to wildlife are discussed in Section 4.9 (Wildlife and Wildlife Habitat).

The following size classes are summarized in Table 4.2-8 and Figure 4.2-2, and were derived from DNRC's SLI database:

- **Non-stocked.** Fewer than 50 seedlings and saplings per acre or grass/forb
- **Seedlings/saplings.** Predominantly trees less than 5 inches dbh
- **Poletimber.** Predominantly trees between 5 and 9 inches dbh
- **Young sawtimber.** Predominantly trees greater than 9 inches dbh and less than 100 years old with at least 10 percent crown cover
- **Mature sawtimber.** Predominantly trees greater than 9 inches dbh and greater than 100 years old with at least 10 percent crown cover, but many acres lack old-growth characteristics, such as large live trees greater than 150 years old, snags, and significant amounts of CWD.

TABLE 4.2-8. HCP PROJECT AREA LANDS BY CURRENT SIZE CLASS AND LAND OFFICE

	NWLO		SWLO		CLO		HCP Project Area	
Size Class	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total
Non-stocked	5,830	2.3	9,657	7.3	1,742	3.1	17,230	3.9
Seedling/sapling	30,271	11.7	7,033	5.3	1,056	2.0	38,360	8.5
Poletimber	17,969	7.0	6,115	4.6	13,278	23.4	37,362	8.4
Young Sawtimber	37,688	14.6	30,707	23.3	24,335	43.0	92,730	20.8
Mature Sawtimber	166,142	64.4	78,024	59.3	16,246	28.7	260,412	58.4
Total	**257,901**	**100.0**	**131,537**	**100.0**	**56,656**	**100.0**	**446,094**	**100.0**

Note: Totals may not sum due to rounding.
Source: DNRC (2008a).

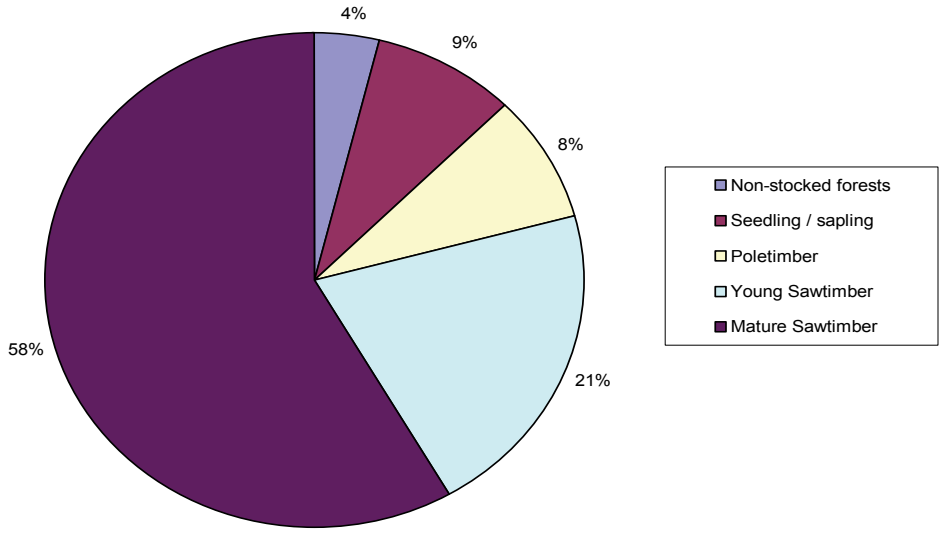

FIGURE 4.2-2. CURRENT SIZE CLASSES IN THE HCP PROJECT AREA

Across the three land offices in the HCP project area, 3.9 percent of the forested trust lands are classified as non-stocked, while 8.5 percent are classified as seedling/sapling (Table 4.2-8). Poletimber and sawtimber stands represent a total of 87.5 percent of the forested acres, with young and mature sawtimber stands representing almost 80 percent of the area across the three land offices.

The relative amounts of the seedling/sapling class are highest in the NWLO (11.7 percent) and lowest in the CLO (2.0 percent). This difference reflects the higher proportion of stands in the NWLO that receive regeneration (even-aged) harvests compared to the more common partial harvests (uneven-aged) applied in the SWLO and CLO. The NWLO has more cool, moist sites where even-aged management is more appropriate as compared to more warm, dry sites on the SWLO and CLO where uneven-aged management is more appropriate. Also on the SWLO and CLO, many sites retain a sufficient number of sawtimber-sized trees (overstory) post-harvest to still be classified as sawtimber stands.

Many of the sawtimber stands also have a seedling/sapling and/or poletimber understory component due to natural or post-harvest conditions. Such stands are typically characterized by two distinct size and age classes consisting of some large, residual overstory trees with an understory of smaller trees. These stands are typically categorized as low-volume sawtimber stands because the younger trees do not have any board foot volume associated with them until they grow to commercial size (8 inches dbh or more). Therefore, the actual amount of area with either a seedling/sapling (8.5 percent) and/or a poletimber (8.4 percent) component is likely higher than what is shown in Table 4.2-8.

Age Class

Similar to size class, DNRC assigns an age class to all stands in the SLI database based on the predominant size class of the stand. Age class information is helpful in describing forest structure and development, for describing biodiversity, and for assessing wildlife habitat.

Seedling/sapling stands (less than 5 inches dbh) are typically represented by the 0- to 39-year age class. Likewise, poletimber stands, where most of the trees are 5 to 9 inches dbh, are typically represented by the 40- to 99-year age class. Unlike these younger age stands, however, sawtimber stands (greater than 9 inches dbh) can be represented by the 40- to 99-year, 100- to 150-year, 150-or-more-year age classes, depending on site quality, stocking, past management practices and disturbances, species composition, and many other factors.

Forest structure is also influenced by stand age. In general, younger stands represented by the 0- to 39-year and 40- to 99-year age classes tend to exhibit single- or two-storied canopy structures. Single-storied stands have a single canopy layer with minimal vertical canopy structure or stratification, whereas two-storied stands have two canopy layers, such as an overstory of larger, older trees with an understory of young regeneration. Multi-storied stands, where the canopy is stratified into three or more layers, are typically older (100 years old or older, including old growth), more complex, and further along in stand development.

The coarse-filter approach from the SFLMP emphasizes management for a variety of forest structures and compositions to promote biodiversity. Age class distribution is one of the parameters generally considered when assessing suitability of habitat for a variety of wildlife species. For example, stands in the 100- to 150-year and 150-or-more-year age classes situated on warm sites containing large trees that are open to moderately dense can provide important habitat for species such as flammulated owls. Each age class, with its associated forest structure, provides important wildlife habitat, as discussed in greater detail in Section 4.9 (Wildlife and Wildlife Habitat).

Table 4.2-9 and Figure 4.2-3 provide the current age classes in the HCP project area. Approximately 12 percent of the HCP project area on the NWLO and SWLO is 0 to 39 years old, while roughly 25 percent is 40 to 99 years old. A large number of acres in the HCP project area are in the older age classes (Table 4.2-9). Stands that are 100 or more years old represent 62 percent of the area on the NWLO and 56 percent of the area on the SWLO. Stands in the older age classes have 10 percent or more crown cover consisting of mature sawtimber (greater than 9 inches dbh and 100 or more years in age) but may have an understory of young regeneration (0 to 39 years).

TABLE 4.2-9. HCP PROJECT AREA LANDS BY CURRENT AGE CLASS AND LAND OFFICE

Age Class	CLO[1]		NWLO		SWLO		HCP Project Area	
	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total
No age data[2]	0	0	5,126	2.0	7,085	5.4	12,211	2.7
0 - 39 years	13,282	23.4	31,952	12.4	15,679	11.9	60,913	13.6
40 - 99 years	6,895	12.2	61,588	23.9	34,788	26.4	103,271	23.1
100 - 150 years	22,977	40.6	63,414	24.6	43,310	32.9	129,701	29.1
150+ years	13,503	23.8	95,821	37.2	30,676	23.3	140,000	31.4
Total	**56,657**	**100.0**	**257,901**	**100.0**	**131,537**	**100.0**	**446,095**	**100.0**

[1] Age data for the CLO estimated from age data collected randomly across the CLO.
[2] Acres with no age class defined represent stands where no age data currently exist.
Note: Totals may not sum due to rounding.
Source: DNRC (2008a).

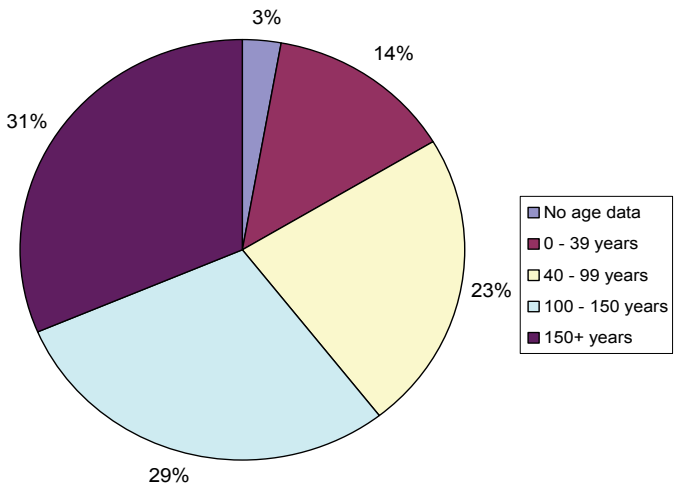

FIGURE 4.2-3. CURRENT AGE CLASSES IN THE HCP PROJECT AREA

Old Growth

The term old growth is sometimes used to describe the later, or older, stages of forest stand natural development (Green et al. 1992), which share some common characteristics or attributes. Characteristics associated with old growth generally include stands with relatively large, old trees where the stand exhibits some degree of a multi-storied structure; has signs of decadence, such as rot and spike-topped trees; and contains standing large snags and large down logs. These attributes vary widely in old-growth stands across the landscape, with some old-growth stands exhibiting high levels of old-growth attributes (i.e., many large trees, a well-developed multi-storied canopy structure, and many standing large snags and large down logs) and some exhibiting low levels of old-growth attributes.

While this qualitative definition of old growth provides a useful description for communication purposes, a quantifiable definition is needed to determine which stands will be classified as old growth for making project-level decisions and treatment recommendations. Therefore, old growth is defined in the ARMs (36.11.403(48)) as "forest stands that meet or exceed the minimum number, size, and age of those large trees" as noted in *Old-Growth Forest Types of the Northern Region* (Green et al. 1992).

Table 4.2-10 shows the number, size, and age of trees needed to meet minimum old-growth requirements for specific cover types. Using these criteria, the number of old-growth acres by land office is shown in Table 4.2-11 for the HCP project area and the unit offices in the NWLO. Figure 4.2-4 shows the percentages of old-growth habitat across the HCP project area.

TABLE 4.2-10. CRITERIA USED TO IDENTIFY OLD-GROWTH FOREST STANDS ON FORESTED TRUST LANDS IN WESTERN MONTANA

Cover Type	Minimum Age	Trees per Acre	Minimum dbh (inches)
Mixed conifer	180	10	21
Western larch/Douglas-fir	170	10	21
Douglas-fir	170	8	21
Ponderosa pine	170	8	21
Lodgepole pine	140	10	13
Alpine fir	180	10	17
Western white pine	180	10	21

Source: Adapted from *Old-Growth Forest Types of the Northern Region* (Green et al. 1992).

TABLE 4.2-11. ACRES OF OLD GROWTH BY LAND OFFICE IN THE HCP PROJECT AREA

Land Office and Administrative Unit	Total acres	Total Old-Growth Acres	Percent of Total Acres that are Old Growth
NWLO			
Swan Unit	37,913	12,829	33.8
Stillwater Unit	107,328	15,775	14.7
Other NWLO Units	112,660	8,247	7.3
Total NWLO	257,901	36,851	14.3
SWLO	131,537	10,839	8.2
CLO	56,657	5,666	10.0
Total	**446,095**	**53,356**	**12.0**

Note: Totals may not sum due to rounding.
Source: DNRC (2008a).

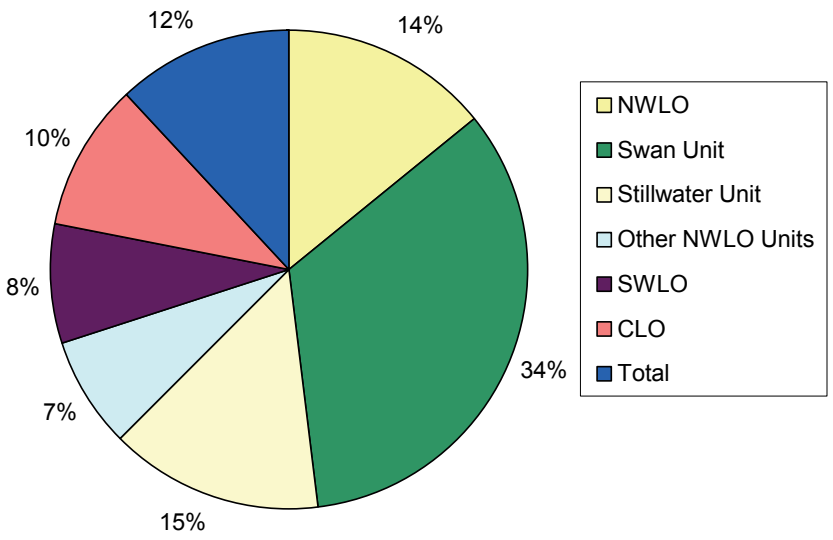

FIGURE 4.2-4. PERCENTAGE OF OLD-GROWTH HABITAT IN THE HCP PROJECT AREA

Within the HCP project area, 12 percent of the area is classified as old growth. Among the three land offices within the HCP project area, the NWLO has the highest proportion of old growth, with 33.8 percent of the Swan Unit classified as old growth, 14.7 percent of the Stillwater Unit classified as old growth, and 7.3 percent across the other NWLO administrative units, which contain scattered parcels rather than blocked lands.

Crown Closure

Crown cover is the ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and is commonly expressed as a percent of total ground area. For the purpose of this analysis, the term crown closure will be used synonymously with crown cover. DNRC uses percent total crown closure as a surrogate for stocking levels. Stocking levels refer to the density of the trees in a stand relative to a desired level. The size of trees in a stand is also a consideration when describing stocking levels. A fully stocked sapling stand may have 400 trees per acre, whereas a sawtimber stand may be considered fully stocked with just 100 trees per acre. Figures 4.2-5 through 4.2-7 illustrate the differences in crown cover for low-stocked, medium-stocked, and well-stocked stands.

Crown closure has implications for forest productivity, forest health, biodiversity, and wildlife habitat. Densely stocked stands, where tree crowns touch or overlap each other, for example, are often more susceptible to insect and disease, because the individual trees are more likely to suffer stress from competition for limited site resources such as water, sunlight, and nutrients. Low-stocked stands, where tree crowns are spread widely apart and do not touch each other, may be less productive from a timber standpoint because some of the site resources are not being captured and converted into tree growth.

Crown closure is also an important parameter for describing the characteristics and quality of habitat for many wildlife species. A more complete discussion of wildlife habitat and species associations related to stocking levels and stand density is provided in Section 4.9 (Wildlife and Wildlife Habitat).

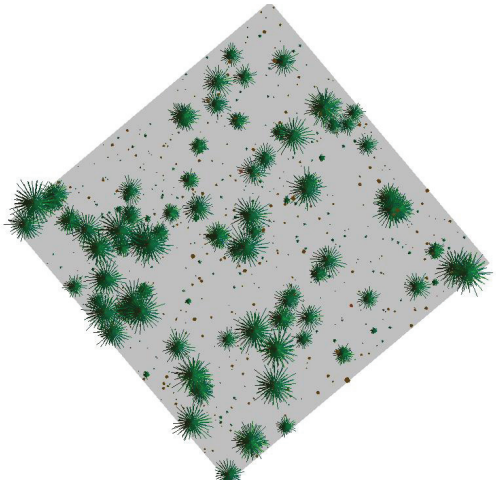

FIGURE 4.2-5. OVERHEAD VIEW OF REPRESENTATIVE CROWN CLOSURE IN A LOW-STOCKED STAND

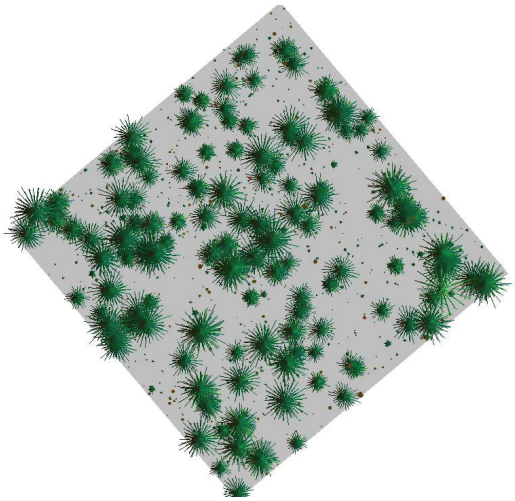

FIGURE 4.2-6. OVERHEAD VIEW OF REPRESENTATIVE CROWN CLOSURE IN A MEDIUM-STOCKED STAND

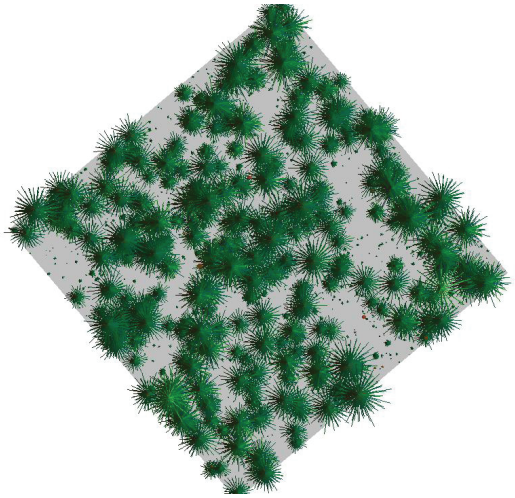

FIGURE 4.2-7. OVERHEAD VIEW OF REPRESENTATIVE CROWN CLOSURE IN A WELL-STOCKED STAND

Table 4.2-12 summarizes forested trust lands within the HCP project area by crown closure (stocking level) and land office. Stocking level is represented by the percentage of total crown cover occurring within each SLI stand. Total crown cover includes the overstory, mid-story, and understory canopy layers.

TABLE 4.2-12. HCP PROJECT AREA LANDS BY CROWN CLOSURE (STOCKING LEVEL) BY LAND OFFICE

	CLO		NWLO		SWLO		HCP Project Area	
Crown Closure (Stocking Level)	**Forest Acres**	**Percent of Land Office**	**Forest Acres**	**Percent of Land Office**	**Forest Acres**	**Percent of Land Office**	**Forest Acres**	**Percent of HCP Project Area**
Well-stocked (>70% crown cover)	25,743	45.4	165,442	64.1	61,899	47.1	253,084	56.7
Medium-stocked (40-69% crown cover)	17,536	31.0	67,644	26.2	40,268	30.6	125,449	28.1
Low-stocked (<40% crown cover)	12,303	21.7	18,985	7.4	19,713	15.0	51,000	11.4
Non-stocked	1,075	1.9	5,830	2.3	9,657	7.3	16,562	3.7
Total	**56,657**	**100.0**	**257,901**	**100.0**	**131,537**	**100.0**	**446,095**	**100.0**

Note: Totals may not sum due to rounding.
Source: DNRC (2008a).

As shown in Table 4.2-12 and Figure 4.2-8, 56.7 percent of the HCP project area is classified as well-stocked and 28.1 percent as medium-stocked. The NWLO has the highest proportion of medium- to well-stocked stands and the lowest proportion of low-stocked stands, as compared to the CLO and SWLO. This stocking trend reflects the change from higher-productivity stands in the NWLO to comparatively lower-productivity stands in the SWLO and CLO as well as a higher percentage of low-stocked stands moving eastward due to a higher amount of savannah-like forest types (forests with widely spaced trees and sparse crown cover).

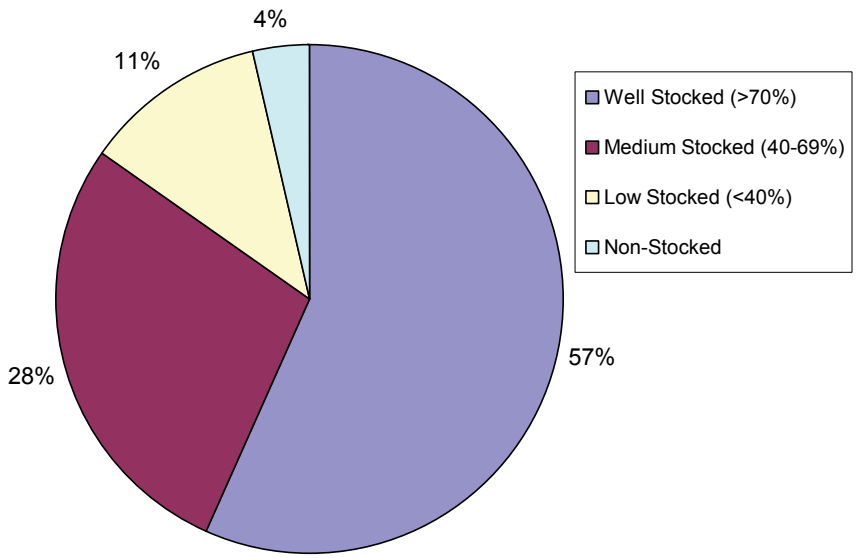

FIGURE 4.2-8. CURRENT CROWN CLOSURE (STOCKING LEVEL) IN THE HCP PROJECT AREA

Disturbance Processes

There are two primary disturbance processes of concern to DNRC forest managers: wildfires and insect or disease outbreaks. Both of these processes are endemic to state forests and have long played important ecological roles in shaping forest vegetation across the landscape. These processes are further described below.

Wildfire

This section describes the frequency, causes, and trends of fires in the planning area.

Fire Frequency

Fire has a long-standing ecological role in the forests of the northern Rocky Mountains. Fire regimes, reflecting the frequency and severity of fires in a given area over time, vary based on forest vegetation, climate, and precipitation. To characterize fire frequency and conditions in the planning area, forests are grouped into four categories: dry montane forests, moist montane forests, lower supalpine forests, and upper subalpine forests. These forests are characterized below followed by historical and current fire conditions for each. The following information is summarized from *Forest Fires in the U. S. Northern Rockies: A Primer* (Cilimburg and Short 2005):

- **Dry montane forests.** Low-elevation, warm, dry sites with less than 20 inches of rain per year, typically dominated by ponderosa pine, Douglas-fir, and western larch.
- **Moist montane forests (mixed conifer forests).** Mid-elevation forests (3,000 to 7,000 feet) receiving at least 20 inches of mean annual precipitation. The wetter conditions allow drought-tolerant tree species such as ponderosa pine, Douglas-fir, western larch, western white pine, and lodgepole pine (*Pinus contorta*) to grow alongside less drought-tolerant

species like grand fir (*Abies grandis*), western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Englemann spruce (*Picea engelmanii*), and subalpine fir (*Abies lasiocarpa*).

- **Lower supalpine forests.** Generally located on cool, moist sites between 5,000 and 7,000 feet in elevation. Mean annual precipitation ranges from 20 to 50 inches, with much falling as snow. Subalpine fir and Englemann spruce dominate many stands of this forest type.
- **Upper subalpine forests.** Generally occurring above 7,000 feet and extending to the upper timberline. Mean annual precipitation ranges from 25 to 60 inches, with extreme cold in winter and severe frosts in summer. Only the most cold-tolerant tree species, like subalpine fir, Englemann spruce, lodgepole pine, and whitebark pine (*Pinus albicaulis*), can persist within the region's upper subalpine zone.

Fires in the dry, montane forests of Montana and Idaho occur frequently because vegetation is regularly flammable (Cilimburg and Short 2005). Historically, fire in dry montane forests led to stands with groups of widely spaced trees often with sparse, low foliage. Native Americans likely increased the fire frequency in these forests, particularly in heavily used valleys, whereas more recent fire suppression has had the opposite effect. These efforts created thick forests with regenerating trees, increasing the likelihood that a fire would carry through the treetops and leave many dead trees in its wake.

Fires in the moist montane forests of Montana and Idaho are highly variable, with a mean return interval of 78 years and a range of 25 to 50 years on the warmest and driest of these forests (typically Douglas-fir cover types) to 70 to 250 years for the moist, humid forests usually dominated by western redcedar and western hemlock (Cilimburg and Short 2005). The warm, wet conditions of moist montane forests encourage dense growth, but also tend to snuff out most ignitions. The longer a stand goes without fire, however, the more likely the fire will carry up to the tree canopies. Therefore, these stands are predisposed to crown fire. Under normal weather conditions, fires in these forests will creep through the understory with occasional flare-ups in the dry areas, fuel laden areas, or on steep slopes. During drought years, stand-replacing fires can occur particularly on steep slopes.

Fires in lower subalpine forests of Montana and Idaho are typically infrequent, with a mean fire return interval of 117 years. These sites tend to develop dense thickets of fire-sensitive trees. Thus, when periodic drought occurs, these heavily stocked stands are prone to severe, stand-replacing fires. However, lodgepole cover types within this forest category follow a different pattern. These drier stands often support regular understory fires in addition to periodic stand-replacing fires, and recent increases in mountain pine beetle outbreaks encourage crown fires in these stands (Cilimburg and Short 2005).

Fires in upper subalpine forests of Montana and Idaho tend to be infrequent, with a mean return interval of 139 years due to the cold weather, rocky conditions, and widely spaced vegetation in this elevation zone. Fires that do occur tend to creep through the understory and affect few trees. Crown fires are infrequent, with a recurrence interval of 200 years (Cilimburg and Short 2005).

Fire Causes

Fire ignitions are commonly classified as either lightning- or human-caused (NIFC 2001). Historically, lightning strikes from dry thunderstorms caused the majority of fires in the planning area. Native Americans also likely contributed to historical forest fires as well (Cilimburg and Short 2005). Today, data from 1998 through 2007 indicate that nearly half of all fires on lands for which DNRC has direct protection responsibilities statewide are human-caused (DNRC 2008c). However, lightning-caused fires still burn more acres than human-caused fires (DNRC 2008c) because human-caused fires are more quickly reported, accessed, and extinguished (often due to threats to human life or property) (Cilimburg and Short 2005).

Fire Season

The forest fire season in the Northern Rockies peaks in midsummer when temperatures are high and humidity is low, forest vegetation is dry, dry lightning is pervasive, and winds are common (Cooper et al. 1991; Rorig and Ferguson 1999; Kipfmueller and Swetnam 2000). Each year has a fire season, but some years bring more fires than others. More of the forest is capable of supporting fires and spreading fires during drought years than in normal years. Recent notable fire seasons across the Northern Rockies occurred in 2000, 2001, and 2003 where regions were reported to be in moderate to severe drought (NIFC 2001; Anonymous 2003).

Recent Fire Data

Figure 4.2-9 shows the amount of trust land acres burned from 1988 to 2007 across three landscape scales: the HCP project area, planning area, and statewide. Since 2000, severe fire seasons have become more frequent. Prior to 2000, the amount of acres burned in the HCP project and planning areas was relatively stable, with occasional years, such as 1988, showing increased activity. From 1988 through 1999, only 1 year (1988) exceeded 5,000 acres burned across all three landscape scales. However, from 2000 through 2007, 3 years (2000, 2001, and 2006) have seen more than 5,000 acres burned in the HCP project and planning areas, and 5 years have seen over 5,000 acres of trust lands burned statewide. Comparing the trend in annual acres burned across each landscape scale shows similarity for all years except 2006, when much of the fire activity occurred on the east side of the state, outside of the HCP project and planning areas.

The average amount of acres burned on all ownerships in the planning area has also increased when comparing the two time periods: 1988 to 1999 and 2000 to 2007. For all ownerships combined, the average amount of acres burned annually has increased from 63,482 acres burned annually from 1988 to 1999 to 268,714 acres from 2000 to 2007, which is a 323 percent increase.

The impact of this increase in terms of the percent of each ownership burned from 1988 to 2007 differs greatly. From 1998 to 2007, a higher proportion of National Park Service (NPS) and USFS ownerships burned (24.6 and 13.3 percent, respectively) than other ownerships.

Comparatively, just 3.3 percent of trust lands in the planning area burned from 1988 to 2007. The variability in the proportion of ownership burned can be attributed in part to differing forest and fire management policies among ownerships. For example, NPS lands are virtually excluded from active forest management, and fires are generally allowed to burn on NPS land unless there is a risk to structures or private property.

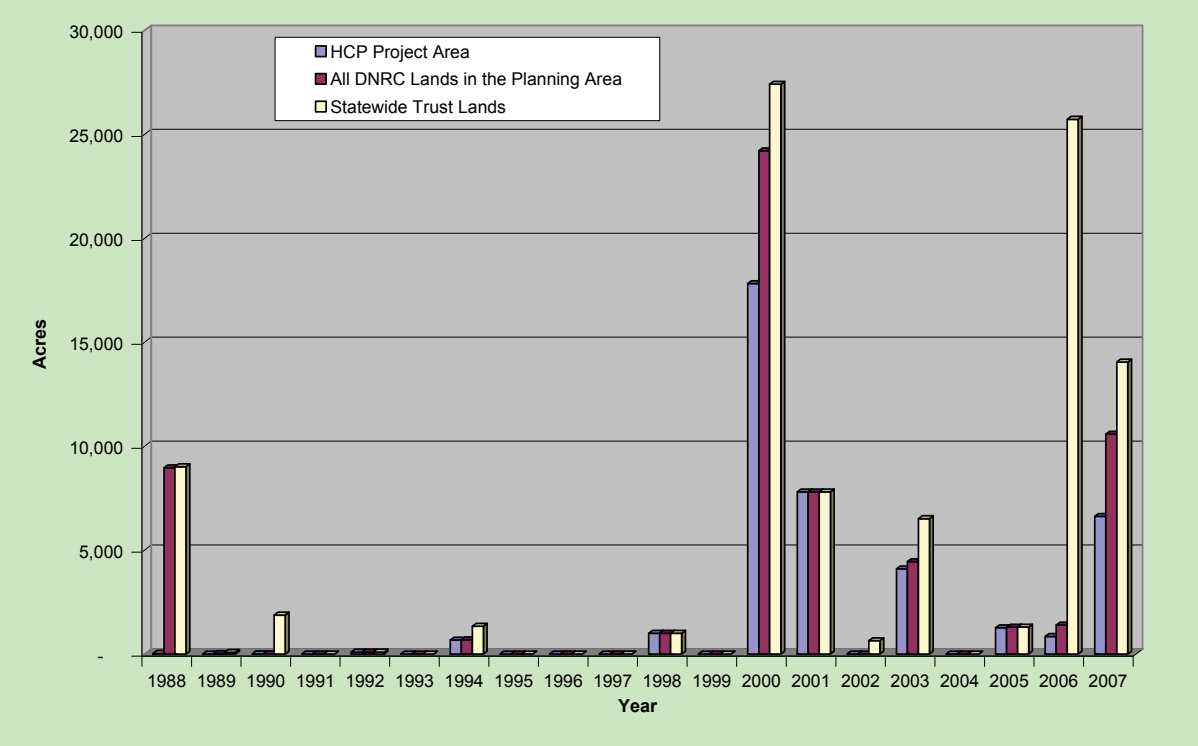

FIGURE 4.2-9. ANNUAL TRUST LAND ACRES BURNED FROM 1988 TO 2007

Based on the data from 1988 to 2007, severe fire seasons have become more common since 2000. This trend is consistent across all ownerships within the planning area. Given current forest conditions and the drought status in Montana (MNRIS 2005a), the trend of increasing acres burned now appears to be the norm rather than the exception they once were. Forest management and fire suppression policies that differ by ownership will also impact the amount of acres burned in the HCP project and planning areas. Fire activity is more likely on ownerships with large amounts of acreage in the HCP planning area that have less-aggressive forest and fire management policies, such as the USFS and NPS. Fires on those ownerships could affect adjacent managed forest ownerships, such as trust lands, in the project and planning area.

Forest Insects and Diseases

The following subsections describe two disturbance processes affecting forest health. insects and forest disease. Even healthy, well-managed forests exhibit certain endemic levels of insects and disease. However, several factors as described below are likely to contribute to higher insect infestation and disease infection levels on forested trust lands in the foreseeable future.

Insects

Forest stands in Montana may be susceptible to damage from a variety of insect pests, including, but not limited to

- Spruce budworm (*Choristoneura occidentalis*)
- Mountain pine beetle (*Dendroctonus ponderosae*)
- Western pine beetle (*Dendroctonus brevicomis*)

- Douglas-fir beetle (*Dendroctonus pseudotsugae*)
- Spruce beetle (*Dendroctonus rufipennis*).

Insects affect specific species of trees as their names indicate; however, stands with high densities, multi-stories, or previous injuries tend to be more susceptible (USFS et al. 1996; Johnson and Lyon 1991; Hagle et al. 2003; and Sinclair et al. 1987). Some insects cause deformities or reduce seed production, but most of them cause reduced growth or mortality. Insect infestations are typically prevented by maintaining species- and age-diverse stands; maintaining vigorous trees with minimal injuries; and for some insects, by thinning stands. If detected in a timely manner, insect infestations can be treated with insecticides or prompt removal of infested trees.

DNRC assesses stand susceptibility to each insect and assigns a hazard rating of low, medium, or high (DNRC 2005b). Hazard ratings represent the relative susceptibility of stands to attack by the specified insect. A given acre may have a high hazard rating for some insects and a low rating for others. The hazard ratings are dependent on factors such as tree species mix, size, stocking level, and elevation. DNRC also conducts annual insect and pest damage flights, which are used to identify infested stands and possible salvage needs. DNRC rarely uses insecticides to treat stands, but does use the rating system to select and prioritize stands for treatment.

Table 4.2-13 shows the forest acres assigned to high, medium, or low hazard ratings for several common forest insects within the HCP project area. Approximately 42.6 percent of forested trust lands within the HCP project area is at high risk for spruce budworm infestation. A high number of acres are also at medium risk of attack by Douglas-fir beetle (64.9 percent), mountain pine beetle in stands with ponderosa pine (48.6 percent), and mountain pine beetle in stands with lodgepole pine (55.1 percent).

TABLE 4.2-13. FOREST ACRES AT RISK OF INSECT INFESTATION IN THE HCP PROJECT AREA

Insect Hazard Rating	Acres at Risk	Percent of Project Area at Risk
Spruce Beetle		
Medium	89,342	20.0
Low	106,867	24.0
Douglas-fir Beetle		
Medium	289,738	64.9
Low	134,418	30.1
Mountain Pine Beetle in Stands with Ponderosa Pine Present		
Medium	216,634	48.6
Low	38,986	8.7
Mountain Pine Beetle in Stands with Lodgepole Pine Present		
Medium	245,788	55.1
Low	73,118	16.4
Spruce Budworm		
High	189,949	42.6
Medium	161,983	36.3
Low	89,796	20.1

Source: DNRC (2008a).

The acres at risk and insect outbreaks are likely to increase in the foreseeable future on forested trust lands. Due to years of declining forest management on federal lands, fire suppression, and drier conditions associated with ongoing drought, many western forests are at an increased risk of large-scale insect outbreaks.

Diseases

In addition to forest insects, a number of forest diseases also occur in Montana. The primary diseases affecting forested trust lands in Montana include, but are not limited to

- Dwarf mistletoe (*Arceuthobium spp.*)
- Indian paint fungus (*Echinodontium tinctorium*)
- Armillaria root disease (often caused by *Armillaria mellea*)
- Red ring rot (*Phellinus pini*)
- White pine blister rust (*Cronartium ribicola*).

Other occasional disease problems include larch needle cast (*Meria larcicis*) and larch needle blight (*Hypodermella laricis*). Four of the five more common diseases, dwarf mistletoe, Indian paint fungus root disease, and red ring rot, generally affect conifer stands that are dense, older, and multistoried (USFS et al. 1996; Hagle et al. 2003; Sinclair et al. 1987). The primary effects on forest vegetation include reduced tree growth and productivity or susceptibility to windthrow (USFS et al. 1996; Hagle et al. 2003; Sinclair et al. 1987). Prevention of diseases is achieved by minimizing wounding of trees during other forest management activities, maintaining diverse stands, and limiting overstocking to maintain vigorous tree growth. Common treatments include removing affected trees, thinning young stands to improve vigor and air flow, maintaining younger stands, and in the case of root disease, removing infected root systems and stumps (USFS et al. 1996; Hagle et al. 2003; Sinclair et al. 1987). The other more common disease, white pine blister rust, is a non-native disease that affects five-needle pines, such as western white pine (*Pinus monticola*), whitebark pine (*Pinus albicaulis*), and limber pine (*Pinus flexilis*). Blister rust kills host trees by causing a canker to develop on the stem of the tree that eventually girdles the tree. Management options for this disease include planting rust-resistant stock, pruning the lower crown on young trees, and retaining trees that appear to exhibit natural resistance to blister rust when applying cutting treatments.

Broad-scale comprehensive information about the extent and severity of disease infections on forested trust lands is not available. Local knowledge and information about existing disease levels, however, is used to identify stands for treatment as part of DNRC's annual timber sale planning process.

Similar to trends in insect outbreaks, disease problems on forested trust lands are likely to remain constant or increase in the foreseeable future. Several factors have contributed to this increased level of disease across Montana, including over-mature forest conditions combined with ongoing drought and disease epidemics (DNRC 2004d).

4.2.2 ENVIRONMENTAL CONSEQUENCES

This section discusses the potential direct and indirect effects on forest vegetation of the three proposed action alternatives relative to those anticipated under the no-action alternative over the short and long terms. Cumulative effects of the proposed alternatives are addressed in Chapter 5 (Cumulative Effects). Because representations of the forest attributes are similar in the HCP project area and planning area, only the HCP project area information is presented in this discussion of environmental consequences.

4.2.2.1 Introduction and Evaluation Criteria

To describe how the amount, type, and/or distribution of forest vegetation and associated timber harvest) would be expected to change in the HCP project area under the proposed alternatives, several evaluation criteria were evaluated:

Timber harvest

- Changes in DNRC's annual sustainable yield.

Forest vegetation

- Changes in current cover types and DFCs, size class, age class, and crown cover
- Changes in the timeframe for achieving DFCs
- Changes in size, intensity, and frequency of wildfire in the HCP project area
- Changes in the acres infested by insects or diseases in the HCP project area.

For those attributes listed above as evaluation criteria, for which the forest model or the SLI database was capable of and suitable for providing quantitative data for the comparison of alternatives, these data are presented and used to compare the effects of the alternatives. However, for many of the attributes listed above, neither the forest model nor the SLI database is capable of providing quantitative data for the comparison of alternatives; i.e., the model and database cannot predict the acres of forest within each attribute category. Instead, a qualitative analysis of how the commitments are expected to affect forest attributes is provided. This is based on current conditions, application of the conservation commitments, application of DNRC's stand management objectives and treatments, and ongoing natural processes.

For many of the forest attributes discussed under Section 4.2.1 (Affected Environment), the changes in conservation commitments proposed in the action alternatives would not be expected to result in changes in forest vegetation that are discernable at the landscape scale. However, some changes may be discernable at the localized scale, for example within the Stillwater Core, and these are identified and described below.

This section also addresses issues raised during public scoping, including

- A request by EPA that the EIS address fuel loads, fire risk, forest type, stand densities, and species composition
- A request by the Montana Old Growth Project that the HCP contain provisions for old-growth protections and recruitment.

Regarding the first scoping issue, implementing the HCP is not expected to affect fuel loads or fire risk. The effect of the HCP alternatives on fire frequency and causes is described below under Wildfire. DNRC uses cover type rather than forest type, and this attribute is evaluated below. The HCP commitments are not expected to differentially affect stand densities or species composition in a measurable way at a programmatic scale; thus, these attributes are not further evaluated in this section.

Regarding the second scoping issue, the HCP contains conservation commitments, including habitat commitments, specific to grizzly bears and Canada lynx. The HCP does not specifically contain commitments for old-growth forests, nor does it propose changes in old-growth management as regulated in the ARMs. The effect of the HCP commitments on old growth is qualitatively discussed below under Age Class.

4.2.2.2 Sustainable Yield

The same contractor (Mason, Bruce & Girard [MB&G]) used the same forest management model to determine the 2004 SYC (no-action) to re-calculate the no-action SYC and determine the annual sustainable yield for all action alternatives. In addition to the constraints specified to model the no-action alternative, constraints associated with the conservation strategies for each HCP alternative were also incorporated into the forest management model. This provided a mechanism to estimate and compare the impacts of each alternative on the annual sustainable yield (Table 4.2-14). DNRC is required to review and re-determine the annual sustainable yield at least once every 10 years; therefore, under all alternatives the annual sustainable yield would be subject to change. Should an action alternative be selected, HCP commitments would be incorporated into future re-calculations of the annual sustainable yield. Also, the current amount of acreage available for harvest could change in the future under the no-action alternative or action alternatives, which include a provision for lands to be added to or removed from the HCP project area through purchases, sales, or exchanges. Information regarding the transition of lands into or out of the HCP project area is provided in HCP Chapter 3, Transition Lands Strategy (Appendix A, HCP).

Under Alternative 1, the annual sustainable yield would remain at the current level of 53.2 million board feet per year (Table 4.2-14). The PNV for this alternative is $146.1 million. Under Alternatives 2 (Proposed HCP) and 4 (Increased Management Flexibility HCP), the annual sustainable yield from trust lands statewide would be 58.0 million board feet (Table 4.2-14). PNV would be $159.1 million under Alternative 2 and $160.2 million under Alternative 4. The lower PNV associated with Alternative 2 can be attributed to the timing of implementation of several of the HCP commitments, which would create increased costs early in the planning horizon that affect the PNV. The economics associated with PNV for each alternative are further discussed in Section 4.13 (Socioeconomics).

The increase in sustainable yield under Alternatives 2 and 4 is primarily due to the increase in active management on 39,600 acres located in the Stillwater Core in the Stillwater State Forest that are currently minimally managed. The increase in active management of those acres allows greater flexibility for management activities across the Stillwater Block as a whole, thus increasing the annual sustainable yield.

TABLE 4.2-14. ANNUAL HARVEST (SUSTAINABLE YIELD) IN MILLION BOARD FEET BY LAND OFFICE AND NWLO ADMINISTRATIVE UNIT FOR EACH ALTERNATIVE

	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Land Office and Administrative Unit	**Annual Harvest**	**Percent of Total Harvest**	**Annual Harvest**	**Percent of Total Harvest**	**Annual Harvest**	**Percent of Total Harvest**	**Annual Harvest**	**Percent of Total Harvest**
NWLO	33.2	62.4	39.0	67.3	33.2	65.6	38.6	66.6
Stillwater Unit	10.1	19.0	14.8	25.5	10.3	20.4	14.9	25.6
Swan Unit	6.7	12.6	6.9	11.9	6.6	13.1	6.8	11.8
Other NWLO Units	16.4	30.8	17.4	29.9	16.2	32.1	17.0	29.3
SWLO	13.6	25.6	12.7	21.8	11.3	22.4	12.9	22.3
CLO	3.9	7.3	4.0	6.9	3.7	7.3	4.1	7.0
Eastern Land Offices	2.5	4.7	2.3	4.0	2.4	4.7	2.3	4.0
Total All Land Offices	**53.2**	**100.0**	**58.0**	**100.0**	**50.6**	**100.0**	**58.0**	**100.0**
Present Net Value (million)	**$146.1**		**$159.1**		**$124.5**		**$160.2**	

Source: DNRC (2008d).

Under Alternative 3 (Increased Conservation HCP) the sustainable yield from trust lands would be 50.6 million board feet. The PNV for this alternative is $124.5 million.

The lower harvest levels under Alternative 3 compared to Alternatives 2 and 4 are due to retaining the current management approach for the Stillwater Core, which greatly limits DNRC's ability to manage timber in that area, as well as a number of factors that stem from the conservation strategies outlined for this alternative, including: wider riparian zones, additional restrictions on springtime activities occurring on scattered parcels in grizzly bear recovery zones, limits on road densities in scattered parcels in grizzly bear recovery zones, and increased requirements for the minimum amount of acres to be set aside as denning habitat in LMAs. While each of these conservation strategies does not remove acreage from management, they may effectively reduce the amount of area available for management activities by making some areas essentially inaccessible (e.g., through wider riparian zones or the inability to create access to an area using roads).

4.2.2.3 Cover Types and Desired Future Conditions

This section presents a qualitative discussion of the differences in cover types and ability to achieve DFC under the no-action and action alternatives.

Under all alternatives, DNRC would continue to manage stands toward a DFC. While this would be expected to result in changes in cover types in some stands at a localized scale, it would not yield discernable differences between the alternatives in cover types across the landscape within the next 50 years. Additional differences that may be seen at the localized scale include changes in cover type in the Stillwater Core under Alternatives 2 and 4, where management would lead to changes in cover type and quicker achievement of DFC compared to Alternatives 1 and 3. About two-thirds of the Stillwater Core is currently not in the designated DFC cover type.

For all alternatives in managed areas, seral cover types dominated by shade-intolerant species, such as ponderosa pine, western larch/Douglas-fir, and western white pine, would be expected to increase in the project area, while late-successional cover types dominated by shade tolerant species, such as mixed conifer and western redcedar, would be expected to decrease. For all alternatives in unmanaged stands, cover types that typically consist of shade-tolerant tree species are expected to increase, whereas cover types that typically consist of shade-intolerant species are expected to decrease.

Figures 4.2-10 and 4.2-11 demonstrate the progress toward DFCs established in the SFLMP that are predicted to be made under each alternative by tracking the presence of two key seral species in two important seral cover types: ponderosa pine and western larch. The amounts of these species in managed and unmanaged stands in ponderosa pine and western larch/Douglas-fir cover types can serve as an indicator of the movement toward or away from the DFC. In these figures, each line represents the percent of a species or species group as a proportion of all species in stands that share a DFC. Each period in these figures represents 5 years.

These figures illustrate the similarity among alternatives in progress toward DFCs, as shown by the shape of the lines for each species through time. These figures also illustrate the positive influence of management on achieving DFCs, as the proportion of ponderosa pine and western larch increase in managed stands, and the proportion of shade-tolerant species decreases. In unmanaged stands, the proportions of shade-tolerant species increase slightly through time, while the proportions of ponderosa pine and western larch remain relatively stable or decrease through time.

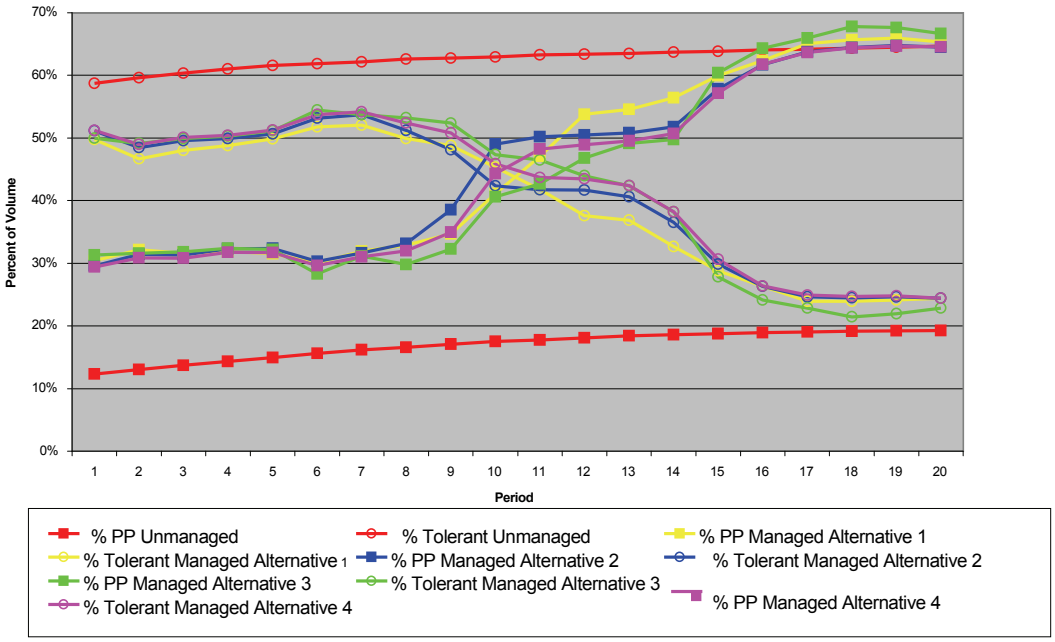

FIGURE 4.2-10. POTENTIAL CHANGES IN EXPECTED VOLUME OF PONDEROSA PINE (PP) AND SHADE-TOLERANT SPECIES IN MANAGED AND UNMANAGED STANDS WITH A DESIRED FUTURE CONDITION OF PONDEROSA PINE BY ALTERNATIVE

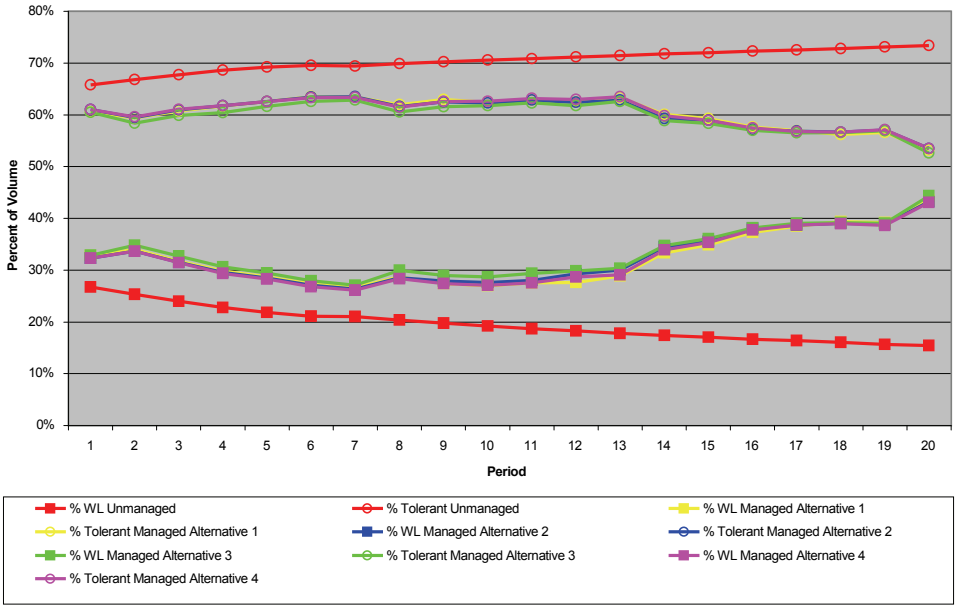

FIGURE 4.2-11. POTENTIAL CHANGES IN EXPECTED VOLUME OF WESTERN LARCH (WL) AND SHADE-TOLERANT SPECIES IN MANAGED AND UNMANAGED STANDS WITH A DESIRED FUTURE CONDITION OF WESTERN LARCH/DOUGLAS-FIR BY ALTERNATIVE

4.2.2.4 Size Class

In general, there are no discernable differences in the effects on size classes across the HCP project area among the four alternatives. As shown in Table 4.2-15, the proportion of acres in each size class is similar for each alternative. Non-stocked areas would occupy about 2 percent of the acres across the HCP project area, the seedling/sapling classes would occupy 21 to 25 percent, the poletimber class would occupy just over 3 percent, the young sawtimber class would be found on about 15 percent, and mature sawtimber, which includes old growth, would be found on 55 to 59 percent of the area.

TABLE 4.2-15. ACRES BY SIZE CLASS FOR HCP PROJECT AREA LANDS UNDER EXISTING CONDITIONS AND FOR ALL ALTERNATIVES AT YEAR 50, POST-PERMIT ISSUANCE

	Existing Condition		Alternative 1 (No Action)		Alternative 2		Alternative 3		Alternative 4	
Structural Stage	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**	**Acres**	**Percent of Total**
Non-stocked forests	17,230	3.9	7,934	1.8	9,302	2.1	8,769	2.0	9,373	2.1
Seedling/sapling	38,360	8.6	98,941	22.2	110,121	24.7	92,664	20.8	110,033	24.7
Poletimber	37,362	8.4	14,853	3.3	14,543	3.3	14,588	3.3	14,463	3.2
Young sawtimber	92,730	20.8	66,831	15.0	68,339	15.3	66,930	15.0	68,107	15.3
Mature sawtimber	260,413	58.4	257,536	57.7	243,790	54.6	263,144	59.0	244,119	54.7
Total	**446,095**	**100.0**	**446,095**	**100.0**	**446,095**	**100.0**	**446,095**	**100.0**	**446,095**	**100.0**

Source: DNRC (2008d).

Alternatives 2 and 4 would yield slightly higher proportions of acres in the seedling/sapling size class and slightly lower proportions of acres in the mature sawtimber size class compared to Alternatives 1 and 3. The increase in seedling/sapling acres and decrease in mature sawtimber across the HCP project area can be attributed to the effects of the increased acreage available for active management in the Stillwater Unit under Alternatives 2 and 4. This results in shifting acreage from the mature sawtimber class to the seedling/sapling class over the 50-year Permit term due to the elevated harvest levels afforded by the increase in available acres to manage, and the fact that most of those acres available for harvest are in the mature sawtimber age class.

Alternative 3 would yield a slightly higher proportion (5 percent) of mature sawtimber than the other alternatives. This can be attributed in part to the wider riparian zones associated with this alternative, but the other conservation strategies for this alternative affect stand size class as well. Increasing the width of riparian zones, while not removing those acres from active management, would preclude management activities in those areas, essentially making them *de facto* set-aside areas where forests would grow and increase in size over the Permit term. Other conservation strategies for this alternative, such as spring restrictions and limited road densities on scattered parcels in grizzly bear recovery zones, and lynx denning habitat requirements, limit activities associated with timber management in certain areas and consequently reduce the annual sustainable yield. While these strategies do not reduce the amount of acres available for harvesting, they result in a delay in harvesting acres that could potentially be harvested under other alternatives, allowing forests on those acres to grow and increase in size.

4.2.2.5 Age Class

This section provides a qualitative analysis of how the age class of stands in the HCP project area may change under each alternative.

As with size class, the differences among alternatives with regard to effects on age class are not discernable. The effects of each alternative on age class would be expected to correlate with the effects of each alternative on size class at the landscape scale. DNRC's harvesting treatments attempt to maintain a distribution of all age classes that would occur under naturally occurring disturbance patterns. As previously mentioned, much of the project area is currently in older age classes. For this reason, harvesting is most likely to occur in the older age classes, particularly in 100- to 150-year-old stands, and to a lesser extent in stands greater than 150 years old. Some stands in the 40- to 99-year range, particularly those on more productive sites, would also see harvesting activity, while stands in the 0- to 39-year range would be unlikely to see commercial harvesting activity.

Because of harvesting, the proportion of stands in the 100- to 150-year age class would be expected to decrease across the project area, as would stands in the 150-year-or-older age class. In turn, an increase in the acreage of 0- to 39-year-old stands across the project area would be expected over the 50-year Permit term due to regeneration harvests in older stands. The proportion of acres in the 40- to 99-year age class would decrease somewhat, as stands currently in that age class would be recruited into the 100- to 150-year age class. Although recruitment from current young stands (0 to 39 years) into the 40- to 99-year age class would also be expected, there are not enough acres available for recruitment from the younger age class to offset the movement of stands currently in

the 40- to 99-year age class into the 100- to 150-year age class, resulting in a net decrease in the proportion of acres in the 40- to 99-year age class.

Among the alternatives, Alternatives 2 and 4 would be expected to have a slightly greater decrease in the amount of 100- to 150-year and 150-year-or-older stands, and a greater increase in the amount of 0- to 39-year-old stands when compared to Alternatives 1 and 3. This is due to the greater flexibility for management activities in the Stillwater Unit under Alternatives 2 and 4.

Old Growth

The DNRC's policies and management approach for old-growth stands would not change under the HCP alternatives. DNRC would continue to have the same old-growth management options it currently has as outlined in ARM 36.11.418 – old-growth restoration, old-growth maintenance, and old-growth removal.

Provisions were made in the sustainable yield model for tracking old-growth amounts over the planning horizon to determine whether landscape-level biodiversity objectives in the SFLMP and ARMs were met. At the initiation of the model runs, approximately 11 percent of DNRC's forested ownership met DNRC's old-growth definition. After incorporating DNRC's old-growth management regimes and all relevant constraints into the model, approximately 8 percent of the landscape was intended to be in an old-growth condition at model year 100.

The amount of old growth harvested and the effects of proposed projects on old growth would continue to be analyzed on a project-by-project basis. Under all alternatives, the amount of old growth present on trust lands is expected to decrease because the proportion of lands in the 100- to 150-year and 150-year-or-older age classes is currently high and likely to receive the most harvesting.

The magnitude of the decrease is likely to vary among alternatives, particularly at the localized scale. Under Alternatives 2 and 4, the increased flexibility for management in the Stillwater Unit would result in greater decreases in the amount of old growth in the Stillwater Core compared to Alternatives 1 and 3 as some of those acres are brought into active management.

Under Alternative 3, the decrease in the amount of old growth is likely to be less than other alternatives, at least within riparian areas. The increased riparian area width outlined by the conservation strategies for this alternative would promote the development of old growth in those areas because they are essentially set aside from active management. The decreased annual sustainable yield associated with this alternative would also delay harvesting in some old-growth stands, allowing a greater proportion of old growth to remain on the landscape through the 50-year Permit term than other alternatives.

4.2.2.6 Crown Closure

No discernable difference would be expected among alternatives with regard to crown closure. The types of cutting prescriptions used would not differ under any of the alternatives; therefore, the level of crown cover would not be expected to differ among alternatives. Following harvesting activities, stands would be expected to naturally regenerate and eventually achieve a crown cover level indicative of a fully stocked stand. In cases where natural regeneration is not sufficient to reach desired stocking levels or in situations where on-site seed sources do not exist to provide natural

regeneration, DNRC evaluates the need and may implement tree planting to reach the desired stocking level.

4.2.2.7 Wildfire

Under all alternatives, the frequency of wildfire is likely to increase somewhat on forested trust lands through the 50-year Permit term. This is not due to management activities or commitments in the HCP alternatives, but instead to outside factors, such as persistent drought, increasingly warmer and drier summers, and the influence of activities (or the lack of them) on adjacent ownerships.

Among the many factors influencing wildfire, forest management activities are one factor that can reduce the frequency, intensity, or size of a fire. Reduction in the frequency of fires can be achieved by implementing silvicultural treatments that mimic natural disturbance regimes, such as stand-replacement fire, mixed-severity fire, or non-lethal fire. The intensity and possibly the size of fires can be reduced by decreasing fuels in a stand and improving access to stands for quicker suppression in roaded landscapes. DNRC currently uses such practices in its management of forested trust lands, and such prescriptions would continue under all alternatives; therefore, silvicultural practices would not result in discernable differences in the amount of acres burned among alternatives.

The ability to manage additional acres in the Stillwater Unit under Alternatives 2 and 4 may reduce the likelihood of fire not only on those additional acres but also on surrounding managed lands, when compared to Alternatives 1 and 3.

Under all alternatives, road miles across the HCP project area would increase, providing greater access and ability to put out fire starts in a timely manner. While most of these roads would be restricted from public access, increased road miles across the project area could increase the rate of human-caused fires on DNRC lands.

Overall, given the many factors that influence frequency, size, or intensity of fires we are not able to predict how fires will be affected under the action alternatives over the course of the 50-year Permit term. Because all factors contributing to or reducing the potential for fires is similar for all alternatives, no discernible difference is predicted for fires between alternatives.

4.2.2.8 Forest Insects and Disease

This section provides a qualitative analysis of the effects of each alternative on forest insects and diseases.

Section 4.2.1.3 (Current Conditions) presents information about the primary forest insects and diseases found in Montana. Aerial detection flights that DNRC participates in indicate that the amount of acres infested by various insects is generally increasing and the amount of the annual change in acres infested is also increasing (Meyer 2006). This information is useful for determining expected changes in infestation levels and threats associated with the alternatives. Broad-scale information about the current status of diseases in Montana is not currently available, making it difficult to estimate the impacts of each HCP alternative on the future levels of diseases in Montana. However, knowledge of the characteristics of each disease coupled with information about current forest conditions and the drought status in Montana (MNRIS 2005a), the level of forest

management activities, and expected changes to forests within the project area over the 50-year Permit term can offer some insight into expected outcomes.

In general, the differences among alternatives on insect and disease conditions throughout the project area are not likely to be discernable at the landscape scale. Alternatives 2 and 4 would provide more opportunities to actively manage for insect and disease problems within the Stillwater Unit as needed, but there is likely to be little difference among alternatives in terms of the potential for and acres affected by insect and disease outbreaks in the HCP project area. Overall, the potential for insect and disease outbreaks would likely increase over the project area due to factors outside of DNRC's management activities. Continued trends of warmer and more drought-filled summers, which stress forests, could increase their susceptibility to insect and disease outbreaks. Existing conditions on state and public forests where stands are over-mature and over-crowded, combined with decreasing timber harvest levels on adjacent federal lands, and the resulting continued development of high-density stands composed of shade-tolerant species could also increase the likelihood of insect and disease outbreaks on HCP project area lands. DNRC's management aims to promote healthy and biologically diverse forests on trust lands, and while such management will continue to address forest health problems currently and in the future, that alone is unlikely to offset other factors contributing to the threat or likelihood of forest insects and diseases. Progress toward DFCs and the use of silvicultural systems that mimic natural disturbance regimes and/or directly address insect and disease problems will promote the resistance to and resiliency from insects and diseases. Management activities on trust lands would work to either reduce or keep the threat of an insect or disease epidemic at or near current levels, but outside influences such as ongoing hot, dry summers, as well as drought conditions, would counter these activities, thus increasing the threat of insects and disease on trust lands.

More recently, DNRC has joined a multi-party effort to address a variety of issues where land ownerships are intermingled. A pilot project has been initiated near Butte in the Anaconda Unit to address stream rehabilitation and fish passage issues as well as insect- and disease-infested trees that cover a variety of land ownerships. Such efforts would continue under all alternatives and for these localized areas could reduce or prevent the further spread of insect or disease outbreaks on trust lands and adjacent ownerships.

4.2.2.9 Summary

For Alternative 3, additional constraints associated with the conservation strategies reduce the sustainable yield under that alternative compared to Alternative 1. The greatest vegetation-related difference between alternatives would result from a different approach to conservation of grizzly bear habitat. Currently, in parts of the Stillwater Block, DNRC employs a security core strategy to conserve grizzly bear habitat. In Alternatives 2 and 4, DNRC would move to an approach that incorporates a fixed transportation plan with various annual and seasonal road restrictions, and the area now identified as the Stillwater Core would be more available for management. The extra acres available for management would increase the sustainable yield of timber in Alternatives 2 and 4. Additional constraints associated with the conservations strategies for Alternative 3 would reduce the sustainable yield under that alternative compared to Alternative 1.

The effects on forest stand attributes would be similar and in most cases differences are not discernable among alternatives regarding individual stand attributes. Under all alternatives,

progress toward DFCs would continue, with seral forest types increasing and late-successional forest types decreasing compared to current levels.

Across the project area, the acreage in the seedling/sapling size class would increase compared to current conditions, and poletimber, young sawtimber, and mature sawtimber classes would decrease under each alternative. Changes in age class under each alternative would follow trends for size class: the amount of young stands would increase, and the amount of older stands would decrease.

There are no discernable differences at the landscape scale in the potential effects on wildfire or insects and diseases among alternatives. Within the Stillwater Unit, increased management may reduce the chances of wildfire or insect or disease spread in managed stands.

4.3 AIR QUALITY

4.3.1 AFFECTED ENVIRONMENT

This section describes the regulatory framework under which air quality is considered, provides a description of air quality conditions in the planning area, and identifies air quality concerns related to timber management activities.

The primary impact of forestland management on air quality in the state of Montana is the emission of particulate matter from wildfires and prescribed burning. Air quality impacts from intentional and naturally occurring fires are a function of a number of factors, including density of fuel (dead fall and vegetation that is available to be burned), moisture content, and atmospheric conditions. The particulate emissions of concern are those particles less than 10 micrometers in diameter, known as PM_{10}, and particles less than 2.5 micrometers in diameter, known as $PM_{2.5}$. These particles are small enough that they can be inhaled into the lungs and cause respiratory problems.

4.3.1.1 Regulatory Framework

Clean Air Act

Federal air quality standards are defined by the National Ambient Air Quality Standards (NAAQS), which were established by the Clean Air Act (CAA). The NAAQS identify criteria pollutants and establish target pollutant concentrations that are designed to protect human health and welfare. Criteria pollutants include particulate matter, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, carbon monoxide (CO), and lead. These standards are further broken down into primary and secondary standards. Primary standards are intended to protect against health effects, particularly in sensitive groups such as children and the elderly. Secondary standards are intended to protect against welfare effects, including damage to farm crops, damage to buildings, and aesthetic impacts.

Montana has developed a state implementation plan to adhere to the requirements of the CAA. The state implementation plan is executed through MDEQ. Under MCA 75-2-301, the state allows formation of local air pollution control programs to execute and enforce the state air pollution regulations. The state has developed its own set of air quality standards called the Montana Ambient Air Quality Standards (MAAQS). These standards are at least as stringent as national standards and are designed to be protective of human health.

Wildfires

Wildland fire protection and suppression benefit air quality as well as protect resources and human lives. Wildland fire protection in Montana is accomplished through cooperative efforts between state, federal, and local governments. DNRC is primarily responsible for wildland fire protection on state and private lands, while the five federal land managers in western Montana (United States Bureau of Indian Affairs [BIA], BLM, NPS, USFWS, and USFS) are primarily responsible for protection on federal lands. DNRC has a direct protection program that covers 5.2 million acres of western Montana. In eastern Montana, local government provides fire protection on private and state lands. The lands protected by the different agencies are intermingled throughout the state, and

interagency agreements are used to coordinate efforts for fire prevention, detection, and suppression.

The top priorities of DNRC's direct protection program are fuel reduction, rapid initial attack of small fires, control of large fires that have escaped initial attack, and control of all fires on trust lands. DNRC's goal is the protection of lives, property, and resources, and its overall fire suppression strategy is to control 95 percent of wildfires at less than 10 acres. DNRC ensures wildfire protection through coordination with other programs including training, fire prevention, equipment development, communication, engineering, aviation, and technical support activities. Training develops a team of wildland fire suppression and fire management professionals within the state.

In 2007, MCA 76-13-115 established a state fire policy with eight general tenets:

1. Public and firefighter safety is paramount in all wildfire suppression activities.
2. Minimizing property and resources losses from wildfires, as well as costs, through aggressive and rapid initial efforts is a priority.
3. Interagency cooperation is intended and encouraged.
4. Fire prevention, hazard reduction, and loss mitigation are fundamental components.
5. All property in Montana has wildfire protection from a recognized fire protection entity.
6. All property owners (private, state, and federal) have a responsibility to manage resources, mitigate fire hazards, and otherwise prevent fires on their property.
7. Sound forest management activities to reduce fire risk improve forest health and the environment.
8. Development of fire protection guidelines for the wildland-urban interface is critical to improving public safety and for reducing risk and loss (the guidelines are being drafted at this time: http://dnrc.mt.gov/forestry/fire/Prevention/WUIguidelines.asp).

Open Burning Permit

Open burning has the potential to emit large quantities of particulate matter and other pollutants, and therefore is regulated to aid in maintaining compliance with air quality standards. For any agency or company, a major open burning permit is required for any burning that has the potential to emit more than 500 tons of CO or 50 tons of any other regulated pollutant. Thirteen government agencies and private companies currently hold major open burning permits in Montana. For five of the counties in the HCP project area: Yellowstone, Cascade, Lincoln, Flathead, and Missoula and all Native American reservations, permitting has been delegated to their local air pollution control programs. In all other counties, permits are issued through MDEQ. Wildland burning, including burning to eliminate waste from logging practices, is permitted year-round and must implement best available control technologies.

Prescribed Burning

DNRC has land management responsibilities related to prescribed fires, which also have the potential to emit large quantities of pollutants that could contribute to violations of air quality

standards if not regulated and managed. Under MCA 77-5-103, DNRC is directed to execute "all matters pertaining to forestry within the jurisdiction of the state; have charge of all fire wardens of the state and direct and aid them in their duties; direct the protection, improvement, and condition of state forests; take such action as is authorized by law to prevent and extinguish forest, brush, and grass fires; enforce the laws pertaining to forest and brushcover lands and prosecute for any violation of those laws."

To address air quality concerns related to prescribed burning, a memorandum of agreement was signed in 1978 by federal, state, and local agencies and private organizations involved in prescribed burning. The involved parties created the Montana-Idaho Smoke Management Group (later re-named the Montana/Idaho Airshed Management Group) to implement the memoranda of agreement and smoke management programs as contained in their *Montana/Idaho Airshed Group Operating Guide* (Montana/Idaho Airshed Group 2006).

The Montana/Idaho Airshed Group Smoke Management Program has two primary purposes:

1. Minimize or prevent the accumulation of smoke in Montana to such degree as is necessary to maintain compliance with state and federal ambient air quality standards when prescribed burning is necessary for the conduct of accepted forest practices, such as hazard reduction, regeneration, and wildlife habitat improvement. The development of alternative methods shall be encouraged when such methods are practical.

2. Develop a smoke management plan for reporting and coordinating burning operations on all forest and range lands in the state. Guidelines in the plan are based upon the principles of and technical information currently available on smoke dispersion and on state and federal air quality regulations.

MCA 76-13-1 identifies that a permit must be obtained for timber-harvest-related burning activities, and that vehicles operated in forestlands must be equipped with spark arrestors so as to prevent the accidental ignition of fires. When DNRC burns slash from a timber harvest, DNRC applies for and obtains a burning permit.

Historically, smoke from timber harvest activities has rarely been a concern on an individual project or harvest; therefore, detailed BMPs are not routinely mandated or implemented. When DNRC has a concern about the potential for smoke from a specific project, such concerns are typically addressed in the MEPA process with site-specific mitigation measures written specifically for that sale. Burning permits may also include conditions intended to minimize smoke-related impacts. In general, these mitigation measures and burning permit conditions are timing- and/or weather-condition-related restrictions intended to confine burning activities to appropriate seasons (i.e., spring and fall), and to periods when weather conditions are favorable for smoke dispersion. If weather conditions are unfavorable for smoke dispersion, burning must be postponed until weather conditions are more suitable.

4.3.1.2 Existing Air Quality Conditions

Due to a relatively low population, a majority of Montana enjoys good air quality. However, a few parts of the state do not currently meet state and federal air quality standards. These areas are known as non-attainment areas. There are currently a total of 18 non-attainment areas in the state,

including 10 for particulate matter. Of the particulate non-attainment areas, nine are within the planning area (Table 4.3-1), and all are associated with urban, rather than rural, areas. Smoke from wildfires and prescribed burning is not the primary cause of any area being classified as non-attainment (Wolfe 2008, personal communication).

TABLE 4.3-1. AIR QUALITY NON-ATTAINMENT AREAS WITHIN THE PLANNING AREA

City	County	Non-attainment Designation and Pollutant	Reason for Non-attainment[1]
Butte	Silver Bow	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Columbia Falls	Flathead	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Kalispell	Flathead	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Libby	Lincoln	PM_{10}, $PM_{2.5}$	PM_{10}: Summer-time road dust, wind-blown dust, etc. $PM_{2.5}$: Winter-time wood stoves
Missoula	Missoula	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Polson	Lake	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Ronan	Lake	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Thompson Falls	Sanders	PM_{10}	Summer-time road dust, wind-blown dust, etc.
Whitefish	Flathead	PM_{10}	Summer-time road dust, wind-blown dust, etc.

[1] Source: Wolfe (2008, personal communication). Wildfires and prescribed burning are not the primary cause of any area being classified as non-attainment. Wood smoke is predominantly $PM_{2.5}$. The only area that is non-attainment for $PM_{2.5}$ is Libby, and the primary cause of exceeding the $PM_{2.5}$ air quality standard is smoke from wood stoves during the winter.
Source: MDEQ (2005a).

4.3.1.3 Air Quality Effects from Forest Management Activities

Fire occurs on forestlands due to wildfires and prescribed burning. Prescribed burning includes slash burning (burning of residual materials from harvesting) and intentional land burning (burning to remove hazardous fuel loads, manage invasive species, improve foraging habitat, and promote biodiversity). Figure 4.2-9 in Section 4.2 (Forest Vegetation) summarizes the amount of land burned annually in the HCP project area, planning area, and statewide, including both wildfires and prescribed burns. These data illustrate that the occurrence and extent of burning in any given year are highly variable. As summarized in Section 4.2 (Forest Vegetation), nearly half of all fires on lands for which DNRC has direct protection responsibilities statewide are human-caused, although lightning-caused fires still burn more acres than human-caused fires.

Smoke emitted from wildfires and prescribed burning is the primary source of air pollutants associated with forest management practices. Smoke contains large quantities of particulate matter, the primary air quality pollutant associated with fires. Much of that particulate matter is small and falls into the range of PM_{10} or $PM_{2.5}$. Particulates in these size ranges are of concern because they are easily ingested deep into the respiratory tract and can cause respiratory illness, particularly in sensitive groups, such as children, the elderly, and people with pre-existing respiratory illnesses. While the effects of fire on humans are often considered negative (health risks, unusable recreation lands, aesthetic impacts, potential impacts on the economy of areas that depend on recreational visitors for income), maintenance of the fire cycle can help maintain habitat needed for fire-dependent plants and wildlife.

The amount of particulate matter emitted per unit of burned area can vary substantially due to a number of factors. A fire that burns hotter will burn more completely, emitting less particulate matter. The density of the burned material can also impact the amount of smoke produced. Larger, denser fuel will tend to smolder longer, emitting more smoke. Fuel loading will also lead to greater emissions, due to a greater amount of material burned per unit area.

The season of burning can also impact the distribution of smoke and particulate matter. During the hot, dry summer months, when a majority of wildfires occur (see the discussion of Wildfire in Section 4.2.1.3, Current Conditions), dispersion is good, preventing significant deterioration of air quality. In contrast, during the fall and spring, when a majority of prescriptive burning takes place, stagnant air leads to poor dispersion and significant deterioration of air quality.

4.3.2 ENVIRONMENTAL CONSEQUENCES

This section describes the effects on air quality resulting from changes to forest management activities under the four alternatives.

4.3.2.1 Introduction and Evaluation Criteria

As noted above, the primary effect of forestland management on air quality is the emission of particulate matter (i.e., smoke) from wildfires and prescribed burning. Particulate matter is of concern because it can be inhaled into people's lungs and cause respiratory problems.

This section evaluates whether air quality conditions, specifically levels of particulate matter from smoke, would be appreciably different under any of the alternatives. Levels of particulate matter from smoke in the air can be affected by changes in the frequency and size of wildfires and changes in prescribed burning. Factors contributing to the frequency and size of wildfires include amounts of fuel available to burn (fuel loading), wildfire suppression policies, and access to wildfires, while factors affecting changes in prescribed burning include changes in policies and expected levels of burning.

To compare changes to air quality resulting from the different alternatives, the following evaluation criteria were used:

- Changes in the amount of older forest (fuel loading)
- Changes in the amount of unmanaged forest (fuel loading)
- Changes in wildfire suppression activities
- Changes in prescribed burning policies and levels of burning.

During public scoping, concern was expressed that changes to DNRC's forest management program could result in exceedances of air quality standards. DNRC's process for evaluating impacts to air quality and meeting air quality standards will not change under any of the alternatives. Consequently, no changes are expected in the potential risk of exceeding air quality standards from DNRC's forest management activities.

4.3.2.2 Comparison of Alternatives

Changes in the amount of older forest over the Permit term from the four alternatives are discussed in Section 4.2.1.3 (Current Conditions) under Size Class and Age Class. In general, the amounts of forested trust lands in larger size classes and older age classes would be expected to decrease somewhat over the Permit term because DNRC's harvest activities would be most likely to occur on these lands. However, differences in the amount of decrease among alternatives at the landscape scale are not discernable.

DNRC's management philosophy and strategy is to move its forestlands toward a DFC resulting in a healthier, more fire-resistant forest. Treatments would be applied to emulate natural disturbances and remove material that would normally burn. Section 4.2.1.3 (Current Conditions), under Current Forest Cover Types and Desired Future Conditions, provides additional information on changes to forest management practices that would result in a shift to the DFC. However, considering DNRC's forestlands on average, the shift to the DFC would occur very slowly over a long period. No definitive changes in wildfire frequency and intensity or prescribed burning are predictable based on DNRC's intention to shift forestlands to the DFC.

For all the alternatives, DNRC would continue to follow existing management strategies and policies related to wildfire response actions and prescribed burning that would directly and indirectly influence particulate matter generation and air quality. Therefore, implementation of the alternatives would result in no discernable differences in effects on air quality at the regional scale. Localized changes from management practices in the Stillwater Core may occur, but these would not affect broader regional air quality.

Effects on air quality from much broader general environmental factors would most likely overwhelm or obscure the differences in management of the Stillwater Core under the alternatives. These factors include drought, demographic trends, and technology innovations (industrial, wood stoves, automobiles, etc.). See Section 4.2.2.7 (Wildfire) for additional discussion of the differences between alternatives with respect to wildfire on forestlands.

The amount of smoke from prescribed burning is expected to generally correlate with harvest volumes, which would be determined from forest sustainable yield calculations found in Section 4.2.2.2 (Sustainable Yield) and Table 4.2-14. While localized changes in harvest volumes and locations may occur, no overall, definitive long-term trend is predictable for the amount of timber that would be harvested in future years.

Under Alternatives 2 and 4, the Stillwater Core could potentially be opened to wildfire suppression activities, as well as timber harvest activities and prescribed burning. The net effect on air quality is uncertain because wildfire suppression activities would improve air quality, while prescribed burning would degrade air quality. Overall, the Stillwater Core represents a very small percentage

of forested trust lands, and a change in management policy for that area would have little net impact (either positive or negative) when considered in aggregate with all forested trust lands in the HCP project area.

4.3.2.3 Summary

At the landscape scale, there would be no appreciable differences in terms of effects on air quality due to changes in forest management activities among the four alternatives. Any increase in the frequency and size of wildfire on forested trust lands would likely be due to outside factors, such as persistent drought, increasingly warmer and drier summers, and the influence of activities (or the lack of them) on adjacent ownerships.

Localized changes may be observed within the Stillwater Block, however. Under Alternatives 2 and 4, forest management activities within the Stillwater Core could result in additional prescribed burning where it does not currently occur.

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4.4 TRANSPORTATION

Trust lands support a network of roads that provide access to forested trust lands for the purposes of conducting forest management activities; providing public access to various recreational resources; and providing access to adjacent land ownerships (i.e., USFS or private landowner access to a cabin site). 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 pressure).

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. Specific road-related effects on other resources are discussed in Sections 4.5. (Geology and Soils), 4.6 (Water Resources), 4.8 (Fish and Fish Habitat), 4.9 (Wildlife and Wildlife Habitat), and 4.10 (Recreation). 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 DNRC-managed roads within the planning and HCP project areas. The subsequent analysis of environmental consequences addresses issues raised during public scoping and describes likely changes to DNRC's road network and its management under the no-action and action alternatives.

4.4.1 AFFECTED ENVIRONMENT

To establish the affected environment for roads, this section describes current policies, rules, and regulations affecting road management on forested trust lands, as well as the current status of the road network in terms of the amount, distribution, and condition of roads in the network, both in the planning area and the HCP project area.

As described in Chapter 2 (Environmental and Procedural Setting), DNRC's road-related activities supporting forest management activities on 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 activities are also partially funded through DNRC's forest improvement program.

4.4.1.1 Regulatory Framework

Road management standards were established in the SFLMP and subsequently adopted as part of the Forest Management ARMs. Key elements of the road management standards (ARM 36.11.421) are listed below.

- Minimize number of road miles.
- When planning the location, design, construction, and maintenance of all roads
  - Comply with BMPs as necessary to avoid unacceptable adverse impacts or, as funding is available, to improve existing roads.
  - Build roads to the minimum standard necessary to best meet current and future management needs and objectives.

- Manage roads to minimize maintenance.
- Relocate existing roads if reconstruction, maintenance, and/or use of those roads would produce greater undesirable impacts than new construction.
- Use existing roads in SMZs only if potential water quality impacts can be adequately mitigated, while primarily considering economic and watershed implications of relocating roads outside SMZs.

- Assess road maintenance needs by inspecting conditions on both open and closed roads every 5 years, and prioritize maintenance operations based on the results of those inspections.

  (Currently, DNRC does not inventory all roads every 5 years. While roads in the Stillwater Block and Swan River State Forest are assessed every 5 years, roads on scattered parcels are assessed during timber sale planning and watershed inventories. DNRC is currently in the process of examining its program to determine how this requirement could be met and, if it cannot, may seek to revise the rules.)

- Consider closure or abandonment of roads accessible to motorized vehicles that are non-essential to near-term future management plans or where unrestricted access would cause excessive resource damage.
- In the Swan River State Forest, plan road closures in accordance with the terms of the Swan Agreement.
- Inspect road closure structures as part of ongoing administrative duties and in response to notice of ineffective road closures received from the public. Inspections are to occur at least every 5 years. Repair or modify effective closures or consider alternative methods of closure. Repairs are to be a high priority when allocating time and budget.

Roads on trust lands may be maintained by DNRC, its cooperators, or third parties as provided by departmental rules, policies, and contracts. DNRC may (1) enter into cost-share agreements with the USFS, (2) exchange easements with the BLM, and/or (3) conduct reciprocal access agreements and easement exchanges with cooperating persons or corporations. Each of these processes addresses construction, use, and maintenance to be performed by DNRC or its cooperators. Further, DNRC may grant easements on trust land as provided by its access road policy, or it may purchase an easement to provide access to trust lands in accordance with the State Purchase Program.

DNRC's policy for reviewing and granting easements is contained in the document *Access Road Easement Policy* (DNRC 2006b). This easement policy requires the applicant to demonstrate that all other options for access have been exhausted. Approval is granted by DNRC only after review and MEPA evaluation are complete, as described in the Policy.

The process of purchasing of road easements on non-trust lands by DNRC is directed by Montana law (MCA 77-2-361 through 77-2-367) and rules (ARMs 36.25.812 through 36.25.817). This process requires DNRC to prepare a financial analysis and determine the financial risks and benefits associated with the acquisition to ensure that it is in the best interest of the affected trusts. Additional information DNRC provides to support the Land Board's decision for an easement includes an inventory of current environmental conditions and identification of any changes in

access to other trust lands. An appraisal and due-diligence review are also required. Approval of easement purchases is granted by the Land Board.

To implement the road management standards outlined in the ARMs, DNRC maintains a database of its road network. The database layer is maintained by the FMB Technical Services Section. Information necessary to perform updates to the database is provided by the individual unit offices. Non-DNRC roads (e.g., federal, county, local, and private) that are outside forested trust lands and not needed for trust-related activities (forestry, cabin leases, etc.) are not maintained or updated within the GIS data layer. These roads are not included in the summaries below. Non-DNRC roads located on forested trust lands (e.g., private roads, highways, county roads) are included and maintained in DNRC's GIS roads data layer. The information presented in this section is summarized from the DNRC roads database.

Two of the attributes maintained by DNRC in its GIS roads data layer are access classification and seasonal restrictions. Seasonal restrictions are typically specified by start and end dates depending on the location of the road in the planning area. DNRC currently uses five levels of access classification as defined in the Forest Management ARMs:

- **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.

4.4.1.2 Amount 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. Tables 4.4-1 through 4.4-3 summarize miles of existing roads on trust lands by land office (as maintained in DNRC's GIS roads data layer). Table 4.4-1 shows total road miles by land office within the planning and HCP project areas. Tables 4.4-2 and 4.4-3 present total road miles by access classification for the planning area and HCP project area, respectively.

TABLE 4.4-1. MILES OF ROAD ON TRUST LANDS BY LAND OFFICE

Land Office	Miles of Road on Trust Lands in the Planning Area[1]	Miles of Road on Trust Lands in the HCP Project Area[1]	Percent of Total Road Miles on Trust Lands in the HCP Project Area[2]
NWLO	1,669.4	1,412.3	84.6
Stillwater Block	362.7	361.3	99.6
Swan River State Forest	226.7	224.2	98.8
Scattered	1080.0	826.7	76.5
SWLO	1,238.9	942.5	76.1
CLO	2,517.8	290.4	11.5
Total	**5,426.1**	**2,645.1**	**48.7**
Blocked	**589.4**	**585.5**	**99.3**
Scattered	**4,836.7**	**2,059.6**	**42.6**

[1] Roads classified as proposed were not included in mileage calculations.
[2] Percentage calculated as miles of road on trust lands in the HCP project area divided by miles of road on trust lands in the planning area.
Source: DNRC (2008a).

TABLE 4.4-2. MILES OF ROAD ON TRUST LANDS WITHIN THE PLANNING AREA BY CLASS AND LAND OFFICE

Land Office	Highway/ County	Open	Restricted Seasonally	Restricted Year-Round	Abandoned	Reclaimed	Total
NWLO	44.5	796.5	16.8	736.0	45.5	30.2	1,669.4
Stillwater Block	2.4	123.9	6.4	229.6	0.0	0.3	362.7
Swan River State Forest	7.3	40.1	5.3	164.4	9.3	0.4	226.7
Scattered	92.0	580.4	5.1	342.0	36.2	29.5	1080.0
SWLO	253.1	551.7	18.4	374.9	40.9	18.3	1,238.9
CLO	99.4	2,291.8	13.8	87.7	28.9	9.9	2,517.8
Total	**454.2**	**3,550.6**	**49.0**	**1,198.6**	**115.3**	**58.4**	**5,426.1**
Blocked	**9.7**	**164.0**	**11.7**	**394.0**	**9.3**	**0.7**	**589.4**
Scattered	**444.5**	**3,386.6**	**37.3**	**804.6**	**106.0**	**57.7**	**4,836.7**

Note: Roads classified as proposed were not included in mileage calculations.
Source: DNRC (2008a).

TABLE 4.4-3. MILES OF ROAD ON TRUST LANDS WITHIN THE PROJECT AREA BY CLASS AND LAND OFFICE

Land Office	Highway/ County	Open	Restricted Seasonally	Restricted Year-Round	Abandoned	Reclaimed	Total
NWLO	25.5	641.8	16.8	674.2	37.3	16.7	1,412.3
Stillwater Block	1.9	123.4	6.4	229.3	0.0	0.3	361.3
Swan River State Forest	6.9	38.1	5.3	164.2	9.3	0.4	224.2
Scattered	73.9	423.1	5.1	280.8	28.0	15.9	826.7
SWLO	225.0	323.3	14.9	332.9	29.6	16.7	942.4
CLO	10.8	210.3	12.8	22.3	28.4	5.8	290.5
Total	**318.4**	**1,118.2**	**44.5**	**1,029.5**	**95.2**	**39.2**	**2,645.1**
Blocked	**8.8**	**161.5**	**11.7**	**393.5**	**9.3**	**0.7**	**585.5**
Scattered	**309.6**	**956.7**	**32.8**	**636.0**	**85.9**	**38.5**	**2,059.6**

Note: Roads classified as proposed were not included in mileage calculations.
Source: DNRC (2008a).

Planning Area and HCP Project Area

There are approximately 5,426 miles of road on trust lands within the planning area, and 2,645 (49 percent) of these road miles are located on trust lands included in the HCP project area (Table 4.4-1). More than half of the road miles included in the HCP project area are located within the NWLO (1,412 miles). Roads within the NWLO and SWLO comprise nearly 90 percent of all the road miles within the HCP project area. Within the NWLO, about 85 percent of the road miles on trust lands are included in the project area (1,412 of 1,669 miles), while approximately 76 percent are included for the SWLO (942 of 1,239 miles) and about 12 percent are included for the CLO (291 of 2,518 miles).

On all trust lands within the planning area (Table 4.4-2), 4,005 miles of the 5,426 miles of road are classified as open to public access (including highways and county roads), and 1,199 miles are restricted year-round to public access. The remaining road miles are split between seasonally restricted (49 miles), abandoned (115 miles), and reclaimed (58 miles). Within the HCP project area (Table 4.4-3), there are 1,437 miles of open roads (including highways and county roads), 1,030 miles of year-round restricted roads, 45 miles of seasonally restricted roads, 95 miles of abandoned roads, and 39 miles of reclaimed roads.

Stillwater Block

Approximately 363 miles of road are located within the Stillwater Block, and 361 of these are included in the HCP project area (Table 4.4-1). Of those roads included in the HCP project area, 125 miles are open to public access (including highways and county roads), 229 miles are restricted year-round to public access, 6 miles are restricted seasonally, and less than 0.5 mile has been reclaimed (Table 4.4-3). DNRC currently restricts public access, either year-round or seasonally, on nearly 65 percent of the roads within the Stillwater Block.

The Stillwater Core has been managed in the past, so roads, excavated skid trails, and regenerating clearcuts are present (Figure D-4 in Appendix D, EIS Figures). Two road systems access this area, which is currently managed as grizzly bear security core – Stryker Basin, which leads to Stryker Lake, and Herrig Basin, which leads to Herrig Lake. While DNRC is using these road systems minimally due to grizzly bear security core restrictions, these road miles are included in the presentation of total road miles in the Stillwater Block contained in Tables 4.4-1 through 4.4-3. Current ARMs dictate that forest management activities conducted during the non-denning season are conducted around the perimeter of the area using methods that do not require roaded access.

Swan River State Forest

The blocked lands within the Swan River State Forest are included in the area covered by the Swan Agreement. Under this agreement, the USFS (Flathead National Forest), Plum Creek, and DNRC coordinate management of their lands as a large contiguous block. The USFWS is also a party to this agreement since the grizzly bear is a federally listed species. This agreement contains habitat management guidelines that affect how DNRC manages roads within the Swan River State Forest (USFWS 1995). The guidelines applicable to road management include the following:

- Reduce open road density with BMU subunits, then maintain lower densities over the long term.
- Limit construction of new roads, and minimize density/mileage of new roads in preferred habitat areas and riparian zones.
- Reclaim existing roads not required for short-term management.
- Relocate roads needed for ongoing primary access when reasonable.

All but about 3 of the 227 miles of road located on blocked Swan River State Forest lands are included in the HCP project area (Table 4.4-1) (Figure D-5 in Appendix D, EIS Figures). Of all the Swan River State Forest roads in the HCP project area, 45 miles are open to public access (including highway and county roads), 164 miles are restricted year-round to public access, 5 miles are restricted seasonally, 9 miles are abandoned, and less than 0.5 mile has been reclaimed (Table 4.4-3). More than 75 percent of the road miles on blocked HCP project area lands within the Swan River State Forest are closed to public access either seasonally or year-round.

Scattered Parcels

Outside the Stillwater Block and Swan River State Forest, which are both located in the NWLO, trust lands within the rest of the HCP project area are scattered throughout the planning area and generally not contiguous. Of the 5,426 miles of road on trust lands within the planning area, 4,837 (89 percent) are on scattered parcels. While nearly all roads located within blocked trust lands are included in the HCP project area, less than half (43 percent) of all roads located on scattered parcels are included (Table 4.4-1). Within the HCP project area, 2,060 of the 2,645 miles (78 percent) are located on scattered parcels (Table 4.4-1). Of these 2,060 miles, more than half (1,266 miles) are open to public access year-round (including highways and county roads), more than 30 percent (669 miles) are restricted seasonally or year-round, and about 6 percent (124 miles) have been either abandoned or reclaimed (Table 4.4-3).

Roads located on scattered parcels within the NWLO total 1,080 miles, and 827 miles (77 percent) of these roads are included in the HCP project area (Table 4.4-1). Within both the planning area and HCP project area, more than half the road miles on scattered parcels in the NWLO (580 and 423, respectively) are open to public access year-round (Tables 4.4-2 and 4.4-3). For the remaining roads on NWLO scattered parcels in the HCP project area, about 35 percent (286 miles) are restricted either seasonally or year-round (Table 4.4-3).

Within the SWLO, roads located on trust lands total 1,239 miles (Tables 4.4-1 and 4.4-2), while those located on HCP project area lands total about 942 miles (Table 4.4-3). Of those roads on HCP project area lands in the SWLO, more than half (548 miles) are open to public access year-round (including highways and county roads), and about 37 percent (348 miles) are restricted either seasonally or year-round.

There are approximately 2,518 miles of road on trust lands within the CLO (Tables 4.4-1 and 4.4-2), and about 290 miles (12 percent) of these roads are included in the HCP project area (Table 4.4-3). These 290 miles of road constitute about 14 percent of all road miles on scattered parcels included in the HCP project area. About 72 percent of the HCP project area roads in the CLO (210 miles) are maintained as open to public access year-round (Table 4.4-3).

4.4.1.3 Distribution of Roads

While miles of road, as discussed above, provides a measure of total potential impacts, road density (mi/mi^2) 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.

Tables 4.4-4 and 4.4-5 summarize existing total and open road density on trust lands by land office for the planning area and HCP project area, respectively. These densities were calculated using DNRC's GIS roads data layer. Additionally, linear road densities were calculated for all trust lands within each category summarized in the tables, rather than for individual parcels.

<u>Planning Area and HCP Project Area</u>

The total road density for trust lands in the HCP project area is substantially higher than for trust lands within the planning area (3.1 mi/mi^2 versus 1.9 mi/mi^2). Because nearly all roads in the blocked lands are included in the HCP project area, this difference is primarily due to the inclusion of scattered parcels that tend to be more heavily roaded as a result of forest management activities (Tables 4.4-4 and 4.4-5).

<u>Stillwater Block</u>

For planning area and HCP project area lands within the Stillwater Block, the total road densities are similar (2.6 mi/mi^2 and 2.5 mi/mi^2, respectively), and open road densities are the same (0.9 mi/mi^2) (Tables 4.4-4 and 4.4-5). Lower open road densities for the Coal Creek and Stillwater State Forests reflect DNRC's road management strategy for blocked lands. Coal Creek and Stillwater State Forest roads are managed at a landscape level to meet threatened and endangered species, big game, sensitive species, and biodiversity resource management standards when

conducting forest management activities. This includes managing roads within this block to minimize the amount of land with open road densities greater than 1.0 mi/mi^2 (ARM 36.11.432). As shown in Tables 4.4-4 and 4.4-5, the open road density within this entire block is currently less than the 1.0 mi/mi^2 threshold for both the planning area and HCP project area.

Swan River State Forest

Under the Swan Agreement, DNRC, the USFS, and Plum Creek cooperatively manage roads on their lands in the Swan River Valley at a landscape level to meet Swan Agreement requirements. In the Swan River State Forest, the total and open road densities on trust lands are the same (3.6 mi/mi^2 and 0.7 mi/mi^2, respectively) for both the planning area and HCP project area (Tables 4.4-4 and 4.4-5). Total road density within this block is higher than for the NWLO as a whole in both the planning area and HCP project area (3.6 mi/mi^2 versus 3.4 mi/mi^2), while open road density is lower than for the Stillwater Block and NWLO scattered parcels in both the planning area and HCP project area (Tables 4.4-4 and 4.4-5).

Scattered Parcels

Linear road densities for scattered parcels within the HCP project area are generally similar to those for scattered parcels in the planning area. Most differences in linear road densities on scattered parcels between the planning area and the HCP project area are small (higher or lower by 0.1 to 0.3 mi/mi^2) (Tables 4.4-4 and 4.4-5).

For scattered parcels in the HCP project area, total road densities range from 1.6 mi/mi^2 for the CLO to 3.7 mi/mi^2 for the NWLO and SWLO. Open road densities are generally low, ranging from 1.3 to 1.9 mi/mi^2 (Table 4.4-5). For scattered parcels in both the NWLO and SWLO, open road densities in the HCP project area are slightly lower than those in the planning area. Conversely, the open road density for scattered parcels in the CLO is slightly higher in the HCP project area than in the planning area (Tables 4.4-4 and 4.4-5).

The lowest total road density for scattered parcels within the planning area is found within the CLO (1.3 mi/mi^2) (Table 4.4-4). The CLO also has the lowest total road density for scattered parcels in the HCP project area (1.6 mi/mi^2) (Table 4.4-5). The lower densities in the CLO reflect a lower level of available timber for commercial harvest (as compared to the NWLO and SWLO), which requires road networks to access lands for harvest.

TABLE 4.4-4. MILES AND LINEAR DENSITY OF ROAD ON TRUST LANDS WITHIN THE PLANNING AREA BY LAND OFFICE

Land Office	Trust Land Area (Acres)	Trust Land Area (Square Miles[5])	Miles of Road[6]	Linear Road Density[7]
NWLO	**316,255**	**494.1**	**1,669.4**	**3.4**
Stillwater Block[1]	**90,802**	**141.9**	**362.7**	**2.6**
Highway/County/Private[2]			2.4	0.0
Open[3]			123.9	0.9
Restricted Seasonally[3]			6.4	0.0
Restricted Year-Round			229.6	1.6
Abandoned/Reclaimed			0.3	0.0
Swan River State Forest	**39,833**	**62.2**	**226.7**	**3.6**
Highway/County/Private[2]			7.3	0.1
Open/Restricted Seasonally[4]			45.4	0.7
Restricted Year-Round			164.4	2.6
Abandoned/Reclaimed			9.7	0.2
Scattered Parcels	**185,620**	**290.0**	**1,080.0**	**3.7**
Highway/County/Private[2]			92.0	0.3
Open/Restricted Seasonally[4]			580.4	2.0
Restricted Year-Round			342.0	1.2
Abandoned/Reclaimed			65.7	0.2
SWLO (Scattered Parcels)	**234,744**	**366.8**	**1,238.9**	**3.4**
Highway/County/Private[2]			253.1	0.7
Open/Restricted Seasonally[4]			551.7	1.5
Restricted Year-Round			374.9	1.0
Abandoned/Reclaimed			59.2	0.2
CLO (Scattered Parcels)	**1,262,530**	**1,972.7**	**2,517.8**	**1.3**
Highway/County/Private[2]			99.4	0.1
Open/Restricted Seasonally[4]			2,291.8	1.2
Restricted Year-Round			87.7	0.0
Abandoned/Reclaimed			38.8	0.0
Project Area Total	**1,813,529**	**2,833.6**	**5,426.1**	**1.9**

[1] Includes the Coal Creek State Forest and the blocked portion of the Stillwater State Forest.
[2] The Highway/County/Private category contains those roads over which DNRC has no ownership.
[3] For the Stillwater Block, the Open and Restricted Seasonally road categories are displayed separately.
[4] For the Swan River State Forest and scattered parcels, the Open/Restricted Seasonally category primarily represents open roads, because there are very few seasonally restricted roads in these road systems under current conditions.
[5] Square miles of trust lands calculated as acres of trust lands divided by 640.
[6] Proposed roads were not included in mileage calculations.
[7] Density calculated as miles of total roads on trust lands divided by square miles of trust lands.
Source: DNRC (2008a).

TABLE 4.4-5. MILES AND LINEAR DENSITY OF ROAD ON TRUST LANDS WITHIN THE PROJECT AREA BY LAND OFFICE

Land Office	Trust Land Area (Acres)	Trust Land Area (Square Miles[5])	Miles of Road[6]	Linear Road Density[7]
NWLO	**273,400**	**427.2**	**1,412.3**	**3.3**
Stillwater Block[1]	**90,720**	**141.8**	**361.3**	**2.5**
Highway/County/Private[2]			1.9	0.0
Open[3]			123.4	0.9
Restricted Seasonally[3]			6.4	0.0
Restricted Year-Round			229.3	1.6
Abandoned/Reclaimed			0.3	0.0
Swan River State Forest	**39,699**	**62.0**	**224.2**	**3.6**
Highway/County/Private[2]			6.9	0.1
Open/Restricted Seasonally[4]			43.4	0.7
Restricted Year-Round			164.2	2.6
Abandoned/Reclaimed			9.7	0.2
Scattered Parcels	**142,981**	**223.4**	**826.7**	**3.7**
Highway/County/Private[2]			73.9	0.3
Open/Restricted Seasonally[4]			428.2	1.9
Restricted Year-Round			280.8	1.3
Abandoned/Reclaimed			43.9	0.2
SWLO (Scattered Parcels)	**161,927**	**253.0**	**942.4**	**3.7**
Highway/County/Private[2]			225.0	0.9
Open/Restricted Seasonally[4]			338.2	1.3
Restricted Year-Round			332.9	1.3
Abandoned/Reclaimed			46.3	0.2
CLO (Scattered Parcels)	**113,182**	**176.8**	**290.5**	**1.6**
Highway/County/Private[2]			10.8	0.1
Open/Restricted Seasonally[4]			223.1	1.3
Restricted Year-Round			22.3	0.1
Abandoned/Reclaimed			34.2	0.2
Project Area Total	**548,509**	**857.0**	**2,645.1**	**3.1**

[1] Includes the Coal Creek State Forest and the blocked portion of the Stillwater State Forest.
[2] The Highway/County/Private category contains those roads over which DNRC has no ownership.
[3] For the Stillwater Block, the Open and Restricted Seasonally road categories are displayed separately.
[4] For the Swan River State Forest and scattered parcels, the Open/Restricted Seasonally category primarily represents open roads, because there are very few seasonally restricted roads in these road systems under current conditions.
[5] Square miles of trust lands calculated as acres of trust lands divided by 640.
[6] Proposed roads were not included in mileage calculations.
[7] Density calculated as miles of total roads on trust lands divided by square miles of trust lands.
Source: DNRC (2008a).

4.4.2 ENVIRONMENTAL CONSEQUENCES

This section describes the effects of the no-action alternative and the three action alternatives on transportation management issues relating to the current and future road networks on trust lands. Effects discussed in this section include potential short- and long-term direct and indirect effects anticipated under the proposed action alternatives relative to what is expected to occur under the no-action alternative over the Permit term.

4.4.2.1 Introduction and Evaluation Criteria

Roads provide access to forested trust lands for the purposes of conducting forest management activities; public access to various recreational resources; and access to adjacent land. In contrast, 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 pressure). While the types of road-related effects specific to these resources (geology and soils, water, fisheries, wildlife, and recreation) are addressed in their respective sections, changes in levels of road-related effects on these resources between alternatives depend on changes to the road network and how it is managed. This section, therefore, describes how the current road network would be expected to change across the landscape during the Permit term under the various alternatives.

Changes in the road network are evaluated in terms of amount, distribution (density and location), and condition of roads. The specific evaluation criteria used for this analysis are

- Expected changes to road management
- Expected changes in amount of road (miles)
- Expected changes in distribution (density and location) of roads.

To support this evaluation, existing miles of road by classification were determined using DNRC's GIS roads data layer (as described in Section 4.4.1, Affected Environment), and miles of road present at the end of the Permit term under each alternative were estimated using methods described by DNRC (2007b, 2007c). Roads classified as highway, county, or private do change over time. However, DNRC has no ownership of these roads and any changes over time in these roads could not be predicted. An additional class (proposed roads) was added to the data layer. Proposed roads include roads not yet constructed but proposed for construction under each alternative. DNRC also uses temporary roads, which are reclaimed after use. They do not appear in the GIS layer due to their short life span. Expected changes to DNRC's road network are described within each area of blocked lands (Stillwater Block and Swan River State Forest) and at the landscape level for scattered parcels throughout the rest of the HCP project area.

It should be noted, however, that the classifications for abandoned and reclaimed roads would be modified somewhat under the action alternatives. For these three alternatives, abandoned roads would include those roads made impassable and effectively closed using gates or other barriers, with drainage structures maintained. Reclaimed roads would be defined as roads that are impassable due to effective closure and not used for low-intensity or commercial forest management activities. These roads would be stabilized, with any culverts and other structures removed, but the road prism may remain.

This section also addresses concerns raised during public scoping, including

- Access to trust lands (e.g., for recreation)
- Access to private and other public lands through trust lands
- Restricted access to lands due to road closures
- Effects of the HCP on existing roads
- Minimization of new road construction to reduce adverse environmental impacts
- Identification of road management strategies to reduce adverse environmental impacts (e.g., minimizing new road construction and correct sizing of culverts and bridges)
- Access to closed roads for administrative uses (e.g., maintaining existing drainage structures)
- Active management of roads (open for a defined number of years, then closed for a specific period of time)
- DNRC's ability to control timing and use of cost-share road systems.

4.4.2.2 Alternative 1 (No Action)

Road Management

Under Alternative 1, at the program level, DNRC would continue to direct road management according to ARM 36.11.421. Generally, DNRC would aim to minimize the extent of roads and impacts of roads on resources.

Within grizzly bear recovery zones, DNRC would examine and repair road closures on the Stillwater Block and Swan River State Forest annually as required under ARM (36.11.432(j)) with no schedule specified, however), but would not do so on scattered parcels. DNRC would continue to consider environmental impacts from easements using its *Access Road Easement Policy* (DNRC 2006c). On the scattered parcels in recovery zones, DNRC would not allow any permanent increases in open road densities for parcels already exceeding 1.0 mi/mi^2 but would not require documentation of rationale for not restricting or closing open roads. Total road density would be reduced when compatible with other agency goals and objectives. DNRC's GIS roads data layer would be updated only through project implementation.

In the Stillwater Block, there would be no long-term transportation commitments; however, there would continue to be no net increase from 1996 baseline in the proportion of BMUs with road densities exceeding 1.0 mi/mi^2 without FMB chief approval. Under the existing policy, the Stillwater Core would receive minimal management, and the two existing major road systems in this area (Stryker Basin and Herrig Basin) would continue to be restricted year-round to motorized public access. Seasonal closures and activity restrictions to mitigate for proposed actions would be developed on a case-by-case basis.

In the Swan River State Forest, the transportation system would continue to be managed in accordance with the Swan Agreement. Under this agreement, DNRC would continue to keep open

road densities below 1.0 mi/mi^2 on at least 33 percent of BMU subunits, but there would be no limit on new permanent or temporary road construction (closed to public access) or traffic limits on DNRC restricted-use roads.

Within the Stillwater Block and Swan River State Forest, road maintenance needs would continue to be identified and prioritized within the required 5-year cycle, and ineffective road closures would be monitored annually and repaired within one operating season. For roads on scattered parcels, road maintenance needs and ineffective road closures may not be identified for more than 5 years if DNRC remains unable to meet the 5-year requirement or revises the rules to extend the cycle for these roads. Under existing practices on scattered parcels, maintenance activities and repairs would not be required to be completed within any specified timeframe. Road maintenance needs could remain unidentified for up to five years in the Stillwater Block and Swan River State Forest, and five or more years on scattered parcels, potentially causing adverse effects to other resources during this time and until these sites are addressed.

In NROH, DNRC would consider public access, wildlife habitat, and needs of adjacent landowners in managing existing roads and building new roads.

To minimize sediment delivery from roads, existing BMPs would be implemented and construction of new roads would be prohibited in SMZs, except where stream crossings are needed. DNRC's ongoing sediment delivery road inventory would continue, but no completion date would be specified. DNRC would complete sediment delivery road inventory during timber sale planning, design, and environmental assessment. Roads would be brought up to BMP standards on a project-by-project basis where feasible and when funding is available. While not required by the ARMs, a DNRC water resource specialist typically reviews proposed road management activities in watersheds with sensitive fish species and makes recommendations to reduce the risk of sediment delivery.

For any new road construction or maintenance of existing roads, DNRC would incorporate appropriate fish passage designs at all stream crossings on fish-bearing streams as specified in MCA 87-5-501 and the Montana Stream Protection Act (124 permits). All information on fish passage at road crossings would be maintained in the existing DNRC fish passage inventory and connectivity assessment. However, the timeframe for retrofitting existing stream crossings with fish-passable structures would be undetermined and instead based on road construction and maintenance schedules. Additionally, new or repaired structures would only need to be designed to meet hydraulic conditions, rather than taking into consideration HCP fish species passage and connectivity.

Amount of Roads

Under Alternative 1, the mileage of road is expected to increase from the existing 2,645 miles of road on HCP project area lands to 4,053 miles by Year 50 (Table 4.4-6). This represents a 53 percent increase in total road mileage compared to existing conditions. Approximately 1,079 miles of newly constructed road would be restricted year-round to public access, while 41 miles would be open or restricted seasonally. About 94 percent of the new road mileage is projected to occur on scattered parcels within the three land offices. The NWLO would have the greatest increase in road mileage, with approximately 731 miles added. Approximately 89 miles of

new road would occur in the Stillwater Block and Swan River State Forest combined, all of which would be restricted year-round to public access. In the Swan River State Forest, there would be no increase in open road miles due to limitations established in the Swan Agreement. By the end of the 50-year Permit term, the SWLO and CLO would have 473 and 204 miles of new road, respectively.

Distribution of Roads

Table 4.4-7 provides estimates of road densities expected by the end of the Permit term. For the entire HCP project area, total road density would increase from 3.1 to 4.7 mi/mi^2.

Total road density on all scattered parcels would increase from 3.6 to 6.6 mi/mi^2, largely due to increases in densities of roads restricted year-round to public access. Total road density on these lands would be reduced when compatible with other agency goals and objectives. On the scattered parcels in recovery zones and in the CYE, DNRC would not allow any permanent increases in open road densities for parcels already exceeding 1.0 mi/mi^2 but would not require documentation of rationale for not restricting or closing open roads.

Within the NWLO, total road density is expected to increase from 3.3 to 5.0 mi/mi^2. Most of this increase would occur from additional roads on the scattered parcels within this land office. The open road density for scattered parcels in the NWLO would increase slightly from 1.9 to 2.0 mi/mi^2.

Under Alternative 1, total road density in the SWLO is expected to increase from 3.7 to 5.6 mi/mi^2 and, in the CLO, from 1.6 to 2.8 mi/mi^2. As in the NWLO, most of these increases would result from additional roads restricted year-round to public access. Open road density would increase slightly in the SWLO (1.3 to 1.4 mi/mi^2) and remain unchanged in the CLO (1.3 mi/mi^2).

Locations of new roads constructed under Alternative 1 would be determined on a project-by-project basis. However, these roads would be subject to requirements and restrictions existing under the current regulatory framework. While the road management ARM includes landscape-level transportation planning, as well as directives to minimize new road construction and in some areas, maintain low open road densities, DNRC would not commit to a specific transportation plan for the Permit term under Alternative 1. DNRC's GIS roads data layer would be updated only through project implementation.

TABLE 4.4-6. PREDICTED LINEAR MILES OF ROAD BY ROAD CLASS ON DNRC BLOCKED LANDS AND SCATTERED PARCELS IN THE HCP PROJECT AREA, BY ALTERNATIVE, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

		Alternative			
Land Office	**Current Condition**	**1 No Action**	**2 Proposed HCP**	**3 Increased Mitigation Measures**	**4 Increased Management Flexibility**
NWLO	**1,412.3**	**2,143.6**	**2,132.8**	**2,087.3**	**2,132.8**
Stillwater Block[1]	**361.3**	**378.9**	**380.5**	**378.9**	**380.5**
Highway/County/Private[2]	1.9	1.9	1.9	1.9	1.9
Open[3]	123.4	123.4	105.1	123.4	105.1
Restricted Seasonally[3]	6.4	6.4	54.0	6.4	54.0
Restricted Year-Round	229.3	246.9	219.2	246.9	219.2
Abandoned/Reclaimed	0.3	0.3	0.3	0.3	0.3
Swan River State Forest	**224.2**	**295.7**	**295.7**	**295.7**	**295.7**
Highway/County/Private[2]	6.9	6.9	6.9	6.9	6.9
Open/Restricted Seasonally[4]	43.4	43.4	66.5[5]	66.5[5]	66.5[5]
Restricted Year-Round	164.2	234.5	211.4	211.4	211.4
Abandoned/Reclaimed	9.7	10.9	10.9	10.9	10.9
Scattered Parcels	**826.7**	**1,469.0**	**1,456.6**	**1,412.7**	**1,456.6**
Highway/County/Private[2]	73.9	73.9	73.9	73.9	73.9
Open/Restricted Seasonally[4]	428.2	448.0	435.6	435.6	435.6
Restricted Year-Round	280.8	679.8	679.8	635.8	679.8
Abandoned/Reclaimed	43.9	267.4	267.4	267.4	267.4
SWLO (Scattered Parcels)	**942.4**	**1,414.9**	**1,408.2**	**1,389.4**	**1,408.2**
Highway/County/Private[2]	225.0	225.0	225.0	225.0	225.0
Open/Restricted Seasonally[4]	338.2	353.8	347.0	347.0	347.0
Restricted Year-Round	332.9	741.4	741.4	722.6	741.4
Abandoned/Reclaimed	46.3	94.8	94.8	94.8	94.8
CLO (Scattered Parcels)	**290.5**	**494.5**	**491.4**	**490.4**	**491.4**
Highway/County/Private[2]	10.8	10.8	10.8	10.8	10.8
Open/Restricted Seasonally[4]	223.1	229.1	226.0	226.0	226.0
Restricted Year-Round	22.3	206.3	206.3	205.3	206.3
Abandoned/Reclaimed	34.2	48.2	48.2	48.2	48.2
Project Area Total	**2,645.1**	**4,053.0**	**4,032.5**	**3,967.1**	**4,032.5**

[1] Includes the Coal Creek State Forest and the blocked portion of the Stillwater State Forest.
[2] The Highway/County/Private category contains those roads over which DNRC has no ownership; thus the mileages remain constant throughout the Permit term by alternative because DNRC cannot predict how those road mileages may change over time.
[3] For the Stillwater Block, increases in the Open and Restricted Seasonally road categories are displayed separately. Unlike the other road systems in the HCP project area, there are several miles of seasonally restricted road under Alternatives 2 and 4.
[4] For the Swan River State Forest and scattered parcels, the Open/Restricted Seasonally category primarily represents open roads, because there are very few seasonally restricted roads in these road systems under current conditions and all alternatives.
[5] The estimated total of 66.5 miles of open road in the Swan River State Forest under the action alternatives reflects a worst-case scenario.
Source: DNRC (2008a).

TABLE 4.4-7. PREDICTED ROAD DENSITY BY ROAD CLASS USING LINEAR CALCULATION OF MILES PER SQUARE MILE ON DNRC BLOCKED LANDS AND SCATTERED PARCELS IN THE HCP PROJECT AREA, BY ALTERNATIVE, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

		Alternative			
Land Office	**Current Condition**	**1 No Action**	**2 Proposed HCP**	**3 Increased Mitigation Measures**	**4 Increased Management Flexibility**
NWLO	**3.3**	**5.0**	**5.0**	**4.9**	**5.0**
Stillwater Block[1]	**2.6**	**2.7**	**2.7**	**2.7**	**2.7**
Highway/County/Private[2]	0.0	0.0	0.0	0.0	0.0
Open[3]	0.9	0.9	0.7	0.9	0.7
Restricted Seasonally[3]	0.0	0.0	0.4	0.0	0.4
Restricted Year-Round	1.6	1.7	1.5	1.7	1.5
Abandoned/Reclaimed	0.0	0.0	0.0	0.0	0.0
Swan River State Forest	**3.6**	**4.8**	**4.8**	**4.8**	**4.8**
Highway/County/Private[2]	0.1	0.1	0.1	0.1	0.1
Open/Restricted Seasonally[4]	0.7	0.7	1.1[5]	1.1[5]	1.1[5]
Restricted Year-Round	2.6	3.8	3.4	3.4	3.4
Abandoned/Reclaimed	0.2	0.2	0.2	0.2	0.2
Scattered Parcels	**3.7**	**6.6**	**6.5**	**6.3**	**6.5**
Highway/County/Private[2]	0.3	0.3	0.3	0.3	0.3
Open/Restricted Seasonally[4]	1.9	2.0	1.9	1.9	1.9
Restricted Year-Round	1.3	3.0	3.0	2.8	3.0
Abandoned/Reclaimed	0.2	1.2	1.2	1.2	1.2
SWLO (Scattered Parcels)	**3.7**	**5.6**	**5.6**	**5.5**	**5.6**
Highway/County/Private[2]	0.9	0.9	0.9	0.9	0.9
Open/Restricted Seasonally[4]	1.3	1.4	1.4	1.4	1.4
Restricted Year-Round	1.3	2.9	2.9	2.9	2.9
Abandoned/Reclaimed	0.2	0.4	0.4	0.4	0.4
CLO (Scattered Parcels)	**1.6**	**2.8**	**2.8**	**2.8**	**2.8**
Highway/County/Private[2]	0.1	0.1	0.1	0.1	0.1
Open/Restricted Seasonally[4]	1.3	1.3	1.3	1.3	1.3
Restricted Year-Round	0.1	1.2	1.2	1.2	1.2
Abandoned/Reclaimed	0.2	0.3	0.3	0.3	0.3
Project Area Total	**3.1**	**4.7**	**4.7**	**4.6**	**4.7**

[1] Includes the Coal Creek State Forest and the blocked portion of the Stillwater State Forest.
[2] The Highway/County/Private category contains those roads over which DNRC has no ownership; thus the mileages remain constant throughout the Permit term by alternative because DNRC cannot predict how those road mileages may change over time.
[3] For the Stillwater Block, increases in the Open and Restricted Seasonally road categories are displayed separately. Unlike the other road systems in the HCP project area, there are several miles of seasonally restricted road under Alternatives 2 and 4.
[4] For the Swan River State Forest and scattered parcels, the Open/Restricted Seasonally category primarily represents open roads, because there are very few seasonally restricted roads in these road systems under current conditions and all alternatives.
[5] The estimated total of 66.5 miles of open road in the Swan River State Forest under the action alternatives reflects a worst-case scenario.

Source: DNRC (2008a).

4.4.2.3 Alternative 2 (Proposed HCP)

Road Management

Under Alternative 2, implementation of the HCP would result in many of the same commitments as Alternative 1 at the program level, such as minimizing total roads, implementing BMPs, improving stream crossings, and reducing sediment delivery. For this alternative, however, additional elements related to road management have been added to these and other commitments. The proposed HCP also includes transportation management plans for the Stillwater Block and Swan River State Forest.

As part of its grizzly bear conservation strategy proposed under Alternative 2, DNRC would commit to 50-year transportation management plans for the Stillwater Block (commitment GB-ST1) and Swan River State Forest (commitment GB-SW1). These plans are summarized below, and detailed descriptions are provided in HCP Chapter 2, Conservation Strategies (Appendix A, HCP).

Stillwater Block Transportation Management Plan

DNRC's transportation management plan for the Stillwater Block includes identification of road miles by class, restriction type under current management strategies and estimated under this alternative, and permanent routes needed but not yet constructed by DNRC to fulfill agency responsibilities for the Permit term (see Table 2-2 in Appendix A, HCP). In developing the Stillwater Block transportation plan, DNRC identified situations where greater opportunities exist to provide conservation through consideration of the federal ESA conservation obligations of major adjoining landowners (e.g., USFS, industrial private, or rural and/or residential private). The plan is designed to take advantage of situations where ownership characteristics are likely to provide greater conservation opportunities. Most of the HCP project area within the Stillwater Block is adjacent to federal ownership, where active recovery efforts are occurring; industrial private ownership, where efforts are designed to avoid or minimize take; or rural and/or residential private ownership, where grizzly bears face increases in human activity.

Within the NCDE recovery zone for grizzly bears, this transportation management plan would commit DNRC to a static road system. This transportation plan would minimize the number of new permanent roads and rely on operational equipment that does not require extensive road systems. Having a fixed system would provide for seasonal security associated with habitat value, particularly in the spring period when secure habitat is likely to be most limiting.

The Stillwater Block transportation plan would facilitate management of large blocks of forested trust lands adjacent to USFS lands (subzones) on a schedule of 4 years of management and 8 years of rest. Construction of additional permanent roads in these areas would be prohibited for the Permit term. The fixed transportation system, along with seasonal restrictions and management of the subzones in rest, is a departure from the existing ARMs that require no net increase in open or total road density and no net decrease in grizzly bear security core from the 1996 DNRC baseline road inventory. Under this alternative, the concept of security core would evolve from habitat being located in fixed areas on the landscape to one of providing seasonal security on the forest and providing 8-year rest periods on subzones adjacent to USFS lands classified as security core.

Swan River State Forest Transportation Management Plan

If the Swan Agreement is terminated during the Permit term, the Swan River State Forest would not be able to rely on cooperative road access management, but would continue to implement similar measures as specified in the grizzly bear conservation strategy included in the proposed HCP (Appendix A, HCP). The ability of trust lands alone to provide for linkage would be appreciably compromised if the Swan Agreement is terminated because DNRC would have reduced control of access due to existing easements and loss of cooperative access management with Plum Creek and the USFS. The strategy presented in the proposed HCP is a worst-case scenario for open roads in the area and would not necessarily preclude DNRC participation in future access management agreements. If the Swan Agreement is terminated, land ownership patterns and access options on other ownerships are uncertain. The Swan River State Forest commitments in the proposed HCP would apply to DNRC's HCP project area and roads over which it has full control. This commitment is described in more detail in HCP Chapter 2, Conservation Strategies (Appendix A, HCP), including identification of road miles by class, restriction type under the current Swan Agreement and estimated under this alternative, and permanent routes needed but not yet constructed by DNRC to fulfill agency responsibilities for the Permit term (see Table 2-3 in Appendix A, HCP). This plan also limits new road construction by decade (see Table 2-4 in Appendix A, HCP).

Other Commitments Affecting Road Management

Under Alternative 2, road construction and maintenance would differ from Alternative 1 in terms of limiting new open road construction, increasing rates of and prioritizing road inventory and maintenance to reduce sediment delivery from roads, and increasing rates of and specifying structural requirements for stream crossing improvements on roads for which DNRC has legal access and sole ownership or cost-share or reciprocal agreements.

Under Alternative 2, DNRC's commitment to minimize total roads would be the same as Alternative 1. However, under this alternative, DNRC would minimize open road construction in riparian zones and avalanche chutes (commitment GB-PR4) to protect potential grizzly bear habitat.

Within grizzly bear recovery zones, DNRC would examine all primary road closures on an annual basis and repair ineffective closures within 1 year of identification (commitment GB-RZ3). DNRC would also avoid granting existing or new access across HCP project area lands where possible, except for reciprocal access and cost-share agreements. DNRC would evaluate and condition easements with grizzly bear mitigation measures and work with existing and future reciprocal access grantees to avoid or mitigate impacts to grizzly bears (commitment GB-RZ2).

In NROH, DNRC would minimize construction of new open roads but not establish targets or caps on total road densities (commitment GB-NR1). DNRC would also discourage granting of easements that relinquish DNRC control of roads (commitment GB-NR2).

Road management on the scattered parcels in grizzly bear recovery zones would consist of three primary components (commitment GB-SC1). First, DNRC would evaluate the potential for reducing open roads at the project level and would be required to document rationale for not restricting or closing open roads. Second, at the administrative unit level, open road length would be kept below the HCP analysis baseline. Lastly, DNRC would continually update its GIS roads

data layer. In the CYE, all three components would apply, and for the first component, DNRC would address open road density in an expedited manner (commitment GB-CY4).

Unlike Alternative 1's more general guidelines for reducing sediment delivery from existing roads, Alternative 2 would result in a standardized approach to classifying and prioritizing road segments in need of corrective actions. According to commitment AQ-SD2, DNRC would inventory roads for which it has legal access and sole ownership or cost-share or reciprocal road agreements for sediment delivery in bull trout watersheds within 10 years and westslope cutthroat trout (westslope cutthroat trout) and Columbia redband trout watersheds within 20 years. Corrective actions at sites with high risk of sediment delivery in bull trout watersheds would be completed within 15 years and within 25 years for westslope cutthroat trout and Columbia redband trout watersheds. This alternative would also require that moderate-risk sediment delivery roads in watersheds with HCP fish species be corrected on a project-by-project basis. On roads with shared ownership, DNRC would work with other cooperators to address high-risk sediment delivery road segments.

According to commitment AQ-FC10, any road work would be subject to standard requirements to further minimize impacts to HCP fish species. These requirements would include performing all in-water work within designated construction work windows, excluding fish from affected stream segments during construction, and salvaging fish entrapped by construction activities. Additionally, a DNRC water resource specialist would be required to review all road management activities associated with forest management activities within watersheds supporting HCP fish species and recommend actions to reduce risk of sediment delivery (commitment AQ-SD3). This is in contrast to Alternative 1, under which such review would be expected to typically occur, as it does currently, but would not be required.

According to commitment AQ-FC1 and 2, DNRC would provide connectivity on streams supporting HCP fish species along roads where DNRC has legal access and sole ownership, cost-share agreements, or reciprocal road agreements. Structures would be designed to emulate streambed form and function for low to bankfull flows to minimize adverse effects to bull trout, westslope cutthroat trout, and Columbia redband trout. Selection of new and replacement structures would be dictated by stream conditions, cost, sediment risks, and anticipated use and would be subject to permit approval (commitment AQ-FC9). This measure generally would require DNRC to install larger culverts or bridges than would be required for just hydraulic considerations. DNRC would continually update the fish passage assessment to inventory and assess connectivity for all existing stream crossings so that road-stream crossing improvements could be prioritized for streams with HCP fish species based on connectivity, HCP fish species presence and status, and population conservation goals. For fish connectivity (commitments AQ-FC5, 6, and 7), DNRC would complete connectivity improvements for streams with HCP fish species within 15 years for bull trout streams and 30 years for westslope cutthroat trout and Columbia redband trout streams, with some allowances. Every 5 years, commitment AQ-FC8 would require that one-sixth of all sites not meeting fish connectivity conservation strategy objectives be improved to meet the strategy, or at least have final plans and designs completed for improvement.

Amount of Roads

Under Alternative 2, the miles of new road constructed by year 50 (1,387 miles) would be approximately 21 miles lower than Alternative 1, which represents a 1.5 percent reduction

(Table 4.4-6). The NWLO, SWLO, and CLO would have 11, 7, and 3 fewer miles of new permanent road, respectively, compared to Alternative 1. Total road miles in the Stillwater Block would be approximately 2 miles higher than under Alternative 1. Miles of new road in the Swan River State Forest would be the same as under Alternative 1, but as many as 23 miles could be reclassified as open or restricted seasonally from restricted year-round if the Swan Agreement dissolves during the Permit term (Table 4.4-6).

Under Alternative 2, a relatively low amount of road construction would occur in the Stillwater Block (11 new roads totaling approximately 19 miles), but these roads would be closed to the public year-round. Some of these roads would provide additional access within the Stillwater Core, but DNRC would primarily improve existing roads that are currently closed. Overall in the Stillwater Block, open roads would be reduced by approximately 18 miles and these roads would be reclassified as closed year-round. Roads closed to motorized public access but open to unrestricted DNRC use would be reduced overall by approximately 29 miles and distributed into other road classes that also restrict DNRC use. Roads seasonally restricted from motorized public access and subject to varying degrees of DNRC use would increase by approximately 54 miles (see Table 2-2 in Appendix A, HCP).

Under this alternative, DNRC would construct approximately 70 miles of new road in the Swan River State Forest (Table 4.4-6). These new roads would become part of the permanent road system but not open for public use. Some slight variation in precise road locations, versus those specified in the transportation plan, would be needed to better accommodate BMPs and logging system design. New temporary roads would be limited to no more than 5 miles per year. DNRC would limit traffic on DNRC restricted-use roads to "low use" (less than 1 vehicle per day) except roads used for commercial forest management activities.

Classifications of roads in the Swan River State Forest would vary depending on whether the Swan Agreement stays in effect or is terminated. The estimated miles of road by type shown in Table 4.4-6 reflect the worst-case scenario should the Swan Agreement be terminated. If this happens, or if neighboring lands change ownership, as many as approximately 28.4 miles of road originally classified as restricted (either seasonally or year-round) in existing reciprocal access agreements could change to open under subsequent reciprocal access agreements. The total miles of open road would increase from 43.4 miles to as much as 66.5 miles, depending on the status of access agreements with adjacent landowners and the timing of individual landowners' decisions to pursue access across parcels of trust land. Additionally, all existing roads without reciprocal access agreements (approximately 41.4 miles) would then be managed under the proposed HCP and acquire greater restrictions on commercial and DNRC access for forest management activities. However, if the Swan Agreement remains in effect, no changes in miles of open road would be expected. Under either scenario, no new restrictions would be placed on any roads currently classified as open to public access.

Distribution of Roads

Road densities by year 50 under Alternative 2 would be similar to those estimated for Alternative 1 (Table 4.4-7). For the entire HCP project area, total road density would also reach 4.7 mi/mi^2 by the end of the Permit term. Road densities at Year 50 on scattered parcels in the SWLO and CLO would be the same as those estimated for Alternative 1, although slight differences in actual road

miles would occur (Table 4.4-6). For both the Stillwater Block and Swan River State Forest, Alternative 2 would result in higher open road densities (including seasonally restricted roads) and lower year-round restricted road densities as compared to Alternative 1. The increase in open road density in the Swan River State Forest would be worse-case should the Swan Agreement dissolve; otherwise, this density would be the same as under Alternative 1. For scattered parcels in the NWLO, total and open road densities would be slightly lower than for Alternative 1 (6.5 versus 6.6 mi/mi^2 and 1.9 versus 2.0 mi/mi^2, respectively).

For the Stillwater Block, DNRC would implement a 50-year transportation plan, which defines a fixed transportation system and limits or prohibits road construction in certain areas. Under this alternative, DNRC would commit to the locations and classifications of roads identified in this plan (Figure D-4 in Appendix D, EIS Figures). Should the Swan Agreement dissolve, DNRC would also implement a 50-year transportation plan for the Swan River State Forest. This plan would also define a fixed transportation system to be implemented over the 50-year Permit term (Figure D-5 in Appendix D, EIS Figures).

4.4.2.4 Alternative 3 (Increased Conservation HCP)

Road Management

HCP commitments related to road management under Alternative 3 would be similar to those under Alternative 2. Additional restrictions and shorter timeframes for completing some commitments would result in lower risk for road-related effects. Within the Stillwater Block, however, a transportation management plan would not be adopted as would occur under Alternative 2.

Road management on the scattered parcels in grizzly bear recovery zones would be the same as Alternative 2, with the additional restriction of no net increase in baseline total road density for forest management projects at the administrative unit level.

While Alternative 2 would require all ineffective road closures to be repaired within 1 year, Alternative 3 would require that all ineffective closures be repaired within the same operating season, unless time, manpower, or contracting funds are limited in a particular year due to the need to address multiple closures. In such a case, Alternative 3 would require DNRC to prioritize closures, repair as many as possible within the same season, and repair all closures within 1 year of their identification. Under this alternative, most closures would likely be repaired sooner than would be required under Alternative 2, reducing the potential for effects from unauthorized use prior to repair.

Under this alternative, DNRC would inventory roads for sediment delivery in bull trout watersheds within 5 years and in westslope cutthroat trout and Columbia redband trout watersheds within 10 years. DNRC would also complete corrective actions on high-risk sites in bull trout watersheds within 10 years and in westslope cutthroat trout and Columbia redband trout watersheds within 20 years. All these timeframes are 5 to 10 years shorter than specified under Alternative 2 and would result in quicker identification and repair of high-risk sites, thereby reducing the sediment delivery from these sites sooner than would happen under Alternative 2.

Fish connectivity improvements would be completed within 10 years for bull trout streams and within 20 years for westslope cutthroat trout and Columbia redband trout streams. Compared to

Alternative 2, bull trout stream connectivity improvements would be completed 5 years sooner and westslope cutthroat trout and Columbia redband trout stream connectivity improvements would be completed 10 years sooner.

Amount of Roads

Alternative 3 would result in the lowest total miles of new road in the HCP project area (1,322 miles) of any alternative (Table 4.4-6). The amount of new road miles in the Stillwater Block would be the same as Alternative 1, and for the Swan River State Forest, the total miles would be the same as Alternatives 1 and 2. However, in the scattered parcels, miles of new road constructed by year 50 would be approximately 64 miles lower than Alternative 2, resulting from fewer new roads classified as restricted year-round. However, most of the overall increase in total road miles would still be from roads classified as restricted year-round.

Distribution of Roads

Except for the Stillwater Block and roads restricted year-round on scattered parcels in the NWLO, road densities by year 50 under Alternative 3 would be the same as those estimated under Alternative 2 (Table 4.4-7), although slight differences in actual road miles would occur (Table 4.4-6). In the Stillwater Block, road densities would be the same as those under Alternative 1. For roads restricted year-round on scattered parcels in the NWLO, density would increase to 2.8 mi/mi^2 instead of 3.0 mi/mi^2, as would occur under Alternatives 1 and 2. For the entire HCP project area, total road density would be slightly lower than for Alternatives 1 and 2 by the end of the Permit term (4.6 mi/mi^2), and this would primarily be due to the lower density of roads restricted year-round on scattered parcels in the NWLO.

As under Alternative 1, the Stillwater Core would remain relatively unmanaged, and not be opened up to active forest management activities during the Permit term. A transportation plan would not be adopted for the Stillwater Block, so locations and classifications of new roads would not be fixed as they would be under Alternative 2.

4.4.2.5 Alternative 4 (Increased Management Flexibility HCP)

Road Management

Alternative 4 commitments related to road management would be similar to those under Alternative 2. However, some commitments would be less restrictive or specify longer timeframes for completion, resulting in higher risk for road-related effects.

Examination and repair of road closures would be the same as Alternative 2, except that primary closures on scattered parcels would be examined every 2 years instead of annually. Repair of ineffective closures would still be required within 1 year, however. This would result in an increased risk of effects from unauthorized road use on scattered parcels for up to an additional year until ineffective closures are identified and repaired. Although inspections would occur on a slower schedule than Alternative 2 for scattered parcels, this rate of road closure and inspection for the Stillwater Block, Swan River State Forest, and scattered parcels in recovery zones would be faster than would occur under Alternative 1.

To address sediment delivery reduction under Alternative 4, DNRC would inventory roads for sediment delivery in bull trout watersheds within 15 years, and in westslope cutthroat trout and Columbia redband trout watersheds within 25 years. These two timeframes are 5 years longer than specified under Alternative 2 and 10 to 15 years longer than Alternative 3. While Alternatives 2 and 3 specify timeframes for completing corrective actions on high-risk sites, Alternative 4 would only require that corrective actions be completed on a project-by-project basis, similar to what would occur under Alternative 1 when high-risk sites are identified during inventory for timber sale planning, design, and environmental assessment. While the rate of completing corrective actions would be the same as under Alternative 1, Alternative 4 would still implement the same approach as Alternatives 2 and 3 to inventory and prioritize corrective actions based on sediment delivery risk, so that higher-risk sites could be repaired sooner than they would be under Alternative 1.

For fish connectivity improvements, Alternative 4 would be the similar to Alternative 1. No timeframe would be specified for completing connectivity improvements for streams with HCP fish species; instead, they would be completed on a project-by-project basis. Consequently, this alternative could result in stream crossings potentially posing risks to other resources for extended periods as opposed to Alternatives 2 and 3. However, as under Alternatives 2 and 3, every 5 years one-sixth of all sites not meeting fish connectivity conservation strategy objectives would have to be improved to meet the strategy, or at least have final plans and designs completed for improvement.

Amount of Roads

Alternative 4 would result in the same total new road miles and road management classifications in the HCP project area as Alternative 2 (Table 4.4-6).

Distribution of Roads

For the entire HCP project area, Alternative 4 would result in the same road densities as for Alternative 2 (Table 4.4-7). As for Alternative 2, Alternative 4 would also result in the adoption of a 50-year transportation plan and active forest management activities within the Stillwater Core, including road construction, reconstruction, maintenance, and use.

4.4.2.6 Summary

By the end of the Permit term, all four alternatives would result in more roads on trust lands within the HCP project area. At the land office scale, as well as for scattered parcels, new road miles would be highest under Alternative 1 and lowest under Alternative 3. Miles of new road would be the same for Alternatives 2 and 4 and would fall between Alternatives 1 and 3. In the Stillwater Block, Alternatives 2 and 4 would result in more new road miles than Alternatives 1 and 3, reflecting an increase in roads to support forest management activities in the Stillwater Core (Table 4.4-6). Road densities would reflect the same differences as those noted for road miles, although smaller differences in road miles are not reflected in the densities shown in Table 4.4-7.

Within the Stillwater Block, there would only be slight differences in new road miles among the four alternatives, and these differences would primarily be due to changes in access classifications. Alternatives 1 and 3 would result in no change in miles of road classified as open or seasonally restricted as compared to current conditions. Only roads classified as restricted year-round would increase. Under a 50-year transportation plan, Alternatives 2 and 4 would result in a decrease in

roads open year-round and roads restricted year-round, while miles of road restricted seasonally would increase. Public access to roads, at least on a seasonal basis, would increase under Alternatives 2 and 4 (Table 4.4-6).

If the Swan Agreement remains in effect for the entire Permit term, there would be no differences in road miles and classifications between the four alternatives for the Swan River State Forest. If this agreement is terminated, road management for these blocked lands under Alternatives 2, 3, and 4 would be subject to a 50-year transportation management plan. Up to 23 miles of road could be converted from restricted year-round to open year-round or seasonally restricted, depending on DNRC's ability to negotiate reciprocal access agreements after land ownership changes or termination of the Swan Agreement (Table 4.4-6).

On scattered parcels in the HCP project area, most new roads under all four alternatives would be classified as restricted year-round. Alternative 3 would result in the fewest new road miles, while Alternative 1 would result in the most new road miles. The largest increases in roads open to the public, at least on a seasonal basis, would occur under Alternative 1, while miles of open roads would be the same between Alternatives 2, 3, and 4. Miles of road restricted year-round would be the same for Alternatives 1, 2, and 4, and lower for Alternative 3 (Table 4.4-6).

During the Permit term, differences in road conditions between the four alternatives would primarily result from varying rates of identifying and completing repairs to road segments with high risk of delivering sediments to streams, stream crossing structures affecting fish passage, and ineffective road closures. Alternative 3 would result in the highest rate of inspection and repair, following Alternatives 2, 4, then 1. Consequently, road conditions would likely be improved quickest under Alternative 3, followed by Alternative 2. Both Alternatives 2 and 3 require improvements for sediment delivery reduction and fish connectivity to be completed by the end of the Permit term, similar timeframes would not be applied under Alternatives 1 and 4. For these two alternatives, improvements would be completed on a project-by-project basis.

4.5 GEOLOGY AND SOILS

This section describes the affected environment and environmental consequences on geology and soils from changes to DNRC's forest management program under the no-action and action alternatives. Maintaining soil productivity is important to sustaining long-term forest growth and long-term trust revenues.

4.5.1 AFFECTED ENVIRONMENT

The following description of affected environmental for geology and soils in the planning area includes discussions of the current regulatory framework under which DNRC considers and protects geologic and soils resources as part of its forest management program (Section 4.5.1.1), existing land features (Section 4.5.1.2), effects of forest management activities on soils (Section 4.5.1.3), and gravel sources (Section 4.5.1.4).

Potential effects of forest management activities on soils include accelerated rate of erosion, compaction, and displacement, and subsequent adverse effects on the long-term productivity of the soil resource. Soil erosion caused by forest management activities can result in sediments reaching waterbodies and potentially adversely affecting water quality and fish. The effects of sediments on water quality are discussed in Section 4.6 (Water Resources), while effects on fish are discussed in Section 4.8 (Fish and Fish Habitat).

4.5.1.1 Regulatory Framework

DNRC's forest management activities are subject to multiple rules and regulations intended to avoid or mitigate effects of these activities on geologic and soil resources. Table 4.5-1 summarizes these rules and regulations, most of which are part of the Forest Management ARMs and based on the management philosophy and direction provided in the SFLMP (DNRC 1996).

As part of its forest management activities, DNRC incorporates various formal operational requirements contained in the Forest Management ARMs (ARMs 36.11.410, 414, and 421 through 427), SMZ Law, Montana Stream Protection Act, and all applicable Montana Forestry BMPs. Montana Forestry BMPs contain a broad range of specific practices addressing road planning and location, road drainage, road construction, road maintenance, stream crossing design, stream crossing installation, and harvest design. In addition, DNRC currently uses information from many different sources (including the Flathead Basin Commission monitoring committee, Plum Creek, the USFS, and MFWP) as part of a suite of decision tools for planning and implementing sediment reduction activities.

The following subsections provide additional detail on DNRC's regulatory framework regarding soil productivity, soil stability and erosion, gravel sources, and monitoring.

TABLE 4.5-1. APPLICABLE EXISTING RULES AND REGULATIONS RELATED TO GEOLOGIC AND SOIL RESOURCES

Rule or Regulation	Purpose
Biodiversity – Nutrient Retention (ARM 36.11.410)	Requires DNRC to minimize the removal of fine branches and leafy material during treatments
Biodiversity – Coarse Woody Debris (ARM 36.11.414)	Requires DNRC to leave adequate CWD on site to facilitate nutrient conservation and cycling
Road Management (ARM 36.11.421)	Provides specific guidelines for road design, construction, use, inspection, and maintenance, including compliance with BMPs
Watershed Management (ARM 36.11.422)	Requires incorporation of BMPs into project design and all forest management activities
Watershed Management – Cumulative Effects (ARM 36.11.423)	Requires assessment and minimization of cumulative watershed effects
Watershed Management - Monitoring (ARM 36.11.424)	Requires monitoring to assess watershed impacts and the effectiveness of mitigation measures, including BMP audits
Watershed Management – Streamside Management Zones and Riparian Management Zones (ARM 36.11.425)	Establishes SMZs and RMZs, and regulates timber harvest, including road-related activities within them.
Watershed Management - Wetland Management Zone (ARM 36.11.426)	Establishes WMZs, and regulates timber harvest, including road-related activities within them.
Fisheries (ARM 36.11.427)	Requires DNRC to minimize impacts to fish populations and habitat
SMZ Law (MCA 77-5-301 and ARMs 36.11.301 through 313)	Regulates timber harvest, including road-related activities, near streams and other waterbodies
Montana Stream Protection Act (MCA 87-5-501 and 87-5-509)	Regulates activities that may affect the natural and existing shape and form of any stream or its banks or tributaries (124 Permits)
Grazing on Classified Forest Lands (ARM 36.11.444)	Regulates grazing practices on classified forested trust lands to maintain or improve range condition and minimize loss of riparian and streambank vegetation and structural damage to stream banks
Montana Opencut Mining Act (MCA-82-4-4 and ARMs 17.24.201 through 225)	Regulates open-cut operations for sand, gravel, and other mine minerals

Soil Productivity

Soil productivity directly influences forest growth by providing a healthy growing medium, including nutrients, which are replenished over time by the decay of plant and animal matter. To maximize tree growth, and thus long-term return to trust beneficiaries, DNRC is required to maintain soil productivity. For timber harvest activities, ARMs 36.11.410 and 36.11.414 require DNRC to leave behind fine branches and leafy material, as well as adequate CWD, after treatment to retain nutrients on site.

To maintain soil productivity on classified forest trust lands with grazing licenses, ARM 36.11.444 requires DNRC to determine appropriate types of livestock, stocking levels, and grazing periods. This ARM also directs DNRC to regularly inspect range conditions to ensure maintenance or improvement of range conditions.

Soil compaction can also affect productivity and reduce tree growth. DNRC implements Montana Forestry BMPs to minimize soil compaction and avoid soils that are easily compacted. BMPs for harvest design, logging systems, yarding systems, slash treatment and site preparation, and winter harvest activities address soil compaction.

Slope Stability and Erosion

Timber harvest, including road-related activities, cause soil disturbance that can potentially affect slope and soil stability and lead to mass movement or surface erosion. The road management ARM (36.11.421) provides DNRC with specific guidelines for road design, construction, use, inspection, and maintenance. This ARM also requires DNRC to comply with applicable BMPs, including those that address road use management, planning and locating, construction, drainage control, grading, maintenance, and closures to reduce the likelihood of road-related mass movement and road surface erosion. DNRC also complies with BMPs designed to reduce the likelihood of mass movement and surface erosion associated with timber harvest and reforestation activities.

The SMZ Law and ARMs 36.11.425 through 427 also regulate timber harvest, including road-related activities, conducted immediately adjacent to streams, lakes, and other waterbodies to provide effective sediment filtration to maintain high water quality. The SMZ Law prohibits the construction of roads in an SMZ except when necessary to cross a stream, and it prohibits depositing road fill material within an SMZ during road construction, except as necessary to construct a stream crossing. However, the SMZ Law does not determine, or provide a means to determine, when it is necessary to construct a stream crossing. The SMZ Law also prohibits the side-casting of road material during maintenance into a stream, lake, wetland, or other waterbody.

Under the Montana Stream Protection Act (MCA 87-5-501 and 87-5-509), DNRC is required to apply for and obtain a 124 permit from MFWP before initiating any activities that may alter the bed or banks of any stream in the state. DNRC obtains these permits for all installations and removals of stream crossing structures. A 124 permit may require specific designs, operating restrictions, or other mitigation measures, and it may also require DNRC to obtain a short-term exemption from Montana water quality standards. These permits are called 318 authorizations, and are obtained from MDEQ. A 318 authorization may also require specific designs, operating restrictions, or other mitigation measures.

Gravel Sources

Occasionally, road construction or improvement projects require large amounts of fill or road surface material, requiring the development of nearby borrow sites or gravel pits. Large sources of gravel or fill (those removing more than 10,000 cubic yards of material) are subject to the rules and regulations (ARMs 17.24.201 through 225) governing the Montana Opencut Mining Act (MCA 82-4-4), which is administered by MDEQ. Operations of this size are subject to permitting, which requires submission of a detailed operating plan and reclamation plan. The operating plan must include measures to protect on-site and off-site surface and ground water. Additionally, the Montana Forestry BMPs require DNRC to minimize sediment production from borrow pits and gravel sources through proper location, development, and reclamation of those sites.

Monitoring

The DNRC forest management program developed a comprehensive approach to monitor and evaluate forest management effects on soil erosion, soil physical properties, and sediment delivery risk and practices to mitigate these impacts (DNRC 2003c, 2004e). This program includes monitoring of the implementation and effectiveness of Montana Forestry BMPs, as required by the

watershed management ARM (36.11.424). DNRC is also currently required to assess and prioritize road maintenance needs by inspecting the condition of both open and closed roads every 5 years (ARM 36.11.421(12)). Under the watershed monitoring program (ARM 36.11.424), DNRC has been conducting a systematic inventory of watershed conditions of forested trust lands since 1998, particularly as they relate to roads and road crossings. Most of the watershed inventories conducted to date have been completed on forested trust lands included in the HCP project area.

4.5.1.2 Land Features

The geology and soils of western and central Montana are highly variable and complex. The planning area includes a diverse range of landforms exhibited by a dramatic mix of mountains, hills, and valley bottoms across the area.

The NWLO and SWLO are located within the Northern Rocky Mountains physiographic province, which consists mostly of high mountains separated by broad to narrow valleys. Valley elevations typically are between 3,000 and 5,000 feet surrounded by mountains with elevations ranging from 8,000 to 10,000 feet. Many of these highlands were glaciated during the Pleistocene Epoch 2.5 million to 10,000 years ago, forming rugged glacial landforms. Mountain ranges in the NWLO, include the Cabinet and Purcell Mountains and the Whitefish, Flathead, Lewis, Swan, Mission, and Salish Ranges, which are closely spaced with narrow valleys. The Bitterroot Range, Sapphire Mountains, Garnet Range, and part of the Mission Mountains and Swan Range are located in the SWLO.

The CLO contains a wide variety of land types and climate zones, with the Continental Divide forming its western boundary. This land office includes portions of several physiographic provinces: Northern Rocky Mountains, Middle Rocky Mountains, and the Great Plains. The Great Plains region is generally flat or gently rolling, and the glaciated northern portion has many lakes, while the unglaciated south is somewhat drier and less dissected. Elevations range from about 4,000 feet at the edge of the Rocky Mountains down to about 2,000 feet on the eastern side of the CLO. Mountains within the CLO include the Abasoroka Range, Beartooth Range, Bitterroot Range, Pioneer Mountains, Beaverhead Mountains, Tobacco Root Mountains, Madison Range, Gravelly Range, Snow Crest Range, Bridger Range, and Big Belt Mountains. Montana's highest point, the 12,799-foot Granite Peak, is located in the Beartooth Range. In the eastern portion of the CLO, smaller mountain ranges, which are outliers of the Rocky Mountains, include the Crazy Mountains, Little Belt Mountains, and Sweet Grass Hills.

Geology

The dramatic landscapes of Montana are formed by the ancient and ongoing forces of mountain building that have been eroded over millions of years by numerous erosional processes, including continental and alpine glaciations, wind and water transport, and mass movements. Starting about 1.5 billion years ago, thick deposits of sand, silt, clay, and marine sediments began to accumulate in what is now the western one-third of Montana. These deposits were metamorphosed by deep burial to form thick formations of quartzite, amphibolites, and marble that were then uplifted by a period of mountain building called the Laramide orogeny. This period started in western North America about 70 to 80 million years ago and ended 35 to 55 million years ago. It created the Belt

Formation, which underlies much of northwestern and parts of southwestern Montana and includes the Rocky Mountains.

Much later, local areas of sedimentary and volcanic rocks and igneous intrusions also formed part of the bedrock of the region. Uplift and faulting formed these rock units into the mountains that are constantly modified by surface erosion, mass movements, rivers, and glaciers. During the ice ages, glaciers flowed out of British Columbia and also formed in the higher elevation mountains of Montana. Much of northwestern and parts of southwestern Montana were covered by ice or large lakes in valleys blocked by these glaciers. The glaciers sculpted the mountains, widened the valleys, and left behind glacial tills, outwash, and lake deposits. The variety of parent materials, climatic conditions, and glacial modifications of the mountains and valleys of the region formed the wide variety of surface materials and soils now found in the project area.

Soils

Surface and soil conditions are a function of the geologic materials from which they formed, the topography and slope conditions, vegetation, climate, and biological factors. Summary soils information was obtained for the planning area from the State Soil Geographic Database (USDA 1995). This database provided generalized information and depicts the dominant soils and attributes comprising the landscape. The State Soil Geographic Database was designed primarily for landscape-scale resource planning, management, and monitoring, which is appropriate for this programmatic EIS analysis.

Northwest Land Office

Forest growth potential is high in northwestern Montana because of the precipitation and productive soil types that support forest growth. Soils in the NWLO were formed from glacial deposits and weathered Belt Formation rocks. These include shallow and deep soils formed from glacial tills, outwash, lake deposits, and residual soils formed from weathered bedrock. Most of these soils are relatively young and poorly developed because glaciers disrupted, covered, or modified older, pre-glacial soils. Gravely loam and gravely silt loam soil textures are common, and volcanic ash also caps many of the soils. Volcanic ash is a productive soil component that helps form adequate soil nutrient and water retention. Valley soils include alluvium, glacial outwash, and lake deposits; these soils are commonly used for agricultural, residential, and urban areas.

Southwest Land Office

Soils in the SWLO are mostly residual soils formed from diverse bedrock types, along with more limited soils formed in glacial soils at higher elevations. About a quarter of the soils in the land office include volcanic ash influences. Valley soils include alluvium, glacial outwash and till, and lake deposits. As in the NWLO, these soils are commonly used for agricultural, residential, and urban areas. Many soils in the southwest region of Montana are typically less productive because of lower precipitation and droughty soil conditions, as well as nutrient pools.

Central Land Office

Unlike the NWLO and SWLO, the CLO has more diverse soil types due to the variety of bedrock and more varied climate conditions within the area. Many soils are similar to those in southwestern Montana, but with more high elevation and climate limitations. More productive soils are typically

located in local moist areas, such as riparian zones, wetlands, and valley bottoms, which frequently consist of alluvium washed from the hills and mountains.

4.5.1.3 Effects of Forest Management Activities on Soils

Over the past century, rates of soil compaction, displacement, and erosion have been accelerated and soil productivity has been degraded by a number of factors, including fires; forest practices; mining; agriculture; dams; transportation and utility routes; recreation; residential, commercial, and industrial development; and many other development-related influences.

By removing large amounts of woody material, timber harvest may reduce the organic matter available to enrich soils and increase compaction of the soil, both of which can reduce soil productivity. Additionally, timber harvest and forest roads may increase mass movement and surface erosion above natural levels by disturbing soils and vegetation, reducing interception and infiltration of precipitation, and increasing surface runoff (Swanson et al. 1987). Increased erosion related to forest practices can increase sediment delivery to stream channels, lakes, and wetlands where it can negatively affect aquatic resources (Bisson et al. 1987). Effects of sediment delivery from forest management on aquatic resources are discussed in Sections 4.6 (Water Resources), and 4.8 (Fish and Fish Habitat).

Prior to adoption of BMPs in 1987 and the SFLMP in 1996, historical forest harvest and road construction and maintenance often did not use practices that minimized short- or long-term adverse impacts to soils and that were protective of water quality and stream habitats. As a result, poor road construction and logging practices sometimes or often led to excessive levels of soil compaction, displacement, and accelerated rates of soil erosion on forested landscapes. Most of the sites where soils have been affected by poor historical logging practices have recovered and are re-vegetated and considered relatively stable. Many existing problem sites require upgrades, frequent maintenance, and in some cases, abandonment. Surface erosion from roads and stream crossings are the majority of identified problem sites remaining from historical forest management activities. Identifying and prescribing practical and effective solutions for problem sites on forested trust lands and the present road networks takes experienced foresters, forest hydrologists, soil scientists, and forest road engineers familiar with the region.

Currently, all DNRC forest management projects reference available soils information and implement designs and management practices that maintain or improve soil productivity, emphasizing conservation over restoration. While DNRC currently has no guidelines for maximum acceptable impacts to soils related to timber harvest activities, it has taken a conservative approach by assuming that soil productivity is maintained when detrimental soil impacts (severe compaction, displacement, and erosion) are limited to 15 percent or less of a harvest area. However, actual levels of impacts on tree growth vary by soil and site (DNRC 2004e).

From 1988 through 2004, DNRC monitored 74 sites in areas harvested during past DNRC non-salvage timber sales to validate the effectiveness of harvest design measures to protect soils. All of the 74 soil monitoring sites were located within the HCP planning area, and 65 (88 percent) of the sites were located on timber harvest projects within the HCP project area. This soil monitoring was prioritized on areas where the risk of soil impacts (compaction, displacement, and erosion) was high. On these 74 sites, DNRC found that total detrimental soil impacts ranged

between 3 and 44 percent of harvest area, with 35 of these sites (47 percent) having less than 10 percent impacted area, 13 sites having 15 to 20 percent impacted area, and 12 sites (16 percent) having more than 20 percent impacted area. All the sites with more than 20 percent impacted area were harvested between 1987 and 1989, just as BMPs were being adopted. Also, sites with the largest impacted area occurred on fine-textured soils and steep slopes with parent materials of lacustrine (Lake Missoula silts), loamy glacial tills, and tertiary sediments (DNRC 2004e).

The following subsections specifically discuss the effects of forest management activities on soils with respect to soil productivity (nutrient cycling, compaction, and displacement), slope stability, and erosion. Additional findings from DNRC's soil monitoring report (DNRC 2004e) are also summarized. These discussions are followed by a summary of DNRC's ongoing monitoring of implementation and effectiveness of BMPs.

Soil Productivity

Maintaining soil productivity by preserving rich, organic topsoil layers is critical for long-term forest growth. Natural processes such as fire, surface erosion, and mass movement (i.e., landslide), and the forest management activities of yarding, road construction, and vegetation removal can adversely impact soil productivity by changing surface runoff amounts and drainage patterns, soil saturation, soil compaction, displacement, surface permeability, aeration, and nutrient supply. Minimizing areas of soil disturbance and retaining coarse and fine woody material (nutrient management) are the main ways DNRC mitigates soil productivity impacts.

Breakdown of organic matter is the primary source of forest soil nutrients, along with long-term weathering of surface materials. The removal of large volumes of both coarse and fine woody material through timber harvesting reduces the amount of organic matter and nutrients available for nutrient cycling, and this can affect the long-term productivity of a site. As part of its forest management program, DNRC minimizes the removal of fine branches and leafy material and retains adequate volumes of CWD on site after harvest for nutrient cycling.

Forest management activities can result in compaction and displacement of soils, which can also prevent the recovery of vegetation following forest practices. Roads, landings, and gravel and rock quarrying often lead to long-term damage to surface soils and may preclude them from future forest production. Roads are needed to access areas for management and fire response, and construction permanently impacts surface soils within the road prism and typically removes vegetation from the roadbed and cutslopes. Skid trails, cable corridors, and temporary roads also impact surface soils, but to a lesser degree and for shorter time periods, so that these soils are not precluded from future forest production.

Generally, the more acres harvested and the steeper the slopes on which harvest occurs, the greater the potential for soil disturbance, compaction, displacement, and nutrient loss. The amount of disturbed soils from harvest also varies by method and harvest intensity, with ground-based logging systems compacting and disturbing more soils than cable and helicopter logging (Graham et al. 1991; Beschta and Boyle 1995). Landwehr (1992) and the USFS (1993) found that ground-based methods disturb about 8 percent of harvest area, while cable/skyline methods disturb about 6 percent and helicopter methods disturb about 1 percent. Most logging on forested trust lands uses conventional ground-based skidders.

In addition to ARMs 36.11.410 and 36.11.414, which require retention of fine and coarse woody debris on site after harvest, DNRC also designs harvest plans that account for site conditions and season of operation and include applicable BMPs to minimize soil compaction and displacement. Additionally, a DNRC water resource specialist typically reviews proposed forest management activities in watersheds with sensitive fish species and makes recommendations to reduce the risk of sediment delivery.

Although DNRC has adopted harvest practices and BMPs to minimize effects from harvest activities on soil productivity, some impacts still occur. On the 74 sites monitored by DNRC from 1988 through 2004, severe soil compaction ranged from 0 to 56 percent of the harvest area, with 67 of the sites (90 percent) having less than 10 percent severely compacted area and four sites (5 percent) having 19 percent or more. Based on this monitoring, DNRC found that harvest on gentle slopes on fine-textured soils generally produced the most compaction, harvest in wet conditions produced greater areas of severe compaction, harvest in dry or frozen conditions reduced areas of severe compaction, and severe compaction most commonly occurred on sites that also showed displacement (DNRC 2004e).

During its monitoring, DNRC also found that displacement ranged from 0 to 43.5 percent on the 74 sites. For 50 of the sites (68 percent), less than 10 percent of the harvest area had displaced soil, while 13 sites (18 percent) had more than 15 percent soil displacement in the harvest area. DNRC also found that sites with the highest displacement of soils were located on steep slopes and dozer-piled sites (DNRC 2004e).

There are currently 391 individual classified forest trust land parcels with grazing licenses in the HCP project area, and these cover nearly 165,000 acres (DNRC 2008a), or about 30 percent, of the 548,500-acre HCP project area. Grazing by livestock can cause some degree of damage to soil structure, primarily in concentrated use areas, including salting areas, areas around watering troughs, stock trails, and dispersed camping sites. Soil compaction, displacement, and erosion can occur in concentrated use areas; however, these can vary based on the intensity, duration, and timing of the concentrated use. DNRC minimizes grazing-related impacts to soils and other resources through licenses that specify livestock carrying capacity, allowable season of use, and stipulations for addressing any problems or corrective actions necessary to prevent or mitigate previous or existing impacts. DNRC also monitors resource conditions through detailed grazing inspections prior to license renewal and at midterm, which is typically year 5 of a 10-year license.

Slope Stability

Timber harvest and associated road-related activities can potentially decrease slope stability by increasing water yields, road surface drainage concentrations, and exceedance of soil strength. Decreased slope stability can lead to mass movement, which is the downslope motion of earth materials under the influence of gravity. Types of mass movement include rock falls, soil creep, earth flows, debris flows, and slumps. Landslides, a general term for a variety of mass movements, involve the sliding, toppling, falling, or spreading of relatively large and often fairly intact masses along a failure surface (Gray and Leiser 1982; Gray and Sotir 1996). These events can occur rapidly or over a period of hours, weeks, or even years. The geologic processes and mechanics of landslides are well-understood, but the site-specific conditions of individual slides can be quite

variable (Swanston 1974; Burroughs et al. 1976; Varnes 1978; Swanson et al. 1987; Chatwin et al. 1991; Selby 1993; Montgomery et al. 1998; Washington Department of Ecology 2005).

All types of gravity-induced down-slope movement of surface materials occur naturally on slopes, including tree falls, surface erosion, and landslides. The three main processes related to forest harvest and access roads are runoff-related surface erosion, washouts of road stream crossings, and various types of landslides. Landslides are typically not very common on forested trust lands, except for smaller slumps on steeper terrace faces and stream banks. Streambank stability and erosion from road surfaces and road stream crossings are discussed in later subsections.

Portions of the landscape with a higher probability of slope instability and erosion hazard can be estimated based on the geology, landforms, topographic position and shape, soil types, surface and shallow groundwater locations, vegetation conditions, and other site factors. Steep slopes are one of the main factors leading to landslides and increased erosion hazard, and they are often used as a first-level screening for identifying landslide or erosion hazard areas (Burroughs 1985).

Slopes less than about 15 percent (9 degrees) generally have a low probability of instability, and they are typically less susceptible to problems caused by timber harvest and roads, except near surface waters. Slopes in the range of about 15 percent to 49 percent (9 to 26 degrees) can have more management issues, especially when located at low-permeability geologic contacts, springs, or near shallow groundwater sources such as road cuts. Generally, problems within this slope range can be avoided or minimized by building fully engineered roads, use of BMPs, and regular monitoring and maintenance.

Slopes over 67 percent (34 degrees) are generally classified as high-risk landslide hazard areas for roads, and slopes over about 72 percent (36 degrees) are very high risk for roads and forest harvest and can cause a significant increase in landslides and erosion problems if disturbed (Swanston 1997; Gray and Sotir 1996; Dunne and Leopold 1978). Many surface soils on slopes over about 67 percent slope (34 degrees), or about 49 percent slope (26 degrees) for weaker soils, do not have enough soil strength to remain stable after harvest, road construction, or other ground or vegetation disturbance. Additional soil strength from vegetation, well drained surface conditions, and especially deep and dense roots helps keep slopes intact (Swanston 1997; Gray and Sotir 1996; Dunne and Leopold 1978). Vegetation reduces shallow groundwater by interception and evapotransporation, and it forms an interwoven web of roots that reinforces the soil. Loss of this additional strength due to ground or vegetation disturbance from forest roads or harvest on steeper slopes can lead to increased surface erosion or landslides depending on site conditions.

To minimize the potential for caused by roads, DNRC implements applicable BMPs. These BMPs direct DNRC to minimize the number of roads, including the use of existing roads where practicable, and cooperation and planning with adjacent landowners. Additional BMPs require DNRC to locate roads on stable geology and avoid unsuitable areas, such as slumps and slide-prone areas characterized by steep slopes. Additional BMPs are implemented by DNRC during construction and maintenance.

DNRC also implements applicable BMPs in project designs to minimize the risk of landslides resulting from timber harvest. These BMPs include planning timber harvests using economically feasible logging systems that best fit site characteristics and season of harvest, while minimizing soil

disturbance. Ground-based harvest is best suited for slopes less than 40 percent, while slopes up to about 65 percent are more suited for cable/skyline harvest methods. Over about 65 percent slope, potential slope instability is greater, and helicopter harvest methods are typically employed on these slopes.

Table 4.5-2 summarizes slope characteristics within the entire planning area, on trust lands within the planning area, and in the HCP project area. For both the entire planning area and trust lands within the planning area, low-gradient land (0 to 10 degrees slope) makes up a much larger portion of the CLO, as compared to the NWLO and SWLO. This is due to the flatter land features present east of the Rocky Mountains. However, in the HCP project area, the proportions of low-gradient land and lands with 10 to 30 degrees slope are similar across the three land offices, reflecting the similarity of lands across the three land offices that support timber. Lands with steeper slopes (30 degrees or greater) make up a small percentage of total lands in all three land offices (Table 4.5-2).

TABLE 4.5-2. AREA OF SLOPE CLASSES FOR THE PLANNING AREA, TRUST LANDS WITHIN THE PLANNING AREA, AND THE HCP PROJECT AREA

Slope Class (Degrees)	CLO		NWLO		SWLO		Total Acres	% of Total
	Acres	% of Total	Acres	% of Total	Acres	% of Total		
Planning Area (All Ownerships)								
0 – 10	14,403,965	62.9	2,992,263	32.9	2,471,348	33.3	19,867,576	50.4
10 - 30	7,421,636	32.4	4,911,790	54.1	4,186,971	56.3	16,520,398	41.9
> 30	1,070,623	4.7	1,179,851	13.0	773,972	10.4	3,024,445	7.7
Total	**22,896,225**	**100.0**	**9,083,903**	**100.0**	**7,432,291**	**100.0**	**39,412,419**	**100.0**
Trust Lands in the Planning Area								
0 – 10	937,888	74.3	135,536	42.9	109,631	46.7	1,183,055	65.2
10 - 30	311,027	24.6	158,069	50.0	114,264	48.7	583,360	32.2
> 30	13,531	1.1	22,680	7.2	10,857	4.6	47,068	2.6
Total	**1,262,446**	**100.0**	**316,286**	**100.0**	**234,752**	**100.0**	**1,813,484**	**100.0**
HCP Project Area								
0 – 10	33,010	29.2	107,850	39.4	61,264	37.8	202,123	36.8
10 - 30	74,242	65.6	143,664	52.5	92,358	57.0	310,264	56.6
> 30	5,962	5.3	21,908	8.0	8,319	5.1	36,189	6.6
Total	**113,214**	**100.0**	**273,422**	**100.0**	**161,940**	**100.0**	**548,576**	**100.0**

Source: DNRC (2008a).

Streambank Stability

A site-specific form of mass movement and surface erosion is found along stream banks and involves the same processes as those found on slopes, except with the added influence of channel flow and flood energy on streambank stability. The stability of stream banks is largely determined by the size, type, and cohesion of bank material, vegetation cover, and the amount of bedload carried by the channel (Sullivan et al. 1987). The web of roots, trunks, and down trees provided by

dense riparian vegetation helps bind soil together, making it more resistant to erosion and slope failure (Wu and Sidle 1995). Dense riparian vegetation also provides hydraulic roughness that dissipates stream energy during high flows, which reduces bank erosion. Vegetation growing out of the stream bank and immediately adjacent to a stream channel is important in maintaining the present bank integrity (FEMAT 1993). Additionally, in migrating channels, vegetation within the CMZ is important in minimizing future bank erosion and providing complex hydraulic and habitat conditions over longer periods.

Road- and harvest-related slides, and especially those that occur near streams or on steep slopes above streams, often can deliver substantial sediment to streams and can increase in size from smaller features to larger ones delivering sediment over many years. While channel alterations from landslides are a natural part of hillslope and channel processes in mountainous areas, the frequency of shallow landslides is elevated in areas of forest harvest and especially in areas of increased road densities because of ground disturbance and changes to runoff (Swanston and Swanson 1976; Benda and Dunne 1997). Key factors related to forest practices that may affect streambank stability are changes in the amount and location of runoff, increased supply of fine and coarse sediment, modification of bank vegetation, and volume and supply of LWD. Channel conditions may change because of riparian zone harvest and channel or bank erosion from modified flow and sediment supply.

To conduct timber harvest and related road activities near streams, DNRC adheres to the SMZ Law and Montana Stream Protection Act. These acts require additional measures to minimize the risk of mass movement along stream banks beyond what is specified by the Forest Management ARMs and applicable BMPs. DNRC incorporates these additional measures into its project plans. A DNRC water resource specialist typically reviews project plans and may identify additional site-specific measures to reduce the potential for mass movement and sediment delivery.

Erosion

Erosion is the displacement and movement of soil particles by water, wind, ice, and gravity (DNRC 2004e). DNRC identifies three common types of erosion. Sheet erosion occurs when a shallow uniform layer of soils is removed from the land surface by runoff water. Rill erosion is a process in which multiple small shallow channels (up to a few inches deep) are formed by runoff water, while gully erosion occurs when water accumulates in narrow channels and quickly removes soil from these channels to a depth of one foot or greater (DNRC 2004e). Sheetwash erosion is common on hillslopes and roads, while rill and gully erosion forms where surface runoff is concentrated by the slope shape and road drainage. Erosion can also be caused by road drainage problems.

Precipitation, as rain or snowmelt, is the primary factor driving erosion. Raindrops cause rainsplash erosion on exposed areas. If rainfall intensity and duration are large enough, water cannot soak into the ground fast enough, and overland flow accumulates and starts to erode exposed surfaces. With enough rainfall, overland flow will concentrate and form rills and eventually gullies that further concentrate runoff. Snowmelt on disturbed areas (roads, landings, and skid trails) accumulates on those compact, unvegetated surfaces and generates runoff that can also cause erosion.

Base erosion rates are highly variable and primarily influenced by the amount of precipitation and soil texture (Gray and Sotir 1996). Vegetation condition and slope drainage length can also influence erosion, varying over several orders of magnitude (Gray and Sotir 1996). The loose surface duff layer and small local depressions protect the surface from erosion and temporarily store precipitation, thereby delaying or preventing surface runoff. Vegetation and the related surface duff layer are among the main factors controlling erosion. Interception of rainfall by the canopy and ground cover protects the soil surface from rainsplash, reducing and often eliminating overland flow. Therefore, a common erosion control approach is to minimize the area of vegetation and duff layer disturbance or stabilize the disturbed area until vegetation can re-establish.

The potential erodibility of surface soils is summarized in soil surveys using the K factor, which is a useful index for comparing erosion potential of various surface soils. The K factor indicates the susceptibility of a surface soil to sheet and rill erosion. It is an experimentally derived measure of soil erodibility under standard soil conditions based primarily on the percentage of silt, sand, and organic matter in the soil; soil structure; and permeability. For undisturbed sites, soil erodibility factors vary by about an order of magnitude. The K factor typically varies from 0.02 to 0.64, with a higher number indicating more susceptibility for surface soil erosion and a low K factor indicating a soil that is not very susceptible to erosion in an undisturbed condition. Soils with low susceptibility to erosion have K factors up to about 0.2, while moderately susceptible soils have K factors between 0.2 and 0.4. The most erodible soils tend to have K factors greater than 0.4 (Michigan State University 2002).

Table 4.5-3 summarizes K factors for surface soils in the entire planning area, on trust lands in the planning area, and in the HCP project area. Overall, the HCP project area has proportionately more land area with lower erosion susceptibility (a K factor of 0.20 or lower). Within the planning area, about 63 percent of the lands have surface soils with a low K factor, while surface soils on about 34 percent of trust lands within the planning area have a low K factor. About 79 percent of HCP project area lands have a lower K factor. Very few lands in the HCP project area (1.2 percent) have surface soils that are highly susceptibility to erosion (Table 4.5-3).

Road Surface Erosion

Research over the past 60 years clearly demonstrates that forest roads are a major source of sediment and soil erosion in forested watersheds (Grace and Clinton 2006). Surface runoff and the erosion it causes can deliver fine sediment, sand, and sometimes coarse sediment to surface waters, thereby degrading water quality, channel conditions, and aquatic habitat. Of the suite of DNRC management practices, erosion generated from road-stream crossings and surface erosion from valley bottom roads have been found to be the greatest contributors to sediment in surface waters (DNRC 2006d).

Surface erosion from roads tends to be a chronic source of fine sediment to the drainage network that can adversely impact the physical habitat of the aquatic system and degrade water quality for other water uses. Road-related surface erosion is affected by the road use level, road surface material, maintenance level, the intensity and amount of precipitation, weather conditions during hauling, and other factors (Megahan and Kidd 1972; Reid and Dunne 1984; Montgomery 1994; Burroughs 1990). Forest roads are known to be significant areas of sediment erosion (Megahan and Kidd 1972; Cederholm and Reid 1987; Chamberlin et al. 1991; Harr and Nichols 1993; Best et al. 1995; Nolan and Janda 1995; Bolda and Meyers 1997; Reid and Dunne 1984). Road surface

erosion can dramatically increase with greater traffic levels, especially during wet periods (Reid 1981).

TABLE 4.5-3. EROSION SUSCEPTIBILITY (K FACTOR) OF SURFACE SOILS IN THE PLANNING AREA, TRUST LANDS WITHIN THE PLANNING AREA, AND THE HCP PROJECT AREA BY LAND OFFICE

Erosion Susceptibility (K Factor)	CLO		NWLO		SWLO			
	Acres	% of Total	Acres	% of Total	Acres	% of Total	Total Acres	% of Total
Planning Area (All Ownerships)								
< 0.02 - 0.2	11,697,477	54.4	6,596,056	77.1	5,030,042	69.9	23,323,576	62.6
0.2 - 0.4	8,688,090	40.4	1,602,115	18.7	2,040,553	28.4	12,330,757	33.1
0.4 - 0.64	1,036,153	4.8	302,306	3.5	91,959	1.3	1,430,418	3.8
No Value	68,589	0.3	53,320	0.6	33,660	0.5	155,569	0.4
Total	**21,490,308**	**100**	**8,553,799**	**100**	**7,196,213**	**100**	**37,240,320**	**100**
Trust Lands in the Planning Area								
< 0.02 - 0.2	251,440	20.0	225,665	71.5	139,318	59.7	616,422	34.1
0.2 - 0.4	533,699	42.4	77,335	24.5	69,860	29.9	680,895	37.6
0.4 - 0.64	474,173	37.6	11,557	3.7	23,876	10.2	509,605	28.2
No Value	131	0.0	1,276	0.4	418	0.2	1,825	0.1
Total	**1,259,442**	**100**	**315,832**	**100**	**233,472**	**100**	**1,808,746**	**100**
HCP Project Area								
< 0.02 - 0.2	95,768	84.6	217,983	79.7	120,083	74.2	433,833	79.1
0.2 - 0.4	16,130	14.3	51,669	18.9	38,763	23.9	106,562	19.4
0.4 - 0.64	1,147	1.0	2,630	1.0	2,660	1.6	6,437	1.2
No Value	131	0.1	1,162	0.4	418	0.3	1,711	0.3
Total	**113,176**	**100**	**273,443**	**100**	**161,925**	**100**	**548,545**	**100**

Note: K factor generally ranges from 0.02 to 0.64. A low value indicates surface soils not very susceptible to erosion in an undisturbed condition
Source: DNRC (2008a).

Roads commonly intercept shallow stormflow groundwater at low-permeability rock or soil units and at small swales or drainages that often only flow during wet periods (LaMarche and Lettenmaier 2001; Bowling and Lettenmaier 2001). Road cuts and the need to drain the road bed concentrates this water, and it is often directed in ditches to minimize cross drains. The increased flow during storms causes more rilling and gullies in the ditches or on the slopes across which the water is discharged. Additional cross drains, water bars, and grade dips help keep the water dispersed and reduce potential for erosion and delivery of sediment to surface waters.

Erosion occurs from four main processes: freeze-thaw cycles, rainsplash, sheetwash, and channel flow. Rainsplash and sheetwash erode the exposed road surfaces, and ruts and ditches concentrate it into channel flow. During rainstorms and snowmelt periods, the compact, unvegetated road surface generates runoff that erodes the sand, silt, and clay from the road surface. If the road runoff crosses steep, loose, unvegetated fill, additional erosion occurs forming rills in the fill material and farther

down slope. Roadside ditches or ruts on long steep slopes are common sources of erosion because the drainage area can be substantial and the runoff is often concentrated on steep grades with resultant high-erosion energy. Consequently, one of the most common erosion control methods controls drainage by dispersing runoff to avoid concentrated flow.

The potential for soil erosion from road areas is greatest immediately after construction and lessens with time (Grace 2000). Work conducted by Megahan and Kidd (1972) indicates that, for cutslope erosion, the first winter's erosion rate is about five times the rate during the following years. After construction or repairs and maintenance, vegetation starts to stabilize cutslopes, but the weakest, most vulnerable portions often have already failed during the first wet season. DNRC has observed more frequent small-scale and problematic failures from fillslopes. While re-vegetation after construction or repair and maintenance can also reduce the risk of fillslope erosion, other factors can increase the risk of failure. These factors include the use of vegetative debris in the fill portion of the road prism, disturbance or removal of trees and shrubs at the toe of the fillslope, and concentrated surface runoff from the road.

Road crossings of streams encroach into the channel and floodway and CMZ, thereby modifying the passage of water, especially floods and low flows, sediment passage, and channel migration processes. Road stream crossings typically include fill placed across the stream floodway, CMZ, and most of the active channel, with a culvert or bridge centered on the original channel. Culverts and bridges are sized to pass typical estimated flows, but do not allow for passage of large floods or sediment and woody debris that move during floods. Overtopping of a culvert occurs when flows are greater than culvert capacity or when plugging occurs. A reduced floodway makes a road crossing vulnerable to failure during floods, leading to failure and washing out of part or all of the road fill. Road stream crossings also introduce additional sediment to streams from the road surface of the approaches and fill. These sediments are easily delivered to streams because of the proximity and lack of room for a buffer or sediment trap.

The most substantial erosion and sediment delivery problems with road crossings are chronic sediment delivery from poor culvert armoring and rill erosion of fill material and, less frequently, failure of the crossing structure (DNRC 2006c). When road crossing failures occur, they are likely to deliver fine- and coarse-grained sediment directly to channels until repaired. Road crossings often fail when the flood volume is far greater than the culvert can pass during larger storms or when bedload sediment and woody debris are transported from the streambed and block the culvert. The historical use of undersized culverts (those with inadequate capacity due to size, damage, or plugging) or the partial or total plugging of a culvert causes the road fill to function like a dam. The subsequent seepage of water through the road fill or excessive erosion of the fill by water flowing over the top of the road substantially increases the failure potential. Consequently, crossings with large volumes of fill and steep upstream channel segments have a greater potential for failure. Areas with an increased frequency of large storms or increased stream flows resulting from large road surface areas or extensive harvest densities are also more likely to have stream crossing failures.

The current approach DNRC uses to minimize the amount of potential sediment delivery from new road construction, reconstruction, maintenance, abandonment, reclamation, and use is based on the SMZ Law (MCA 77-5-301 through 307), the road management ARM (ARM 36.11.421), and applicable Montana Forestry BMPs. DNRC builds roads to the minimum standard necessary to

best meet current and future management needs and objectives and to minimize necessary maintenance. Relocation of an existing road is considered when reconstruction, maintenance, and/or use of that existing road would produce greater undesirable impacts than relocation. DNRC avoids use of existing roads in SMZs when potential water quality impacts cannot be adequately mitigated. DNRC also considers closing or abandoning roads that are non-essential to near-term future management plans, or where unrestricted access would cause excessive resource damage. DNRC also maintains drainage structures and other resource protection measures on both restricted and open roads.

Where possible and feasible, DNRC plans road systems cooperatively with adjacent landowners and considers yarding systems that minimize road needs. DNRC also attempts to minimize the number of stream crossings necessary for project objectives. DNRC road use agreements, including rights-of-way, incorporate road maintenance requirements proportional to road use. These requirements are enforced during the administration of those agreements. For cost-share and reciprocal access roads, DNRC works with its cooperators to address road maintenance and any erosion problems.

Comprehensive road management planning, including determining which roads to build, improve, maintain, close, abandon, or obliterate, is usually completed during project-level analysis. When planning the location, design, construction, and maintenance of all roads, DNRC complies with BMPs necessary to avoid unacceptable adverse impacts. A DNRC water resource specialist and/or soil scientist reviews most DNRC timber sales and timber permits involving substantial levels of new road construction or reconstruction. General and site-specific BMP designs and other mitigation measures recommended by specialists are incorporated into timber sale EAs and contracts. DNRC timber sale contracts include detailed information, standards, and specifications for implementing site-specific BMPs, mitigations, and other resource protection measures. The timber sale contracts also contain road construction, road improvement, and road maintenance specifications, specification drawings, and detailed road logs.

DNRC typically implements actions aimed at reducing or eliminating identified or potential sources of sediment from existing roads at the project level and as funding is available. These actions usually consist of various road improvements, road maintenance activities, and road upgrades that have been identified within the project area. These actions are generally intended to bring the existing roads up to a standard that complies with BMPs. In some cases, a particular road or segment of road cannot be brought up to acceptable standards due to location, road conditions, or other factors. In those cases, the road or portion of the road may be relocated, abandoned, or obliterated. DNRC generally determines which roads to close, abandon, or reclaim during project-level analysis. Abandoned and reclaimed roads are left in a condition providing adequate drainage and stabilization without requiring periodic maintenance.

DNRC administers all road construction and road improvement projects to ensure that activities are conducted as specified in contracts and that resource protection requirements are being met. Adjustments are made in cases where operations fail to meet requirements, unforeseen circumstances are encountered, or when operating conditions may require design modifications. Projects are typically monitored through weekly inspections. Results of contract inspections are documented through the completion of written contract inspection reports. Every 5 years, DNRC compiles the results of all contract inspection reports and includes a summary of the information in a monitoring report completed for the Land Board.

Research on the effectiveness of BMPs for reducing surface runoff and erosion shows they can reduce sediment yield and delivery to surface waters when properly applied and maintained (Grace and Clinton 2007). Appropriate BMPs can reduce sediment yield from roads by 40 to 85 percent (Burroughs 1990; Burroughs and King 1989; Burroughs and King 1985; Grace et al. 1998; Grace 2002; Grace et al. 1999; Madej 2001). Common measures include adding cross drains or drainage dips; re-vegetating ditch slopes, fillslopes, and cutslopes; adding rock check dams to the ditch or road surface; placing slash or berms along the road edge; diverting drainage to areas with wide streamside buffers; and limiting road traffic to dry or frozen periods.

Road inspections and other road inventory activities are the primary mechanism used to identify existing and potential sources of road erosion and sediment delivery to streams. DNRC employs several different approaches to conduct these road assessments on forested trust lands. Within the Stillwater Block and Swan River State Forest, DNRC currently identifies and prioritizes road maintenance needs and ineffective road closures on a 5-year cycle, as required by ARM 36.11.421. Road on scattered parcels are assessed on a less regular frequency during timber sale planning and watershed inventories. DNRC is currently in the process of examining its program to determine whether the ARM requirement to assess all roads every 5 years can be met, especially on scattered parcels. Under the watershed monitoring program (ARM 36.11.424), DNRC has been conducting a systematic inventory of watershed conditions of forested trust lands since 1998. Coordinated by the FMB, these inventories are conducted statewide and include comprehensive evaluations of existing road systems, stream crossing structures, and other potential sources of erosion and subsequent sediment delivery to streams. This information is used to characterize existing road conditions, determine maintenance needs, and prioritize necessary improvements. Watershed assessment and analysis completed for timber sale projects typically include a similar level of comprehensive road evaluation, specifically for existing road conditions and maintenance needs within the project planning area. Other road improvement needs are identified through casual observations or reports made by DNRC field staff during the normal course of carrying out their administrative duties.

Between 1998 and 2001, DNRC inventoried about 405 miles of road in selected watersheds managed by DNRC (DNRC 2006d) (Figure 4.5-1). These watershed inventories addressed all road networks in the predefined project area and current conditions of all crossing sites (both wet and dry). The inventory identified high-risk road sediment delivery and drainage problems, along with general maintenance needs for various road features. The 405 miles of road represent the data used in the inventory analysis and is different than the 763 miles of road reported by DNRC to have been included in watershed inventories to date (DNRC 2005b). This difference is due to the lack of summary data available for some internal inventories. The 1998 through 2001 inventory accounts for 15 percent of the roads within the HCP project area, and provides a statistically significant sample of road problems that are commonly seen on forested trust lands (DNRC 2006d).

For the 1998 through 2001 inventory, the average road width was 13.8 feet, road grades ranged from 1 to 15 percent, and the average problem road segment lengths found was 629 feet (DNRC 2006d). Problems with a high risk of sediment delivery identified in the inventory were used to compile a table of high-risk road problems associated with the 365 road features evaluated (Table 4.5-4). Each high-risk problem identified by the inventory was associated with one of 13 feature categories. These feature categories were used to identify road features that were either

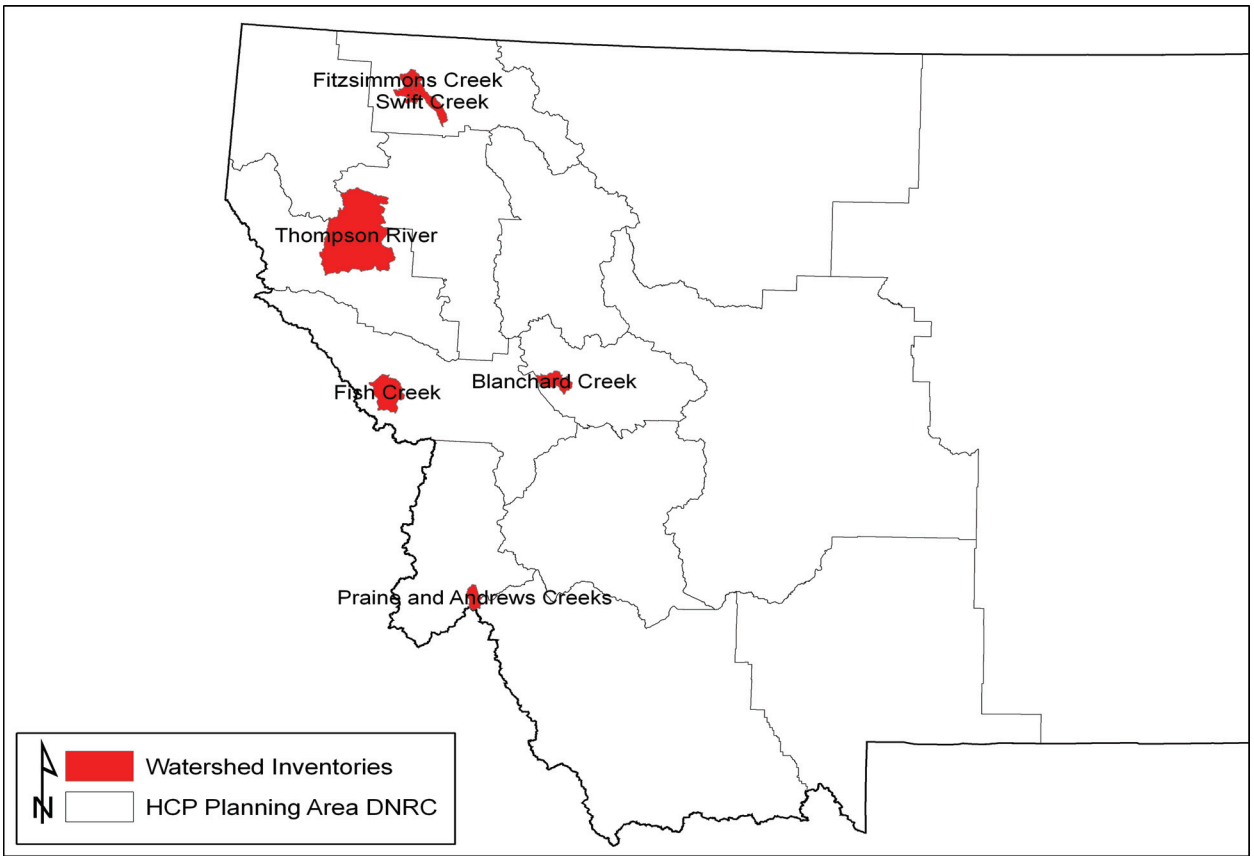

FIGURE 4.5-1. WATERSHEDS INCLUDED IN DNRC'S 1998 THROUGH 2001 INVENTORY

solely responsible for direct delivery of sediment, or posed a high risk of delivery in the future. Examples of the feature categories included are stream crossing culverts, drain dips, and relief corrugated metal pipes (CMPs). A relief CMP is a crossdrain structure for an inboard ditch on a road segment.

The results of the inventory are contained in Table 4.5-4. Road features associated with stream crossings were found to be a major source of erosion and direct delivery of sediment to surface waters in the area inventoried, representing 196 of the 365 (54 percent) problems identified (DNRC 2006c, d). Of the 196 stream crossing features identified as high-risk problems, 168 (46 percent of all features inventoried) were associated with stream CMPs. For these features, the most common problems were capacity/plugged (28 percent of stream CMPs), alignment/grade (24 percent), and energy control/armoring (20 percent). Forty-six percent of all features were associated with inadequate road surface drainage. The most common road surface drainage features identified as high-risk problems were relief CMPs (20 percent) and drain dips (15 percent). More than half of the relief CMPs (57 percent) had capacity/plugged issues, while 85 percent of the drain dips had surface drainage problems. Only one high-risk problem was associated with mass wasting, which was due to issues of energy control, road fill eroding, and/or armoring.

TABLE 4.5-4. SUMMARY OF PROBLEMS ASSOCIATED WITH ROAD FEATURES IDENTIFIED DURING DNRC'S 1998 THROUGH 2001 ROAD INVENTORY

Road Features					Problems Associated with Each Road Feature Category								
Feature Category ID	Feature Category	Number of Features with High-risk Problems Identified	Percent of Sample	Average Number of Problems Associated with Feature	Alignment/ Grade (% of Features)	Capacity/ Plugged (% of Features)	CMP Needed (% of Features)	Energy Control/ Road Fill Eroding/ Armoring (% of Features)	Filtration (% of Features)	Structure Damage (% of Features)	Surface Drainage (% of Features)	Direct Delivery (% of Features)	Total Number of Problems
Features Related to Stream Crossings													
1	Bridge	3	0.8	2.00	0.0	50.0	0.0	16.7	16.7	0.0	16.7	0.0	**6**
5	Ford	3	0.8	2.00	0.0	0.0	33.3	16.7	16.7	16.7	16.7	0.0	**6**
7	Native Material Crossing	16	4.4	1.65	0.0	18.5	0.0	25.9	18.5	14.8	22.2	0.0	**27**
8	Native Material/Fill Crossing	6	1.6	1.54	0.0	22.2	11.1	22.2	0.0	33.3	11.1	0.0	**9**
12	Stream CMP	168	46.2	1.31	24.2	28.0	0.0	19.5	11.4	0.4	14.0	2.5	**236**
Total		**196**	**53.8**		**57**	**76**	**3**	**57**	**34**	**9**	**42**	**6**	**284**
Features Related to Road Surface Drainage													
2	Ditch	3	0.8	1.30	0.0	25.0	25.0	50.0	0.0	0.0	0.0	0.0	**4**
3	Drain Dip	53	14.6	1.00	0.0	0.0	0.0	15.1	0.0	0.0	84.9	0.0	**53**
4	Dry CMP	7	1.9	1.57	9.1	27.3	9.1	36.4	18.2	0.0	0.0	0.0	**11**
9	Road Segment	30	8.2	1.08	0.0	0.0	14.3	53.6	0.0	0.0	21.4	10.7	**28**
10	Relief CMP	71	19.5	1.16	11.9	57.1	4.8	9.5	3.6	4.8	7.1	1.2	**84**
11	Seeps	3	0.8	1.00	0.0	0.0	66.7	0.0	0.0	0.0	0.0	33.3	**3**
13	Water Bar	1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1**
Total		**168**	**46.1**		**11**	**52**	**12**	**37**	**5**	**4**	**57**	**5**	**183**
Other Features													
6	Cutslope Failure	1	0.3	1.00	0.0	0.0	0.0	100.0	0.0	0.0	0.%	0.0	**1**
Total		**1**	**0.3**		**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Sum		**365**			**68**	**128**	**15**	**95**	**39**	**13**	**99**	**11**	**468**
%			**100.0**		**14.5**	**27.4**	**3.2**	**20.3**	**8.3**	**2.8**	**21.2**	**2.4**	

Source: DNRC (2006e).

Erosion from Timber Harvest

Harvest area soil disturbance includes detachment, compaction, and erosion, mostly related to skid trails and landings. Effects of harvest on soil compaction and displacement were also discussed above under Soil Productivity. Tractor logging skid trails and landings disturb and compact surface soils and can concentrate runoff in ruts. Cable logging using partial suspension methods form ruts along drag lines and can concentrate surface runoff depending on the degree of log suspension. Clearcuts create the greatest area of soil disturbance (Hermann 1978), but ground disturbance from felling, yarding, and skid trails in partial cuts also causes ground disturbance and compaction. Levels of soil disturbance in clearcut and partial cut areas can be comparable in some areas because of the need for equivalent access through a harvest unit (Cromack et al. 1978). Most of the areas harvested by DNRC are well buffered from surface waters (i.e., in riparian areas); consequently, local surface erosion is buffered and typically does not reach streams or other waterbodies.

To minimize erosion from harvest, as well as slash treatment and site preparation, DNRC implements applicable BMPs in project designs. These designs use economically feasible logging systems and slash treatment and site preparation methods that best fit site characteristics and season of harvest, while also minimizing soil disturbance. A DNRC water resource specialist typically reviews project plans and may identify site-specific measures to further reduce the risk of erosion.

Of the 74 harvest sites monitored by DNRC from 1988 through 2004, observed surface erosion only occurred on skid trails at four (5 percent) of the sites. Soil impacts on these sites ranged from 0 to 3 percent of harvest area, but there was no delivery of sediment to surface waters. Observed erosion on fire salvage sales ranged from low to high and occurred on both logged and unlogged monitoring sites (DNRC 2004e). Watershed monitoring by DNRC indicates the delivery of sediment from harvest area erosion to surface waters is limited, particularly compared to the delivery of sediment from roads (DNRC 2006d).

Post-harvest site preparation may include scarification to expose mineral soil for seedling establishment and to reduce plant competition. Scarification promotes natural conifer regeneration from seeds of nearby trees, and many of the harvest sites monitored by DNRC had a silvicultural goal for scarification on 30 to 40 percent of harvest area. DNRC defines scarification as the mechanical removal of competing vegetation and debris and considers it slight disturbance of the soil surface. Slight disturbance ranged from 0 to 60 percent of harvest area on the 74 monitored sites, with only 16 sites having more than 30 percent of the area slightly disturbed (DNRC 2004e). Slight disturbance is not considered a detrimental soil impact.

Streambank Erosion

Forest practices affect levels of surface erosion primarily by changing sediment yield and delivery to surface waters. However, not all material that erodes from roads or slopes is transported to surface waters. Streamside buffers allow road or hillslope surface runoff to infiltrate, and the eroded and transported sediment to deposit in the buffer, before it reaches surface waters. Buffer width, slope, soil conditions, and vegetation density are primary factors controlling how much eroded sediment can be removed from the runoff volume and prevented from entering a stream. Dense vegetation and loose non-disturbed soils are required to effectively remove eroded sediment during storm runoff periods.

Buffers are substantially more effective at removing coarse-grained material (gravel and coarse sand) than finer-grained material (fine sand, silt, and clay) (Rashin et al. 1999). Runoff from road surfaces includes a high percentage of fines, so they often are the biggest contributor of sediment to streams (Grace 2004). Roads and drainage ditches are important components affecting erosion because they are typically bare, erodible dirt after construction or cleaning. The road surface, cutslopes and fillslopes, and ditches can all increase and concentrate surface runoff, which can erode and transport sediment directly to surface waters. If there is a wide buffer between surface waters and the road or the road cross drains, most or all of the eroded sediment typically deposits within the buffer area, minimizing sediment delivery to the stream.

The primary harvest area erosion risks occur from harvest activities within SMZs and RMZs that can degrade the effectiveness of the buffer zone to remove sediments. However, the overall risk appears to be relatively small. The existing SMZ Law, Forest Management ARMs, Montana Forestry BMPs, and DNRC forest management policies are generally effective at minimizing the soil disturbance activities (DNRC 2005b). In addition, existing harvest methods and procedures minimize soil disturbance, and existing riparian buffers provide adequate filtration of sediments.

Streamside buffers can substantially reduce coarse and fine sediment that is transported over land (Rashin et al. 1999). The filtering capacity of buffers is affected by timber harvest activities within the buffer area. Soil and vegetation disturbance generally increase the sediment delivery potential, and the addition of obstructions on the forest floor from tree limbs and limb-free trunks associated with partial logging, can somewhat offset the diminished filtration (Burroughs and King 1989). These factors influence the ability of buffers to trap sediment by controlling the infiltration rate, flow path length, and velocity of overland flow.

Studies in various regions show that one size of buffer does not fit all situations (Rashin et al. 1999). Johnson and Ryba (1992) prepared a summary of recommended buffer widths based on an extensive literature review. For sediment control, these buffers ranged from 10 to 300 feet, depending on site conditions. In a study of exposed soils and sediment delivery from various harvest methods, Rashin et al. (1999) found that in areas with no stream buffers, BMPs were not effective in preventing sediment from reaching streams. They determined that buffers at least 30 feet wide were needed for effective filtering of sediment under the limited rainfall conditions of the study.

The potential for reducing in-stream effects of road-related mass movement and surface erosion with buffers is most critical where roads are close to surface waters. Some legacy roads (those historical roads constructed prior to BMP development and implementation) were built right along creeks to avoid steep valley wall slopes and where roads approach and cross streams. Table 4.5-5 summarizes miles of road within 100 feet and 300 feet of streams on all ownerships in the planning area, trust lands within the planning area, and HCP project area lands. For roads within 100 feet of streams in the planning area, only about 6 percent are on trust lands, while only 5 percent of planning area roads within 300 feet of streams are on trust lands. However, more than half the roads within 100 feet and 300 feet of streams on trust lands within the planning area are also included in the HCP project area (Table 4.5-5). Given the large proportion of high-risk problem sites identified from DNRC's watershed inventory due to road surface drainage (46 percent of documented sites, Table 4.5-4), management of near-stream roads and their vegetated buffer zones is important to address delivery of sediment to streams and subsequent effects on water quality and aquatic habitat conditions.

TABLE 4.5-5. MILES OF ROAD WITHIN 100 FEET AND 300 FEET OF STREAMS IN THE PLANNING AREA, ON TRUST LANDS WITHIN THE PLANNING AREA, AND IN THE HCP PROJECT AREA BY LAND OFFICE

Forest Road Streamside Buffers	CLO		NWLO		SWLO		Total Road Miles
	Road Miles	% of Total	Road Miles	% of Total	Road Miles	% of Total	
Planning Area (All Ownerships)							
Road Miles within 100 Feet of Streams	2,187	31.4	1,927	27.7	2,844	40.9	6,958
Road Miles between 100 and 300 Feet of Streams	8,272	35.7	6,604	28.5	8,288	35.8	23,164
Total Road Miles within 300 Feet of Streams	**10,459**	**34.7**	**8,532**	**28.3**	**11,132**	**37.0**	**30,122**
Trust Lands in the Planning Area							
Road Miles within 100 Feet of Streams	138	35.0	121	30.7	136	34.3	395
Road Miles between 100 and 300 Feet of Streams	487	38.7	414	32.9	359	28.5	1,260
Total Road Miles within 300 feet of streams	**626**	**37.8**	**535**	**32.3**	**495**	**29.9**	**1,656**
HCP Project Area							
Road Miles within 100 Feet of Streams	24	10.2	103	43.5	110	46.3	238
Road Miles between 100 and 300 Feet of Streams	73	10.3	358	50.3	280	39.4	712
Total Road Miles within 300 Feet of Streams	**98**	**10.3**	**462**	**48.6**	**390**	**41.1**	**950**

Note: Numbers are summarized by land office; consequently, they do not match those presented in Table 4.8-7, which are based on EIS aquatic analysis unit.
Source: DNRC (2008a).

Monitoring Implementation and Effectiveness of BMPs

Montana Forestry BMPs contain a broad range of specific practices addressing road planning and location, road drainage, road construction, road maintenance, stream crossing design, stream crossing installation, and harvest design. The proper application of appropriate BMPs has been repeatedly demonstrated to minimize sediment transport and delivery from roads (Burroughs and King 1989; Cook and King 1983; DNRC 2004c; Rothwell 1983; Seyedbagheri 1996). Montana Forestry BMPs are designed to ensure that forestry activities meet state water quality standards. In fact, under the *State of Montana: Nonpoint Source Management Plan* (MDHES 1991; MDEQ 2006), Montana Forestry BMPs are recognized as the primary mechanism to enable achievement of water quality standards.

All road construction, reconstruction, maintenance, use, abandonment, and reclamation associated with DNRC forest management activities are designed to implement appropriate and applicable BMPs (ARMs 36.11.421(3) and 36.11.422(2)). DNRC complies with BMPs as necessary to avoid

unacceptable adverse impacts. BMPs appropriate for a given project or situation are generally determined during project development and environmental analysis.

DNRC has participated in monitoring the implementation and effectiveness of Montana Forestry BMPs since 1988. DNRC participates in statewide forestry BMP audits conducted by interdisciplinary teams with representatives from federal and state agencies, private landowners, and conservation groups. The statewide BMP audits use on-site inspections and evaluations to assess both BMP implementation and effectiveness at preventing erosion and/or sediment delivery to streams or ephemeral drainage features. These audits are conducted every 2 years under the direction of the Montana Environmental Quality Council (MEQC), and results are presented in a written report to the MEQC and Montana Legislature.

DNRC also conducts internal BMP audits on ongoing and recently completed DNRC timber sales. Water resource specialists from both the FMB and DNRC area land offices conduct these audits. The DNRC internal BMP audits use the same methods and rating systems used for the statewide BMP audits. Additionally, DNRC conducts other site-specific monitoring projects designed to quantitatively determine the effectiveness of BMPs and other mitigation measures in reducing erosion and non-point source pollution.

Overall, DNRC's use of BMPs and mitigation measures to minimize detrimental soil impacts from compaction, displacement, and erosion on harvest areas has been effective. Since the inception of the statewide BMP audits in 1990, DNRC has consistently ranked among the highest of all ownership groups in both BMP application and effectiveness (DNRC 2000b, 2002, 2004c, 2005b, 2006e). These local results and other BMP effectiveness studies indicate the risk of water quality impacts from forest roads can be reduced with proper use of BMPs (NACASI 1979, 1994a, b; Cook and King 1983; Burroughs and King 1989; Rashin et al. 1999). Internal BMP audits on 83 DNRC timber sales found that BMPs were applied 97 to 98 percent of the time, and these results were comparable to statewide audits (DNRC 2005b).

4.5.1.4 Gravel Sources

Another potential source of erosion is borrow sites and gravel pits. Gravel and rock sources are sometimes used to supply materials for road maintenance and new road construction on trust lands. Covered forest management activities include gravel pit and borrow site development, use, and reclamation for the purposes of mining or borrowing material used in forest road construction, reconstruction, and maintenance. In general, most gravel operations associated with DNRC forest management road activities are relatively small borrow sites where native materials are excavated and used as fill or surfacing material without further processing. These sites are generally associated with road cuts and are less than 0.1 acre of additional disturbance (DNRC 2007d). While borrow sites may extend the width of the roadway and disturb a greater area than a normal road segment, the effects are usually localized and are adequately addressed under BMPs, the SMZ Law, and the Forest Management ARMs (DNRC 2007d).

A medium gravel pit is a source of gravel or rock that may involve 1 to 4.9 acres of disturbed area. Medium pits receive intermediate levels of use and may be activated periodically to serve as sources for multiple road maintenance and/or construction projects in any given year or across multiple years. The majority of these sites serve as pit run sites (a truck enters, gets what it needs, and

leaves), and no further processing of materials occurs onsite. However, medium pits may also involve crushing, sorting, and/or asphalt operations.

Infrequently, DNRC initiates major forest road construction or improvement projects that require large amounts of cleaned, sorted, and, in some cases, crushed gravel. These larger gravel developments may involve extensive gravel processing operations, larger areas of disturbance, and detailed reclamation plans (DNRC 2007d). They include sorting and/or crushing operations and removal of more than 10,000 cubic yards of material. Pits involving the excavation of more than 10,000 cubic yards of material are subject to the rules and regulations (ARMs 17.24.201 through 225) governing the Montana Open Cut Mining Act (MCA 82-4-4) administered by MDEQ. Operations of this size are subject to permitting, which requires submission of a detailed plan of operation and reclamation plan, as well as posting of a reclamation bond. The operating plan must include measures to protect onsite and offsite surface and ground water.

There are currently a limited number of gravel pits in the HCP project area, and most are typically medium pits and operated for specific projects. Once these projects are completed, the gravel pits are typically reclaimed or intermittently operated to support local road maintenance activities. The recent trend in the SWLO and CLO has been to order gravel and rock from private sources and have it delivered to the DNRC project area.

4.5.2 ENVIRONMENTAL CONSEQUENCES

This section discusses and compares the potential differences in effects on soil productivity, slope stability, erosion, and gravel sources from changes to DNRC forest management program under the four EIS alternatives. Effects of sediment delivery on water quality and aquatic life from changes in slope stability and erosion are discussed in Sections 4.6 (Water Resources) and 4.8 (Fish and Fish Habitat).

4.5.2.1 Introduction and Evaluation Criteria

Soil productivity, slope stability, and erosion are affected by land-disturbing activities, including forest management activities. Changes in DNRC's forest management program could increase or decrease potential risks of adverse effects on soil productivity, slope stability, and erosion. Both the amount of land-disturbing activities and any program policies addressing effects from such activities on the soil resource can influence the potential risk of adverse effects on soils. The following evaluation criteria were identified to support the comparison of changes in effects on soils between the alternatives:

Soil Productivity (compaction and displacement)

- Changes in miles of new road
- Changes in level of harvest (annual sustainable yield)
- Changes in grazing management policies.

Slope Stability

- Changes in miles of new road
- Changes in rates of road stream crossing repairs

- Changes in levels of harvest
- Changes in management policies to identify and avoid or protect unstable areas, as well as monitor and mitigate any areas where failures occur.

Erosion

- Changes in miles of new road
- Changes in rates of road stream crossing repairs
- Changes in levels of harvest
- Changes in management policies to avoid, control, or mitigate sediment production and delivery to streams.

The development, management, and availability of gravel sources are dependent on DNRC's management policies for that resource. The alternatives are compared based on any changes in DNRC's management policies for gravel sources.

Mass movements, or landslides, are not considered a major sediment source related to forest practices on HCP project area lands, except for some steep terrace faces, steep or high road cuts or fills, and high stream banks. DNRC implements applicable BMPs to avoid steep slopes and minimize the risk of sediment delivery from potential mass movement. As mentioned in Section 4.5.1 (Affected Environment), DNRC has consistently ranked among the highest of all ownership groups in both BMP application and effectiveness. Forest management activities adjacent to streams and on stream banks are also restricted by the SMZ Law and Montana Stream Protection Act. Consequently, slope stability is not discussed further in this evaluation of alternatives.

With respect to road-related erosion, the timing of road inventories and implementation rate of corrective actions, through the use of BMPs, monitoring, and upgrades to roads, are the primary factors that vary between the alternatives. All of the alternatives include minimizing miles of road, implementing appropriate BMPs, and prohibiting roads within SMZs except where needed to cross streams.

To compare erosion from stream crossings between alternatives, DNRC used data collected from its inventory of a portion of the HCP project area between 1998 and 2001. From this inventory, DNRC identified 127 problematic stream crossing sites, which are summarized in Table 4.5-6. Corrugated metal pipe diameter and length data collected during the inventory were used to estimate the volume of sediments that would be delivered to the streams at each crossing should a catastrophic failure occur (Table 4.5-6). The failure rate was determined using a simple runoff model to estimate the probability and recurrence interval of storm events large enough to exceed the hydrologic capacity of the existing culvert at each site. This analysis estimated an average failure probability (over the Permit term) of 52 percent for the identified problem CMPs, and an average at-risk sediment volume of about 57 cubic yards (Table 4.5-6). However, these estimates are considered conservative because they are based on the probability of exceeding the carrying capacity of the culvert under recurrent storm events, which does not necessarily correlate to catastrophic failures.

Site-specific upgrades, maintenance, and applications of BMPs are expected to minimize stream crossing failures on forested trust lands. These upgrades are applied based on the schedule or strategy specific to each alternative. As high-risk crossings are upgraded, they are less likely to fail,

reducing the cumulative potential for erosion of sediment into HCP project area streams. Therefore, the alternatives are compared based on how fast the high-risk culverts are upgraded.

TABLE 4.5-6. SUMMARY OF THE FAILURE POTENTIAL AT PROBLEM STREAM CROSSING SITES IDENTIFIED FROM 1998 THROUGH 2001 DURING DNRC WATERSHED INVENTORIES

Watershed	Total Sediment Volume (cubic yards)	Number of Sites	Average Sediment Volume per Site (cubic yards)	Average Probability of Failure in 50 Years (percent)
Blanchard	188	6	31	84
Fish Creek	512	10	51	69
Fitzsimmons	232	6	39	63
Lower Swift	3,974	29	137	64
Lower Thompson	716	11	65	72
Middle Swift	1,251	28	45	33
Praine/Andrews	33	1	33	1
Upper Thompson	827	13	64	72
West Fork Swift	1,141	23	50	11
Total/Average	**8,874**	**127**	**57**	**52**

Source: DNRC (2008e).

4.5.2.2 Alternative 1 (No Action)

Under Alternative 1, DNRC would continue its forest management activities subject to current program policies defined by the Forest Management ARMs, the SFLMP, and other applicable regulatory framework as described in Section 4.5.1.1. Changes to the program may occur in the future; however, the nature of possible changes is not known and cannot be evaluated.

Soil Productivity

Approximately 1,408 miles of new road would be constructed under Alternative 1 (Table 4.4-6), resulting in a permanent or long-term loss of productivity of the soils underlying these roads. Additional areas of soil compaction and displacement would occur from disturbance of adjacent areas during road construction, although these effects would be short term because applicable BMPs would be used to avoid or minimize the risk of soil compaction or displacement from road-related activities and promote the restabilization of disturbed soils.

Under Alternative 1, the annual sustainable yield would be 53.2 million board feet statewide and 50.7 million board feet within the HCP project area (Table 4.2-14), which is the same as the current levels. Because the level of harvest would be the same as under the current program, the risk of effects on soil productivity would likely also be the same, although site-specific conditions would result in some variation in levels of disturbance. DNRC would continue to implement BMPs designed to avoid or minimize soil compaction and displacement and retain fine and coarse woody debris to support nutrient cycling. DNRC would also continue to follow the SMZ Law, which restricts equipment use in SMZs to minimize soil compaction from harvest-related activities.

DNRC's current program policies also include monitoring grazing licenses prior to granting a new license or license renewal and at midterm (typically every 5 years). These monitoring events provide an opportunity for DNRC to identify potential adverse effects to soil productivity in areas of concentrated use and implement corrective actions if necessary. For each license, DNRC also specifies livestock use levels, season of use, and other applicable stipulations to minimize the risk of effects on soils.

Erosion

Road-related Erosion

Under Alternative 1, an estimated 1,408 additional miles of road would be constructed by year 50 (Table 4.4-6), and road densities in the HCP project area would increase by approximately 1 percent (Table 4.4-7). Because DNRC would construct these new roads using all applicable BMPs, the risk of erosion would be minimized. However, as noted in Section 4.5.1 (Affected Environment), the risk of erosion is higher for the first few years after construction until disturbed areas, such as cutslopes and fillslopes, have revegetated and stabilized. As roads are built throughout the Permit term and previously constructed roads require repair, the risk of erosion would likely increase.

For existing roads, DNRC would continue to be required to assess open and closed roads every 5 years and prioritize problems. However, the current program does not specify how problems would be prioritized or provide a timeline for fixing identified problems. Also, it is uncertain whether DNRC can meet the 5-year assessment requirement for roads on scattered parcels, and this may remain the case under Alternative 1 during the Permit term.

Although some existing roads would be abandoned and reclaimed and others would be upgraded to at least the current standards, these would not necessarily occur in the areas presenting the greatest erosion potential. Corrective actions to bring roads up to BMP standards would continue, but as part of each harvest project only when funding is available. As is currently the case, a DNRC water resource specialist would typically review proposed road activities in watersheds with sensitive fish and make recommendations to reduce sediment delivery; however, this is not specifically required under Alternative 1.

Alternative 1 would continue implementation of existing laws, regulations, and BMPs that are generally effective at minimizing erosion of road surfaces, as well as upgrading existing problem road areas. This alternative would also continue to minimize construction of new roads and avoid new road construction within SMZs and RMZs, except where stream crossings are needed.

Over the Permit term, DNRC would continue to build new roads to current standards using BMPs and upgrade existing roads to meet current BMP standards. As a result, forest road conditions would improve over time under Alternative 1, resulting in an overall reduction of surface erosion and subsequent sediment delivery to HCP project area streams over the long term as the pool of remaining problem areas is reduced through upgrades.

Erosion from Stream Crossings

Over time, most of the existing culverts in the HCP project area would be removed or replaced. This would result in a gradual reduction in the risk of culvert failure. However, Alternative 1 would not necessarily result in the timely replacement of the most problematic culverts, or a consistent

schedule for replacement. The replacement rate would be based on the actual need for the road for forest management activities and on available funding.

Harvest-related Erosion

The overall level of harvest in the HCP project area is estimated to result in an annual sustainable yield of 50.7 million board feet, contributing to a statewide total of 53.2 million board feet. Harvest area soil disturbance would be expected to continue to be minimized by following existing harvest management laws and regulations and applicable BMPs, which are generally effective at reducing erosion effects of harvest activities.

As discussed in Section 4.5.1 (Affected Environment), the primary harvest-related erosion risks occur from harvest activities within SMZs and RMZs, and these areas would be protected under existing SMZ and RMZ rules. Harvest-related erosion potential in SMZs could occur under Alternative 1 because partial harvest would still be allowed. Because each SMZ extends from the stream bank to between 50 and 100 feet landward, erosion, soil compaction, or displacement are more likely to result in sediment delivery to project area streams during storm runoff periods than from harvest in areas outside of SMZs. Alternative 1 also does not incorporate a CMZ, so actively migrating channels could easily diminish SMZ buffer areas and potentially increase erosion risk and subsequent sediment delivery over the long term.

Gravel Sources

Gravel pit operations are expected to continue to be relatively small under Alternative 1, and typically would be distributed along the roadway alignments. These operations would continue to be sited away from streams and riparian areas, according to existing rules and regulations, and with no specific restrictions on the number of actives sites. Borrow sites and medium pits developed for a specific project would typically be reclaimed soon after project completion. DNRC would continue to implement applicable BMPs to avoid or minimize the risk of erosion from activities at these sites.

4.5.2.3 Alternative 2 (Proposed HCP)

Under Alternative 2, annual sustainable yield would be higher and miles of new road lower than under Alternative 1, but DNRC would implement additional resource protection measures to reduce the risk of forest management activities affecting soil productivity and erosion. Also under this alternative, forest management activities would increase in the Stillwater Core.

Soil Productivity

Under Alternative 2, approximately 1,387 miles of new road would be constructed, which is about 21 miles fewer than under Alternative 1 (Table 4.4-6). While this alternative would result in a lower level of permanent soil productivity loss due to fewer roads being constructed, the reduction would not be substantial at the landscape scale. DNRC would continue to implement applicable BMPs to minimize risks to soil productivity from compaction and displacement from road-related activities.

The annual sustainable yield under Alternative 2 would be 58.0 million board feet, which is a 9 percent increase over Alternative 1 (Table 4.2-14). With a higher level of harvest predicted, a comparable increase in the amount of soil disturbance would also likely occur, increasing the risk of impacts to soil from compaction or displacement. Unlike Alternative 1, this alternative would include active forest management within the Stillwater Core, resulting in soil disturbances that would not occur in this area under the no-action alternative. However, DNRC would continue to implement applicable BMPs to avoid or minimize soil compaction and displacement from harvest-related activities.

DNRC would also continue to follow the Forest Management ARMs regarding retention of woody debris. However, additional CWD may be left in some units under this alternative to meet lynx habitat requirements for potential den sites (commitments LY-HB2 and LY-HB3), which could result in higher levels of nutrient retention in these areas.

For Class 1 streams with HCP fish species, commitments AQ-RM1 and AQ-SD4 would reduce levels of soil disturbance in areas adjacent to these streams by increasing restrictions on forest management activities and equipment use in areas adjacent to those streams. RMZs established under Alternative 2 would be the same width as under Alternative 1, but under Alternative 2, no harvest would typically be permitted within the first 25 feet. For other streams, risks of effects on soil productivity adjacent to those streams would be the same under this alternative as they would be under Alternative 1 because there would be no changes in policy for these streams.

Under Alternative 2 (commitment AQ-GR1), DNRC would maintain the 5-year monitoring cycle for grazing licenses, but enhance the level of monitoring conducted at midterm and renewal. DNRC would also commit to a process for correcting verified grazing problems, prioritizing and setting time limits for correcting problems for grazing licenses affecting streams with HCP fish species, and monitoring completed improvements. Commitment AQ-GR1 would also require DNRC to prepare monitoring reports at 1- and 5-year intervals. These enhancements to the grazing program would help to identify and address any problems affecting soil productivity in a more timely and thorough manner compared to current policies that would continue under Alternative 1. Within grizzly bear recovery zones, DNRC also would not authorize new, or conversion to, small livestock grazing licenses or initiate establishment of new grazing licenses (commitment GB-RZ4). Implementation of this commitment could reduce the amount of land within the recovery zones affected by small livestock grazing and reduce the risk of effects on soil productivity from small livestock use.

Erosion

Road-related Erosion

Unlike Alternative 1, Alternative 2 (commitment AQ-SD2) would commit DNRC to reducing erosion from existing roads for which DNRC has legal access and sole ownership. Also under Alternative 2, DNRC would work with cooperators to address reduction of erosion on roads with shared ownership. DNRC would commit to completing a road sediment delivery inventory within 10 years for bull trout watersheds and within 20 years for watersheds with westslope cutthroat trout or Columbia redband trout. Based on prioritizations established through the inventory process, corrective actions for DNRC-owned roads with high risk of sediment delivery would be completed within 15 years in bull trout watersheds and within 25 years for westslope cutthroat trout and Columbia redband trout watersheds. Alternative 2 would also address roads with moderate

sediment delivery risk on a project-by-project basis. On cost-share and reciprocal use roads, DNRC would work with other cooperators to address high-risk road segments. Compared to Alternative 1, the faster timeframe for corrective actions with Alternative 2, primarily through BMP upgrades, would reduce the risk of road-related erosion impacts because the most problematic areas would be identified and upgraded sooner.

Alternative 2 would result in about 1,387 miles of new road, which is 21 miles fewer than Alternative 1 at the end of the Permit term (Table 4.4-6). For new roads, commitment AQ-SD3 would require a DNRC water resource specialist to review proposed road activities in watersheds with HCP fish species and make recommendations to reduce sediment delivery. While these actions typically occur under the current program (Alternative 1), and would likely continue to occur, they are not required or assured. As under Alternative 1, these additional new roads would increase the risk of erosion, especially during the first few years following construction. While erosion potential would continue to increase over time as new roads are built and previously constructed roads require repair, these increases would likely be smaller than Alternative 1 due to the additional commitments under Alternative 2 for identifying and correcting road problems with high risk of sediment delivery to streams.

Erosion from Stream Crossings

While Alternative 2 would not commit DNRC to completing more stream crossing improvements than Alternative 1, it would commit DNRC to completing improvements faster. Under this alternative, DNRC would update its existing fish passage assessment to inventory and assess connectivity for all existing stream crossings on known and presumed bull trout, westslope cutthroat trout, and Columbia redband trout habitat (commitment AQ-FC3). Alternative 2 calls for prioritizing streams with HCP fish species (commitment AQ-FC4) and improving existing crossings within 15 years for bull trout watersheds and 30 years for westslope cutthroat trout and Columbia redband trout watersheds (commitments AQ-FC5, 6, 7). It would also implement improvements faster by requiring one-sixth of all sites that do not meet connectivity conservation objectives to be improved every 5 years (commitment AQ-FC8). These improvements would be specifically intended to improve in-stream conditions for fish, but would also reduce erosion and potential failure risks by addressing the most problematic sites earlier than under Alternative 1. Commitment AQ-FC9 would also require DNRC to consider stream conditions, cost, sediment risks, and anticipated use when selecting crossing structures, rather than just providing for fish passage as under Alternative 1. The faster timeframe for stream crossing upgrades would help reduce cumulative erosion and delivery of sediment to streams over the entire Permit term compared to Alternative 1, where the upgrades would occur more slowly.

Harvest-related Erosion

Under Alternative 2, commitments AQ-SD4 and AQ-RM1 would reduce the risk of erosion from timber harvest, site preparation, and slash treatments more than existing measures employed as part of DNRC's current program (Alternative 1). Under Alternative 2, DNRC would make a formal commitment to require a water resource specialist to review proposed harvest plans greater than 100 thousand board feet (mbf) in watersheds with HCP fish species and make recommendations to reduce sediment delivery. While typically done, specialist review would not be required under Alternative 1. This plan oversight, combined with a 25-foot SMZ no-harvest buffer along Tier 1 stream corridors and greater control on timber harvest in the RMZ, would reduce the potential for

delivery of eroded sediment to streams or lakes. In addition, no more than 15 percent of the Tier 1 RMZ of an administrative unit would be allowed in non-stocked or seeding/sapling structural stages, which would also reduce potential effects of harvest on erosion.

However, this alternative would result in an annual sustainable yield of 58 million board feet per year statewide and about 55.7 million board feet within the HCP project area, which is about 5 million board feet more than Alternative 1. In addition, much of this additional yield would be harvested from the Stillwater Unit, where the abundance of HCP fish species is relatively high. While the no-cut buffer would protect the areas supporting these species to a greater extent than existing harvest activities under Alternative 1, harvest in the upper watersheds would generally continue similarly to existing conditions. The monitoring and adaptive management measures that are part of Alternative 2 would provide a means to verify the implementation and effectiveness of the commitments and site-specific mitigation measures and ensure that expected reductions in risks from harvest area erosion are attained. If not, these measures would then provide a mechanism for modifying commitments to improve effectiveness. With this process in place, Alternative 2 would result in a greater potential for minimizing the potential effects of harvest area erosion.

Gravel Sources

Gravel pit operations are expected to continue to be relatively small and isolated under Alternative 2, and would be reclaimed soon after specific road projects are completed. The number and size of the gravel pits developed under Alternative 2 would generally correspond to the number of road miles constructed. As a result, these operations are expected to be similar in size and distribution to those expected for Alternative 1. The operations would also continue to be sited away from streams and riparian areas, so the additional riparian buffer and stream protection measures provided by the proposed HCP are not expected to substantially change the limited effects of gravel pit operations. Commitment AQ-SD5 provides additional restrictions beyond Montana Forestry BMPs to reduce the potential for sediment delivery caused by erosion at these sites. In addition, some areas would be subject to restrictions on numbers, locations, sites, and seasons of use of borrow and gravel pits to avoid or minimize effects on grizzly bear habitat or habitat use (commitments GB-NR6, GB-ST5, GB-SW5, GB-SC4).

4.5.2.4 Alternative 3 (Increased Conservation HCP)

Under Alternative 3, annual sustainable yield and miles of new road would be lower than Alternatives 1 and 2. DNRC would also implement resource protection measures that would further reduce the risk of effects of forest management activities on soil productivity and erosion as compared to Alternative 2.

Soil Productivity

Under Alternative 3, approximately 1,322 miles of new road would be constructed, which is about 86 miles fewer than under Alternative 1 and about 65 miles fewer than Alternative 2 (Table 4.4-6). As for Alternative 2, this alternative would result in a lower level of permanent soil productivity loss due to fewer roads being constructed, as compared to Alternative 1, but the reduction would not be substantial at the landscape scale. As for Alternatives 1 and 2, DNRC would continue to implement

applicable BMPs to minimize risks to soil productivity from compaction and displacement from road-related activities.

The annual sustainable yield under Alternative 3 would be 50.6 million board feet, which is a 5 percent decrease from Alternative 1 (Table 4.2-14). With a lower level of harvest predicted, a comparable decrease in amount of soil disturbance would also likely occur, decreasing the risk of impacts to soil from compaction or displacement. Like Alternative 1, this alternative would include minimal forest management within the Stillwater Core. As for Alternatives 1 and 2, DNRC would continue to implement applicable BMPs to avoid or minimize soil compaction and displacement from harvest-related activities.

As for Alternatives 1 and 2, DNRC would continue to follow the Forest Management ARMs regarding retention of woody debris. Compared to Alternative 2, however, this alternative would result in higher levels of CWD left in units within lynx denning habitat, which could result in higher levels of nutrient retention in these areas.

Harvest activities adjacent to Class 1 streams with HCP fish species would be further restricted compared to Alternative 2. The no-harvest buffer would be extended to the full RMZ (typically 80 to 100 feet), rather than just the first 25 feet. There would be no policy changes for other streams, so risks of effects on soil productivity adjacent to those streams would be the same under this alternative as they would under Alternatives 1 and 2.

Grazing management under Alternative 3 would be the same as under Alternative 2, except that DNRC would increase the review cycle for grazing licenses to every year and include measurable targets for DFCs. By reviewing grazing licenses more frequently, any problems affecting soil productivity can be identified and corrected sooner to minimize the amount of time such problems can pose risks to other resources.

Erosion

Road-related Erosion

Under Alternative 3, additional commitments beyond those in Alternative 2 for reducing sediment delivery from existing roads would result in faster identification and corrective action for problem road areas where eroded sediments are being delivered to streams. With Alternative 3, the completion timeline for road sediment delivery inventories is faster than Alternative 2, within 5 years for bull trout watersheds, and within 10 years for westslope cutthroat trout and Columbia redband trout watersheds. Corrective actions for DNRC-owned roads with high risk of sediment delivery would also be completed 5 years faster than the other alternatives, particularly Alternative 1, where implementation of corrective actions would occur as part of specific harvest or road projects in the watershed and then only if funding is available. Alternative 3 also addresses moderate sediment delivery roads on a project-specific basis, similar to Alternative 2. As for Alternative 2, a DNRC water resource specialist would also be required to review proposed road activities in watersheds with HCP fish species and make recommendations to reduce sediment delivery, which would also be done under Alternative 1, but not as a requirement.

Alternative 3 is predicted to have fewer miles of new road, with about 1,322 miles within 50 years, which is about 65 miles (about 5 percent) less than Alternative 2 and 86 miles (6 percent) less than

Alternative 1 (Table 4.4-6). With a slightly lower total of new roads expected under Alternative 3, increases in the risk of erosion would be slightly less than what would be expected under Alternatives 1 and 2.

Erosion from Stream Crossings

Alternative 3 stream crossing commitments are the same as for Alternative 2, except that upgrades would occur within 10 years for bull trout watersheds and 20 years for westslope cutthroat trout and Columbia redband trout watersheds, instead of 15 and 30 years, respectively, under Alternative 2. This faster timeframe for stream crossing upgrades would help reduce erosion and sediment delivery to the HCP project areas streams compared to Alternatives 1 and 2, where the upgrades would occur more slowly.

Harvest-related Erosion

The provision for a full no-cut buffer around Tier 1 streams, and the requirement for a water resource specialist to review harvest plans, are expected to reduce the risk of effects from harvest area erosion. In addition, this alternative would result in a lower annual sustainable yield (50.6 million board feet per year statewide, 48.2 million board feet within the HCP project area) than the other alternatives. As under Alternative 1, forest management would be minimal in the Stillwater Core under Alternative 3. As for Alternative 2, this alternative would include monitoring and adaptive management provisions to ensure that commitments and site-specific mitigation requirements are performing as expected and, if not, to modify them to improve performance. With this process in place, Alternative 3 would result in a greater potential for minimizing the potential effects of harvest area erosion than Alternative 2.

Compared to Alternative 2, Alternative 3 has additional riparian harvest commitments that expand the no-harvest buffer to the full RMZ (one site potential tree height [SPTH], or typically 80 to 100 feet) and in some cases to the full CMZ for Tier 1 streams. When combined with the commitments for reducing the potential for surface erosion from harvest, site preparation, and slash treatment (which are the same as for Alternative 2), this wide buffer would substantially reduce the risk of sediment delivery to surface waters with HCP fish species. This also would be expected to result in less sediment entering the buffers and the buffers having less surface soil and vegetation disturbance.

Gravel Sources

Corresponding to the number of road miles constructed under Alternative 3, the number and size of the gravel pits developed are also expected to be less than the other alternatives. Site-specific gravel pit operations are expected to be similar to existing conditions, which are generally effective at reducing erosion and erosion effects. As a result, the increased mitigation measures provided by Alternative 3 are not expected to substantially change the overall effects of gravel operations in the HCP project area. As under Alternative 2, all gravel pits would be subject to commitments for reducing potential sediment delivery and some areas would be subject to restrictions on numbers, locations, sites, and seasons of use of borrow and gravel pits to avoid or minimize effects on grizzly bear habitat or habitat use.

4.5.2.5 Alternative 4 (Increased Management Flexibility HCP)

Under Alternative 4, annual sustainable yield and miles of new road would be the same as Alternative 2. DNRC would also implement resource protection measures that would reduce the risk of effects of forest management activities on soil productivity and erosion to a level between Alternatives 1 and 2.

Soil Productivity

With the same annual sustainable yield and number of new road miles as Alternative 2, this alternative would result in the same levels of permanent loss of soil productivity and risk of impacts to soil from compaction or displacement. Like Alternative 2, under this alternative forest management would increase in the Stillwater Core. As for the other alternatives, DNRC would continue to implement applicable BMPs to minimize risks to soil productivity from compaction and displacement from road- and forest-related activities.

Regarding nutrient cycling from retained CWD, Alternative 4 would be the same as Alternative 2 regarding retention of at least two potential den sites per square mile in lynx habitat; however, this requirement would also apply to blowdown areas, so less CWD would be retained in these areas as compared to Alternative 1.

Harvest activities adjacent to Class 1 streams with HCP fish species would be less restrictive than Alternative 2, but more restrictive than Alternative 1. While RMZs would be defined in the same manner as under Alternative 1, harvest would not be allowed in the first 25 feet. There would be no policy changes for other streams, so risks of effects on soil productivity adjacent to those streams would be the same under this alternative as they would under Alternatives 1 and 2.

Grazing management under Alternative 4 would be similar to Alternative 1, except that DNRC would decrease the review cycle for grazing licenses to 10 years. By reviewing grazing licenses less frequently, any problems affecting soil productivity may not be identified as readily as under the other alternatives. Therefore, the amount of time such problems could pose risks to other resources would be higher under Alternative 4.

Erosion

Road-related Erosion

Compared to Alternatives 2 and 3, Alternative 4 would retain the process for prioritizing corrective actions based on risk of sediment delivery and a timeline for completing road sediment inventories; however, this alternative would not require completion of corrective actions under specific timelines. The timeline for completing inventories would be 5 years slower than under Alternative 2, and more similar to Alternative 1, Alternative 4 would require implementation on a project-specific basis. As for Alternatives 2 and 3, a DNRC water resource specialist would be required to review proposed road activities in watersheds with HCP fish species and make recommendations to reduce sediment delivery, although this would also typically occur under Alternative 1. Over the Permit term, the potential for cumulative erosion from road problems under Alternative 4 would be lower than Alternative 1, but higher than Alternatives 2 and 3.

New road construction, reconstruction, and maintenance would be the same as for Alternatives 2 and 3. Alternative 4 would result in about the same miles of additional road over time as Alternative 2 (Table 4.4-6), so increases in risk of erosion from roads would be similar to that under Alternative 2.

Erosion from Stream Crossings

Alternative 4 stream crossing commitments are the same as for Alternatives 2 and 3, except that they are implemented on a project-specific basis instead of within a fixed schedule. This would increase the overall time required for improving or replacing problem crossings, which are more likely to fail. As a result, Alternative 4 would lead to an increased probability of more erosion causing sediment delivery to streams compared to Alternatives 2 and 3, but less than Alternative 1.

Harvest-related Erosion

Alternative 4 commitments for harvest-related surface erosion, site preparation, and slash treatments are the same as for Alternative 1, resulting in a similar potential for harvest area erosion effects. However, Alternative 4 also has a higher annual sustainable yield than Alternative 1, with much of this increase resulting from increasing forest management in the Stillwater Core. Therefore, the overall harvest area erosion risks are likely to be greater for Alternative 4 than the other alternatives.

Alternative 4 has similar riparian commitments as Alternative 1, except that this alternative would include a 25-foot no-harvest buffer in Tier 1 SMZs, and CMZs would be managed the same as under Alternative 2. Alternative 4 would reduce the risk of erosion increasing sediment delivery to buffers and streams compared to Alternative 1. However, the risk of erosion in riparian areas under Alternative 4 would be higher than under Alternatives 2 and 3.

Gravel Sources

Corresponding to the number of road miles constructed under Alternative 4, the number and size of the gravel pits developed are also expected to be similar to Alternative 2, and more than Alternative 3. However, the overall difference in gravel pit operations between alternatives is expected to be relatively small, and similar to existing conditions, which are generally effective at reducing erosion and erosion effects. As a result, the increased flexibility Alternative 4 provides would not be expected to substantially change the overall effects of gravel operations in the HCP project area. As for Alternatives 2 and 3, all gravel pits would be subject to sediment delivery reduction commitments and some would be subject to restrictions intended to avoid or minimize effects on grizzly bear habitat or habitat use.

4.5.2.6 Summary

Maintaining soil productivity by preserving rich, organic topsoil layers is critical for long-term forest growth. Forest management activities can affect soil productivity by causing nutrient loss, compaction, displacement, erosion, and mass movement. As noted previously in this section, mass movement is not considered a major sediment source related to forest practices on HCP project area lands, except for some steep terrace faces, steep or high road cutslopes or fillslopes, and high stream banks. Consequently, alternatives were compared based on differences in changes to soil productivity (nutrient loss, compaction, and displacement) and risks of erosion.

By implementing existing BMPs and complying with the existing regulatory framework, all four alternatives would minimize the risk of effects on soil productivity. However, additional conservation commitments specified by the action alternatives would decrease risks associated with specific activities (e.g., grazing) and locations (e.g., riparian areas). The overall risk of effects on soil productivity was evaluated based on miles of new road and annual sustainable yield, which both provide an indication of the amount of soil disturbance that would occur for each alternative. Based on these evaluations, as well as conservation commitments specified by the alternatives, Alternative 3 would result in the lowest risk of effects on soil productivity, followed by Alternatives 2, 4, then 1. Under all four alternatives, productivity would be permanently lost for soils on which roads are built. Only Alternatives 2 and 4 would result in soil disturbance in the Stillwater Core.

In terms of potential effects from erosion, all four alternatives would be expected to provide adequate protection from erosion effects because they are all primarily based on existing rules, regulations, and BMPs. The existing SMZ Law and Rules, Forest Management ARMs, Montana Forestry BMPs, and DNRC forest management policies are generally effective at minimizing soil disturbance activities (DNRC 2006e). In addition, existing harvest methods and procedures minimize soil disturbance, and existing riparian buffers provide adequate filtration of sediments.

Overall, there would be relatively small differences between the alternatives with regard to the risk of erosion based on level of soil disturbance as measured by annual sustainable yield and miles of new road. Alternatives 2 and 4 would result in the largest amounts of soil disturbance based on an annual sustainable yield of 55.7 million board feet within the HCP project area, followed by Alternative 1 (50.7 million board feet in the project area), and Alternative 3 (48.2 million board feet in the project area). This would suggest that Alternatives 2 and 4 might have a greater risk of erosion problems, based on the increased harvest activities and resulting soil disturbance. Similarly, estimates of new road miles (at 50 years) provide an indication of the risk of erosion from soil disturbance associated with road-related activities. Alternative 1 would result in the most new road miles at 50 years (1,408 miles), followed by Alternatives 2 and 4 (1,387 miles) and Alternative 3 (1,322 miles). With the lower annual sustained yield and miles of new road, Alternative 3 would likely result in the lowest risk of erosion-related effects.

Many of the aquatic conservation commitments focus on the reduction of sediment delivery to streams, and the primary mechanism for sediment reaching streams is the erosion and transport of soils from road surfaces and road-stream crossings into streams. Variations between alternatives in terms of how sediment delivery, and also erosion, would be reduced provide a more discriminating way to compare alternatives. While the number of culverts that would be replaced over the Permit term would not change between alternatives, the speed at which high-risk culverts are replaced can have a substantial effect on how much sediment is delivered to streams over time. More aggressive identification and replacement of high-risk structures can reduce the cumulative amount of sediment entering streams at these locations over time. Based on commitments for identifying, prioritizing, and correcting road and stream crossing problems, Alternative 3 would result in the least amount of sediment reaching streams, followed by Alternatives 2, 4, then 1. Both Alternatives 2 and 3 would require inventories and corrective actions to be completed within specified timeframes for affected streams with HCP fish species. Alternative 4 would require inventories to be completed within specific timeframes, but would then schedule corrective actions on a project-by-project basis. Alternative 1 would not require any specific timelines for inventories or corrective actions, but would schedule corrective actions on a project-by-project basis when funds are available.

Evaluating the three factors discussed above: (1) risk of effects on soil productivity, (2) risk of erosion, and (3) rate of identification and repair of high-risk road-related sediment delivery problems, Alternative 3 would result in the least potential for adverse effects from forest management activities and provide the greatest benefit in terms of reducing ongoing sediment delivery to streams. Alternatives 2, 4, and 1 would have increasingly higher potential for adverse effects and decreasing benefits for reducing sediment delivery to streams.

4.6 WATER RESOURCES

This section describes water quality and water quantity in the planning area and evaluates how the alternatives may affect the quality and quantity of surface water and groundwater. Rivers, streams, lakes, reservoirs, and other waterbodies in the planning area support numerous beneficial uses. Among these are complex aquatic ecosystems that support stocks of HCP fish species (bull trout, westslope cutthroat trout, and Columbia redband trout) and other aquatic species. Key human uses include drinking water, recreation, and agricultural and industrial water supplies. Activities that reduce the suitability of water for these uses are a major source of concern for resource managers as well as the public.

4.6.1 AFFECTED ENVIRONMENT

This section is divided into four primary parts. Section 4.6.1.1 (Regulatory Framework) introduces the key water-related statutes and regulations that govern DNRC as it manages trust lands. Section 4.6.1.2 (Surface Waters in the Planning Area) describes the streams and lakes that occur in the area and introduces the key water quality and water quantity parameters that may be influenced by timber management activities on trust lands. Section 4.6.1.3 (Surface Water Quality) describes water quality conditions that may be impacted by forest management activities, followed by a summary of current water quality in the HCP project area. Finally, Section 4.6.1.4 (Surface Water Quantity) provides a brief overview of the potential for timber harvest and road building to produce changes in the timing and quantity of water that flows from a watershed, specifically water yield, low flows, and peak flows.

Precipitation is a primary factor influencing vegetation conditions, runoff, sediment yield, and water quality. The highest volume of stream flow in Montana rivers occurs during the spring and early summer months with the melting of the winter snow pack. Heavy rains falling during the spring thaw occasionally constitute a serious flood threat (WRCC 2005). Ice jams, which occur during the spring breakup (usually in March), can cause backwater flooding. Flash floods are probably the most common form of flooding and result from locally heavy rainstorms in the spring and summer. Climate and precipitation are discussed in greater detail in Section 4.1 9 (Introduction).

4.6.1.1 Regulatory Framework

The current regulatory framework for water quality in the state of Montana is based on the federal CWA, which was established in 1972 to regulate the discharge of pollutants into waters by establishing national water quality standards and permit guidelines. In 1974, the EPA, which oversees the implementation of the federal CWA, delegated to Montana the authority to enact many of the provisions of the CWA. The Montana Water Quality Act (MCA 75-5-101 et seq.) is the state's primary legislation for fulfilling its responsibilities under the CWA. While the EPA maintains ultimate authority to administer the CWA in Montana, it has granted MDEQ, Water Protection Bureau, the primary responsibility for implementing the act in Montana. For projects on trust lands, DNRC works in conjunction with local agencies, MDEQ, MFWP, and EPA to ensure compliance with the regulations governing waterbodies within the planning area.

At the state level, MFWP administers the Montana Stream Preservation Act (124 permits) for activities that disturb the bed or bank of a stream. The Forest Management ARMs (ARM 36.11.423)

require an assessment of CWE on projects involving substantial vegetation removal or ground disturbance, and using the assessment, ensure the protection of beneficial uses and identify opportunities to mitigate adverse effects. CWE assessments typically address surface water runoff generation and physical effects to stream channels and sediment production, as well as effects to habitat and ecosystem functions (Reid 1993). As stated in Section 4.5.1.1 (Geology and Soils, Regulatory Framework), the Montana Forestry BMPs are recognized as the primary mechanism for achievement of water quality standards.

DNRC also adheres to the SMZ Law, which regulates forest management activities within SMZs on private, state, and federal lands. This law prohibits seven forest management activities in SMZs: (1) broadcast burning; (2) operating wheeled or tracked vehicles, except on established roads; (3) clearcutting; (4) construction of roads, except when necessary to cross a stream or wetland; (5) improper handling, storage, use, or disposal of hazardous or toxic substances; (6) side-casting of road material into waterbodies; and (7) deposit of slash in waterbodies.

The Forest Management ARMs also specify how DNRC manages grazing licenses on classified forested trust lands (ARM 36.11.444). This ARM directs DNRC to manage licenses to maintain or restore both herbaceous and woody riparian vegetation to a healthy and vigorous condition, facilitate all age classes of riparian community, leave sufficient plant biomass and residue for adequate filter and energy dissipation during floodplain function, and minimize physical damage to stream banks. DNRC is also required to design grazing plans to minimize loss of riparian stream bank vegetation and to reduce structural damage to stream banks. Inspections occur on a 5-year cycle using a coarse-filter approach specified in the ARM to identify potential problem areas.

DNRC's trust lands are also subject to Montana's open range doctrine, which requires landowners not wishing to allow livestock grazing on their land to fence the livestock out (MCA 81-4-203). This can lead to unauthorized livestock use from open range cattle.

Waterbody Classification

Montana waterbodies are classified according to the present and beneficial uses they normally would be capable of supporting (MCA 75-5-301). The state water use classification system (ARMs 17.30.604 through 629) identifies the following beneficial uses:

- Drinking, culinary use, and food processing
- Growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers
- Bathing, swimming, recreation, and aesthetics
- Agricultural water supply
- Industrial water supply.

Surface waters are classified primarily by

- The level of protection they require,
- The type of fisheries they support (warmwater or coldwater),
- Their natural ability to support use for drinking water, agriculture, etc.

The use classification was designed for streams; consequently, some of the uses designated by the classification system are not always applicable to lakes and wetlands. The designated beneficial uses for each class in the system are summarized in Table 4.6-1.

TABLE 4.6-1. DESIGNATED BENEFICIAL USES BY WATER USE CLASS

	Water Use Class							
Beneficial Use	**A-Closed**	**A-1**	**B-1**	**B-2**	**B-3**	**C-1**	**C-2**	**C-3**
Drinking Water (Human Health)	X[1]	X	X	X	X			X[2]
Fisheries (Salmonid)	X	X	X	X[3]		X	X[3]	
Fisheries (Non-salmonid)					X			X
Aquatic Life	X	X	X	X	X	X	X	X
Recreation	X	X	X	X	X	X	X	X
Agriculture, Industry	X	X	X	X	X	X	X	X[2]

[1] Waters classified A-Closed are to be maintained suitable for drinking, culinary, and food processing purposes after simple disinfection; all other A- and B-class waters require conventional treatment.
[2] The quality of waters classified C-3 is naturally marginal for drinking, culinary, and food processing purposes, as well as agricultural and industrial supply.
[3] Waters classified B-2 and C-2 are marginally suitable for propagation of salmonid fishes and associated aquatic life.
Source: ARM 17.30.620 *et seq.*

Surface waters support beneficial uses when they meet water quality standards established to protect those uses. Surface waters are considered to be impaired when sufficient credible data shows that the waterbody is failing to achieve compliance with applicable water quality standards and beneficial uses are not fully supported. In some cases, non-compliance with a standard will result in the impairment of only a single use; in other situations, non-compliance with one or more standards may result in the impairment of all uses for the applicable classification.

When natural conditions limit or preclude a designated use, permitted point source discharges or non-point source discharges may not degrade the natural conditions. Montana's antidegradation policy (ARM 17.30.705) requires that waters of higher quality than applicable standards be maintained in their higher quality.

Water Quality Standards

Water quality standards for Montana are based on stream classification and are set by administrative rule (ARM 16.20.601 et seq.). Standards are established at varying levels for individual waterbodies based on water use class (Table 4.6-2). Surface waters are assigned to use classes based on the drainage basin in which they occur. As a result, all state waters are classified and have designated uses and supporting standards.

Activities associated with the management of forested trust lands must comply with the CWA to meet state water quality standards for waters that may be affected by those activities. To work toward meeting water quality standards, DNRC uses BMPs to reduce erosion and soil impacts that can influence water quality (see Section 4.5, Geology and Soils). DNRC also monitors erosion and soil disturbance during watershed surveys and monitors water quality of selected rivers and lakes (DNRC 2005b). Water quality monitoring is conducted on the Stillwater and Swan River State Forests to detect trends in water quantity, nutrients, and sediments in the Whitefish Lake and Stillwater River basins. This monitoring began in 1976 on the Stillwater State Forest and in 2003 in

the Swan River drainage and continues today. DNRC is also conducting stream temperature monitoring on an additional approximately 30 sites within the planning area.

The 303(d) List and TMDLs

When water quality monitoring data reveal changes to natural conditions that exceed those allowed by state standards, the water is determined to be impaired (i.e., does not fully meet standards) or threatened (i.e., is likely to violate standards in the near future). More precisely, the specific beneficial uses that are protected by the exceeded standard(s) are determined to be impaired or threatened. Under Section 303(d) of the CWA and Part 7 of the Montana Water Quality Act (MCA 75-5-701 et seq.), the state is required to develop a list of water quality-limited waterbody segments. The laws require the state to establish priority rankings for waterbodies on the list and to develop action plans to improve their water quality. As part of each plan, MDEQ is required to calculate the TMDL of each pollutant of concern that could enter listed waters and still meet its water quality standards and support all designated beneficial uses (see Section 4.6.1.3, Surface Water Quality, for a discussion of impaired streams identified within the EIS planning area and HCP project area).

As part of the 303(d) assessment process, waterbodies are assigned to different categories based on their assessment status:

- **Category 1.** Waters attaining all standards
- **Category 2.** Waters attaining some standards
- **Category 3.** Waters with insufficient information to determine whether any beneficial uses are supported
- **Category 4.** Impaired or threatened waters that do not need or already have completed a TMDL
- **Category 5.** Impaired waters for which a TMDL is required.

Category 4 is further divided into three sub-categories: 4A (all necessary TMDLs have been completed and approved), 4B (other pollution control requirements are expected to result in the attainment of water quality standards), and 4C (identified threats or impairments result from categories for which TMDLs cannot be developed, such as dewatering or habitat modification).

The list of waters in Category 5 is typically called the 303(d) list. The 303(d) list is revised every 2 years, and the most recent list is contained in a draft 2006 report.

Water Quantity Standards

Montana's regulatory framework for water quality does not include streamflow criteria to protect volumes and levels of flow necessary to support existing uses. However, the state does have biological criteria through narrative criteria such as "suitable for salmonids and associated aquatic life." The state is in the process of developing more specific criteria that may include numeric standards.

TABLE 4.6-2. MONTANA WATER QUALITY STANDARDS FOR THE MAJOR NON-CHEMICAL PARAMETERS OF CONCERN

Water Use Class	Dissolved Oxygen		Turbidity	Temperature	Sediment
	Early Life Stages[1,2]	Other Life Stages[3]			
A-Closed	No change from naturally occurring levels.		No increase above naturally occurring turbidity.	No increase above naturally occurring temperature.	Narrative standard[4]
A-1	9.5[5]	6.5	No increase above naturally occurring turbidity.	No increase greater than 1° F above naturally occurring temperatures between 32° F and 66° F, but not to exceed 67° F. When natural conditions exceed 66.5° F, no increase greater than 0.5° F.	Narrative standard[4]
B-1	9.5[5]	6.5	No more than 5 NTU[6] above naturally occurring levels.	Same as Class A-1	Narrative standard[4]
B-2	9.5[5]	6.5	No more than 10 NTU above naturally occurring levels.	Same as Class A-1	Narrative standard[4]
B-3	6.0	5.5	No more than 10 NTU above naturally occurring levels.	No increase greater than 3° F above naturally occurring temperatures between 32° F and 79.5° F, but not to exceed 80° F. When natural conditions exceed 79.5° F, no increase greater than 0.5° F.	Narrative standard[4]
C-1	9.5[5]	6.5	No more than 5 NTU above naturally occurring levels.	No greater than 1° F above naturally occurring temperature between 32° F and 66.5° F, but not to exceed 67° F. When natural conditions exceed 66.5° F, no increase greater than 0.5° F.	Narrative standard[4]
C-2	9.5[5]	6.5	No more than 10 NTU above naturally occurring levels.	Same as Class C-1	Narrative standard[4]
C-3	6.0	5.5	No more than 10 NTU above naturally occurring levels.	No greater than 3° F above naturally occurring temperature between 32° F and 79.5° F, but not to exceed 80° F. When natural conditions exceed 79.5° F, no increase greater than 0.5° F.	Narrative standard[4]

[1] Includes all embryonic and larval stages, and all juvenile forms of fish to 30 days following hatching.
[2] 7-day mean, in milligrams per liter (mg/L); lower values have been established as 7-day mean minima.
[3] 30-day mean, in mg/L; lower values have been established as 7-day mean minima and 1-day minima.
[4] No increases above naturally occurring concentrations, if such increases would create a nuisance or render waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
[5] This is the water column concentration recommended to achieve the required inter-gravel dissolved oxygen level concentration of 6.5 mg/L. For species that have early life stages exposed directly to the water column, the minimum standard 7-day mean value is 6.5 mg/L.
[6] NTU: Nephelometric Turbidity Units, the measurement units of turbidity using a nephelometer (light reflected by particles in suspension at a right angle to the original source).
Source: MCA 17.30.620 *et seq.* and MDEQ (2008).

4.6.1.2 Surface Waters in the Planning Area

Waters in the planning area flow into three river basins. Precipitation west of the Continental Divide (NWLO and SWLO) drains to the Pacific Ocean via the Columbia River. East of the Continental Divide (the CLO), most water flows into the Missouri River, eventually joining the Mississippi and emptying into the Gulf of Mexico. The far northern portion of the CLO is drained by the Saint Mary River, which feeds the north-flowing Saskatchewan River and ultimately flows into Hudson Bay. The following subsections describe the stream and lake resources within the boundaries of the three land offices comprising the planning area. Figures D-6A through D-6C (Appendix D, EIS Figures) show the locations of major lakes and rivers in the planning area. Subsequent discussions address parameters of concern for surface water quality and quantity.

Streams and Lakes

The Clark Fork River is the largest river flowing within the boundaries of the NWLO, although the river's headwaters are in the SWLO. The largest tributary to the Clark Fork River within the NWLO boundary, the Flathead River, originates in Glacier National Park, the Bob Marshall Wilderness, and southern British Columbia and drains the northern portion of the Clark Fork basin. The Kootenai River originates in Canada and flows through the northwestern corner of the NWLO before passing through Idaho and discharging into the Columbia River in Canada. The largest waterbodies in the land office are Flathead Lake, the largest freshwater lake in the United States west of the Mississippi River, and the Lake Koocanusa reservoir, which impounds approximately 48 miles of the Kootenai River upstream of Libby Dam. Other major waterbodies include Hungry Horse Reservoir, Lake MacDonald, Whitefish Lake, Swan Lake, and Noxon Reservoir.

The SWLO is almost entirely within the Clark Fork River basin. Major tributaries to the Clark Fork within the SWLO include the Blackfoot and Bitterroot Rivers, both of which converge with the Clark Fork River in the vicinity of Missoula. The southeastern portion of the SWLO is within the basin of the Big Hole River, which drains into the Missouri River via the Jefferson River. The largest lake within this land office is 3,000-acre Georgetown Lake, which was created by the construction of Flint Creek Dam.

Nearly all of the CLO is drained by the Missouri River. The Missouri River is formed by the convergence of the Jefferson, Gallatin, and Madison Rivers near Three Forks within the CLO. From north to south, other major tributaries within the CLO include the Milk, Marias, Teton, Sun, and Smith Rivers. The southeastern portion of the CLO is within the Upper Yellowstone River basin. The northwestern extreme of the CLO is drained by the Saint Mary River. Major waterbodies within the CLO include (in descending order of area) Canyon Ferry Reservoir, Tiber Reservoir, Hebgen Lake, Clark Canyon Reservoir, Lima Reservoir, and Saint Mary Lake.

Based on information in Montana's hydrography dataset (DNRC 2008a), the planning area has nearly 100,000 miles of intermittent and perennial streams; approximately 4,300 miles of the total stream length (4 percent) occur on trust lands managed by DNRC (Table 4.6-3). This is representative of the general distribution of DNRC-managed lands, which make up approximately 5 percent of the total acreage of the planning area. In the NWLO and SWLO, the majority of streams on trust lands are on parcels included in the HCP project area (75 percent for the two western land offices combined). Less than 10 percent of the stream miles in the CLO are on parcels

within the HCP project area. While nearly one-half of the total stream mileage in the planning area occurs in the CLO, only 226 of the stream miles (14 percent) within this land office are located within the HCP project area.

TABLE 4.6-3. MILES OF STREAM IN THE PLANNING AREA AND HCP PROJECT AREA BY LAND OFFICE

	Streams in the Planning Area			Proportion of Streams in the HCP Project Area	
Land Office	**Stream Miles in the Planning Area**	**Stream Miles on Trust Lands[1]**	**Stream Miles in the HCP Project Area**	**Percent of Stream Miles in the Planning Area**	**Percent of Stream Miles on Trust Lands**
NWLO	25,990	996	849	3	85
SWLO	24,631	775	503	2	65
CLO	44,832	2,521	226	1	9
Total	**95,452**	**4,292**	**1,578**	**2**	**37**

[1] Includes all trust lands managed by DNRC, including those comprising the HCP project area.
Source: DNRC (2008a).

Of nearly 500,000 acres of lakes in the planning area, approximately 865 acres (1 percent) occur on trust lands managed by DNRC (Table 4.6-4). Similar to streams, the majority of lake acres on trust lands in the two western land offices are included in the HCP project area; in the CLO, less than one-tenth of 1 percent of lakes on trust lands are in the HCP project area.

TABLE 4.6-4. ACRES OF LAKES IN THE PLANNING AREA AND HCP PROJECT AREA BY LAND OFFICE

	Lakes in the Planning Area (Acres)			Proportion of Lakes in the HCP Project Area	
Land Office	**Total**	**DNRC Lands[1]**	**HCP Project Area**	**Percent of Total Acres**	**Percent of DNRC Acres**
NWLO	255,808	865	598	0.2	69
SWLO	32,556	293	204	0.6	70
CLO	197,893	5,433	3	0.0	0.1
Total	**486,257**	**6,591**	**805**	**0.2**	**12**

[1] Includes all trust lands managed by DNRC, including those in the HCP project area.
Source: DNRC (2008a).

4.6.1.3 Surface Water Quality

Forest practices can affect the water quality of aquatic habitat primarily through changes in water temperature and dissolved oxygen, as well as sediment delivery from roads. Management activities on forested trust lands must provide for adequate water quality protection for fish and wildlife habitat. Water quality conditions impacted by forest management activities are summarized in the following subsections, and these are followed by a summary of current water quality in the HCP project area. Water quality related to aquatic species is also discussed in Section 4.8 (Fish and Fish Habitat).

Temperature

Water temperature is a critical determinant of habitat suitability for aquatic species. Most aquatic organisms are cold-blooded, with internal temperatures that closely follow the temperature of the water in which they live. In general, warmer temperatures result in increased biological activity; a 10 percent increase in metabolic rate per 1° C (1.8° F) increase in water temperature is a typical average (Gorden et al. 1992). As metabolic rates of aquatic species increase with warmer waters, so does their need for oxygen. Warmer water also holds less oxygen, thus compounding the potential effects on aquatic habitat conditions (Brooks et al. 1997).

Many aquatic species can only tolerate a relatively limited range of temperatures. Increased water temperatures associated with timber harvest and road building can have adverse impacts on species adapted to cold-water conditions. Salmonid species are particularly sensitive to increases in water temperatures, and Montana's native bull trout is widely considered the most temperature-sensitive of all the state's salmonids. Although a variety of factors influence the status of these fish species, water temperature has been identified as an important limiting factor (MFWP 2005a).

Timber harvest and forest road construction can influence water temperature by removal of riparian forest that shades streams and from changes to the upland hydrology that alters the amount, timing, and temperature of watershed runoff. Water temperatures can increase when stream-shading vegetation is lost, thereby increasing direct solar heating (Beschta et al. 1987). First- to third-order headwaters streams, which typically make up about 85 percent of the total length of the drainage network and where most forest management activities occur, are the most readily influenced by loss of shade from the riparian vegetation. Complete removal of the forest canopy along streams of the Pacific Northwest resulted in an increase in the summer daily maximum temperature of 3 to 8° C (5.4 to 14.4° F) (Hartman et al. 1987).

Water temperature can be impacted by forestry activities that modify the timing and quantity of stream flow (Swanston 1991). Forest management activities have been shown to influence the rates of snow accumulation and melt, evapotranspiration rates, interception of shallow groundwater, concentration of surface runoff from roads, and infiltration and transmission of water into and through forest soils. As a consequence, the amount of groundwater recharge to streams may change in managed watersheds, and stream temperatures, which are moderated by groundwater inputs, can be affected (Chamberlin et al. 1991).

Sediment

Excessive fine sediment delivery to streams can adversely affect water quality and aquatic habitat both directly and indirectly. Increased turbidity in the water can reduce light in the stream environment, impair aesthetic quality, and cause gill abrasion in fish. Increased sediment deposition negatively affects salmonid habitat by filling interstitial spaces in the streambed (see Section 4.8.2.1, Fish and Fish Habitat, Sediment). Increased suspended sediment (i.e., total suspended solids [TSS]) can also increase heat absorption and consequently increase water temperature. Indirectly, sediments may contribute nutrients, oxygen-demanding organic materials, or harmful minerals and chemicals that impair water quality. In lakes and large rivers, high levels of suspended sediment can impact aquatic life by blocking light needed by submerged plants and algae.

Logging and roads have been shown to increase sediment deposition in streams, particularly in steep terrains susceptible to mass movements of soil (Reid and Dunne 1984; Swanston 1991). The

amount of fine sediment that reaches a stream depends primarily on the amount of sediment produced through mass wasting and surface erosion, and the ability of sediment to be transported from its source to the stream. A direct source of sediment deposition is erosion of streambank soils.

Forests generally have very low erosion rates unless they are disturbed (Elliot et al. 2000). Common disturbances include timber harvesting, prescribed burning, and wildfires. The impact of these activities on hill-slope soil erosion rates generally only lasts for a few years before the rapid re-growth of vegetation covers the surface with protective plant litter. Forest roads are the most common source of long-term increases in surface soil erosion because road construction, use, and maintenance compact soils, reduce infiltration of rainfall and snowmelt, intercept and concentrate surface runoff and subsurface water, and limit vegetation re-growth. In addition to accelerating the rate of surface erosion and the efficiency of sediment delivery to streams, the soil disturbance and drainage alterations caused by road construction may increase the frequency and magnitude of mass movement. Mass movement (e.g., landslides), a category of natural landscape processes, occurs when large masses of soil are rapidly displaced down slope. Where improperly located, roads may undercut the base of unstable slopes. Where roads intercept and concentrate surface runoff and subsurface flow, water may be diverted to hillsides causing soil saturation and slope failures. Finally, if culverts or other drainage structures become plugged with sediment and debris, road fill can be washed out. Where roads are located on sensitive lands, the probability of mass movement may increase beyond normal frequencies.

The ability of sediment to travel from its source to streams can be affected by timber harvesting in riparian areas. The vegetation in riparian areas generally functions as a filter, removing sediment before it reaches a waterbody. Vegetation immediately adjacent to stream channels is also important in maintaining streambank stability and limiting streambank erosion.

Livestock grazing also has the potential to increase sediment delivery to streams, particularly where rangeland is a large component of a watershed or where livestock are concentrated near streams. Research on a rangeland watershed in North Dakota found that grazing and its attendant effects on depletion of plant cover and litter and trampling of the soil was the most important factor contributing to erosion and sedimentation (Sedivec 1992). Observations while monitoring the application of grazing BMPs at a ranch in western Montana showed evidence that short-term in-stream suspended sediments were associated with the presence of cattle near sampling sites, but the overall effects on stream sedimentation were inconclusive (Sherwood 2000).

Dissolved Oxygen

Dissolved oxygen in water is critical for nearly all forms of aquatic life. Oxygen enters the water by diffusion at the air-water interface, from air bubbles introduced by turbulent flow in rapids, or from rainfall. Oxygen is also a byproduct of photosynthesis by aquatic plants (Gordon et al. 1992). The solubility of oxygen in water is inversely related to water temperature, so the summer is typically a critical time for low dissolved oxygen concentrations.

Dissolved oxygen concentrations are also related to nutrient concentrations through a process known as eutrophication, which is the nutrient enrichment of aquatic systems. In lakes, dissolved oxygen concentrations are often depleted in this process as added nutrients stimulate the growth of aquatic plants and algae, which eventually die and decompose. The decomposition reduces oxygen levels, which in some lakes can reach levels low enough to impact many aquatic species (EPA

1999a). High-gradient streams in forested environments often have enough turbulence that results in rapid replenishment of dissolved oxygen content (Gualtieri and Gualtieri 1999). Low dissolved oxygen concentrations are more likely to be associated with lakes and point sources, such as municipal wastewater treatment facilities or industrial facilities, than with forest streams (MacDonald et al. 1991).

Dissolved oxygen concentrations are strongly associated with thermal changes and organic inputs. By reducing thermal cover and increasing sediment or nutrient input, timber harvest and road building can negatively affect dissolved oxygen concentrations.

Nutrients

Nutrients include a wide range of chemical constituents that plants and animals need to grow and survive. For water quality investigations, the various forms of nitrogen and phosphorus are the primary nutrients of interest. Excessive amounts of these nutrients can stimulate the growth of algae, which in turn can interfere with the beneficial uses of lakes and streams. In excessive amounts, algae can alter the composition of macroinvertebrate and fish communities, change dissolved oxygen levels, and interfere with aesthetic and recreational uses of rivers and streams (Nordin 1985).

Harvest and road building have the potential to increase nutrients in streams by introducing more organic material and sediment (MacDonald et al. 1991). Nutrient loading can increase indirectly as a result of forestry activities, as nutrient uptake is reduced by the reduction of vegetation (Brown 1989).

Existing Surface Water Quality

Available GIS data do not allow an analysis of the use classification for waterbodies in the planning area, on trust lands in the planning area, or in the HCP project area. However, water quality assessments have been completed for approximately 10 percent of the total stream miles and 61 percent of the total lake acres in the planning area (Tables 4.6-5, 4.6-6, and 4.6-7) (DNRC 2008a). Of the streams for which assessments have been completed, approximately 50 percent have been determined to be threatened or impaired and in need of TMDLs, TMDLs have already been completed for an additional 3 percent, and TMDLs are not required for 10 percent. Of the assessed lakes, approximately 64 percent have been determined to be threatened or impaired and in need of TMDLs, and TMDLs are not required for 8 percent. More than 324 streams in the planning area have been identified as threatened or impaired. Of these, approximately 103 occur on trust lands in the NWLO, SWLO, or CLO, and 39 are on located within the HCP project area (Tables 4.6-6 and 4.6-7).

TABLE 4.6-5. MILES OF STREAMS AND ACRES OF LAKES WITH COMPLETED TMDL WATER QUALITY ASSESSMENTS IN THE PLANNING AREA, BY ASSESSMENT CATEGORY

	Streams (Miles)			Lakes (Acres)		
Category[1]	Total	Trust Lands[2]	HCP Project Area	Total	Trust Lands[2]	HCP Project Area
1	688.95	19.21	6.38	10,647.73	7.93	3.48
2	924.31	17.31	3.88	43,182.05	0.0365	0
3	2,085.32	134.60	29.87	28,969.81	182.02	0
4A	274.75	20.35	0	0	0	0
4B	0	0	0	0	0	0
4C	999.81	31.82	15.34	25,009	0	0
5	4,983.36	157.00	55.30	190,635.54	40.65	0.10
Total	**9956.50**	**380.29**	**110.77**	**298,444.13**	**230.64**	**3.58**

[1] Categories are defined in Section 4.6.1.1 (Regulatory Framework – The 303(d) List and TMDLs), above. TMDLs are required for waters in Category 5.
[2] Includes all trust lands managed by DNRC, including those in the HCP project area.
Source: DNRC (2008a).

TABLE 4.6-6. POTENTIAL FORESTRY-RELATED CONTRIBUTIONS TO IMPAIRMENT OF STREAMS IN THE PLANNING AREA

	Number of Stream Segments			Stream Miles		
Cause	Total	Trust Lands[1]	HCP Project Area	Total	Trust Lands[1]	HCP Project Area
Thermal modifications	49	16	4	1,102.60	74	3.30
Habitat alterations	284	91	33	4,234.89	145.43	47.45
Suspended solids	18	4	2	292.36	19.18	11.12
Turbidity	10	2	1	106.12	4.01	0.83
Organic enrichment/ Low dissolved oxygen	6	1	1	114.45	2.60	1.24
Pesticides	0	0	0	0	0	0
Nutrients	84	31	14	1,507.60	51.59	22.41
Total Impairment[2]	**324**	**103**	**39**	**4,989.62**	**166.70**	**53.90**

[1] Includes all trust lands managed by DNRC, including those in the HCP project area.
[2] These totals are not a sum of the columns above. Instead, they represent the total number and mileage of segments impaired by one or more cause, and include the sum of all Category 4A, 4B, 4C, and 5 waters.
Source: DNRC (2008a).

TABLE 4.6-7. POTENTIAL FORESTRY-RELATED CONTRIBUTIONS TO IMPAIRMENT OF LAKES IN THE PLANNING AREA

	Number of Waterbodies			Acres		
Cause	**Total**	**Trust Lands[1]**	**HCP Project Area**	**Total**	**Trust Lands[1]**	**HCP Project Area**
Thermal modifications	0	0	0	0	0	0
Habitat alterations	1	1	0	3,735.76	15.91	0
Suspended solids	0	0	0	0	0	0
Turbidity	0	0	0	0	0	0
Organic enrichment/ Low dissolved oxygen	2	1	0	12,5247.59	24.76	0
Pesticides	1	0	0	3,200.03	0	0
Nutrients	5	1	0	167,177.50	24.76	0
Total Impairment[2]	**5**	**2**	**0**	**170,421.53**	**40.67**	**0**

[1] Includes all trust lands managed by DNRC, including those in the HCP project area.
[2] These totals are not a sum of the columns above. Instead, they represent the total number and mileage of segments impaired by one or more cause, and include the sum of all Category 4A, 4B, 4C, and 5 waters.
Source: DNRC (2008a).

In the HCP project area, the most common cause of impairment is habitat alterations. With the data available for this analysis, it is not possible to determine how many 303(d) listings are related to forest management and how many are a result of other land uses, such as urban development or agriculture, or due to natural conditions.

The most current 303(d) list (2004) documents 49 freshwater segments that have been identified as impaired due to high temperature. Some of these streams may have naturally elevated temperatures, but that determination will not be made until a TMDL is developed for each stream. There are also more than six stream segments listed for dissolved oxygen, along with several listings each for turbidity and fine sediment.

4.6.1.4 Surface Water Quantity

Timber harvest and road building can produce changes in the timing and quantity of water that flows from a watershed. Three key measures of water quantity – water yield, low flows, and peak flows – are discussed in the sections that follow.

Water Yield

Water yield refers to the amount of water that flows from a watershed in a given period of time. Studies have shown that water yields increase for several years after logging (Troendle 1983; King 1989; Burton 1997; WADNR 1994). With water supply shortages in many areas of the western United States, increases in water yield attributable to forest harvest are not always perceived to be detrimental and in some cases may be viewed as beneficial (Haupt 1979; Hibbert 1979; Troendle 1983).

Low Flows

Low flow refers to the period with minimum rates of discharge, which typically occurs during the late summer or early fall in the western United States. Low-flow discharge results from the combined effects of reduced precipitation, declining drainage from groundwater sources, and

sustained high summer rates of evapotranspiration (MacDonald et al. 1991). Similar to the effects on water yield, vegetation changes that reduce evapotranspiration rates have the potential to increase low flows. Because increased low flows (i.e., more water in the stream) for summer months generally do not adversely affect aquatic life, such changes will not be discussed further. Small volumetric increases may provide improved habitat conditions (lower stream temperature, increased in-stream wetted area and volume) and survivability of aquatic species.

Peak Flows

Peak flow refers to the period of maximum discharge associated with individual storms or rapid snowmelt periods.

In forested areas, roads can have significant effects on peak flows if they are improperly constructed and if their drainage networks are allowed to become connected to the stream network through improper construction or inadequate maintenance or abandonment procedures (USFS 2001; CMER 2004).

The interception of surface runoff during storms and interception of shallow groundwater flow by a road prism can affect the routing of surface water, extend the channel network (Wemple et al. 1996), increase the potential for higher peak flows, and increase the potential for mass wasting (Montgomery 1994). Roads can act as extensions of the drainage network if they drain to streams. Road-influenced peak flows have been demonstrated in small watersheds (Ziemer and Lisle 1998); however, the effects of roads on a river basin scale are less understood (Jones and Grant 1996; Beschta and Boyle 1995).

The relationship between timber harvest and increased peak flows is not straightforward. In a study of six basins in northwestern Montana, MacDonald and Hoffman (1995) found no apparent correlation between the magnitude of peak flows and the amount of forest harvest. Most recent research suggests that peak flow changes due to forest practices are difficult to detect on large river systems. Additionally, effects of peak flow changes due to forest practices in small basins are highly variable, but small peaks are apparently affected more than large peaks (e.g., Thomas and Megahan 1998; Beschta et al. 2000).

The quantification of peak flow increases resulting from forest management activities is complicated by naturally high variability in inter-annual peak flows, and by the possibility that management activities may desynchronize runoff peaks, thus increasing water yield but decreasing peak flows.

Peak flow increases resulting from land management activities have been most commonly and confidently identified in first- and second-order headwater streams in which large portions of the watershed have been harvested. The confounding effects of runoff timing and volume can dilute the evidence of peak flow increases downstream of the impacted sites and in higher-order streams and larger watersheds. The scientific literature on peak flow increase is thus variable, and consensus among researchers has not been established (MacDonald et al. 1991; Brooks et al. 1997; WFPB 1997).

The best-understood effect of timber harvest on peak flows is its influence on stream flow relating to altering snow accumulation and melt rate. Increased peak flows can occur in the winter when a

warm, wet storm brings rain after a cold storm deposits substantial amounts of snow. Such rain-on-snow events have been most well-documented in the coastal mountain ranges of western North America. The greatest susceptibility to rain-on-snow events occurs in areas where topography allows the incursion of relatively warm, moist marine air flowing from the Pacific Ocean into the Columbia Plateau and up the Snake River Valley. In the planning area, such areas occur in the NWLO and include northwestern Montana, where valleys open into the Columbia Plateau (Ferguson 2000). While rain-on-snow events are a natural occurrence, their effects can be exacerbated when a watershed has been logged in a short amount of time (25 to 30 years) (Harr and Coffin 1992; Troendle and Leaf 1981).

The two most important watershed variables that affect rain-on-snow events are elevation and extent of timber harvest. Timber harvest has the potential to alter snow accumulation and melt rates in any portion of a watershed, but predominantly in the rain-on-snow zone. The rain-on-snow zone in western Montana typically occurs in mid- to low-elevation areas; for example, the rain-on-snow zone in the Grave Creek watershed near Eureka occurs between 4,500 and 5,500 feet (MDEQ 2005b). Forest openings are conducive to increased snow pack accumulations because more snow reaches the ground as a result of less snow interception by the tree canopy.

Because timber harvest can cause increased snow accumulation in openings, areas where runoff is dominated by snowmelt can theoretically experience increased peak flows (Benda et al. 1998). However, research in the Pacific Northwest has not consistently demonstrated this effect. While Cheng (1989) found as much as a 35 percent increase in peak flows with 30 percent clearcuts in British Columbia, Fowler et al. (1987) found no effect in small watersheds in Oregon. In perhaps the most comprehensive study, Anderson and Hobba (1959) found an 11 percent increase in spring peak flows across 21 watersheds in eastern Oregon.

MacDonald et al. (1991) identified six mechanisms by which forest management activities can increase peak flows:

1. Road building (due to both the impervious surface and the interception or interruption of shallow subsurface flow)
2. Reduction of infiltration rates and soil moisture storage capacity by compaction
3. Reduced rain and snow interception due to removal of the forest canopy
4. Higher soil moisture levels due to the reduction of evapotranspiration
5. Increased rate of snowmelt
6. Change in the timing of flows that result in a synchronization of previously unsynchronized flows.

4.6.2 Environmental Consequences

This section describes how the no-action and the three action alternatives may directly or indirectly affect surface water quality and quantity in the planning area over the short and long terms. Cumulative effects are discussed in Chapter 5.

4.6.2.1 Introduction and Evaluation Criteria

Possible impacts to surface waters from its forest management activities are addressed by DNRC primarily through use of no-harvest and partial-harvest buffers along streams, lakes, and wetlands, as well as adherence to the SMZ Law. As part of analyzing potential effects on fish and fish habitat, streamside forest conditions were modeled to guide management levels that meet temperature and aquatic rules, and these results are discussed in Section 4.8 (Fish and Fish Habitat).

The analyses of each alternative's potential effects on water quality consider (1) widths of and allowable activities within streamside buffers, (2) management commitments concerning water quality (such as minimizing sediment delivery from roads and harvest units), and (3) miles of new road construction. Because all these factors are related to the same management practices, streamside buffers and BMP applications, the effects of each alternative related to dissolved oxygen, turbidity, TSS, and nutrients are discussed together (also see Section 4.8, Fish and Fish Habitat, and Section 4.5, Geology and Soils). Specific criteria for analyzing differences in the effects of each alternative on water quality are

- Changes in widths of and allowable activities within streamside buffers
- Changes in management commitments concerning water quality
- Location and magnitude of expected changes in road miles.

Forest management activities, including timber harvest and road building, can increase both water yield and peak flows by forming a more efficient drainage network that intercepts shallow groundwater and overland flow with roads and ditches, and by reducing evapotranspiration from harvested areas. Machinery used for timber harvest, and the weight of felled trees and logs that are yarded or skidded, can also increase soil compaction and surface runoff. Specific criteria for analyzing the effects of each alternative on water quantity (water yield, peak flow, and low flow) are

- Amount and location of timber harvest
- Location and magnitude of expected changes in road miles.

The greatest potential water quantity effects are from roads and the commitments for minimizing forest management roads, and the alternatives do not differ materially in total road miles predicted. Therefore, impacts from forest management activities on water yield would be similar under all the alternatives and are not assessed further.

Forest management activities can modify groundwater quantity by changing the amount of water that infiltrates, causing the interception of shallow groundwater by roads, and decreasing evapotranspiration. Similar to surface water yield, groundwater quantity effects are not expected to be materially different between the alternatives and are not assessed further. Groundwater quality is not typically changed by forest management activities, with the possible exception of herbicide and fertilizer use. Because herbicide and fertilizer use by DNRC is relatively limited; the materials are applied in accordance with the manufacturer's specifications; and herbicides are restricted in the SMZ; their use relative to groundwater issues is not discussed further.

All of the alternatives include minimizing miles of new and existing road, implementing BMPs, prohibiting roads within SMZs except where needed to cross streams, and assessing and prioritizing

maintenance needs for open and closed roads. All of the action alternatives include monitoring and adaptive management procedures to evaluate the effectiveness of the conservation commitments and thereby provide for improvements to water quality conditions in the planning area. The following sections discuss the effects of implementing the no-action alternative and the three action alternatives over the Permit term.

4.6.2.2 Alternative 1 (No Action)

Water Quality

DNRC has achieved a high level of success limiting sediment delivery to streams through its protection and mitigation efforts under the current forest management program, as evidenced by 97 to 98 percent application and effectiveness of BMPs (DNRC 2006e). Under Alternative 1, DNRC would continue to address water quality issues as it does now under the existing program. Under Alternative 1, management activities would continue to be directed by the current SFLMP, SMZ Law, and Forest Management ARMs. Management of SMZs and RMZs would retain trees to ensure adequate levels of shade, but the potential for water temperature changes would occur under Alternative 1 because partial harvest would be allowed in SMZs.

Under Alterative 1, partial-harvest would be allowed in the entire SMZ and RMZ, resulting in a slightly increased potential for erosion, soil compaction, or displacement to deliver sediment during storm runoff periods. There would also be a potential for the extended partial harvest in the SMZ to reduce the effectiveness of vegetation to filter and retain sediment from adjacent hill slopes. The existing Forest Management ARMs require retention of bank edge trees and trees lying within the stream channel and restrict the use of ground-based equipment. Therefore, under Alternative 1, there is only a low potential for harvest activities to result in channel instability or damage to stream banks that might make them more vulnerable to streambank erosion. There is insufficient research on sediment delivery effects from partial harvest activities to quantify the differences between alternatives. Therefore, it is uncertain whether sediment delivery to streams, lakes, and wetlands from partial harvest under Alternative 1 could increase the potential for measurable impacts to turbidity, TSS, dissolved oxygen, and nutrient loading.

For road and timber harvest activities, Alternative 1 would continue under existing program policies to minimize sediment delivery from roads. While this alternative does not require a DNRC water resource specialist to review proposed road and harvest area activities in watersheds with sensitive fish or make recommendations for reducing sediment delivery, DNRC typically does do this and would continue to do so. Alternative 1 specifies that road inventories and implementation of corrective actions with BMPs occur on a project basis, and then only when funds are available. Within the Stillwater Block and Swan River State Forest, DNRC currently identifies and prioritizes road maintenance needs and ineffective road closures on a 5-year cycle, as required by ARM 36.11.421. Roads on scattered parcels are assessed at a less-regular frequency during timber sale planning and watershed inventories. DNRC is currently in the process of examining its program to determine whether the ARM requirement to assess all roads every 5 years can be met, especially for roads on scattered parcels. Because there is no timeline for inventory or correction of sediment problem sites under the current program, continuation of these practices would result in problem sites potentially impacting water quality until they are identified and corrected.

With Alternative 1, an estimated 1,408 miles of new road would be built within the 50-year Permit term (see Table 4.4-6). Despite the application of ARMs and BMPs in the design and building of roads, any increase in road miles would likely increase runoff and erosion, especially during the first few years following construction, resulting in increased sediment delivery harmful to water quality.

Installation and maintenance of stream crossings would continue under the existing program for Alternative 1. This alternative requires that new structures on fish-bearing streams provide for fish passage as specified under current regulations. Culverts would continue to be replaced on a project-by-project basis, with sites identified through DNRC's fish passage inventory and connectivity assessment and prioritized based on existing levels of connectivity, species status, and biological goals. Additional mitigation associated with stream crossings would be implemented on a case-by-case basis. Where stream crossing failures or potential failures are not identified or not corrected due to project or funding limitations, there would be an increased risk of adverse water quality effects from these sites until they are repaired or replaced.

For Alternative 1, licensed grazing on classified forest trust lands would continue to be managed by DNRC based on existing program policies. Midterm and renewal license inspections would be used to evaluate current conditions, identify problems areas, and assess improvements implemented since the last inspection to mitigate or rehabilitate riparian or stream channel damage greater than levels specified in ARM 36.11.444.

Water Quantity

Alternative 1 plans for about 53.2 million board feet of timber harvest annually in the state, with 50.7 million board feet of that to be harvested within the planning area each year (Table 4.2-14). Measurable changes in water quantity would be expected only where timber harvest occurs in small watersheds, particularly within the rain-on-snow elevation zone. This alternative includes existing program requirements to analyze CWE, including watershed-level thresholds to protect beneficial water uses with a low to moderate degree of risk.

4.6.2.3 Alternative 2 (Proposed HCP)

Water Quality

Alternative 2 would provide the potential for more water quality protection than Alternative 1. This alternative would include the additional commitments for a more formal documentation of CWE analysis and process for setting project-level thresholds.

Unlike Alternative 1, Alternative 2 would include additional riparian harvest commitments for Class 1 streams with HCP fish species (commitment AQ-RM1). In most cases, there would be a 25-foot no-harvest buffer in RMZs. Partial-harvest would be allowed in the rest of the RMZ, which is designed to ensure adequate levels of shade. Alternative 2 also would extend the RMZ for CMZs when they are likely to influence riparian functions. This would provide greater assurance that temperature criteria would be met in Class 1 streams supporting HCP fish species (Tier 1). For Alternative 2, riparian management for Class 1 streams with non-HCP fish species and for Class 2 and 3 streams without fish would be the same as Alternative 1, and would provide relatively less assurance that temperature criteria would be met in those stream reaches.

Alternative 2 commitments for reducing sediment delivery would be greater than for Alternative 1, with commitments AQ-SD4 and AQ-RM1 designed to reduce potential sediment delivery from timber harvest, site preparation, and slash treatments. These commitments, combined with 25-foot no-cut buffers within RMZs and greater DNRC oversight on harvests greater than 100 mbf in watersheds with HCP fish species would reduce the potential for delivery of eroded sediment to streams or lakes.

Under this alternative, a DNRC water resource specialist would be required to review proposed harvests greater than 100 mbf in watersheds with HCP fish species and make recommendations to reduce sediment delivery (commitment AQ-SD4). This would ensure that adequate technical input would be included in project design and would likely reduce the potential for harvest-related eroded sediment reaching streamside buffers, thereby reducing the risk of increased sediment reaching the streams or lakes as compared to Alternative 1.

Alternative 2 also includes additional commitments for reducing sediment delivery from new and existing roads (AQ-SD2 and AS-SD3) compared to Alternative 1. This alternative specifies completion of a road sediment delivery inventory within 10 years for bull trout watersheds and within 20 years for watersheds with westslope cutthroat trout or Columbia redband trout. Corrective actions for roads with a high risk of sediment delivery would be required within 15 years in bull trout watersheds and within 25 years for westslope cutthroat trout and Columbia redband trout watersheds. Alternative 2 would also address roads with moderate risk of sediment delivery on a project basis, and it would incorporate goals, targets, and prescriptions in approved TMDLs applicable to covered forest management activities in some cases. Compared to Alternative 1, the faster timeframe for correction of erosion problem sites with Alternative 2 would reduce road-related erosion impacts because problem areas would be addressed sooner. This, combined with more streamside buffer protection, would reduce the amount of sediment delivered to streams and lakes in a shorter time-period than Alternative 1.

With Alternative 2, and similar to Alternative 1, an estimated 1,387 miles of new road would be built within the 50-year Permit term (Table 4.4-6). These new roads would increase surface storm runoff and erosion, especially during the first few years following construction.

Alternative 2 also commits DNRC to more stream crossing improvements than Alternative 1. It calls for prioritizing streams with HCP fish species and improving crossings within a known timeframe of 15 years for bull trout watersheds and 30 years for westslope cutthroat trout and Columbia redband trout watersheds (commitments AQ-FC5, 6, and 7). This alternative also requires improvements, or at least improvement designs, to be completed faster by calling for one-sixth of all sites that do not meet connectivity conservation objectives to be improved every 5 years (commitment AQ-FC8). These improvements would be specifically for fish criteria, but because the crossings would be modified, erosion and reduced failure risk could also be a part of the designs. The faster timeframe for stream crossing upgrades would help reduce local and cumulative erosion and delivery of sediment to the streams compared to Alternative 1, under which the upgrades would occur more slowly.

Compared to Alternative 1, Alternative 2 includes additional management commitments that would identify grazing impacts to stream banks and riparian vegetation through enhanced coarse-filter reviews during the midterm and renewal periods for grazing licenses (commitment AQ-GR1). To

the extent that the reviews result in actions taken to protect stream banks and riparian plants from grazing impacts, erosion and sediment delivery to streams could be reduced under Alternative 2. Beyond reducing the turbidity, TSS, and nutrient impacts from sediment delivery, additional water quality benefits could result from healthier riparian vegetation that provides more shade to help reduce high water temperatures and increase low dissolved oxygen concentrations.

Water Quantity

Generally, water quantity effects under Alternative 2 are expected to be similar to Alternative 1. There would be a small difference in the overall amount of planned timber harvest, with an increase in harvest of approximately 10 percent under Alternative 2 compared to Alternative 1 (Table 4.2-14). The biggest difference between Alternatives 1 and 2 is in the Stillwater Unit, where Alternative 2 would have nearly 50 percent more harvest than Alternative 1. These differences would have the potential to result in measurable changes in water quantity where more timber harvest would be concentrated in small watersheds, particularly within the rain-on-snow elevation zone. While Alternative 1 would continue existing program commitments to analyze CWE, including watershed-level thresholds to protect beneficial water uses with a low to moderate degree of risk, Alternative 2 includes additional CWE commitments for a more formalized documentation of CWE analysis and process for setting project-level thresholds for watersheds with HCP fish species (commitment AQ-CW1).

4.6.2.4 Alternative 3 (Increased Conservation HCP)

Water Quality

Alternative 3 provides the most protective commitments for streamside buffers and would apply the most commitments for road and harvest area practices. Commitments beyond those specified under other alternatives include a mandatory Level 3 watershed analysis if the equivalent clearcut area (ECA) on an HCP project area watershed exceeds 25 percent. If this analysis indicates a high or moderate watershed risk, then DNRC would be required to prepare a mitigation plan for review and approval by the USFWS. Consequently, this alternative would provide the greatest potential for protection of water quality.

With Alternative 3, forest management activities would be subject to additional riparian harvest commitments for Class 1 streams with HCP fish species. In addition to the streamside buffer commitments specified in Alternative 2, Alternative 3 would prohibit harvest in the full width of the RMZ. Of all the alternatives, this one would provide the greatest protection for shade and temperature. Unlike Alternatives 1 and 2, Alternative 3 would also account for the changing nature of streams by including the CMZ in the no-harvest buffer, providing greater assurance that riparian forest shade and temperature protection would be maintained in the long term, and thereby increasing the potential for meeting temperature water quality criteria.

Alternative 3 includes additional commitments beyond those in Alternative 2 for reducing sediment delivery from roads. The completion timeline for road sediment delivery inventories would be shorter, within 5 years for bull trout watersheds, and within 10 years for westslope cutthroat trout and Columbia redband trout watersheds. Corrective actions for roads with high risk of sediment delivery would also be required to be completed 5 years faster than Alternative 2, within 10 years in

bull trout watersheds and 20 years for westslope cutthroat trout and Columbia redband trout watersheds, while Alternative 1 would incorporate corrective actions into specific harvest or road projects only when funding is available. Similar to Alternative 2, Alternative 3 would also address moderate sediment delivery roads on a project basis and require a DNRC water resource specialist to review proposed road activities in watersheds with HCP fish species and make recommendations to reduce sediment delivery.

Alternative 3 stream crossing design commitments are the same as for Alternative 2, but they would be required to be completed more quickly, within 10 years for bull trout streams and 20 years for streams with westslope cutthroat trout and Columbia redband trout. This faster timeframe for stream crossing upgrades would help reduce cumulative erosion and delivery of sediment to the streams compared to Alternatives 1 and 2 where the upgrades occur more slowly.

Under Alternative 3, an estimated 1,322 miles of new road would be constructed within the 50-year Permit term, which is about 6 fewer miles than Alternative 2 and 86 fewer miles than Alternative 1 (Table 4.4-6). These new roads would increase surface storm runoff and erosion, especially during the first few years following construction, but the increase would be slightly less than for Alternatives 1 and 2.

Compared to Alternative 1, Alternative 3 includes additional management commitments for identifying grazing impacts to stream banks and riparian vegetation through enhanced coarse-filter reviews during the midterm and renewal periods for grazing licenses. These commitments go beyond those of Alternative 2 by requiring the enhanced coarse-filter reviews of grazing effects every year rather than every 5 years. To the extent that the reviews result in actions taken to protect stream banks and riparian plants from grazing impacts, erosion and sediment delivery to streams could be further reduced under Alternative 3. These reductions in grazing impacts could improve water quality conditions for turbidity, TSS, water temperature, and dissolved oxygen.

Water Quantity

Generally, water quantity effects under Alternative 3 are expected to be similar to Alternative 1. There would be a small difference in the overall amount of planned timber harvest between alternatives, with Alternative 3 having about 13 percent less harvest than Alternative 2 and 5 percent less than Alternative 1 within the planning area (Table 4.2-14). The biggest difference between alternatives would be in the Stillwater Unit, where Alternative 3 would have nearly 50 percent less harvest planned than under Alternative 2. The differences would have the potential to result in measurable changes in water quantity only where more timber harvest is concentrated in small watersheds, particularly within the rain-on-snow elevation zone. Alternatives 1, 2, and 3 include conservation commitments to analyze CWE, including watershed-level thresholds to protect beneficial water uses with a low to moderate degree of risk. For watersheds with HCP fish species, Alternative 3 includes additional CWE commitments for a Level 3 watershed analysis wherever ECAs on HCP project area watersheds exceed 25 percent. If Level 3 analysis indicates a moderate or high level of watershed risk, then a mitigation plan would be completed by DNRC and reviewed and approved by the USFWS.

4.6.2.5 Alternative 4 (Increased Management Flexibility HCP)

Water Quality

Alternative 4 provides the potential for more water quality protection compared to Alternative 1, but less than Alternatives 2 and 3. This alternative would include the additional commitments for a more formal documentation of CWE analysis and process for setting project-level thresholds,

With Alternative 4, riparian management activities would be the same as Alternative 1, except with a 25-foot no-harvest buffer added to RMZs for Class 1 streams with HCP fish species. Partial-harvest would be allowed in the rest of the RMZ, and RMZs would also be extended for CMZs, similar to Alternative 2. This would provide greater assurance that temperature criteria would be met in Class 1 streams supporting HCP fish species (Tier 1) compared to Alternative 1. For Alternative 4, and like Alternatives 2 and 3, riparian management for Class 1, 2, and 3 streams with non-HCP fish species and Class 2 and 3 streams without fish would be the same as Alternative 1 and would provide relatively less assurance that temperature criteria could be met on those stream reaches.

Similar to Alternatives 2 and 3, Alternative 4 maintains a 25-foot no-harvest buffer along streams. This provision, along with a CMZ defined the same as for Alternative 2, would reduce the potential for sediment delivery to streams compared to Alternative 1. Alternative 4 commitments for harvest-related surface erosion, site preparation, and slash treatments are the same as for Alternative 1, so more sediment could potentially reach the buffer area compared to Alternatives 2 and 3.

The completion timeline for road sediment delivery inventories is 5 years longer than Alternative 2 and 10 years longer than Alternative 3 for bull trout, westslope cutthroat trout, and Columbia redband trout watersheds. This would increase the potential for water quality degradation from sediment delivery compared to Alternatives 2 and 3. However, because timelines are still a part of this alternative, the potential for water quality degradation would likely be lower compared to Alternative 1.

New road construction, reconstruction, and maintenance commitments are the same as for Alternatives 2 and 3. Alternative 4 would result in the same amount of new roads as Alternative 2, which would be slightly lower than Alternative 1 and slightly higher than Alternative 3 (Table 4.4-6). As for the other alternatives, these new roads would increase surface storm runoff and erosion, especially during the first few years following construction.

Corrective actions for roads with high risk of sediment delivery are less restrictive under Alternative 4 and would only be completed on a project basis, rather than within a specified timeframe as under Alternatives 2 and 3. This would increase the risk of water quality effects relative to Alternatives 2 and 3. As for Alternatives 2 and 3, this alternative requires a DNRC water resource specialist to review proposed road activities in watersheds with HCP fish species and make recommendations to reduce sediment delivery. Alternative 4 would likely have a lower risk of water quality effects than Alternative 1, which would have no timeframe specified or specific method identified for prioritizing corrective actions based on risk of sediment delivery.

Alternative 4 stream crossing commitments are the same as for Alternative 2, but they would be completed on a project basis instead of within a fixed timeframe. This would slow down the

implementation of repairs on the crossings more likely to fail, thereby increasing the probability of increased sediment delivery and water quality impacts to streams as compared to Alternatives 2 and 3 while decreasing the probability as compared to Alternative 1.

Compared to Alternative 1, Alternative 4 includes additional management commitments addressing grazing impacts to stream banks and riparian vegetation through enhanced coarse-filter reviews. These commitments are less restrictive than those of Alternatives 2 and 3 by requiring enhanced coarse-filter reviews of grazing effects only once every 10 years, rather than every 5 years (Alternative 2) or every year (Alternative 3). To the extent that the reviews would result in actions taken to protect stream banks and riparian plants from grazing impacts, erosion and sediment delivery to streams could be reduced under Alternative 4 as compared to Alternative 1.

Water Quantity

Generally, water quantity effects under Alternative 4 are expected to be similar to Alternative 1. The amount of planned timber harvest, including management activities within the Stillwater Core, and CWE commitments under Alternative 4 would be the same as those under Alternative 2, so potential changes to water quantity would likely be the same as well.

4.6.2.6 Summary

DNRC has achieved a high level of success with protection and mitigation efforts under its current forest management program, resulting in 97 to 98 percent application and effectiveness of BMPs to limit sediment delivery to streams (DNRC 2006e). DNRC's existing program would continue under Alternative 1, so this level of success would be expected to continue during the Permit term.

However, compared to the action alternatives, Alternative 1 would not provide any additional protection of streamside buffers, additional commitments for road and harvest area practices that protect water quality, more formal documentation of CWE thresholds and mitigation requirements, or enhanced coarse-filter reviews of grazing effects. All three action alternatives would provide some level of these additional commitments, with Alternative 3 providing the most protective measures and least risk of adverse effects on water quality, followed by Alternative 2, then Alternative 4.

Changes in water quantity effects would generally be similar among all alternatives. Potential to measurably change water quantity would be highest under Alternatives 2 and 4, because these alternatives have the highest levels of planned timber harvest and include increasing management in the Stillwater Core. However, differences among alternatives would have the potential to result in measurable changes in water quantity only where more timber harvest is concentrated in small watersheds, particularly within the rain-on-snow elevation zone.

4.7 PLANT SPECIES OF CONCERN, NOXIOUS WEEDS, AND WETLANDS

4.7.1 PLANT SPECIES OF CONCERN

4.7.1.1 Affected Environment

This section describes the regulatory framework under which DNRC manages for plant species of concern (SOC); describes known presence of plant SOC in the planning area and HCP project area; and identifies management activities that may adversely affect those species.

Regulatory Framework

The USFWS is the federal agency responsible for listing plant species requiring protection under the ESA. While Montana's Nongame and Endangered Species Conservation Act (MCA 87-5-101 through 103) offers protection to endangered indigenous wildlife species, it currently does not offer any protection to threatened or endangered plant species.

The Montana Natural Heritage Program (MNHP) maintains a database and serves as the clearinghouse for Montana SOC, which includes taxa that are at-risk or potentially at-risk due to rarity, restricted distribution, habitat loss, and/or other factors (MNHP 2008a). SOC encompass federally listed threatened, endangered, or candidate species and species identified as sensitive by organizations or agencies in Montana.

DNRC manages for threatened and endangered plant species under ARM 36.11.428 and for sensitive plant species under ARM 36.11.436. Both of these rules direct DNRC to give consideration to these species during project design, conduct surveys if needed to determine specific locations of plant SOC populations, and develop mitigation measures designed to avoid or minimize risk to populations present in areas where management is planned. ARM 36.11.428 also gives DNRC the discretion to participate in interagency working groups established to manage the recovery effort of listed species and requires DNRC to report sightings of listed species to respective working groups or to the MNHP.

During the timber sale planning process and prior to MEPA analysis, DNRC submits a request to the MNHP for a list of plant SOC and associated habitat that may occur within the proposed harvest area. If plant SOC are identified within the area, and DNRC determines that harvest activities may adversely affect those species, field surveys are conducted to identify potential locations or delineate known locations of the plant species. Depending on location of the species, timing of harvest, and harvest method, mitigations may be developed to avoid or minimize potential impacts resulting from harvest activities.

Plant Species of Concern in the Planning Area and HCP Project Area

MNHP produces periodic publications identifying plant SOC and potential plant SOC. MNHP employs the standardized ranking system developed by the international network of Natural Heritage Programs to denote global and state status of individual plant and animal species. MNHP's 2006 *Plant Species of Concern* report identifies 358 vascular plant SOC and 133 vascular plants of potential concern. Taxa included in the SOC category are ranked as S1, S1S2, S2, S2S3,

SH, or G3 (MNHP 2006) and include federally listed threatened and sensitive species. The following definitions describe the different categories of state ranking system used for SOC:

- **S1**. At high risk because of extremely limited and/or rapidly declining population numbers, range, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
- **S2**. At risk because of very limited and/or potentially declining population numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
- **G3 S3**. Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
- **SH**. Historical, known only from records usually 40 or more years old; may be rediscovered.

Plants listed as federally threatened or endangered by the USFWS receive a ranking of S1 or S2.

Of the 358 vascular plant SOC, 279 are known to occur throughout the planning area. No endangered plant species and three federally threatened species have been identified in Montana. Plant SOC known to persist in the planning area include all three federally threatened species. The remaining SOC are ranked as S1, S2, S1S2, S2S3, and SH. Of the 279 plant SOC known to historically or currently exist in the planning area, 55 (including federally threatened species) are known to currently exist in the HCP project area (Table E4-2 in Appendix E, EIS Tables). These species occupy a range of various habitats, including

- **Wetland/Riparian.** Areas along springs, fens, rivers, streams, lakes, and ponds.
- **Grassland.** Meadows, gravelly grasslands, or mesic grasslands in valley bottoms and foothills.
- **Dry Woodland.** Grasslands or meadows in dry open woodlands typically occupied by ponderosa pine.
- **Shrub Steppe.** Areas with sparse vegetation typically dominated by sagebrush.
- **Moist Forest.** Typically densely stocked or mature coniferous forests that have dense litter and vegetation on the forest floor. Also includes open forests that have moist soils.
- **Rock Outcroppings.** Talus slopes or rock crevices.

Of these habitats, most SOC on HCP project area lands exist in wetland/riparian areas and moist forests (Table E4-2 in Appendix E, EIS Tables).

Threatened Plants

Spalding's Campion

Populations of Spalding's campion (*Silene spaldingii*) have been documented in the HCP project area in the NWLO (MNHP 2008b). Known occurrences of this species occur in open, dry grasslands in valleys and foothills in the northwestern part of the state. Invasive weeds, housing development, grazing, road construction, fire exclusion, and population isolation threaten the persistence of this species throughout its extent.

Spalding's campion was listed by the USFWS as threatened on October 10, 2001 (as Spalding's catchfly, 66 FR 51597-51606). When listed, the USFWS found that designation of critical habitat for this species was prudent; however, no such designation has yet been made. A draft recovery plan for Spalding's campion was issued on March 16, 2006 (71 FR 13625-13626) (USFWS 2006a). This plan identifies five distinct physiographic regions in which populations of Spalding's catchfly reside, one of which is located within the NWLO (in intermontane valleys). The recovery strategy presented in this plan includes the identification of key conservation areas within each distinct physiographic region for additional actions to protect, enhance, and maintain existing large populations of Spalding's campion. Recovery actions identified in the plan include enhancing the existing populations, surveying for additional populations, addressing species recovery in management plans, controlling and managing invasive non-native plant species, protecting the species from development, and effectively managing livestock grazing in the species' habitat (USFWS 2005a).

Water Howellia

Populations of water howellia (*Howellia aquatilis*) have been documented in the HCP project area in the Swan River State Forest (MNHP 2008b; Pierce 2000, 2003). Water howellia is restricted to small pothole ponds and abandoned river oxbows associated with broadleaf riparian trees and a well-developed riparian shrub component. Timber harvesting, road construction, land development, certain recreational activities, and invasive plants are factors that threaten this species (Mincemoyer 2005).

Water howellia was listed by the USFWS as threatened on July 14, 1994 (59 FR 35860-35864) (USFWS 2006a). When listed, the USFWS found that designation of critical habitat for this species was not prudent due to the potential for increased take or vandalism of the species. A draft recovery plan for water howellia was completed in 1996; however, it was not finalized or adopted by the USFWS (Mincemoyer 2005). Mincemoyer completed a range-wide status assessment for this species in 2005. The checkerboard ownership within the Swan River Valley was listed as a complicating factor for management of this species, as several occurrences occupy more than one ownership (Mincemoyer 2005).

Ute Ladies' Tresses

Although Ute ladies' tresses (*Sprianthes diluvialis*) has been documented in the planning area, no known populations exist in the HCP project area (MNHP 2008b). This species appears to prefer meandering wetlands and swales in broad, open valleys at margins with calcareous carbonate accumulations. Habitat loss associated with urban development, road construction, and agriculture threatens to reduce current populations of this species (Fertig et al. 2005).

The USFWS listed the Ute ladies' tresses as threatened on January 17, 1992 (57 FR 2048-2054) (USFWS 2006a). When listed, the USFWS found that designation of critical habitat for this species was not prudent due to the potential for increased vulnerability of this orchid to collection. A draft recovery plan for Ute ladies' tresses was completed in 1995; however, it was not finalized by the USFWS (Fertig et al. 2005). On October 12, 2004, the USFWS initiated a 12-month status review of the Ute ladies' tresses in response to a petition for de-listing of the species. A range-wide status review was completed in September 2005 (Fertig et al. 2005), indicating that this species is more widely distributed and abundant than what was known for the original listing. However, a decision

to de-list this species has not been made by the USFWS, and it remains listed as threatened (USFWS 2006a).

Because Ute ladies' tresses have not been document in the HCP project area, they are not further addressed in this analysis.

Management Activities Affecting Plant Species of Concern

DNRC forest management practices that may affect plant SOC and/or their current or potential habitats include timber harvesting, road construction and/or maintenance, and grazing. These activities may either directly remove existing populations or indirectly affect these species by altering the habitat in which they persist. Indirect effects resulting from the above mentioned management activities may include alteration of hydrologic functions; increased sedimentation/siltation into riparian zones; soil disturbance or removal, which may exacerbate noxious weed spread; and alteration of vegetative cover that may decrease the suitability of current habitat.

4.7.1.2 Environmental Consequences

This section discusses the potential direct and indirect effects of the three proposed action alternatives on threatened plant species and other plant SOC and their current or potential habitat in the HCP project area relative to those anticipated under the no-action alternative. Cumulative effects of the alternatives are addressed in Chapter 5.

Introduction and Evaluation Criteria

DNRC recognizes that certain levels of management activities may increase potential risk to existing populations, to populations that have not yet been identified, or to potential habitat for plant SOC. Factors associated with the alternatives that could influence potential risk include amount of new road construction and changes in management strategies addressing specific habitats in which plant SOC may occur. These factors were used to describe and compare the effects among the proposed alternatives on known populations of plant SOC and preferred habitat where unidentified populations may potentially exist.

Under all alternatives, there would be no policy changes specific to the management of plant SOC, including Spalding's campion and water howellia. DNRC would continue to manage for threatened plant species and other plant SOC under ARMs 36.11.428 and 36.11.436, both of which require DNRC to minimize potential impacts to known populations of plant SOC (as described under Regulatory Framework, above). DNRC would continue to inquire about location, status, and recovery efforts associated with plant SOC, and would apply, to the maximum extent practicable, measures that would avoid or minimize impacts to known plant SOC populations. Therefore, impacts associated with all of the alternatives are not expected to adversely effect known populations of the threatened species Spalding's campion and water howellia that occur in the HCP project area.

DNRC recognizes that undiscovered populations of threatened plant species and other plant SOC likely exist throughout portions of the HCP project area. To account for potential impacts to these unknown populations, the following analyses disclose the effects associated with alternatives that

may affect habitat commonly associated with Spalding's campion and water howellia and other plant SOC.

Alternative 1 (No Action)

DNRC would construct approximately 1,400 miles of new road on HCP project area lands within 50 years (derived from Table 4.4-6 including blocked and scattered lands). New road miles may introduce noxious weeds into areas, thereby potentially increasing risk of adverse effects to plant SOC populations or habitat.

Riparian harvest conservation commitments currently in place, which would continue under Alternative 1, contain measures that may provide some degree of protection to wetland/riparian plant SOC including water howellia. For example, SMZs would continue to be extended to create RMZs equal to one SPTH along streams supporting fish populations. This would continue to offer protection to wetland/riparian plant SOC that may occur along such waterways. Other measures include the prohibition of clearcutting; retaining shrubs, sub-merchantable trees, and half of the merchantable trees within SMZs; and retaining trees to provide adequate levels of shade in RMZs. WMZs would continue to be established when forest management activities are proposed within or adjacent to an isolated wetland or adjacent to a wetland found within an SMZ. All of these conservation commitments currently existing in the ARMs would continue to help reduce the disturbance in wetland/riparian areas, and help to maintain desirable shading conditions for potential occurrences of water howellia and other plant SOC associated with that habitat.

Sediment delivery reduction conservation commitments under the existing ARMs, such as minimizing roads, implementing BMPs during new road construction and road maintenance, and prohibiting road construction in SMZs except when necessary to cross a stream, would continue to provide some protection to wetland/riparian plant SOC that are vulnerable to excess sedimentation/siltation. Minimizing roads would also continue to minimize the spread of noxious weeds throughout the HCP project area and potential plant SOC habitat. Gravel pit operations would also continue to require the implementation of BMPs and abide by the opencut mining permit stipulations, all of which would continue to minimize the amount of sedimentation/siltation occurring in wetland/riparian habitat.

Stream banks, riparian vegetation, and noxious weed evaluations would continue during grazing license renewal (10-year cycle) and midterm evaluation (5-year cycle). The licensee would continue to be required to mitigate or rehabilitate riparian areas and stream channels when damage is greater than allowed in the ARMs. This would continue to afford minimal protection to plant SOC associated with wetland/riparian habitats.

Alternative 2 (Proposed HCP)

The differences in road miles and other commitments under Alternative 2 that would affect plant SOC are described below and generally would result in greater indirect protection of threatened plant species and other plant SOC than Alternative 1.

Alternative 2 would retain the commitment of minimizing total roads as in Alternative 1, in addition to minimizing new open road construction in riparian zones and avalanche chutes (commitment

GB-PR4). Some terrestrial plant SOC associated with moist forest habitats would be afforded some degree of protection from minimizing roads in avalanche chutes.

The risk of noxious weed spread due to amount of road miles would be almost indistinguishable between Alternatives 1 and 2. In all, there would be approximately 21 fewer miles of road by year 50 when compared to Alternative 1 (Table 4.4-6). Relative to Alternative 1, under Alternative 2, DNRC would also improve maintenance of road closures on scattered parcels in grizzly bear recovery zone (commitment GB-RZ3), which may slow the spread of noxious weeds that is often associated with off-road vehicle traffic. This would likely decrease the chance of noxious weeds spreading, thereby offering greater protection to plant SOC.

Grizzly bear NROH spring management restrictions (commitment GB-NR3) under Alternative 2 propose to prohibit commercial forest management activities, pre-commercial thinning, and heavy equipment slash treatment more than 100 feet from open roads during the spring in spring habitat. This could provide plant SOC that inhabit low-elevation, moderately moist environments, such as river valley bottoms and mesic meadows (water howellia), some degree of protection as they sprout or come out of dormancy at this time, when they are young and more vulnerable to impacts from forest management activities. Some wetland/riparian or grassland plant SOC would benefit from commercial activity restrictions in spring, especially Spalding's campion, which inhabit open, mesic grasslands in the valleys and foothills, consistent with the spring habitat of grizzly bear.

The post-denning mitigation restrictions (commitment GB-RZ5) in grizzly bear recovery zones under Alternative 2 that prohibit motorized activities on slopes greater than 45 percent above 6,300 feet between April 1 and May 31, could provide slight benefits to plant SOC that occur on steep slopes above 6,300 feet elevation.

Under Alternative 2 in the Stillwater Block, new permanent road construction would be prohibited on Class A lands, and an 8-year rest period of no forest management activities would ensue after 4 years of active management (commitment GB-ST2). The 8-year rest period may be beneficial for any plant SOC occurring in these designated Class A lands by allowing the population a period of time to rebound and recover from the disturbance, depending on the extent of the impact and specific biology of the species.

Riparian harvest conservation commitments (AQ-RM1) under Alternative 2 along non-HCP fish-bearing streams would be the same as those under Alternative 1, and there would be no difference in the impact to plant SOC. However, along HCP fish-bearing streams, Alternative 2 would potentially expand the RMZ by 30 feet or more (depending on slope and 100-year site index tree height), establish a 25-foot no-harvest buffer, and in floodprone areas, expand the RMZ to include the entire CMZ, with no harvest in active floodplains or unstable stream channels. The addition of the no-harvest buffer would increase the protection of wetland/riparian plant SOC, by giving a buffer where these species would not be disturbed and reducing the amount of tree harvest in a larger area beyond the no-harvest buffer. This commitment would offer greater protection to plant SOC occurring in wetland/riparian habitats than Alternative 1.

The sediment delivery reduction conservation commitments (AQ-SD2) under Alternative 2 put deadlines on the inventory and completion of corrective action on roads that have a high risk of sediment delivery. This could help protect the habitat of water howellia and other wetland/riparian plant SOC that are vulnerable to sedimentation.

Under the program-wide grizzly bear conservation commitment for gravel operations (GB-PR7), DNRC would comply with biennial agreements with county weed boards, using an integrated management approach to control noxious weeds as is done currently under Alternative 1. Additionally, Alternative 2 would limit the number of active pits in each administrative unit in addition to a cap on the size of non-vegetated areas associated with large pits. Gravel operations under the aquatic conservation commitments (AQ-SD5) would be prohibited in SMZs and RMZs, except for one medium non-reclaimed pit within the portion of RMZ extending beyond the SMZ in both the Stillwater Block and Swan Unit. These commitments may benefit SOC plants by decreasing the chances for the spread of noxious weeds, reducing overall disturbance across the landscape, and controlling sedimentation from gravel pit sites.

Similar to Alternative 1, stream banks, riparian vegetation, and noxious weed evaluations would continue during grazing license renewal (10-year cycle) and midterm evaluation (5-year cycle). Compared to Alternative 1, Alternative 2 would have more stringent timelines for verifying potential problem sites and implementing corrective actions to address such problems. This would likely offer more protection to plant SOC associated with wetland/riparian habitats than Alternative 1.

Alternative 3 (Increased Conservation HCP)

Overall, Alternative 3 would provide the greatest indirect protection of plant SOC. This is attributed to the following more restrictive commitments that would be implemented under this alternative versus Alternative 2.

Alternative 3 would result in approximately 86 fewer miles of road by year 50 when compared to Alternative 1 (Table 4.4-6). This is the lowest level of road construction of any alternative.

Spring management restrictions (GB-NR3) under Alternative 3 further restrict motorized activities during the spring period. This would be slightly better for plant SOC that inhabit low-elevation, moderately moist environments, such as mesic meadows (Spalding's campion), giving these species 10 more days of protection during their emergence.

The expansion of the no-harvest buffer to include the entire RMZ or CMZ under Alternative 3 (commitment AQ-RM1) would increase protections to potential locations of water howellia and other wetland/riparian plant SOC occurring in riparian habitat associated with lakes or streams supporting HCP fish species.

The time period for evaluation and corrective action for the inventory of roads for sediment delivery would be 5 years faster under Alternative 3 (commitment AQ-SD2), further reducing the risk wetland/riparian plant SOC face from sedimentation, providing slightly better protection than Alternative 2.

The intervals for monitoring grazing effects under Alternative 3 (commitment AQ-GR1) would be more frequent, allowing for faster corrective actions to take place, helping to further protect wetland/riparian plant SOC that could be affected by damages done by grazing.

Under Alternative 3, minimal forest management would occur in the Stillwater Core, thereby increasing the relative protection level of plant SOC that occur in that portion of the HCP project area.

Alternative 4 (Increased Management Flexibility HCP)

Indirect effects on plant SOC under Alternative 4 would be most similar to those described under Alternative 2, with the following exceptions.

Under the spring NROH commitment (GB-NR3), there would be no limit on site preparation, road maintenance, or bridge replacement. This would slightly reduce protection for plant SOC that inhabit low-elevation, moderately moist environments.

The zone along HCP fish bearing streams in which DNRC would retain shrubs, sub-merchantable trees, and at least 50 percent of trees greater than 8 inches dbh under commitment AQ-RM1 would be between 25 and 50 feet instead of between 25 feet and the 100-year site index tree that would be in place under Alternative 2. There would also be increased management flexibility under Alternative 4 in terms of having 5 more years to complete the inventory of sediment delivery reduction sites (commitment AQ-SD2). The grazing commitment (AQ-GR1) would require monitoring grazing effects every 10 years instead of every 5 years, thus possibly increasing chances of plant SOC being affected.

Summary

All alternatives would implement current practices (ARMs and MCA) that address identified plant SOC as described under Regulatory Framework. However, under the action alternatives, some conservation commitments would potentially result in greater protection of potential plant SOC habitat (where unknown populations may exist) over Alternative 1. This would mostly be due to spring management restrictions, restrictions on harvest in riparian areas, and improved monitoring and corrective actions for grazing licenses. All action alternatives offer some form of these commitments, with Alternative 3 providing slightly greater restrictions in riparian areas through an increased no-harvest buffer.

4.7.2 Noxious Weeds

4.7.2.1 Affected Environment

This section describes the regulatory framework under which DNRC manages for noxious weeds; describes noxious weed occurrences and management; and identifies management activities that may contribute to noxious weed spread.

Regulatory Framework

MCA 7-22-21 establishes county weed control throughout the state. Each county is required to establish a weed management district and appoint a district weed board to administer the noxious weed management program for the district. Under MCA 80-7-705, the Montana Department of Agriculture is required to distribute funding to enhance weed management programs in the weed management districts.

MCA 7-22-2151 requires DNRC to enter into a written cooperative agreement with district weed boards throughout the state. The agreement must specify mutual responsibilities for noxious weed management on state-owned lands.

DNRC complies with the existing management policy for controlling noxious weeds through ARMs 36.11.445 and 36.25.159. ARM 36.11.445 requires DNRC to develop management plans that include prevention, education, cultural, biological, and chemical methods as appropriate. Under this rule, DNRC is required to limit herbicide application, prioritize new outbreaks of weeds, promptly re-vegetate disturbed sites, require right-of-way permittees to control weeds, cooperate with weed districts, and review implementation of mitigation and control measures on cooperative projects. Under ARM 36.25.132, DNRC requires lessees or licensees of state trust land to keep the land free of noxious weeds in compliance with MCA 7-22-21.

Noxious Weed Occurrences and Management

The Montana Department of Agriculture places noxious weeds into three categories based on the extent of their distribution in the state:

- Category 1 noxious weeds are currently widespread in many counties of the state.
- Category 2 species have recently been introduced to the state or are rapidly spreading from their current infestation sites.
- Category 3 noxious weeds have not been detected in the state or may be found only in small, scattered, localized infestations.

Published information regarding the biology and ecology of Category 1 through 3 noxious weed species is located on the Center for Invasive Plant Management website (http://www.weedcenter.org/management/weed_mgmt_profiles.html). A list of these species, along with information obtained from this website about their general habitat associations, is provided in Table 4.7-1.

DNRC documents noxious weed occurrences on trust lands through SLI data collection and during grazing inspections. DNRC inventories and maps weed infestations during grazing license renewals and midterm inspections. The information is recorded in a central database maintained by the FMB Technical Services Section.

DNRC regularly conducts weed spraying and herbicide applications. Weed spraying is typically associated with weed infestations on road rights-of-way, skid trails, and log landings. Herbicide applications are typically used for tree planting and spot applications for seedlings to reduce competition. For the most recent year statewide data are available, 2004, DNRC sprayed 5,449 acres for noxious weed control, and applied herbicides on 350 acres (Table 4.7-2). DNRC also released bio-controls on 32 acres in 2005 (DNRC 2008a). Between 1998 and 2004, DNRC sprayed an annual average of 2,392 acres statewide and treated 236 acres statewide by herbicide application (Table 4.7-2).

TABLE 4.7-1. STATE OF MONTANA NOXIOUS WEED SPECIES LIKELY TO OCCUR ON TRUST LANDS BY CATEGORY AND GENERAL HABITAT ASSOCIATION

			General Habitat Association		
Common Name	**Species**	**Category**	**Forest**	**Riparian**	**Grassland/ Shrubland**
Hoary cress	*Cardaria draba*	1	No	Occasionally in aspen/willow communities	Yes
Diffuse knapweed	*Centaurea diffusa*	1	Dry forests below 7,000 feet	No	Yes
Spotted knapweed	*Centaurea maculosa*	1	Ponderosa pine and Douglas-fir	No	Yes
Russian knapweed	*Centaurea repens*	1	No	Yes	Yes
Oxeye daisy	*Chrysanthemum leucanthemum*	1	No	No	Yes
Canada thistle	*Cirsium arvense*	1	No	Yes	Yes
Field bindweed	*Convolvulus arvensis*	1	No	Yes	Yes
Houndstongue	*Cynoglossum officinale*	1	Spruce/fir, aspen birch, Douglas-fir, ponderosa pine, western white pine, larch, lodgepole pine	No	Yes
Leafy spurge	*Euphorbia esula*	1	Low-elevation woodlands	Yes (also in undisturbed areas)	Yes (also in undisturbed areas)
St. Johnswort	*Hypericum perforatum*	1	Low-elevation woodlands	No	Yes
Dalmatian toadflax	*Linaria dalmatica*	1	Spotty	No	Yes
Yellow toadflax	*Linaria vulgaris*	1	Spotty	No	Yes
Sulfur cinquefoil	*Potentilla recta*	1	Ponderosa pine	No	Yes
Common tansy	*Tanacetum vulgare*	1	No	Yes	Yes
Orange hawkweed	*Hieracium aurantiacum*	2	No	No	Yes
Meadow hawkweed complex	*Hieracium pretense, H. floribundum, H. piloselloides*	2	No	No	Yes
Dyer's woad	*Isatis tinctoria*	2	No	No	Yes
Perennial pepperweed	*Lepidium latifolium*	2	No	Yes	No
Purple loosestrife	*Lythrum salicaria,*	2	No	Yes	No
European wand loosestrife	*Lythrum virgatum*	2	No	Yes	No
Tall buttercup	*Ranunculus acris*	2	No data	No data	No data
Tansy ragwort	*Senecio jacobaea*	2	Clearcuts	Yes	Yes
Saltcedar	*Tamarix spp.*	2	No	Yes	No
Yellow starthistle	*Centaurea solstitialis*	3	No	No	Yes
Rush skeletonweed	*Chondrilla juncea*	3	No	No	Yes
Common crupina	*Crupina vulgaris*	3	No	No	Yes
Yellow flag iris	*Iris pseudacorus*	3	No	Wetlands, marshes	No
Eurasian watermilfoil	*Myriophyllum spicatum*	3	No	Wetlands, marshes	No

Source: Data obtained from the Center for Invasive Plant Management website: http://www.weedcenter.org/management/weed_mgmt_profiles.html

TABLE 4.7-2. ACRES OF WEEDS TREATED BY DNRC IN FISCAL YEAR 2004

Method	Annual Average, 1998–2004	Fiscal Year 2004
Spray	2,392	5,449
Herbicide Application	236	350

Source: DNRC (2008a).

Management Activities Affecting Noxious Weeds

Noxious weeds are invasive, non-native plant species that often dominate regions and ecosystems because of their ability to reproduce prolifically and out-compete native species for available resources. Their ability to colonize and dominate newly invaded ecosystems is often attributed to the absence of native, herbivorous control agents, or as new research indicates, the absence of soil biota native to the invasive species' place of origin, which inhibit plant growth more than soil biota native to the weed invasion site (Callaway et al. 2004). Without such natural control mechanisms in place, invasive plants can spread quickly, particularly following human-induced soil disturbances such as road building, agriculture, livestock grazing, and logging.

DNRC management activities on forested trust lands that may affect noxious weed spread include timber harvesting, road construction and/or maintenance, and grazing.

4.7.2.2 Environmental Consequences

Introduction and Evaluation Criteria

The effects of the no-action and action alternatives on the risk of noxious weed spread was assessed by evaluating, at a programmatic level, the amount of ground disturbance, length of road network, and conservation commitments that have the potential to affect weed infestation risk.

Alternative 1 (No Action)

Under Alternative 1, DNRC would continue to implement current practices (ARMs and MCA) that address noxious weeds. Other current practices by DNRC also indirectly help control and minimize the spread of noxious weeds. These include ARMs that limit ground disturbance, limit road vehicle traffic, and monitor grazing.

Under Alternative 1, approximately 1,400 miles of new road would be constructed in the project area by year 50 (derived from Table 4.4-6). Of the total HCP project area (548,500 acres), this alternative would have approximately 106,875 acres of grass-forb (non-stocked forest) and seedling/sapling successional forests at year 50 (Table 4.2-15). It is along these roads and in the young forests (as well as in riparian zones) where weed infestations would be most likely to occur. Although the ARMs require DNRC to identify noxious weeds and prescribe control measures, noxious weeds would continue to persist and spread by wind, water, and vehicles. Roadsides and disturbed areas would continue to be most susceptible (Potash 1991; Smith-Kuebel and Lillybridge 1993). New weed infestations, if left untreated, can displace native vegetation and persist for many years (Floyd et al. 2006).

DNRC would continue to control timber harvest activities within RMZs and SMZs, which would help protect riparian habitats from weed infestations. DNRC would continue to address roads with sediment delivery issues, which would stabilize some sites vulnerable to weed infestation. BMPs implemented for road construction and maintenance and gravel pit operations would help to prevent spread of noxious weeds along the road network.

Under current road management ARMs (36.11.421), DNRC closes and abandons all roads that are non-essential for near-term management activities.

In the Stillwater Block, under Alternative 1, road miles would increase by 17.6 miles over the next 50 years and they would be closed to all motorized public access. DNRC motorized use would likely be seasonally restricted on at least some of the new roads. In the Swan River State Forest, roads would increase by 70.3 miles, but all new roads would be restricted from motorized public access so that there would be no increased risk of weed spread through vehicle travel, particularly because road closures are inspected on a routine schedule.

Grazing licenses would continue to be reviewed at time of license renewal and midterm for noxious weeds (every 5 years). While DNRC and the licensees would be required to rehabilitate riparian areas damaged by grazing (and thus susceptible to weed infestation), there would be no timeframe established and no effectiveness monitoring. Because the number of AUMs issued under a grazing license is generally relatively low, it can be difficult to make improvements cost-effective.

Alternative 2 (Proposed HCP)

Alternative 2 would implement current practices (ARMs and MCA) that address noxious weeds as described under Regulatory Framework. None of the new HCP commitments would specifically address noxious weeds; however, they may indirectly help control and prevent noxious weed invasion better than Alternative 1 through greater restrictions on ground disturbance and road vehicle traffic, and enhanced monitoring and correction of grazing issues.

Alternative 2 would result in fewer miles of total roads and open roads on DNRC land (Table 4.4-6), but would result in approximately 11.7 percent more grass/forb and seedling/sapling forests (Table 4.2-15) relative to Alternative 1.

Minimizing new open road construction in riparian zones and avalanche chutes (commitment GB-PR 4) would help to reduce the chances for noxious weeds to spread in these habitats. Additionally, the aquatic conservation strategy under Alternative 2 would increase RMZ widths along streams and lakes supporting HCP fish species, which would help prevent invasion of weeds along these systems.

Program-wide gravel operation conservation commitments (GB-PR7) under Alternative 2 would comply with biennial agreements with county weed boards. Noxious weeds would be managed using an integrated weed management approach, and medium and large gravel pits would have a cap on their size and number in each administrative unit in addition to a cap on the size of non-vegetated areas associated with large pits. This would likely decrease chances for the spread of noxious weeds.

Relative to Alternative 1, under Alternative 2, DNRC would also improve maintenance of road closures, which may slow the spread of noxious weeds that is often associated with off-road vehicle traffic. Alternative 2 would also require more frequent monitoring and correction of erosion risk areas on roads that, if left untreated, could be invaded by noxious weeds (AQ-SD2). By requiring additional review by water resource specialists and adoption of TMDLs (AQ-SD3), road management activities would be less likely to result in additional erosion sites susceptible to weeds.

In the Stillwater Block, under Alternative 2, road miles would increase by 19.3 miles but they would be closed to all motorized public access, and DNRC motorized use would be seasonally restricted on 10.5 miles of the new road. Under Alternative 2, some existing roads would also be reclassified, resulting in a net increase of 47.6 miles of road that would become seasonally available to public motorized use. Therefore, there could be a slight increase in the spread of noxious weeds in these areas.

In the Swan River State Forest, under all action alternatives, if the Swan Agreement is terminated, overall road miles would increase by 70.3 miles (same as under Alternative 1). In addition, open road miles could increase by 28 miles because DNRC may be required to provide access to adjacent intermingled private lands. However, an additional 41 miles would be reclassified and restricted year-round from motorized public access. For the 28 miles of potential road, there may be an increased risk of noxious weed invasion attributed to new road construction and vehicle traffic. This would be partially offset by restricted vehicle access on 41 miles of road.

Additional commitments under Alternative 2 that would have some beneficial effect on controlling weed infestations include grizzly bear commitments in recovery zones for designing timber sales to protect grizzly bear habitat, leaving up to 100 feet of vegetation between open roads and clearcut and seed tree harvest units, and avoiding granting existing or new access across HCP project area lands where possible (GB-RZ1, GB-NR4, GB-RZ6, respectively).

Under Alternative 2 the aquatic grazing conservation strategy (AQ-GR1) requires DNRC to monitor and address damage to stream banks, riparian vegetation, and noxious weed infestation every 5 years instead of 10 years under Alternative 1. This commitment would also require site-specific corrective actions for addressing verified grazing problems and effectiveness monitoring, which should help address noxious weed problems.

Alternative 3 (Increased Conservation HCP)

Alternative 3 would implement current practices (ARMs and MCA) that address noxious weeds as described under Regulatory Framework. None of the new HCP commitments would specifically address noxious weeds; however, those that further restrict disturbance activities could influence the spread of noxious weeds throughout the HCP project area, resulting in this alternative providing greater indirect benefits for noxious weed control and prevention than the other alternatives. The effects would be similar to Alternative 2, with the following exceptions.

Total road length at year 50 would be the lowest of any of the alternatives (Table 4.4-6), and the acreage of grass/forb and seedling/sapling successional forests would be lower than the other alternatives in year 50 (Table 4.2-15). The aquatic conservation strategy would increase no-harvest zones in RMZs and CMZs beyond what is specified in Alternative 2, creating less opportunity for

weed infestations. The schedule for inventorying and addressing erosion risk areas would be accelerated by 5 years.

Under Alternative 3, because the Stillwater Core would receive minimal forest management, the risk of weed infestation would be lower than under Alternative 2. However, within the Stillwater Block, DNRC would only build 1.6 fewer miles of road than under Alternative 2.

Instead of monitoring grazing impacts every 5 years as under Alternative 2, DNRC would monitor impacts annually, which should help address noxious weed problems.

Alternative 4 (Increased Management Flexibility HCP)

Alternative 4 would implement current practices (ARMs and MCA) that address noxious weeds as described under Regulatory Framework. In terms of the indirect benefits of the commitments on noxious weeds, Alternative 4 would rank between Alternative 1 and Alternative 2.

This alternative would have similar mileage of new roads and acreages of grass/forb and seedling/sapling forests in year 50, and generally the same effects on weed infestations as Alternative 2, with the following exceptions.

Alternative 4 would have slightly greater restrictions in SMZs and RMZs than Alternative 1, but less than Alternatives 2 and 3, retaining the 25-foot no-harvest buffer, but reducing the buffer for restricted harvest from 26 to 50 feet for streams and lakes supporting HCP fish species instead of out to a 100-year site index tree under Alternative 2. The schedule for inventorying and addressing erosion risk areas would be delayed by 5 years compared to Alternative 2.

Grazing commitments would be the same as Alternative 2, except monitoring grazing effects would occur every 10 years instead of every 5 years. This alternative would be similar to the no-action alternative in that DNRC would not require a timeframe completion date for problem licenses that have impacts to stream banks and vegetation and/or weed infestation, or monitoring of effectiveness of corrective actions.

Summary

All alternatives would implement current practices (ARMs and MCA) that address noxious weeds as described under Regulatory Framework. However, under the action alternatives, some conservation commitments would potentially help reduce the spread of noxious weeds as compared to Alternative 1. This would mostly be due to reduced ground disturbance or stabilization of disturbed areas, less road vehicle traffic, and greater grazing monitoring. Alternative 3 would provide the greatest level of protection because it would construct the fewest miles of road, place more roads under restrictions from public access, require the shortest timeframe for correction of eroding roads, and require the most frequent grazing inspections.

4.7.3 WETLANDS

4.7.3.1 Affected Environment

This section describes the regulatory framework under which DNRC manages wetlands, describes wetlands and their functions, and characterizes existing wetland conditions in the planning area.

Regulatory Framework

When forest management activities are proposed within or adjacent to an isolated wetland, or an adjacent wetland found within an SMZ, DNRC establishes WMZ boundaries. Within WMZs, DNRC abides by requirements set forth by the SMZ Law (ARMs 36.11.301 through 36.11.313) and Forest Management ARMs (36.11.426), and avoids use and construction of roads within WMZs, with some exceptions. DNRC also limits harvest and equipment operations within WMZs to low-impact harvest systems that avoid excessive compactions, displacement, or erosion of soil. Operations of ground-based equipment are also limited within WMZs to periods of low soil moisture, frozen soil, or snow-covered ground conditions.

The primary regulation that governs wetland management in the planning area is the federal CWA. This act, which is administered by the U.S. Army Corps of Engineers (ACOE) and EPA, is intended to protect the biological, physical, and chemical integrity of the nation's waters, including wetlands. Two sections of the CWA could pertain to the proposed project: Sections 404 and 401. Section 404 regulates placement of dredge or fill material into waters of the United States, including wetlands. Activities that constitute placement of fill include trenching, ditching, draining, and installing piers or pilings. Project proponents intending to undertake such activities must obtain a permit from the ACOE prior to initiating site work. The purpose of Section 401 water quality certification is to ensure that federally permitted projects are consistent with state water quality standards. Projects that require a Section 404 permit generally must have a Section 401 water quality certification. According to Section 404, certain activities including normal silviculture activities, such as harvesting, are exempt from Section 404 permit requirements.

In addition to the CWA, Executive Order 11990 further protects wetlands when there is federal involvement by mandating that agencies minimize destruction, loss, or degradation to wetlands and preserve and enhance the natural and beneficial value of wetlands by restricting new construction in wetlands. The ARMs provide specific guidelines on wetland management for forestry-related activities within the planning area (Table 4.7-3).

TABLE 4.7-3. APPLICABLE EXISTING WETLAND-RELATED REGULATIONS

Regulation	Requirement
Federal	
Clean Water Act, Section 404	Regulates the discharge of dredged and fill materials into waters, including wetlands.
Clean Water Act, Section 401	Requires water quality certification from the state.
Executive Order 11990	Mandates agencies to minimize the destruction, loss, or degradation of wetlands; preserve and enhance the natural and beneficial values of wetlands; and restrict new construction in wetlands.
State	
ARMs:	
Streamside Management Zones 36.11.301 through 313	Defines wetlands regulated under the SMZ Law. Provides restrictions on timber harvest, equipment operation, and road construction where wetlands exist adjacent to stream channels.
Wetland Management Zones 36.11.426	Defines wetland management zones on forested trust lands and provides restrictions on timber harvest, equipment operation, and road construction and use in these areas.
Montana Water Quality Act	Governs process for obtaining a state water quality certificate, pursuant to Section 401 of the federal CWA.

Wetlands and Their Functions

As formally defined by the ACOE, wetlands are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils (Environmental Laboratory 1987). Typical wetlands include forested swamps, marshes, and bogs.

Under ARM 36.11.403, DNRC defines wetlands in a very similar way to the ACOE definition. Wetlands are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, swamps, bogs, and similar areas. According to ARM 36.11.426, DNRC identifies wetlands by using the following criteria: plant species composition, soil characteristics, or depth of water table.

Wetlands provide important environmental functions. These functions can be divided into two general categories: hydrological and habitat support (Table 4.7-4). Hydrological functions include shoreline and bank stabilization; flood flow alteration; groundwater recharge; sediment removal and retention; and nutrient and pollutant removal, retention, and transformation. Habitat functions include general habitat suitability, as well as specific habitat functions providing fish, birds, amphibians, and other wildlife access to food, cover, and breeding and rearing opportunities. In addition, wetlands may also support cultural and socioeconomic values.

Wetlands in the Planning Area

The National Wetlands Inventory (NWI) wetland data provides GIS data for wetland locations and types (riverine, lacustrine, and palustrine) in the planning area (DNRC 2008a). Riverine wetlands are those wetlands that are contained within a river or stream channel; lacustrine wetlands are

associated with lakes and reservoirs that are generally at least 20 acres in size; and palustrine wetlands include isolated ponds, marshes, swamps, bogs, and wet prairies. The NWI data are based on photo-interpretation and do not capture small wetlands. An NPS study in the Sierra Nevadas of California found that 45 percent of wetlands were missed by NWI data, particularly those obscured by canopy cover. Additionally, classifications of these wetlands were of varying accuracy. Of the sites identified by NWI within the study, lacustrine sites were identified with 97 percent accuracy, palustrine sites were identified with 94 percent accuracy, and riverine sites were identified correctly with only 51 percent accuracy (Werner 2005). There are approximately 440,000 acres of wetlands in the planning area, most of which are lacustrine and palustrine types (Table 4.7-5). Within the HCP project area, approximately 1,800 acres of wetlands occur, most of which are palustrine.

TABLE 4.7-4. WETLAND FUNCTIONS

Function	Description
Hydrological	
Shoreline and bank stabilization	Reduce shoreline and bank erosion by binding soil substrates in wetland plant roots.
Flood flow alteration	Attenuate peak water flow during major storm events.
Groundwater recharge	Help maintain minimum stream base flows by naturally regulating the release of groundwater discharge into streams and by recharging aquifers that discharge groundwater into streams.
Sediment removal and retention	Remove and retain sediments from the water.
Nutrient and pollutant removal, retention, and transformation	Remove, retain, and transform nutrients and pollutants from the water.
Habitat	Provide food, cover, and nesting, rearing, and other habitat functions for a variety of fish and wildlife.

TABLE 4.7-5. ACRES OF RIVERINE, PALUSTRINE, AND LACUSTRINE WETLANDS IN THE PLANNING AREA

Wetland Type	All Ownership in the Planning Area (Acres)	Trust Lands in the Planning Area (Acres)	Non-Trust Lands in Planning Area (Acres)	HCP Project Area (Acres)
Riverine	36,600	900	35,700	200
Lacustrine	208,700	2,000	206,700	60
Palustrine	194,200	8,100	186,100	1,500
Total	**439,600**	**11,100**	**428,500**	**1,800**

Note: Totals may not add up, due to rounding.
Source: DNRC (2008a).

Although assessments of the conditions of the individual wetlands in the planning area are not available, information on wetland condition in Montana as a region is available. The SFLMP (p. III-8 to III-9) summarizes wetland conditions in Montana as follows:

> *"... the integrity of riparian [and wetland] areas has been compromised by the often combined effects of beaver removal, large organic debris removal, logging, livestock grazing, and road construction . . . Mountain riparian ecosystems probably have*

not changed as much as more accessible lowland floodplain areas . . . Southwest Montana shows some fairly significant riparian [and wetland] degradation from livestock grazing. The impact of silviculture is not nearly as severe as that of grazing, but is nonetheless important . . . In the Northwest portion of Montana, livestock grazing is not as prevalent as in the Southwest, but silvicultural impacts are most widespread there."

4.7.3.2 Environmental Consequences

Introduction and Evaluation Criteria

None of the alternatives would change how DNRC protects wetlands or mitigates for impacts. Rather the effects on wetlands were analyzed based on each alternative's riparian timber harvest commitments, road sediment commitments, and grazing evaluations and monitoring requirements.

Alternative 1 (No Action)

Under Alternative 1, wetland protection would continue as under current conditions (ARMs 36.11.301 through 36.11.313 and 36.11.426). Riparian harvest would be restricted along Class 1 and 2 streams and lakes based on the SMZ Law, which extends SMZs to include wetlands and requires retention of shrubs and trees, which would help protect wetlands and wetland functions. DNRC would continue to establish WMZs and limit equipment operations to low-impact harvest systems and operations that do not cause excessive compaction, displacement, or erosion of the soil. DNRC would also continue to select logging systems to minimize erosion within WMZs.

Impacts on wetlands from erosion from roads is currently addressed in the ARMs by requiring an assessment and prioritization of road maintenance needs every 5 years, although DNRC currently does not meet this timeframe on scattered parcels.

Although not explicitly stated, the 10-year grazing license renewal assessment (10-year cycle) and midterm evaluations (5-year cycle) for damage to stream banks, riparian vegetation, and noxious weed infestation also includes wetlands. If wetland damage is documented, DNRC and the licensee are required to mitigate.

Alternative 2 (Proposed HCP)

Under Alternative 2, wetland protection would continue as under current conditions (ARMs 36.11.301 through 36.11.313 and 36.11.426). However, some commitments would be enhanced resulting in an overall improvement in the protection of wetlands under this alternative.

Riparian harvest activities in SMZs and RMZs on lakes and streams supporting HCP fish species (AQ-RM1) would be restricted through a 25-foot no-harvest buffer, a wider buffer with reduced harvest, and a provision to expand the buffer for CMZs, providing greater protection of wetlands.

Sediment and erosion impacts on wetlands would be reduced compared to Alternative 1 by requiring DNRC to complete inventory, assessment, and corrective actions on sediment delivery roads within a specified timeframe based on bull trout, westslope cutthroat trout, and Columbia redband trout presence in the watershed (AQ-SD2).

Alternative 2 would require assessment for damage to stream banks, riparian vegetation, and noxious weed infestation, which also includes wetlands, every 5 years versus 10 years for Alternative 1 (AQ-GR1). Additionally, under Alternative 2, if damage is documented, DNRC and the licensee are required to mitigate within a specified timeframe and monitor corrective actions.

Alternative 3 (Increased Conservation HCP)

Under Alternative 3, wetland protection would continue as under current conditions (ARMs 36.11.301 through 36.11.313 and 36.11.426). However, Alternative 3 requires additional conservation commitments that would have the most beneficial effects on wetlands of any alternative. The effects would be most similar to Alternative 2, with the following exceptions that would increase protection of wetlands.

Riparian harvest activities would be further restricted through a no-harvest zone that would include the entire RMZ and would include CMZs (AQ-RM1). The schedule for identifying and correcting sedimentation issues on roads would be accelerated by 5 years (AQ-SD2), which would further minimize the effects of erosion on wetlands. Instead of monitoring grazing impacts every 5 years as under Alternative 2, DNRC would monitor impacts annually (AQ-GR1).

Alternative 4 (Increased Management Flexibility HCP)

Under Alternative 4, wetland protection would continue as under current conditions (ARMs 36.11.301 through 36.11.313 and 36.11.426). Other commitments that benefit wetlands under Alternative 4 would be very similar to Alternative 2, although the increased management flexibility would slightly reduce protection of wetlands from indirect effects of timber harvest and grazing. The primary differences between this alternative and Alternative 2 are described in the following paragraph.

Alternative 4 would retain the 25-foot no-harvest buffer, but the buffer for restricted harvest would be reduced to the zone from 26 to 50 feet for streams and lakes supporting HCP fish species instead of out to a 100-year site index tree (AQ-RM1). The schedule for identifying and correcting sedimentation issues on roads would be extended by 5 years (AQ-SD2). Grazing impacts would be monitored every 10 years instead of every 5 years (AQ-GR1).

Summary

Under all alternatives, wetland protection would continue as under current conditions (ARMs 36.11.301 through 36.11.313 and 36.11.426). However, under the action alternatives, some conservation commitments would result in enhanced wetland protection over Alternative 1. This would mostly be due to stream buffers that limit riparian harvest; requirements for inventory, assessment, and corrective actions on sediment delivery roads; and increased frequency of inspection requirements for correction of issues associated with grazing licenses. Of the action alternatives, Alternative 3 provides the greatest potential protection of wetlands due to wider streamside buffers where harvest would be prohibited, which would protect wetlands located in the riparian zones of streams. Alternative 3 also has the shortest timeline for identifying and correcting sedimentation issues on roads, which would reduce sediment and erosion impacts on wetlands.

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4.8 FISH AND FISH HABITAT

The planning area provides habitat for a diverse array of fish species, with over 86 fish species known or expected to occur in Montana, more than 50 of which are native to the state. This section addresses the existing conditions and management of fish and fish habitat in the HCP project area. The first subsection provides an overview of existing fisheries-related regulations, the second subsection provides an overview of the important components of the aquatic environment that fish require and that forest practices may affect, and subsequent subsections address various fish species groups (HCP fish species, special status species, and other fish). Emphasis is placed on HCP fish species because these native, cold-water fish would be most influenced by changes in forest management practices resulting from the proposed HCP and other alternatives. Sources of information include communications with local and regional biologists, GIS data from DNRC and other sources, fisheries data from MFWP, and literature review.

4.8.1 REGULATORY FRAMEWORK

Management of the DNRC lands in the planning area is governed by various fisheries-related federal and state regulations (Table 4.8-1). While some of these regulations are specific to individual species (i.e., ESA), other regulations provide more general guidance on the protection of fish habitat, while still others address the various environmental factors and conditions that might affect fish.

The most applicable regulations governing fish management on trust lands include the SMZ Law, and the Forest Management ARMs. These laws and rules were implemented to protect streams, wetlands, and watersheds from the adverse effects of timber harvest and associated activities, such as road building and subsequent erosion into adjacent streams. The primary features of these rules are to restrict the scope and range of activities that may pose a threat to aquatic habitat and species.

This section addresses only those regulations that are specific to fish and in-stream/riparian aquatic habitat. The regulations affecting other types of environmental factors that can directly and indirectly affect fish, such as road building and water quality, are also described, but covered in more detail in Sections 4.4 (Transportation) and 4.6 (Water Resources), respectively.

The SMZ Law (MCA 77-5-301 through 307) and rules (ARMs 36.11.301 through 313) regulate commercial timber harvest conducted immediately adjacent to all streams, specific lakes, and other waterbodies in Montana. The SMZ is defined as the stream, lake, or other waterbody and an adjacent area of varying width where management practices that might affect wildlife habitat or water quality, fish, or other aquatic resources need to be modified (MCA 77-5-302(8)). The primary features of these regulations are to restrict the scope and range of activities associated with commercial timber harvest that may pose a threat to aquatic habitat and species.

TABLE 4.8-1. APPLICABLE EXISTING AQUATIC RESOURCE-RELATED REGULATIONS

Regulation	Overseeing Agency	Purpose
Federal		
Endangered Species Act, 16 USC 1531 et seq.	USFWS	Protect and recover threatened and endangered fish species and their critical habitat (including bull trout).
Fish and Wildlife Coordination Act, 16 USC 661 through 667	USFWS, MFWP	All fish, especially riparian and aquatic wildlife (including bull trout, westslope cutthroat, and Columbia redband trout).
Clean Water Act, Section 303	EPA	Waters of the United States.
Clean Water Act, 33 USC 1251, Section 401	EPA (Administered by MDEQ)	Waters of the United States, including wetlands.
Clean Water Act, 33 USC 1344, Section 404	EPA (Administered by ACOE)	Waters of the United States, including wetlands.
Rivers and Harbors Act, Section 10, 33 USC 403 and 407	U.S. Coast Guard	Navigable waters.
State		
SMZ Law and rules, MCA 77-5-301 through 307 ARMs 36.11.301 through 313	Montana DNRC	Management of timber harvest activities near streams and other waterbodies.
Forest Management ARMs (36.11.422 through 443)	Montana DNRC	Threatened and endangered species, DNRC sensitive species, game species, fish habitat.
Montana Stream Protection Act, MCA 87-5-501 through 507, 87-5-509	MFWP	Any project that may affect the natural and existing shape and form of any stream or its banks or tributaries.

The six established functions of an SMZ are:

1. Acts as a sediment filter to maintain water quality
2. Provides shade to regulate water temperature
3. Supports diverse and productive aquatic and terrestrial habitats
4. Protects the stream channel and banks
5. Provides for the recruitment of LWD to maintain stream channel features
6. Promotes floodplain stability.

The SMZ Law designates three classes of stream based on fish presence and stream flow characteristics, with varying degrees of riparian zone protection measure requirements (Table 4.8-2). These protection measures include minimum buffer widths, exceptions to accommodate wetland protection, tree retention regulations, as well as prohibited or regulated activities within SMZs.

In addition to the SMZ Law, the Forest Management ARMs (36.11.422 through 443) apply to more specific state land management practices. These include rules governing road management, watershed management, cumulative effects, monitoring, RMZs, WMZs, and fisheries (Table 4.8-3).

TABLE 4.8-2. STREAM CLASSIFICATIONS AND ASSOCIATED MANAGEMENT REQUIREMENTS OF THE SMZ LAW TO PROTECT MONTANA WATERBODIES

	Stream Classification		
	Class 1	**Class 2**	**Class 3**
Classification Parameters	Supports fish, or contributes flow to another waterbody for 6 months per year	Contributes flow to another waterbody < 6 months per year, or does not contribute surface flow to another waterbody but has surface flow for 6 or more months	Rarely contributes flow to other waterbodies, and has surface flow < 6 months per year
Minimum SMZ Width	50 feet, or 100 feet for slopes > 35%	50 feet, or 100 feet for slopes > 35%	50 feet
Increase SMZ Size to Accommodate Wetlands	Yes	Yes	Yes
Clearcutting Allowed	No	No	No
Tree Retention Regulations	At least 50%, or 10 per 100 feet, of trees ≥ 8 inches dbh	At least 50%, or 5 per 100 feet, of trees ≥ 8 inches dbh	Sub-merchantable trees and shrubs
Retained Tree Characteristics	Favor leaning trees and trees within 50 feet of stream that represent pre-harvest size and species	Favor leaning trees and trees within 50 feet of stream that represent pre-harvest size and species	None

TABLE 4.8-3. REQUIREMENTS OF FISH-RELATED FOREST MANAGEMENT ARMS

Administrative Rule	Topic	Application on State Lands
36.11.421	Road Management	Minimize the miles and size of roads.
		Build, maintain, and abandon roads to maximize efficiency.
36.11.422	Watershed Management	Maintain high-quality water.
		Incorporate appropriate BMPs.
36.11.423	Cumulative Effects	Assess and minimize CWE.
36.11.424	Monitoring	Develop monitoring strategies to assess watershed impacts of land use activities.
36.11.425	RMZs	Contain size and land use restriction related to RMZs.
36.11.426	WMZs	Protect forested wetlands.
36.11.427	Fisheries	Minimize impacts to fish populations and habitat.
36.11.436	Sensitive Species	Adequately consider sensitive species in assessments and management decisions.

The intent of the ARM related to road management (ARM 36.11.421) is to minimize the number of roads to reduce impacts to fish and fish habitat by reducing sediment delivery to streams and limiting disturbance to streamside vegetation. Some road management practices are prioritized based on actual or potential fish use of area streams or other habitat or water quality concerns.

ARM 36.11.425 requires the establishment of an RMZ, when forest management activities (including timber harvest) are proposed on sites that are adjacent to fish-bearing streams. The total RMZ width, including the SMZ, is equal to the 100-year site index tree height. Harvest conducted within the combined SMZ and RMZ must retain all bank edge trees and retain enough other trees to ensure adequate levels of shade and potential LWD recruitment to the stream. Adequate levels of shade are defined under the ARM as those that maintain natural stream temperature ranges. Adequate levels of LWD recruitment are defined under the ARM as those that maintain channel form and function. Target levels of LWD and shade, and the adequacy of proposed prescriptions in meeting target levels, are currently determined on a site-specific, project-level basis.

In addition to the SMZ and RMZ rules, ARM 36.11.426 provides regulations relative to WMZs. This rule states that for wetlands found within an SMZ, the WMZ boundary shall be 50 feet from the wetland. All requirements under the SMZ Law (ARMs 36.11.301 through 313) must be met for wetlands located within or intercepting the SMZ boundary.

ARMs 36.11.427(2)(i) and 36.11.427(3) also require forest management activities to protect and maintain bull trout, Yellowstone and westslope cutthroat trout, arctic grayling, and all other sensitive fish and aquatic species. The FMB maintains its own list of species that are considered sensitive under the rules. This list is modified using information and classification systems developed by the USFS, USFWS, MNHP, and MFWP. Also under the ARMs, DNRC is required to minimize impacts to fish populations and habitat by making reasonable efforts, in its sole discretion, to cooperate in the implementation of conservation strategies developed for the State of Montana. These include

- *Restoration Plan for Bull Trout in the Clark Fork River Basin and Kootenai River Basin* (MBTRT 2000)
- *Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat and Yellowstone Cutthroat Trout in Montana* (MFWP 2007a)
- *Bull Trout Draft Recovery Plan* (USFWS 2002a)
- Existing institutional practices.

In addition to the protective measures that are directly applicable to DNRC activities (including regulatory measures and those developed by DNRC), other agencies and entities have also developed measures to protect fish and their habitat. These measures include INFISH guidelines developed by the USFS (1995b) and those measures covered under the Plum Creek HCP for forest activities in Montana (Plum Creek 2000). These measures may be implemented on lands adjacent to DNRC lands that are owned by a federal agencies and Plum Creek, respectively.

INFISH, if implemented under the new USFS national forest land management planning strategy, applies federal management guidelines to protect native fish to reduce the risk of population loss and negative impacts to aquatic habitat through the establishment of riparian management objectives and riparian habitat conservation areas. The Plum Creek HCP habitat goals and objectives are based on the principle of providing cold, clean, complex, and connected waters (primarily to benefit salmonids) on 1.4 million acres of Plum Creek Timber Company lands in western Montana.

4.8.2 AFFECTED ENVIRONMENT - KEY AQUATIC HABITAT FACTORS

The distribution and abundance of fish populations within the planning area and HCP project area is largely a function of aquatic habitat quantity and quality. These aquatic habitat parameters are influenced by a number of land use activities and factors that directly or indirectly affect fish or their habitat. These factors include sediment loading from road construction and maintenance, population connectivity relative to stream crossings (blockages), CWE, livestock grazing, and riparian habitat conditions.

Montana contains diverse aquatic resources due to geographic variability across the state, from the Rocky Mountain region in the west, to the broad plains region in the east. This variability is also reflected in the diversity of aquatic habitat available throughout the state (Figures D-6A through D-6C in Appendix D, EIS Figures). The state contains about 2,000 natural lakes; 50 reservoirs of 500 acres or larger; 15,000 miles of cold-water streams; 1,300 miles of warm-water streams; thousands of small reservoirs and ponds; and thousands of miles of intermittent streams (DNRC 2008a). Many of these waterbodies support either cold- or warm-water fish species, while some support both.

The description of the affected environment requires subdividing the HCP project area into discrete, spatially relevant geographic units, which allow appropriate description of existing conditions within a landscape context. Within this EIS, other resources (e.g., wildlife and vegetation) are evaluated at a spatial scale defined by DNRC administrative boundaries, such as land offices and administrative unit offices. However, fish and other aquatic life are influenced by habitat interactions that occur within a river basin and watershed scale, which are not necessarily confined by biologically arbitrary administrative units. Therefore, analysis of habitat and fish population conditions within the HCP project area uses a watershed approach, with 14 EIS aquatic analysis units (Table E4-3 in Appendix E, EIS Tables, and Figure D-7, Appendix D, EIS Figures). For comparative purposes, the relationship of the EIS aquatic analysis units to DNRC administrative units is presented in Table 4.8-4.

The bull trout was initially listed as three separate distinct population segments (DPSs) (63 FR 31647-31674, June 10, 1998, 64 FR 17110-17125, April 8, 1999). The final listing rule for the contiguous United States population of the bull trout consolidated all the population segments into a single listed taxon, bull trout in the contiguous United States (64 FR 58910-58933, November 1, 1999). Five segments of the contiguous United States population of bull trout were identified as interim recovery units: (1) Jarbidge River, (2) Klamath River, (3) Columbia River, (4) Coastal-Puget Sound, and (5) St. Mary-Belly River. A comprehensive discussion of these topics is found in the USFWS's draft recovery plan for bull trout (USFWS 2002a), the USFWS's Science Team Document (Whitesel et al. 2004), the 5-year status review (USFWS 2005b), and the final rule listing designated critical habitat (70 FR 56211-56311, September 26, 2005). The draft bull trout recovery plan (USFWS 2002a) describes an organizational hierarchy for bull trout at nested spatial levels that include recovery units, core areas, and local populations (the lowest level in the organizational hierarchy). Twenty-seven major watersheds were referred to as recovery units; however, terminology has since been revised, and the former recovery units are now referred to as management units. Management units are the major units for managing recovery efforts, with each management unit consisting of one or more core areas, and each core area representing the closest approximation of a biologically functioning unit for bull trout. A local population is a group of bull

TABLE 4.8-4. ACREAGE OF EIS AQUATIC ANALYSIS UNITS WITHIN THE HCP PROJECT AREA BY DNRC LAND OFFICE

DNRC Land Office and Administrative Units	Acres of EIS Aquatic Analysis Unit														Total	Percent of Total Project Area
	Lower Kootenai	Middle Kootenai	Upper Kootenai	North Fork Flathead	Flathead Lake/ Main Fork	Swan	Stillwater	Lower Clark Fork	Middle Clark Fork	Upper Clark Fork	Bitterroot	Blackfoot	Rock Creek	Upper Missouri		
NWLO																
Kalispell	0	7,324	0	0	10,470	4,914	3,454	0	15,493	0	0	0	0	0	**41,654**	7.6
Libby	3,527	21,442	3,480	0	0	0	0	0	2	0	0	0	0	0	**28,452**	5.2
Plains	0	1	0	0	0	0	0	4,185	49,371	0	0	0	0	0	**53,556**	9.8
Stillwater	0	0	7,673	18,499	0	0	83,867	0	0	0	0	0	0	0	**110,039**	20.1
Swan	0	0	0	0	0	39,699	0	0	0	0	0	0	0	0	**39,699**	7.2
SWLO																
Anaconda	0	0	0	0	0	0	0	0	0	33,757	0	3,342	4,592	2,244	**43,935**	8.0
Clearwater	0	0	0	0	0	0	0	0	1	409	0	43,740	0	1	**44,150**	8.0
Hamilton	0	0	0	0	0	0	0	0	0	0	20,913	0	0	0	**20,913**	3.8
Missoula	0	0	0	0	0	0	0	0	23,646	13,007	6,830	9,446	0	0	**52,928**	9.6
CLO																
Bozeman	0	0	0	0	0	0	0	0	0	0	0	0	0	16,483	**16,483**	3.0
Conrad	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0.0
Dillon	0	0	0	0	0	0	0	0	0	0	0	0	0	70,608	**70,608**	12.9
Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	26,106	**26,106**	4.8
TOTAL	**3,527**	**28,767**	**11,153**	**18,499**	**10,470**	**44,613**	**87,321**	**4,185**	**88,512**	**47,173**	**27,743**	**56,528**	**4,592**	**115,441**	**548,525**	
% of Project Area	0.6	5.2	2.0	3.4	1.9	8.1	15.9	0.8	16.1	8.6	5.1	10.3	0.8	21.0		**100**

Source: DNRC (2008a).

trout that spawn within a particular stream or portion of a stream system and is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. Multiple local populations may exist within a core area.

In summary, until the draft recovery plan for bull trout is finalized, the USFWS has adopted the use of local population, core area, management unit, and interim recovery unit for purposes of consultation and recovery.

The EIS aquatic analysis units range greatly in size from less than 500,000 acres (Swan and Lower Kootenai) to more than 12.9 million acres (Upper Missouri). To simplify some discussions, the 14 EIS aquatic analysis units are combined into four EIS aquatic planning basins (Kootenai, Flathead, Clark Fork, and Missouri River basins) (see Table E4-3 in Appendix E, EIS Tables).

The distribution of HCP project area lands is not uniform across the 14 EIS aquatic analysis units. For example, two EIS aquatic analysis units (Stillwater and Swan) each contain a total of over 9 percent of HCP project area lands by area, while four other analysis units (Lower Clark Fork, Rock Creek, Lower Kootenai, Upper Missouri) contain less than 1 percent of the HCP project area within their boundaries (Table 4.8-4).

Most of the planning area is mountainous, resulting in highly variable streamflow, particularly in the small rivers and streams that serve as headwaters for all the major river systems in Montana. Peak flows generally occur May through June from melting snow and rainfall. Increased flows also occasionally occur for short durations in the summer due to thunderstorms. The planning area contains over 75,600 miles of stream habitat, of which about 43,959 miles (58 percent) have intermittent stream flow (Table E4-4 in Appendix E, EIS Tables). In addition, the vast majority of stream miles (intermittent or perennial) are located on non-trust land. Less than 5 percent of the planning area stream miles (3,469 miles) are located on trust land, and about 2 percent (1,578 miles) on HCP project area lands (see Table E4-4 in Appendix E, EIS Tables). Within the planning area, only about 3 percent (1,006 of 31,646 miles) of the perennial stream miles, and almost 3 percent of the intermittent stream miles, occur on trust lands.

A total of 3,469 miles of stream occur on trust lands within the planning area, although only 130 miles (7 percent) support HCP fish species (see Table E4-4 in Appendix E, EIS Tables). Nearly all (99 percent) of this HCP fish species supporting habitat supports westslope cutthroat trout, while 67 percent supports bull trout. Thus, about 10 percent of all bull trout habitat, 8 percent of all Columbia redband trout habitat, and 6 percent of all westslope cutthroat trout habitat in the planning area occurs on trust lands.

4.8.2.1 Sediment

Erosion and sedimentation occur naturally in a watershed and provide the sources and surfaces necessary for habitat formation for aquatic and terrestrial wildlife species (Naiman et al. 1992). A disturbance, be it natural or human induced, is any substantial change in the supply or routing of water, sediment, or woody debris that causes a measurable difference in channel structure and biological community. Natural disturbances such as floods, fire, and landslides are an integral part of watershed dynamics. These events can substantially affect sediment loading to area streams.

While these are natural events, land management activities can influence their degree and frequency.

Land management activities can also have a direct influence on the amount of sediment entering these waterbodies, by affecting stormwater runoff rates, and erosion from road surfaces and other disturbed soil areas. Increased sediment loading to rivers and streams results in filled pools, substrate embeddedness, increased turbidity, and deterioration of in-stream habitat (particularly salmonid spawning habitat).

Importance of Sediment to Fish

Sedimentation rates are important because chronic inflow of fine sediment can seriously diminish salmonid spawning success, alter fish behavior, and cause many other deleterious sub-lethal effects (Cederholm et al. 1981; Servizi and Martens 1992; Kondolf 2000). Fine sediment can cause direct mortality to salmonid eggs (Chapman 1988), sac fry (Reynolds et al. 1989), and juvenile fish (Lloyd 1985). Although all salmonid eggs are susceptible to suffocation from the accumulation of fine sediments in spawning gravel, Bjornn and Reiser (1991) report that cutthroat trout eggs were more sensitive than those of rainbow trout, kokanee trout, steelhead trout, or Chinook salmon. They also report that accumulations of 10 percent fine sediment reduced cutthroat trout embryo survival to about 80 percent of gravels without fine sediments (range 65 to 90 percent), while 17 percent fine sediments reduced embryo survival to approximately 55 percent (range 15 to 75 percent). Shepard et al. (1984) report abrupt increases in incubation mortality in streams with 30 percent fine sediments, with 100 percent mortality with 50 percent fines.

Sub-lethal behavioral effects of suspended sediment on salmonids include habitat avoidance and subsequent effects on fish distribution (Cedarholm and Reid 1987; Servizi and Martens 1992), reduced feeding and repressed growth rates (Newcombe and MacDonald 1991), respiratory impairment (Servizi and Martens 1992), reduced tolerance to disease and toxicants (Goldes et al. 1988), and physiological stress (Servizi and Martens 1992).

DNRC Activities Potentially Affecting Sediment

Forest Management

Although forest management activities have historically resulted in substantial erosion and sediment delivery to Montana streams, current regulations and established BMPs substantially reduce these risks. DNRC recently assessed soil impacts on 74 timber harvest areas, which were harvested between 1988 and 2003 (DNRC 2004e). The results indicate that areas harvested in 1988 and 1989, prior to formal adoption of BMPs, had the highest percentages of impacted area compared to later harvest sites. Overall, about 47 percent of the sites had total detrimental soil impacts less than 20 percent, with an overall range of 3 to 44 percent (DNRC 2004e).

It is generally recognized that one of the greatest potential effects of forest management activities on aquatic habitat is accelerated erosion and subsequent sediment delivery to streams (Waters 1995). Forest road construction, road use, and maintenance activities are a primary source of fine sediment delivery to Montana streams. Stormwater runoff from such roads is a direct source of fine sediments, and the increased runoff rates can contribute to increased erosion of upland soils.

Increased runoff results in increased stream flows and an increased potential for streambank erosion and further sedimentation levels.

Other forest management activities that can contribute to the sediment delivery to Montana streams include timber harvesting, yarding, site preparation, and slash treatment. These activities often increase the levels of soil disturbance, soil compaction, vegetation removal, and the subsequent levels of upland erosion. In general, the potential for impacts increases when these activities are conducted in proximity to streams, and reduces with increased buffer widths. Even with adequate buffer size, however, these activities can still have a substantial effect on sediment delivery to streams due to road crossings. Not only can sediment delivery increase directly from road surface runoff, but such road configurations provide a more direct route for sediment generated by other forest management activities to reach and enter the streams.

Grazing

The impacts of livestock grazing on sediment delivery to streams are also typically greatest when these activities occur in proximity to streams, but can also vary by the intensity, duration, and timing of such activities. The direct access of livestock to streams often results in the greatest sedimentation impacts. This access results in the disturbance of streamside vegetation and soils, and the collapse and tapering of stream banks. This causes increased erosion potential from the area and a direct and site-specific pathway for sediment delivery. The entrance of livestock into stream channels can also result in wider and shallower stream channels, with reduced water velocities and increased sedimentation.

There are currently 391 individual parcels with grazing licenses on classified forest trust lands in the HCP project area, encompassing about 164,931 acres (Table 4.8-5, Figures D-8A through D-8C in Appendix D, EIS Figures). Approximately 163 (42 percent) of these 391 parcels contain a segment of stream known to support at least one of the three HCP fish species, including approximately 111 parcels with bull trout habitat, 161 parcels with westslope cutthroat trout habitat, and 8 parcels with Columbia redband trout habitat. Similarly, about 46 percent (75,566 of 164,931 acres) of the licensed grazing acres in the HCP project area support at least one HCP fish species.

Sixty-seven (60 percent) of the 111 licensed grazing parcels containing bull trout habitat are located in two of the EIS aquatic analysis units, including 27 parcels (24 percent) in the Blackfoot analysis unit and 40 parcels (36 percent) in the Middle Clark Fork analysis unit. Only eight grazing parcels contain Columbia redband trout habitat, with seven occurring in the Middle Kootenai analysis unit. Westslope cutthroat trout habitat is more widely distributed in the project area, occurring in 12 of the 14 analysis units.

However, 60 percent of the parcels occur in the Blackfoot and Middle Clark Fork analysis units. Only about 122 (24 percent) of the HCP project area stream miles that support at least one HCP fish species actually occur within the boundaries of the grazing license parcels (Table 4.8-6). This includes 120.8 miles, 81.6 miles, and 3.9 miles of stream that support westslope cutthroat trout, bull trout, and Columbia redband trout, respectively.

TABLE 4.8-5. DNRC PARCELS AND ACRES WITH GRAZING LICENSES BY AQUATIC ANALYSIS UNIT WITHIN THE HCP PROJECT AREA

EIS Aquatic Analysis Unit	Number of parcels with Grazing Licenses in the HCP Project Area	Number of Grazing License Parcels Containing HCP Fish Species				Acres Under Grazing Licenses in the HCP Project Area	Acres Under Grazing License Containing HCP Fish Species			
		Bull Trout	Westslope Cutthroat Trout	Columbia Redband Trout	Any HCP Fish Species		Bull Trout	Westslope Cutthroat Trout	Columbia Redband Trout	Any HCP Fish Species
Bitterroot	49	16	21	0	21	21,363	8,270	10,636	0	10,636
Blackfoot	87	27	41	0	41	36,306	11,383	18,613	0	18,613
Flathead Lake	8	0	2	0	2	3,483	0	1,234	0	1,234
Lower Clark Fork	5	0	0	0	0	1,597	0	0	0	0
Lower Kootenai	1	1	1	1	1	319	319	319	319	319
Middle Clark Fork	112	40	56	0	56	45,404	16,878	25,294	0	25,294
Middle Kootenai	22	5	11	7	11	9,091	2,269	4,681	2,596	4,681
North Fork Flathead	3	3	3	0	3	912	906	906	0	906
Rock Creek	6	2	1	0	2	2,192	1,110	646	0	1,110
Stillwater	10	3	2	0	3	3,585	1,055	798	0	1,055
Swan	4	2	2	0	2	1,446	994	994	0	994
Upper Clark Fork	37	7	14	0	14	16,612	3,652	7,500	0	7,500
Upper Kootenai	8	5	7	0	7	3,841	1,924	3,223	0	3,223
Upper Missouri	39	0	0	0	0	18,778	0	0	0	0
TOTAL[1]	**391**	**111**	**161**	**8**	**163**	**164,931**	**48,761**	**74,845**	**2,916**	**75,566**

[1] Some individual parcels were double counted if the parcel straddled two or more analysis units.
Source: DNRC (2008a).

TABLE 4.8-6. STREAM MILES AND FISH DISTRIBUTION WITHIN HCP PROJECT AREA GRAZING LICENSE PARCELS

EIS Aquatic Analysis Unit	Stream Miles on Grazing License Parcels Within the HCP Project Area				
	Total Stream Miles	Bull Trout Habitat	Westslope Cutthroat Trout Habitat	Columbia Redband Trout Habitat	Total HCP Fish Species Habitat
Bitterroot	85.7	15.5	19.5	0.0	**19.5**
Blackfoot	102.1	14.6	25.5	0.0	**25.5**
Flathead Lake	9.9	0.0	1.4	0.0	**1.4**
Lower Clark Fork	4.1	0.0	0.0	0.0	**0.0**
Lower Kootenai	0.5	0.5	0.5	0.5	**0.5**
Middle Clark Fork	145.2	30.5	45.1	0.0	**45.1**
Middle Kootenai	25.2	2.5	4.9	3.4	**4.9**
North Fork Flathead	7.0	5.2	5.2	0.0	**5.2**
Rock Creek	8.4	0.8	1.1	0.0	**1.9**
Stillwater	6.4	3.0	2.5	0.0	**3.0**
Swan	2.5	1.5	2.0	0.0	**2.0**
Upper Clark Fork	46.2	5.0	7.9	0.0	**7.9**
Upper Kootenai	13.0	2.5	5.0	0.0	**5.0**
Upper Missouri	45.9	0.0	0.0	0.0	**0.0**
TOTAL	**502.1**	**81.6**	**120.8**	**3.9**	**122.1**

Source: DNRC (2008a).

Existing Sediment Conditions in HCP Project Area

Road-generated Sediment

Despite recent improvements in the implementation of protective BMPs, the construction, maintenance, and use of forest roads can be a substantial source of sediment loading to streams. The overall length and density of roads within the HCP project area indicate the sediment loading potential from DNRC land management activities. GIS analyses indicate approximately 4,570 miles of existing roads are located on trust lands in the planning area, with about 2,646 miles (58 percent) occurring on HCP project area lands (Table 4.8-7). The average road density in the HCP project area is about 3.1 mi/mi^2, ranging between 1.7 and 5.5 mi/mi^2. While the lowest road density estimate is associated with the largest aquatic analysis unit (Upper Missouri), and one of the smallest units (Lower Clark Fork), there is no apparent consistent pattern between area and road density.

As discussed above, roads have the potential to affect HCP fish species, particularly those road segments located within 300 feet of a stream. An estimated 700 miles (27 percent) of the existing roads on HCP project area lands are located within 300 feet of any stream, although only about 8.9 percent of the road miles in the HCP project area are within 300 feet of streams known to support one of the HCP fish species (Table 4.8-7). Because GIS road layers for non-DNRC (federal and private) lands are generally lacking or incomplete, no assessment of road miles, density, or condition could be conducted over the entire planning area. Information on existing road

TABLE 4.8-7. ROAD MILES, FISH USE OF ROADED AREAS, AND ROAD DENSITY WITHIN THE HCP PROJECT AREA

	EIS Aquatic Analysis Unit															
	Bitterroot	**Blackfoot**	**Flathead Lake**	**Lower Clark Fork**	**Lower Kootenai**	**Middle Clark Fork**	**Middle Kootenai**	**North Fork Flathead**	**Rock Creek**	**Stillwater**	**Swan**	**Upper Clark Fork**	**Upper Kootenai**	**Upper Missouri**	**Outside Planning Units**	**Total**
Planning Area Road Miles on DNRC Ownership	257.9	470.5	158.6	14.7	12.1	546.8	195.4	71.1	20.8	482.0	267.1	266.6	98.7	1,204.5	503.0	**4,569.8**
Planning Area Road Miles on all DNRC Ownership within 300 Feet of any Stream	93.4	109.9	36.3	2.3	2.0	168.4	50.2	13.3	5.5	109.7	55.3	74.0	25.5	383.3	21.6	**1,150.9**
HCP Project Area Road Miles	210.1	386.1	81.4	11.4	12.0	447.5	183.9	69.1	13.2	382.6	258.9	195.4	95.1	298.8	N/A	**2,645.5**
HCP Project Area Road Miles within 300 Feet of any Stream	76.9	100.5	19.1	1.7	2.0	136.3	47.6	13.1	3.4	90.7	54.7	54.3	25.1	75.0	N/A	**700.1**
HCP Project Area Road Miles within 300 Feet of Bull Trout Streams	18.1	13.4	0.1	0.3	0.6	45.0	10.8	6.7	0.1	43.9	24.4	9.9	3.3	0.0	N/A	**176.7**
HCP Project Area Road Miles within 300 Feet of Westslope Cutthroat Trout Streams	21.9	28.5	3.9	0.3	0.6	59.5	14.2	8.4	0.3	40.8	27.7	17.6	4.7	6.7	N/A	**235.2**
HCP Project Area Road Miles within 300 Feet of Columbia Redband Trout Streams	0	0.0	0.0	0.0	0.6	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	**11.8**
HCP Project Area Road Miles within 300 Feet of HCP Fish Species Streams	21.9	28.5	3.9	0.3	0.6	59.5	14.2	8.4	0.3	45.2	27.7	17.6	4.7	6.7	N/A	**239.6**
Area (square miles)	43.3	88.3	16.4	6.5	5.5	138.3	44.9	28.9	7.2	136.4	69.7	73.7	17.4	180.4	N/A	**857.1**
Road Density (mi/mi^2)	4.8	4.4	5.0	1.7	2.2	3.2	4.1	2.4	1.8	2.8	3.7	2.7	5.5	1.7	N/A	**3.1**
Road Density within 300 Feet of any HCP Project Area Stream	1.8	1.1	1.2	0.3	0.4	1.0	1.1	0.5	0.5	0.7	0.8	0.7	1.4	0.4	N/A	**0.8**
Road Density within 300 Feet of HCP Fish Species Streams (mi/mi^2)	0.5	0.3	0.2	0.1	0.1	0.4	0.3	0.3	0.0	0.3	0.4	0.2	0.3	0.0	N/A	**0.3**

Source: DNRC (2008a).

conditions on trust lands comes from a variety of programs, including the watershed monitoring program; NWLO and SWLO road monitoring programs; and timber sale planning, design, and EAs. In addition, road improvement needs are identified through casual observations or reports made to DNRC field staff during the normal course of carrying out their administrative duties.

Between 1998 and 2001, DNRC inventoried 405 miles of roadway on forested trust lands in the HCP project area, to assess sediment delivery potential related to forest roads. This represents 15 percent of the 2,646 miles of forested trust land roads in watersheds supporting HCP fish species (DNRC 2006d). These data indicate that about 46 percent of the identified road problem sites causing sediment delivery to streams on forested trust lands are related to inadequate road surface drainage (DNRC 2006d).

To model the amount of sediment generated from inadequate road surface drainage, information from the DNRC road inventories was used to estimate the existing road conditions on HCP project area lands and to estimate the amount of sediment generated by these roads (DNRC 2006f, 2006g, 2008f; Earth Systems 2007, 2008; USDA 2008). Based on several variable parameters (road slope, geometry, road bed material, rainfall patterns, etc.), this modeling exercise generated a range of potential sediment generated per road mile. Although this information is useful in estimating the scale of sediment generated from problem roads, it should be noted that the modeling exercise does not give information on sediment delivery into streams, which is the process that most directly affects aquatic species. The model does not take into account downslope filtration and interception of sediment by vegetation and soils, factor in the exact distance of roads from stream courses, or account for the full range of slope and road surface conditions.

Stream Crossing Generated Sediment

In addition to the miles of road located within 300 feet of streams, there are about 2,258 stream crossings within the HCP project area, although only 24 percent (550 crossings) occur on perennial streams (Table 4.8-8). While the HCP fish species (particularly westslope cutthroat trout) may occupy intermittent streams at certain times of the year, such use is limited. There are 330 stream crossings of streams supporting bull trout, and 446 and 17 crossings of streams supporting westslope cutthroat trout and Columbia redband trout, respectively. The proportion of total stream crossings in the individual aquatic analysis units, that support any HCP fish species, ranges from 0 percent (Rock Creek and Lower Kootenai aquatic analysis units) to 63.3 percent (North Fork Flathead Unit). The next highest proportions of crossings in HCP fish species streams are in the Swan (34.3 percent), Stillwater (30.4 percent), and the Upper Clark Fork (27.7 percent) analysis units. Less than 22 percent of the total stream crossings in the other analysis units occur in HCP fish species streams.

Forty-one percent of the inventoried problems are associated with stream crossing deficiencies. Approximately 132 of the stream crossing CMPs analyzed (34 percent) were identified as problematic as to risk for sediment delivery. The most common stream crossing problems were related to culvert alignment or grade (24 percent), inadequate capacity (26 percent), and inadequate armoring of inlet or outlet (20 percent). In addition, the amount of sediment at risk of delivery was estimated for each problem stream crossing. On average at each problem site, 69 cubic yards of sediment was at risk for potential delivery to the streams. Of the 132 identified road crossing problem sites, 74 percent would deliver less than 100 cubic yards of material to the associated stream assuming a catastrophic failure, and 90 percent would deliver less than about 150 cubic

TABLE 4.8-8. NUMBER OF ROAD-STREAM CROSSINGS IN THE HCP PROJECT AREA BY EIS AQUATIC ANALYSIS UNIT

EIS Aquatic Analysis Unit	Road-stream Crossings[1]	Road-stream Crossings on Perennial Streams	Road-stream Crossings on Intermittent Streams	Road-stream Crossings on Known Bull Trout Streams	Road-stream Crossings on Known Westslope Cutthroat Trout Streams	Road-stream Crossings on Known Columbia Redband Trout Streams	Road-stream Crossings on any HCP Fish Species Streams
Bitterroot	204	46	158	38	44	0	44
Blackfoot	323	41	282	21	46	0	46
Flathead Lake	78	10	68	0	6	0	6
Lower Clark Fork	7	1	6	1	1	0	1
Lower Kootenai	5	0	5	0	0	0	0
Middle Clark Fork	423	77	346	47	75	0	75
Middle Kootenai	180	21	159	17	28	17	28
North Fork Flathead	60	38	22	28	38	0	38
Rock Creek	11	0	11	0	0	0	0
Stillwater	303	106	197	89	80	0	92
Swan	169	58	111	45	58	0	58
Upper Clark Fork	177	54	123	35	49	0	49
Upper Kootenai	99	12	87	9	12	0	12
Upper Missouri	219	86	133	0	9	0	9
TOTAL	**2,258**	**550**	**1,708**	**330**	**446**	**17**	**458**

[1] Road-stream crossings include any type of structure (e.g., bridges, culverts, fords).
Source: DNRC (2008a).

yards. However, it should be noted that these sites are only at risk for failure of sediment delivery. The actual occurrence of sediment delivery is primarily driven by the magnitude and duration of storm events. For example, an undersized culvert is at greater risk of failure due to high flows produced by larger storm events, such as a 100-year storm, which on average has only a 1 percent chance of occurring in any given year.

Using extrapolation based on the frequency of problem culverts, and the average amount of sediment at risk of delivery, the number of problem culverts and total amount of sediment at risk was estimated for each EIS aquatic analysis unit (Table 4.8-9). It should be noted that the volume of sediment at risk would be a "worst-case scenario," and represents the volume of sediment delivered to a stream if all of the problem culverts were to totally fail. Based on probability and the distribution of large storm events, it is extremely unlikely that this entire at-risk volume of sediment would be delivered into HCP project area streams, even over a long time period (i.e., 50 years). In addition, existing DNRC policies and procedures would not preclude all of the at-risk crossings from eventually being improved or upgraded.

Timber Harvest and Landslide Generated Sediment

Timber harvest and landslides can also contribute sediment into streams. However, as discussed in the Section 4.5 (Geology and Soils), these factors are relatively minor contributors of in-stream sediment as compared to road-related sources. Existing timber harvest BMPs have been shown to be effective in reducing or eliminating sediment delivery to streams (Sheridan et al. 1999; Appelbloom et al. 2001; DNRC 2004c).

4.8.2.2 Habitat Complexity

Pristine watersheds tend to consist of complex hydraulic conditions (pools, riffles, and side and braided channels) and habitat elements (LWD, undercut banks, variable substrate sizes, and accumulated organic matter). Stream habitat complexity is also often associated with LWD abundance, as wood contributes to the formation of high-quality aquatic rearing habitat (Stouder et al. 1997). LWD consists of large tree trunks and stems or root wads that fall into stream channels due to natural deterioration (i.e., disease and insect infestation), windthrow, and bank failure. In-stream LWD dissipates hydraulic energy during high-flow periods, develops and maintains in-stream habitat features (i.e., pools and gravel bars), stabilizes streambeds and stream banks by minimizing scour and erosion, and provides excellent habitat and cover diversity (Stouder et al. 1997). The effective size of LWD varies by stream width, with larger streams requiring larger wood to sufficiently alter hydrologic conditions enough to affect habitat (Meehan 1991; Overton et al. 1997).

With the loss of LWD in the channel, stream morphology shifts away from the characteristic step-pool and pool-riffle habitats to a more simplified, glide-dominant channel form, with a subsequent decrease in available rearing (pool) habitat. LWD also provides direct nutrients to streams, as well as substrate for aquatic invertebrate production.

Two primary factors influence the amount of LWD recruitment within a given stream, the size (width) of the stream and the width of the adjacent riparian buffer (Murphy and Koski 1989; Robison and Beschta 1990; McDade et al. 1990; Thomas et al. 1993). Riparian vegetation exerts a greater influence on small streams, where LWD is not easily transported. As a result, individual

TABLE 4.8-9. ESTIMATED NUMBER OF PROBLEM ROAD-STREAM CROSSINGS ON KNOWN HCP FISH SPECIES STREAMS IN THE HCP PROJECT AREA BY EIS AQUATIC ANALYSIS UNIT, AND THE ESTIMATED SEDIMENT VOLUME AT RISK DUE TO CMP FAILURE

EIS Aquatic Analysis Unit	Problem CMPs	Problem Crossings on Known Bull Trout Streams	Problem Crossings on Known westslope cutthroat trout Streams	Problem Crossings on Known Redband Trout Streams	Problem Crossings on any HCP Fish Species Stream	Sediment Volume at Risk Due to CMP Failure on any HCP Fish Species Stream (Cubic Yards)
Bitterroot	70	13	15	0	15	1,024
Blackfoot	111	7	16	0	16	1,070
Flathead Lake	27	0	2	0	2	140
Lower Clark Fork	2	0	0	0	0	23
Lower Kootenai	2	0	0	0	0	0
Middle Clark Fork	145	16	26	0	26	1,745
Middle Kootenai	62	6	10	6	10	651
North Fork Flathead	21	10	13	0	13	884
Rock Creek	4	0	0	0	0	0
Stillwater	104	31	28	0	32	2,140
Swan	58	15	20	0	20	1,349
Upper Clark Fork	61	12	17	0	17	1,140
Upper Kootenai	34	3	4	0	4	279
Upper Missouri	75	0	3	0	3	209
TOTAL	**776**	**113**	**153**	**6**	**157**	**10,655**

Source: DNRC (2008a).

pieces can greatly influence channel morphology, in-stream cover, food resources, and sediment transport (Knutson and Naef 1997). As stream size increases, the influence of riparian vegetation and individual LWD decreases, while the role of logjams (affected by a river's supply and type of LWD) increases.

The width of an effective riparian buffer is a commonly used function to measure aquatic habitat integrity. A buffer width of about 0.75 tree height is effective of protecting over 80 percent of the LWD functions. Other ecological functions (stream shading, root strength, and litter fall) are effective with smaller riparian buffers (FEMAT 1993). Adequate LWD recruitment is generally provided with a high degree of certainty by riparian buffer widths of 100 to 200 feet (about the 100-year site index tree height), depending on the site and stream size (Murphy and Koski 1989; Robison and Beschta 1990; McDade et al. 1990, Thomas et al. 1993). The site index tree height at age 100 years, within the DNRC HCP project area, ranges from approximately 80 to 120 feet.

Channel stability, form, and function are also directly related to habitat complexity. Channel forming processes are not only the primary factor in the formation of in-stream habitat units (e.g., pools and riffles), but also influence lateral and vertical channel migration, in-stream sediment mobilization, transport, and deposition, bank stability and erosion, floodplain connectivity, and the riparian habitat of stream systems (see Section 4.6, Water Resources, for more details).

Importance of Habitat Complexity to Fish

Many ecological processes are associated with LWD in streams. This includes the formation of habitat features critical to fish and a host of other organisms. Wood is important in creating refugia for fish and other aquatic species. In small streams, wood plays a major role in creating invertebrate habitat. In small streams, wood debris dams are instrumental in creating a step-pool profile of habitats, enhancing habitat heterogeneity, retaining organic matter, and changing current velocity (Benke and Wallace 2003). Nearly all wood within stream channels has the capacity to influence habitat. Large wood oriented perpendicular to the thalweg is often associated directly with pool formation (Cherry and Beschta 1989; Hauer et al. 1999). Depending on the characteristics of the stream channel and the size and type of wood, LWD can persist and create habitat diversity for a period of months to centuries (Bilby and Likens 1980).

Perhaps the most important role that LWD provides in relation to fish species is the creation and maintenance of deepwater pool habitat (Dolloff and Warren 2003). Pools and other habitats associated with LWD are important to fish because they provide lower water velocities and greater depths associated with pools during low-flow periods. Salmonids, including trout, as well as drift-feeding minnows inhabit areas with lower water velocities, while making feeding forays into faster water (Matthews 1998). Pools can harbor more and larger fish than shallower areas because the greater volume of habitat available, particularly during periods of low-flow streamflow.

Large wood and complex habitat create sediment storage sites, which contribute to food production (macroinvertebrates) and the formation of fish spawning areas. Wood also affects in-stream biological functions such as facilitating primary production by providing attachment sites for microbes and algae, sources of nutrients, and storage areas for organic matter. Wood also enhances secondary production in ways such as increasing surface area available to macroinvertebrate grazers and scrapers (Benke et al. 1985).

Habitat complexity provides cover, including security from predators, isolation from competitors, and points of refuge from severe environmental stresses. The shadow provided by wood helps hide fish from predators, as well as aiding in seeing approaching predators (Harvey and Stewart 1991). Complexity is particularly important for aggressive species like salmonids, which do not tolerate other fishes near them.

DNRC Activities Potentially Affecting Habitat Complexity

Forest Management

Timber harvest activities (including salvage, and thinning) in proximity to streams can have a substantial effect on habitat complexity, particularly if LWD recruitment is affected. Because LWD plays a critical role in the formation and maintenance of in-stream habitat features, any reduction in LWD would likely reduce habitat complexity over time. Other forest management activities that affect stream flow or sediment loading rates have the potential to affect habitat complexity. Increased sediment loading can result in filling pool habitat, increasing substrate embeddedness, and reducing substrate diversity. In addition, forest management activities can also alter the water and sediment yields within a watershed, subsequently affecting channel stability, form, and function.

Grazing

Grazing activities within the riparian zone can substantially affect stream habitat complexity by increasing the level of fine sediment entering the stream, reducing pool size and frequency, destabilizing stream banks, and removing fish cover habitat. Grazing typically results in wider and shallower stream channels than would naturally occur, and can change meander patterns (Platts 1991).

The SFLMP and ARM 36.11.444 require DNRC to perform midterm inspections of all grazing licenses issued on classified forest trust lands, as well as before the renewal date, to determine range, riparian, and streambank conditions. Recent assessments indicate approximately 251 DNRC-issued grazing licenses on 445 parcels of classified forest trust land. DNRC conducted 228 midterm or license renewal supplemental grazing evaluations between 1998 and 2004 (DNRC 2005b). Of the 183 licenses with stream or other riparian areas on the licensed parcel, about 72 percent (132) were within the criteria established by the SFLMP. These assessments found streambank damage as the most common reason for exceeding the criteria, with 39 individual inspections exceeding the allowable 10 percent damage. In comparison, there were only six licenses with criteria exceeded for riparian forage utilization and 32 inspections exceeding either the moderate or heavy browse utilization criteria. Overall, the majority (79 percent) of the inspections indicated no change in condition compared to previous inspections. While there were also 14 inspections where the conditions improved, 8 inspections indicated a decline in conditions (DNRC 2005b).

Existing Habitat Complexity in the HCP Project Area

Although in-stream habitat complexity in forested sites can be influenced by many factors, the structural component of riparian timber stands is often a primary driver of processes that influence habitat complexity, such as LWD recruitment. These structural components include the number and type of tree species and the number, size (age), and spatial distribution of all trees within a riparian

stand. These stand descriptions (also known as tree lists) can be used to both describe existing riparian stands as well as a basis for modeling stand growth and development into the future. To assess landscape conditions for the SYCs, DNRC assumed the existing conditions on forested trust lands were represented by 77 stand descriptions. However, these stand types were based on upland conditions, and do not accurately represent the growth conditions present within the riparian zone. Therefore, to assess existing stand structural characteristics, DNRC evaluated data from riparian timber cruise plots. The cruise plot data were evaluated to ensure that it was representative of riparian stands representing the variety of physiographic and biological conditions within the HCP project area. A total of five stand types were chosen to represent general baseline riparian conditions and to serve as a basis for growth models specific to the riparian zone. Although these stand types do not account for the full range of conditions within riparian forests, they do nonetheless represent the diversity of riparian stand types and the range of forest conditions within the HCP project area. The stand types, named for the geographic area where the cruise plots were taken, are described below, with summaries and visual representations of each stand type presented in Figures 4.8-1 through 4.8-5.

The Beaver Creek Riparian Stand (Figure 4.8-1) is located in the Upper Willow Creek drainage on the Anaconda Unit. This stand is an *Abies lasiocarpa*/*Clamagrostis canadensis* (subalpine fir/bluejoint reedgrass) habitat type (Hansen et al. 1995). The current stand is dominated by lodgepole pine established following a large stand-replacement fire and several subsequent lower-intensity burns. This stand is representative of a major type of riparian stand that is found within the HCP project area at mid to high elevations throughout west-central Montana and east of the Continental Divide. It commonly occurs along sub-irrigated (areas with a high water table condition) stream terraces, wet meadows, and pond margins.

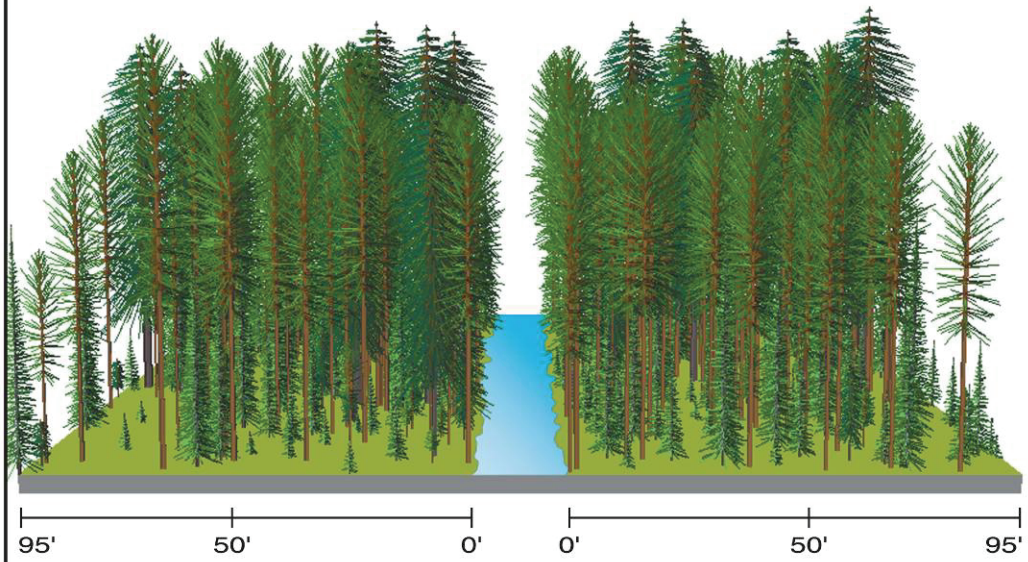
The Gird Creek Riparian Stand (Figure 4.8-2) is located in the Bitterroot River drainage on the Hamilton Unit. This stand is a *Picea/Cornus stolonifera* (spruce/red-osier dogwood) habitat type (Hansen et al. 1995). The current stand is dominated by Engelmann spruce with lesser amounts of Douglas-fir. This stands is representative of a major type of riparian stands found on flat alluvial benches and terraces bordering streams at low to mid elevations in the west central portion of the HCP project area.

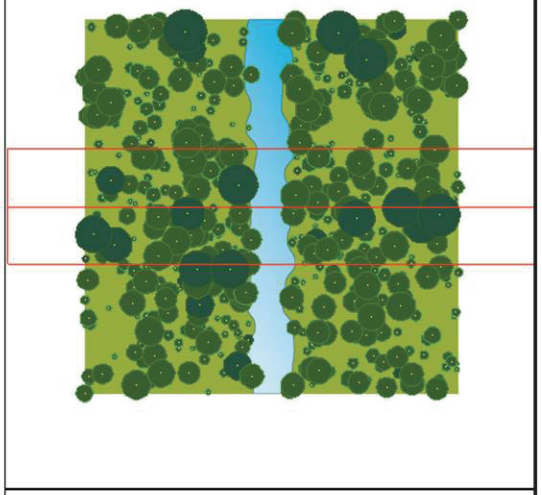
The Dingley Creek Riparian Stand (Figure 4.8-3) is located in the Grasshopper Creek drainage on the Dillon Unit. This stand is a *Picea/Calamagrostis Canadensis* (spruce/bluejoint reedgrass) community type and is considered a late seral stage of *the Abies lasiocarpa/ Calamagrotis canadensis* (subalpine fir/bluejoint reedgrass) habitat type (Hansen et al.1995). This stand is representative of similar riparian stands commonly found on cool, moist sites such as flat alluvial benches bordering streams and ponds at low to high elevations throughout the mountains of the HCP project area.

The South Lost Creek Riparian Stand (Figure 4.8-4) is located in the Swan River State Forest. This stand is a *Thuja plicata/Athyrium filix-femina* (western redcedar/lady fern) habitat type (Hansen et al.1995). The current stand is dominated by western redcedar and grand fir with lesser amounts of Douglas-fir, western larch, and western white pine. These types of stands are found on stream terraces at low to mid elevations in the northwest portion of the HCP project area.

Beaver Creek Riparian Stand

The Beaver Creek Riparian Stand is located in the Upper Willow Creek drainage on the Anaconda Unit. This stand is a *Abies lasiocarpa/Calamagrostis canadensis* (subalpine fir/bluejoint reedgrass) habitat type. The current stand is dominated by lodgepole pine established following a large stand replacement fire and several subsequent lower intensity burns. This stand is representative of a major type of riparian community found within the HCP Project Area at middle to high elevations throughout west-central Montana and east of the Continental Divide. It commonly occurs along subirrigated stream terraces, wet meadows and pond margins.





Site potential tree height of dominant and co-dominant species at 100 years = 74 ft.

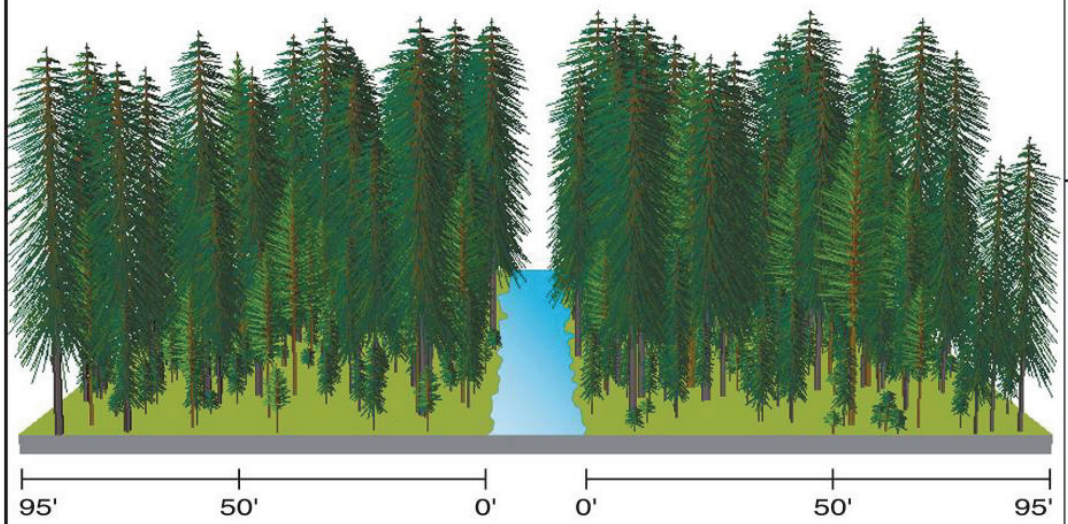
SUMMARY STAND DATA

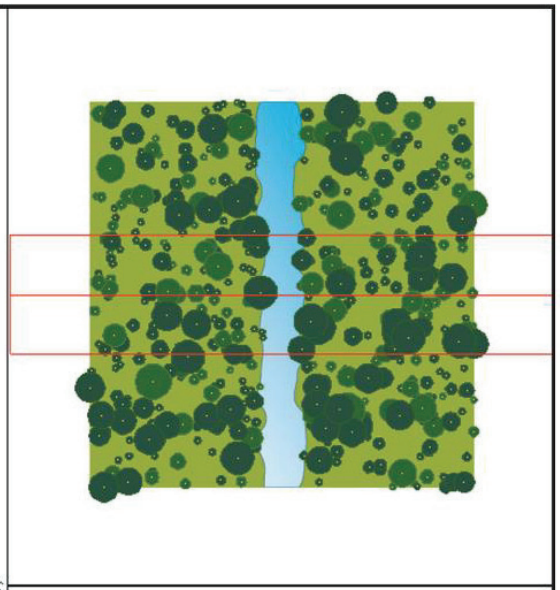
SPECIES	Trees per acre	Quadratic mean diameter (in.)	Basal area (sq. ft. / acre)
Douglas Fir	30	1.4	0.3
Lodgepole Pine	226	9.3	107.0
Spruce	44	15.4	56.7
Subalpine Fir	320	3.3	19.5
All Species	**620**	**7.4**	**183.5**

FIGURE 4.8-1. BEAVER CREEK RIPARIAN STAND DESCRIPTION

Gird Creek Riparian Stand

The Gird Creek Riparian Stand is located in the Bitterroot River drainage on the Hamilton Unit. This stand is a *Picea/Cornus stolonifera* (spruce/red-osier dogwood) habitat type. The current stand is dominated by Engelmann spruce with lesser amounts of Douglas-fir. This stand is representative of a major type of riparian community found on flat alluvial benches and terraces bordering streams at low to middle elevations in the west-central portion of the HCP Project Area.





Site potential tree height of dominant and co-dominant species at 100 years = 119 ft.

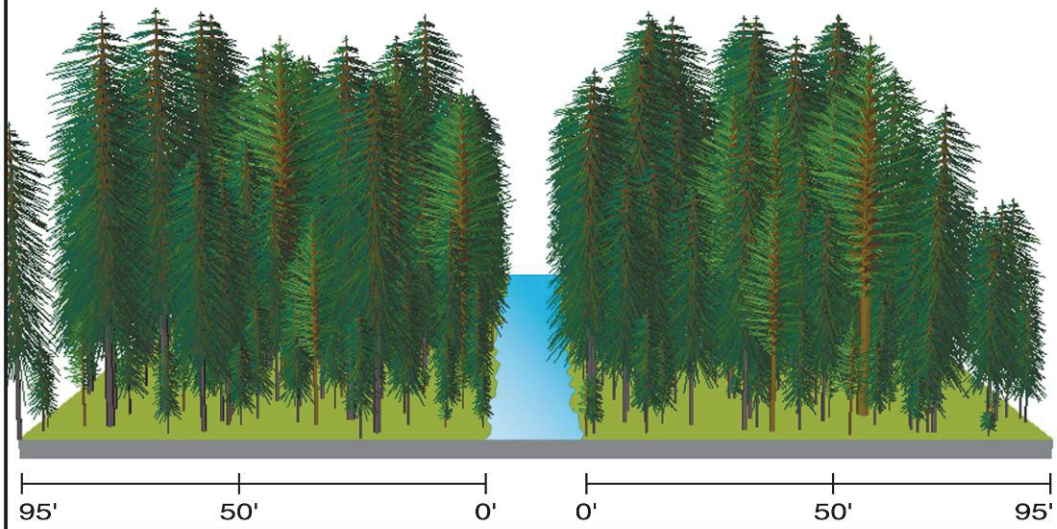
SUMMARY STAND DATA

SPECIES	Trees per acre	Quadratic mean diameter (in.)	Basal area (sq. ft. / acre)
Douglas Fir	178	6.1	36.4
Spruce	377	7.3	109.0
All Species	**555**	**6.9**	**145.4**

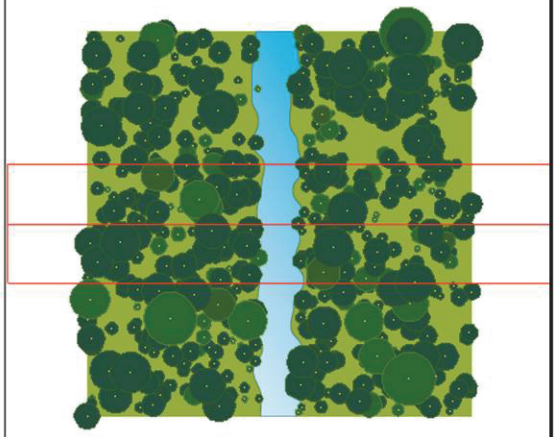
FIGURE 4.8-2. GIRD CREEK RIPARIAN STAND DESCRIPTION

Dingley Creek Riparian Stand

The Dingley Creek Riparian Stand is located in the Grasshopper Creek drainage on the Dillon Unit. This stand is a *Picea/Calamagrostis canadensis* (spruce/bluejoint reedgrass) habitat type and is considered a late seral stage of the *Abies lasiocarpa/Calamagrostis canadensis* (subalpine fir/bluejoint reedgrass) habitat type. The stand is representative of similar riparian stands commonly found on cool, moist sites, such as flat alluvial benches bordering streams and ponds at low to high elevations throughout the mountains of the HCP Project Area.



SUMMARY STAND DATA			
SPECIES	Trees per acre	Quadratic mean diameter (in.)	Basal area (sq. ft. / acre)
Douglas Fir	130	8.0	45.5
Lodgepole Pine	8	12.3	6.6
Spruce	516	7.4	155.4
All Species	**654**	**7.6**	**207.5**

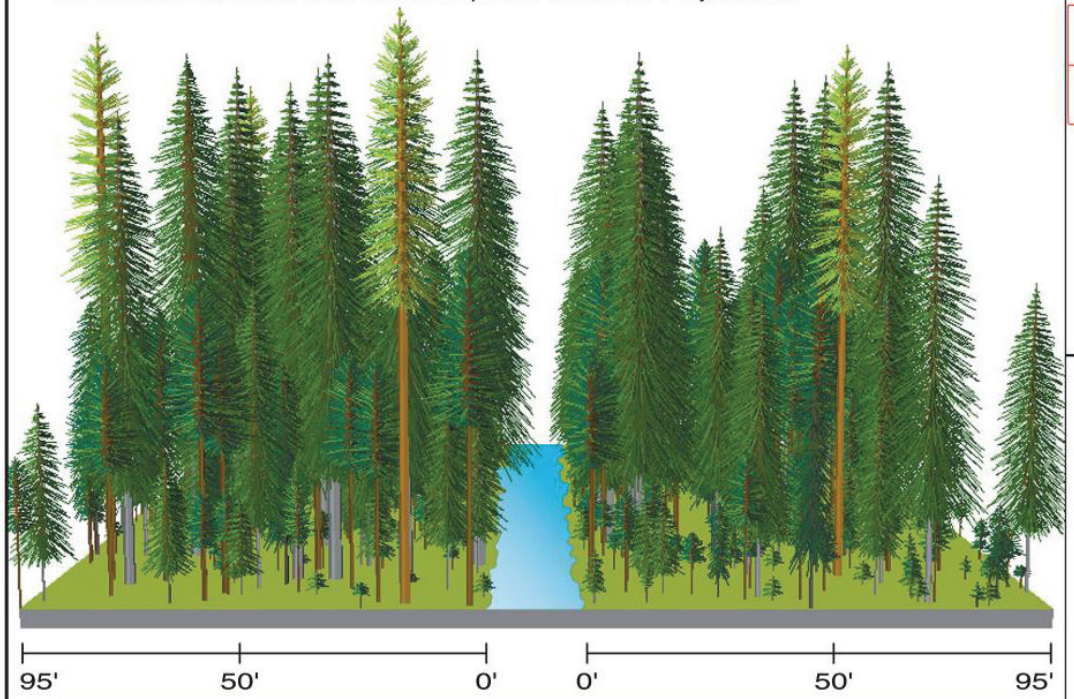


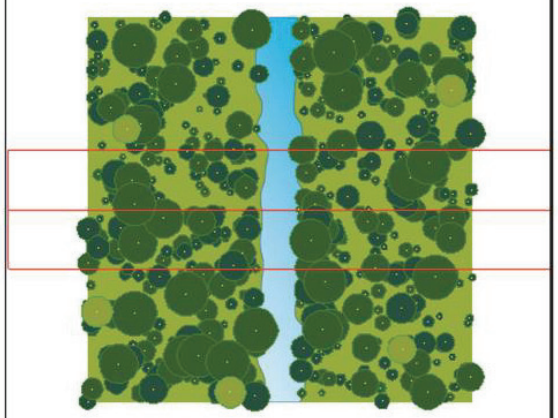
Site potential tree height of dominant and co-dominant species at 100 years = 88 ft.

FIGURE 4.8-3. DINGLEY CREEK RIPARIAN STAND DESCRIPTION

South Lost Creek Riparian Stand

The South Lost Creek Riparian Stand is located in the Swan River State Forest. This stand is a *Thuja plicata/Athyrium filix-femina* (western red cedar/lady fern) habitat type. The current stand is dominated by western red cedar and grand fir with lesser amounts of Douglas-fir, western larch and western white pine. These types of stands are found on stream terraces at low to middle elevations in the northwest portion of the HCP Project Area.





Site potential tree height of dominant and co-dominant species at 100 years = 117 ft.

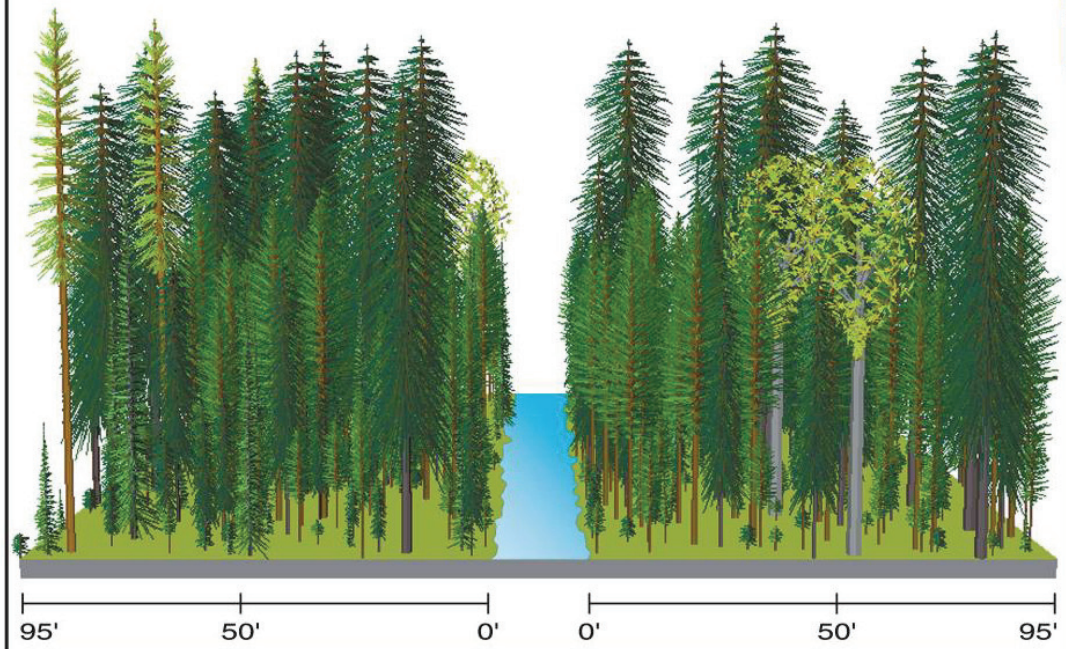
SUMMARY STAND DATA

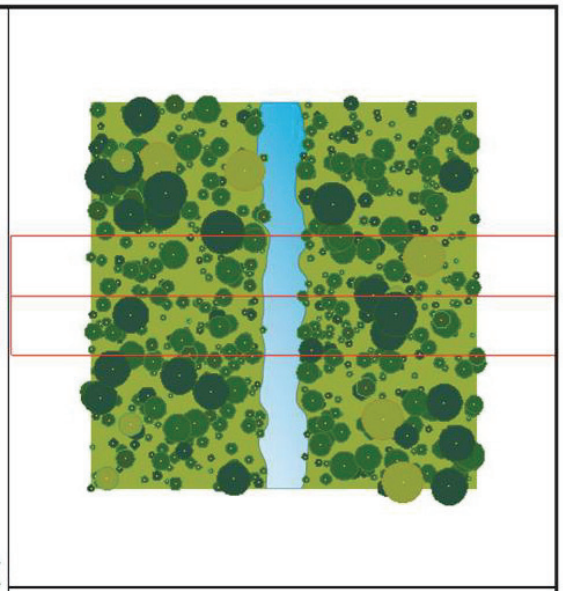
SPECIES	Trees per acre	Quadratic mean diameter (in.)	Basal area (sq. ft. / acre)
Western Red Cedar	254	10.4	150.2
Douglas Fir	20	2.2	0.5
Grand Fir	308	4.8	39.2
Spruce	28	3.5	1.9
Western Larch	8	22.6	22.4
Western White Pine	10	0.0	0.0
All Species	**628**	**7.9**	**214.2**

FIGURE 4.8-4. SOUTH LOST CREEK RIPARIAN STAND DESCRIPTION

Swede Creek Riparian Stand

The Swede Creek Riparian Stand is located in the Swift Creek drainage in the Stillwater State Forest. This stand is a *Abies lasiocarpa/Streptopus amplexifolius* (subalpine fir/twisted stalk) habitat type. The current stand is dominated by spruce and Douglas-fir with lesser amounts of subalpine fir, western larch and black cottonwood. This stand is representative of a common riparian community found along small streams and subirrigated alluvial terraces at middle elevations in the northwest portion of the HCP Project Area.





Site potential tree height of dominant and co-dominant species at 100 years = 111 ft.

SUMMARY STAND DATA

SPECIES	Trees per acre	Quadratic mean diameter (in.)	Basal area (sq. ft. / acre)
Black Cottonwood	5	35.0	33.4
Douglas Fir	440	5.4	69.5
Spruce	218	10.5	132.2
Subalpine Fir	99	5.0	13.5
Western Larch	5	16.0	7.0
All Species	**767**	**7.8**	**255.6**

FIGURE 4.8-5. SWEDE CREEK RIPARIAN STAND DESCRIPTION

The Swede Creek Riparian Stand (Figure 4.8-5) is located in the Swift Creek drainage on the Stillwater State Forest. This stand is an *Abies lasiocarpa /Streptopus amplexifolius* (subalpine fir/twisted stalk) habitat type (Hansen et al.1995). The current stand is dominated by spruce and Douglas-fir with lesser amounts of subalpine fir, western larch, and black cottonwood. This stand is representative of a common type of riparian community found along small streams and sub-irrigated alluvial terraces at mid elevations in northwest portion of the HCP project area.

DNRC currently has scant existing data on current LWD loading in HCP project area streams. Furthermore, the data that DNRC does have is for streams within the Stillwater and Swan River State Forests in the NWLO. These data indicate that within these areas the current LWD frequency for Rosgen Type A, B, and C channels is 86, 85, and 70 pieces per 1,000 feet, respectively. However, LWD loading is a primarily a function of stand type and age, which vary throughout the physiographic regions that encompass the HCP project area. Therefore, in order to estimate the appropriate in-stream LWD loading for each of the five representative stand types, the LWD data from streams on trust land managed for forest harvest were compared to USFS LWD loading data for streams on five national forests representing areas that are not managed for timber harvest. These data indicate that overall, DNRC streams in reaches with adjacent timber harvest have 44, 69, and 100 percent as much in-stream LWD as streams on geographically similar unmanaged USFS ownership for Rosgen Type A, B, and C channels, respectively. Applying these ratios to the USFS dataset yields an approximation of the current in-stream LWD frequencies within the five representative stand types (Table 4.8-10).

TABLE 4.8-10. ESTIMATED EXISTING LWD LOADING RATES (PIECES PER 1,000 FEET) FOR THE FIVE REPRESENTATIVE STAND TYPES

	Rosgen Channel Type		
Tree List	**A**	**B**	**Other (C, D, F, G)**
Beaver Creek	32	35	43
South Lost Creek	87	85	61
Dingley Creek	32	35	43
Gird Creek	32	44	44
Swede Creek	87	85	61

Source: DNRC (2008g).

4.8.2.3 Stream Temperature and Shading

Daily and seasonal water temperatures are influenced by elevation, shade, water sources, streamflow, stream velocity, surface area, depth, undercut embankments, organic debris, and surface and ground water inflow (Allen 1995). However, there is not always a consistent link or interaction between these factors. For example, although the State of Idaho (IDL 2000) established a linear relationship between canopy cover, site elevation, and stream temperature, this relationship tended to overestimate stream temperatures at higher elevations and underestimate temperatures at lower elevations. Such inconsistencies are typically the result of local groundwater and climate (microclimates) conditions, which are influenced largely by geology, air temperature patterns, elevation, wind, and humidity.

Although canopy closure is one contributor to stream shading, there are other factors including the latitude of the stream, stream geomorphology, local topography, and stream channel orientation. It is possible to have a stream that is almost entirely shaded, with a canopy cover of zero, if the stream is located within a steep-walled canyon with no riparian vegetation while a wide stream oriented from north to south may have a high degree of canopy cover and relatively low levels of stream shading.

While natural climatic variations result in daily, seasonal, and annual changes in stream temperature, habitat alterations and land use characteristics can increase the magnitude of these natural variations. In response to natural climatic variations, the magnitude of water temperature fluctuations is affected by riparian condition, stream size, and water volume. As a result, temperature variations tend to be greatest in small streams during low-flow periods, particularly where riparian shade is limited. Reductions in riparian vegetation can result in increased stream temperatures during the summer from increased solar radiation reaching the water surface, but decreased temperatures in the winter due to the reduced insulating capacity of the riparian zone.

The effectiveness of riparian vegetation to provide adequate shade generally depends on the structure and species composition of the riparian vegetation zone. Brown (1971) noted that on very small streams, adequate shade may be provided by brush species. However, brush species provide increasingly less benefits as stream size increases. Taller vegetation is required to provide adequate shade for larger rivers and streams. Riparian species composition also affects the regulation of stream temperature. While deciduous riparian vegetation might provide adequate shade in the summer, the winter insulating capacity might be reduced as a result of leaf loss in the fall.

The size of the riparian buffer might also appear to affect stream temperature regulation effectiveness. Dent and Walsh (1997) found that as stream buffer width increased, 7-day maximum and average stream temperatures decreased. Johnson and Ryba (1992) recommend a buffer width of from 30 to 100 feet to protect stream temperature in forested areas, and Gomi et al. (2003) found that water temperature in the streams with a 33-foot or a 100-foot buffer did not exhibit statistically significant warming. However, Sugden and Steiner (2003) found that existing Montana SMZ regulations adequately protect stream temperature at 10 western Montana sites, even though the regulations allow for timber harvest to be near the stream banks, as long as retention trees and trees that offer bank protection are left in place.

Importance of Stream Temperature and Shading to Fish

Stream temperature influences the behavior, growth, metabolism, and habitat utilization of fish and other aquatic organisms. Most fish have specific suitable and preferred water temperature ranges, and exhibit distinct responses to increasing or decreasing water temperatures within and outside of these preferred ranges. In general, decreasing water temperatures result in decreased feeding and metabolic rates, and a corresponding decrease in growth. In contrast, increasing temperatures tend to result in an increase in all three of these rates (assuming there is an adequate food supply). However, growth is substantially reduced near either end of the suitable temperature range, either because the metabolic rate is too low at low temperatures or all available energy is used for maintenance at high temperatures.

Trout and other cold-water fish species tend to have narrower overall suitable temperature ranges, as well as narrow preferred temperature ranges, than warm- or cool-water species. Thus, they are typically sensitive to relatively small temperature changes. They can exhibit behavioral or habitat utilization changes as a result of increasing or decreasing temperature patterns (Bjornn and Reiser 1991), although in many cases such behavioral changes may have a greater association with overall seasonal changes than just temperature. In particular, freshwater salmonids often change habitats or behavior between summer and winter. While temperature is likely an important factor, other influential parameters likely include changes in streamflow, food availability, and day length.

Water temperature also influences egg incubation rates and the corresponding fry emergence timing. Depending on their extent, such changes could affect fry survival rates either positively or negatively. For example, changes in emergence timing might subject fry to environmental conditions (i.e., flow conditions) that increase or decrease survival, or to different competition or predation forces. In more extreme conditions, water temperature can affect the available fish rearing habitat. Decreased temperatures in the winter can result in deeper and longer ice-over conditions, while warmer summer temperatures can exclude some fish species from using a particular habitat area.

DNRC Activities Potentially Affecting Stream Temperature and Shading

Land use activities that alter the physical stream and riparian parameters can affect stream temperature and the corresponding distribution and viability of aquatic organisms, particularly for temperature-sensitive fish species. Temperature effects primarily result from the alteration of the microclimate in the riparian zone. Of the principle microclimate influencing factors, canopy cover, humidity, and wind conditions are most likely to be affected by riparian land use management. Some land use and land management activities known to influence water temperatures include: forest management practices, stream flow changes due to water discharge or diversion structures, construction and operation of reservoirs, grazing, and road density. These activities can have direct and indirect effects on stream temperature, but such effects can also vary seasonally.

Forest management practices include timber harvest activities located directly in the RMZ and in adjacent upland areas, as well as road building and maintenance activities. Livestock grazing activities also have the potential to directly affect riparian zone characteristics.

Timber harvest in the RMZ can have a substantial influence on stream temperature and other stream habitat conditions. Riparian trees moderate river and stream microclimate conditions, including stream temperature, by providing shade during warm weather conditions to reduce solar warming effects, and also reducing heat loss during cold weather conditions. This is particularly true for smaller streams, where greater stream surface areas could be affected by the changes to the microclimate conditions. Trees and other riparian vegetation help stabilize the banks from erosion, thereby reducing channel enlargement forces and maintaining water depths.

In addition to the potential for streambank erosion, riparian vegetation removal can result in increased erosion of riparian soils and increased sediment loading to the stream. Riparian vegetation also slows surface water runoff, potentially trapping sediments entrained in the runoff flows and increasing the potential infiltration and groundwater recharge rates on the area. Not only does this improve stream water quality and flow conditions during runoff periods, the subsequent

discharge of groundwater results in higher flows and lower water temperatures during the natural low-flow periods. The removal of riparian vegetation can also result in increased soil compaction, which can also reduce water infiltration rates. Riparian harvest also reduces an important source of LWD to the stream.

Upland harvest activities typically have less impact to stream temperature than riparian harvest activities because they typically have little or no effect on shade and microhabitat conditions within the riparian zone. However, they can influence the amount and rate of groundwater recharge and surface water runoff. The building, use, and maintenance of forest roads also typically have limited influence on stream temperature, except for road-related activities in the riparian zone.

The volume and sources of stream inflow also influence stream temperature in several ways. The water volumes associated with high runoff periods result in greater water depths and faster flows, which help to minimize the effects of solar warming. Under such conditions, the effects of riparian cover condition (i.e., percent and density of canopy cover) might have limited influence. However, during low-flow conditions resulting from either natural runoff variations or man-made storage and diversion facilities, the effects of shade and stream velocities are likely greater. The influence of groundwater inflow during low-flow conditions is also expected to be greatest during low-flow conditions.

Livestock grazing can also affect stream temperatures over time because of the loss of riparian vegetation, compaction of riparian soils, and the trend toward wider stream channels in areas used for grazing. The wider stream channels are caused by the destabilized stream banks, and result in a decrease in water depth and increase the surface area influenced by solar energy and other microclimate conditions.

Existing Stream Temperature and Shading in the HCP Project Area

Little data exist regarding existing stream temperature regimes or stream shade in the HCP project area. Therefore, to estimate the amount of shade provided by various stands of mature forest, a shade model was used to compare the shade levels provided by the five representative stand types. The shade model was adapted to the riparian aquatic interaction simulator (RAIS) constructed by Welty et al. (2002). Based on a riparian tree list, the shade model predicts total shade (percent blocking solar radiation) provided the stream by the riparian vegetation.

This model estimates the percent of the total solar radiation blocked from reaching the stream over a discrete time period. Percent blocking solar radiation is influenced by slope steepness, vegetation species composition, tree height, vegetation density, tree distance from the stream bank, and stream width. Although riparian vegetation is a physical barrier between the stream and incoming solar radiation, only a portion of the riparian canopy effectively contributes to shade. Model assumption and inputs are discussed in Section 4.8.2.2 (Habitat Complexity).

Because Rosgen A and B channels have substantially narrower wetted channels than Rosgen C, D, and E channels, the riparian canopy has a greater influence on the stream temperatures than it does on streams and rivers with large wetted widths, where upstream conditions generally control stream temperatures. The relationship between channel width and shade potential is shown in Table 4.8-11, which indicates the predicted shade levels of the five representative stand types. In

addition, this table shows high shade levels for all stand types in A and B channels, which generally represent spawning and rearing reaches for HCP aquatic species. Based on these results, stream temperatures on most HCP project area lands would be expected to be within the range to support native salmonids. The model outputs data from Washington State (Washington State TFW 1990), which indicate that a minimum post-harvest stream shading level of 45 percent (700-meter [2,297-foot] elevation stands) to 70 percent (300-meter [984-foot] elevation stands) is generally adequate to ensure these stream reaches meet Washington State water quality parameters for salmonids. Other studies relate an estimation of canopy closure to the relationship between stream temperatures, elevation, and shading (IDL 2000).

TABLE 4.8-11. ESTIMATED EXISTING SHADING (PERCENT BLOCKING SOLAR RADIATION) FOR THE FIVE REPRESENTATIVE STAND TYPES

	Rosgen Channel Type		
Tree List	**A**	**B**	**Other (C, D, F, G)**
Beaver Creek	90	79	46
South Lost Creek	94	87	58
Dingley Creek	91	78	41
Gird Creek	75	64	31
Swede Creek	96	88	55

Source: Teply (2007).

4.8.2.4 Connectivity

Connectivity typically refers to providing or maintaining the opportunity for fish to move upstream and downstream within, as well as between, streams and/or watersheds at various times of the year. Although maintaining adequate connectivity conditions is also typically considered to be positive for maintaining viable fish populations, there are some circumstances where specific barriers to this movement should remain. Therefore, connectivity becomes a larger task related to fish population management.

Importance of Connectivity to Fish

Although habitat connectivity is important for many fish species, it is particularly important to migratory fish species. Species that utilize or require uniquely different habitat characteristics for various life stages are prone to substantial impacts if access to these habitat areas is blocked or restricted. For example, salmonids typically occupy different habitats for spawning, juvenile rearing, and adult rearing. Sometimes these habitat requirements necessitate the movement of fish between a lake environment and a riverine environment. The blockage of fish from any of these habitats could lead to unsuccessful spawning, increased predation, or reduced growth or survival rates.

In addition to these regular life history requirements, accessibility of different habitats can protect fish populations from unusual or catastrophic events. For example, allowing fish to move to larger waterbodies during severe drought conditions, or to avoid excessive temperature increases after the

destruction of riparian vegetation by fire might encourage survival. This function allows fish to leave their preferred habitat for short periods of time, but return or re-populate the area when appropriate habitat conditions return. Connectivity also facilitates fish species to maintain the genetic integrity to adapt to changing environmental conditions.

In addition to protecting fish populations by allowing the migration or movement between various habitats, protection can also be provided by blocking migration and movement of other fish species (particularly invasive, non-native species). For example, eastern brook trout are known to hybridize, compete with, and even prey upon bull trout. Maintaining a barrier to prevent the movement of brook trout into a stream reach occupied by bull trout populations can be an effective method of protecting bull trout populations from these potential impacts.

DNRC Activities Potentially Affecting Connectivity

The primary DNRC activity affecting connectivity is related to road construction, operation, and maintenance at stream crossings. In these situations, improperly designed or inadequately maintained road-crossing culverts are typically the most universal threat to adequate connectivity in the project area. Design features important for fish passage effectiveness include the size, shape, and slope of the culvert, as well as the stream channel characteristics at the road crossing. Excessive erosion or landslides caused by poorly designed roads or culverts can also result in connectivity blockages, although these tend to be temporary.

Existing Connectivity Conditions in the HCP Project Area

There are an estimated total of 106 fish passage culvert barriers within the HCP project area, classified into four HCP priority levels (Figure D-9 in Appendix D, EIS Figures). The priority levels are based on the occurrence and genetic integrity of HCP fish species in the culvert barrier streams. The priority levels are based on culverts that block fish access to

- **Priority 1**. Habitat supporting any bull trout life stage
- **Priority 2**. Habitat supporting 100 percent, genetically pure, westslope cutthroat trout or Columbia redband trout
- **Priority 3**. Habitat supporting westslope cutthroat trout or Columbia redband trout of unknown genetic purity
- **Priority 4**. Habitat supporting 80 to 99 percent, genetically pure, westslope cutthroat trout or Columbia redband trout.

Within the HCP project area, there are three Priority 2 barriers, 99 Priority 3 barriers, and four Priority 4 barriers (Table 4.8-12). However, there are no Priority 1 barriers identified in the HCP project area. Priority 2 culvert barriers occur only in the Middle Clark Fork and Upper Missouri aquatic analysis units, blocking a total of about 11 miles of stream habitat. Most of the barriers are conservatively classified as Priority 3, primarily because of insufficient genetic information to classify them. Culvert barriers are also further classified within each priority level to address the various degrees of fish passage blockage.

TABLE 4.8-12. DNRC FISH PASSAGE INVENTORY RESULTS BY EIS AQUATIC ANALYSIS UNIT FOR CULVERTS IN THE HCP PROJECT AREA

EIS Aquatic Analysis Unit	Identified Fish Passage Barriers	Stream Miles Upstream of Identified Fish Barriers	Priority 1 Fish Barriers	Stream Miles Upstream of Priority 1 Barriers	Priority 2 Fish Barriers	Stream Miles Upstream of Priority 2 Barriers	Priority 3 Fish Barriers	Stream Miles Upstream of Priority 3 Barriers	Priority 4 Fish Barriers	Stream Miles Upstream of Priority 4 Barriers
Bitterroot	3	3.2	0	0.0	0	0.0	3	3.2	0	0.0
Blackfoot	10	20.3	0	0.0	0	0.0	8	19.8	2	0.4
Flathead Lake	2	2.1	0	0.0	0	0.0	1	1.3	1	0.8
Lower Clark Fork	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Lower Kootenai	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Middle Clark Fork	15	45.2	0	0.0	2	9.5	13	35.7	0	0.0
Middle Kootenai	3	5.8	0	0.0	0	0.0	3	5.8	0	0.0
North Fork Flathead	8	8.5	0	0.0	0	0.0	8	8.5	0	0.0
Rock Creek	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Stillwater	49	41.3	0	0.0	0	0.0	48	37.5	1	3.7
Swan	8	7.3	0	0.0	0	0.0	8	7.3	0	0.0
Upper Clark Fork	3	6.1	0	0.0	0	0.0	3	6.1	0	0.0
Upper Kootenai	3	6.2	0	0.0	0	0.0	3	6.2	0	0.0
Upper Missouri	2	3.9	0	0.0	1	1.4	1	2.4	0	0.0
TOTAL	**106**	**149.9**	**0**	**0.0**	**3**	**11.0**	**99**	**134.0**	**4**	**4.9**

Source: DNRC (2006h).

Seventy-four (70 percent) of the 106 identified culvert barriers in the HCP project area occur in the Stillwater (49), Middle Clark Fork (15), and Blackfoot (10) aquatic analysis units. These three analysis units also contain about 71 percent of the almost 150 miles of stream habitat blocked by barriers within the HCP project area (Table 4.8-12). With the exception of three analysis units with no identified barriers (Lower Clark Fork, Lower Kootenai, and Rock Creek analysis units), the other analysis units contain between two and eight barriers, which block between 2.1 and 8.5 miles of stream.

4.8.2.5 Other Habitat Factors

In addition to the specific habitat factors listed in the previous sections, a number of other factors can affect the HCP fish species or their habitat in the HCP project area. These include turbidity and other water quality parameters, nutrient and contaminant loading, organic material input, the introduction of non-native species, and fishing pressure. Many of these other factors tend to be specific components of the primary habitat considerations in the HCP (as addressed in the previous sections), or represent a different magnitude of occurrence. For example, sedimentation is one of the primary habitat considerations addressed in the HCP (see Section 4.8.2.1, Sediment), and refers to sediment loading levels that result in substantial alteration of the physical stream habitat (e.g., alter substrate characteristics, filling of pools, etc.). However, increased turbidity also occurs as a result of increased sediment loading, but often represents a lower magnitude of effects. Thus, a number of these other habitat factors are influenced by the same land use activities as the primary habitat considerations. Similarly, while these other habitat factors are influenced by the covered activities, they are also affected by activities such as agricultural practices, mining, residential development, and water diversion facilities.

Agricultural practices primarily affect water quality parameters, such as turbidity and pollutant and/or nutrient loading to the area streams. Increased nutrient loading can also indirectly reduce dissolved oxygen levels. Agricultural practices can result in the removal of riparian vegetation, potentially reducing the input of organic material to the stream, increasing temperatures, and sediment loading. Mining practices have the potential to substantially impact fish populations through contaminant and sediment loading.

While residential and commercial development can also affect water quality conditions, there are no substantial development areas within the HCP project area. Water diversion facilities have the potential to affect fish and their habitat in a number of different ways, including blocking the movement of fish (see Section 4.8.2.1, Sediment, under Existing Sediment Conditions in the HCP Project Area). Diversions reduce in-stream flow volumes, thereby potentially increasing or decreasing water temperatures, depending on the time of year. They can also trap gravel, thereby reducing or eliminating gravel recruitment to downstream areas. Storage reservoirs have similar effects, but can also alter the flow regime at various times of the year, resulting in the modification of habitat availability and quality. Storage reservoirs can also substantially change downstream water temperatures, depending on the reservoir size.

<u>Importance of Other Habitat Factors to Fish</u>

All of the above-mentioned habitat factors have the potential to directly or indirectly affect fish. These habitat factors are also influenced by the same land use activities, and in a similar manner as the primary HCP habitat considerations. Using the turbidity example again, the relatively low sediment loading levels typically considered under the turbidity parameter might affect the

physiological and behavioral characteristics of fish by causing respiratory impairment (e.g., gill abrasion), reducing foraging success and associated growth rates, increasing predation rates, and affecting their distribution. While these sediment loading levels are not expected to substantially change the overall sediment characteristic of the stream, they might be sufficient to cause enough accumulation of fine sediment in fish spawning areas to cause increased embryo mortality by reducing inter-gravel water exchange rates.

DNRC Activities Potentially Affecting Other Habitat Factors

Although mining activities are excluded from the HCP, some road building and maintenance activities, such as local gravel mining operations for use on forest road surfaces, have been included in the HCP. These covered activities could lead to increased sediment loading to area streams from the road surface or the borrow area.

Existing Conditions of Other Habitat Factors in the HCP Project Area

The existing conditions of HCP project area streams in regard to water quality, including turbidity, nutrients, and contaminant loading are discussed in Section 4.6 (Water Resources). Fishing pressure, although generally not considered a substantial impact to HCP aquatic species, is discussed in Section 4.10 (Recreation).

Historically, the introduction of non-native species into some streams and rivers within the planning area and HCP project area has occurred. In most cases, these introductions have occurred to increase the number and/or distribution of sport fish species (i.e., eastern brook trout, smallmouth bass). These introductions have occurred through both the actions of fish management agencies, such as MFWP, and through the actions of members of the general public. In certain cases, fish passage barriers can act in a positive way to isolate genetically "pure" populations of native fish from non-native populations, as discussed in above (Section 4.8.2.4, Connectivity).

4.8.2.6 Cumulative Watershed Effects

Cumulative effects are the collective impacts on the human environment of a proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (MCA 75-1-220). Thus, CWE represent the collective aquatic impacts specifically affecting watershed resource features. Such features include: water yield, flow regimes, channel stability, and in-stream and upland sedimentation due to surface erosion and mass wasting. CWE also refers to existing watershed conditions, relative to additional risks associated with land use management activities on specific in-stream habitat elements, including temperature, sedimentation, and habitat complexity.

Analyzing CWE is not a new idea, and the concept has been part of the management philosophy of forested trust lands since the early 1980s. With respect to forested trust lands, however, CWE are exceedingly difficult to measure because the actions affecting watershed resources occur across multiple land ownerships, are temporally and spatially complex, and are typically problematic to accurately inventory and evaluate.

ARM 36.11.423 requires DNRC to assess CWE when substantial vegetation removal or ground disturbance is anticipated from proposed actions on forested trust lands. MEPA also requires DNRC to assess cumulative effects as part of a review of potential impacts to the human environment. And as a signatory to the *Montana Cumulative Watershed Effects Cooperative Memorandum of Understanding*, DNRC has agreed to complete and share CWE analyses and data necessary to conduct CWE assessments with other cooperators.

Assessment results indicating a low potential for CWE, implies that a low likelihood of adverse CWE from a proposed action could be detected and foreseen by DNRC when considering past and present activities on all ownerships. Unacceptable CWE imply a high degree of risk that an adverse CWE of an action can be foreseen and detected by DNRC when considering past and present activities on all ownerships. Future actions are also considered when they are state-sponsored actions that are under concurrent consideration by any state agency through environmental analysis or permit processing procedures.

Importance of Cumulative Watershed Effects to Fish

CWE are important to the protection of fish populations because the effects of an individual action or activity might only result in an incrementally small change in habitat, but still have a substantial effect relative to the needs of a fish species. For example, a small increase in water temperature might result in little or no effect on fish when existing temperatures are in the middle of the tolerance range for the species. However, if the existing water temperatures are near the extreme of the tolerance range, the small additional change might result in exceeding the tolerance range.

Cumulative effects can also include impacts to limited habitat features. If previous activities have resulted in a substantial decrease in an ecologically important habitat, any additional impacts (however small) can have a substantial effect of fish species dependent on that habitat.

Existing Cumulative Watershed Effects in the HCP Project Area

For the 2004 DNRC SYC, DNRC identified all forested parcels that were located in watersheds that DNRC considered "sensitive." Stands located within these parcels were assigned the status of "sensitive." Sensitive watersheds were those watersheds where future DNRC harvest activities are likely to be constrained by existing or the potential for CWE. CWE of concerns were primarily related to the potential for increased water yields and increased magnitude and duration of peak flows. Harvests of stands located in sensitive watersheds were constrained in the forest management model for the 2004 SYC so that no more than 25 percent of the acres could be less than 40 years old at any point in time.

The sensitive watersheds were identified through a coarse-filter process that primarily relied on the knowledge of DNRC forest management program hydrologists. Criteria used to identify parcels likely to be constrained by CWE include (1) documented CWE concerns (from previous DNRC project analysis, existing or ongoing TMDLs or 303(d) listing), (2) watersheds with high levels timber harvest or stand-replacement fire, (3) watersheds in which a majority of the ownership is industrial timberland, and (4) municipal watersheds. Conversely, watersheds were also eliminated from consideration as being classified as sensitive if there were offsetting reasons thought to reduce the risks of future CWE constraints on DNRC timber harvest. These criteria included (1) forested

stands located in watersheds whose area is dominated by non-forest rangeland, (2) areas that are drained by ephemeral or discontinuous drainage features, (3) those areas with no surface drainage features such as terraces on large rivers, or (4) those watersheds were recent project-level analysis had demonstrated low risk of CWE.

There are currently 225 sensitive parcels within classified forest trust lands in the HCP project area, encompassing about 109,155 acres or approximately 19.9 percent of HCP project area acres (Table 4.8-13; Figures D-10A through D-10C in Appendix D, EIS Figures). The Stillwater aquatic analysis unit has more sensitive parcels (71 parcels) than any other analysis unit, and nearly 36 percent of all the sensitive parcel area in the HCP project area. Four other analysis units (Bitterroot, Blackfoot, North Fork Flathead, and Swan) each contain between 10 and 15 percent of the acres of HCP project area sensitive parcels, totaling about 52 percent of the total sensitive parcel area. The other nine analysis units each contain less than five percent of the sensitive parcels, totaling about 13 percent of the sensitive parcel acres in the HCP project area.

Of the estimated 109,155 acres of sensitive parcels in the HCP project area, about 107,617 acres (99 percent) occur in basins occupied by westslope cutthroat trout and 101,510 acres (93 percent) by bull trout (Table 4.8-13). There is a limited distribution of Columbia redband trout in the project area. Therefore, only 2,145 acres (2 percent) of the sensitive parcels occur in basins occupied by Columbia redband trout (Middle and Upper Kootenai aquatic analysis units). The Stillwater aquatic analysis unit contains about 38 and 36 percent of the total sensitive parcel acres occupied by bull trout and westslope cutthroat trout, respectively.

There are a total of about 1,578 miles of streams in the HCP project area (see Table E4-4 in Appendix E, EIS Tables), although only about 374 (24 percent) of these stream miles occur within sensitive parcels (Table 4.8-14). This is also similar to the proportion of sensitive parcel area (20 percent) within the HCP project area (Table 4.8-13). About 33 percent (123 miles) of the sensitive area stream miles occur in the Stillwater analysis unit. An additional 55 percent of the sensitive parcel stream miles occur in four other aquatic analysis units (Bitterroot, Blackfoot, North Fork Flathead, and Swan), each containing between about 42 and 67 stream miles.

Although a total of about 451 miles (29 percent) of HCP project area stream habitat supports at least one HCP fish species (see Table E4-4 in Appendix E, EIS Tables), about 36 percent (162 miles) of this HCP fish habitat occurs in sensitive parcels (see Table 4.8-14). While westslope cutthroat trout occur in nearly all of these sensitive area stream miles (162.3 miles), bull trout occur in about 88 percent of these areas (143.6 miles). However, only 1.2 miles of known Columbia redband trout habitat occur in the sensitive area parcels in the HCP project area.

4.8.3 AFFECTED ENVIRONMENT - FISH RESOURCES

There are about 86 species of fish known to occur in Montana, including 30 introduced or non-native species. Extensive information concerning the distribution of these fish species is available through the Montana Natural Resource Information System (NRIS) internet database (Montana NRIS 2005). While some of these species occur over a wide area of the state, others have relatively limited distributions. These variable distribution patterns occur because of the diverse habitat requirements of the different fish species. Some species have very specific habitat requirements or are physically confined to an area, resulting in limited statewide distributions, while others can

TABLE 4.8-13. DNRC SENSITIVE PARCELS IN THE HCP PROJECT AREA BY EIS AQUATIC ANALYSIS UNIT

EIS Aquatic Analysis Unit	Sensitive Parcels in the Project Area[1]	Acres of Sensitive Parcels	Percent of Total Sensitive Parcel Acres in the Project Area	Total Project Area (Acres)	Percent of Total Project Area Occurring in Sensitive Parcels by Aquatic Analysis Unit	Acres of Sensitive Parcels Within Bull Trout Habitat[2]	Acres of Sensitive Parcels Within westslope cutthroat trout Habitat[2]	Acres of Sensitive Parcels Within Columbia Redband Trout Habitat[2]	Acres of Sensitive Parcels Within HCP Fish Species Habitat[2]
Bitterroot	30	14,757	13.5	27,743	53.2	14,757	14,757	0	14,757
Blackfoot	32	13,477	12.3	56,528	23.8	10,710	12,837	0	12,837
Flathead Lake	4	2,230	2.0	10,470	21.3	0	2,230	0	2,230
Lower Clark Fork	0	0	0	4,185	0.0	0	0	0	0
Lower Kootenai	1	324	0.3	3,527	9.2	324	324	37	324
Middle Clark Fork	6	2,724	2.5	88,512	3.1	2,724	2,724	0	2,724
Middle Kootenai	4	2,500	2.3	28,767	8.7	2,498	2,500	1,855	2,500
North Fork Flathead	40	16,716	15.3	18,499	90.4	16,716	16,716	0	16,716
Rock Creek	1	476	0.4	4,592	10.4	476	476	0	476
Stillwater	71	38,860	35.6	87,321	44.5	38,860	38,074	0	38,860
Swan	19	11,291	10.3	44,613	25.3	11,291	11,291	0	11,291
Upper Clark Fork	12	5,189	4.8	47,173	11.0	2,543	5,077	0	5,189
Upper Kootenai	5	611	0.6	11,153	5.5	611	611	252	611
Upper Missouri	0	0	0.0	115,441	0.0	0	0	0	0
TOTAL	**225**	**109,155**	**100**	**548,525**	**19.9**	**101,510**	**107,617**	**2,145**	**108,515**

[1] Individual parcels were double counted if the parcel straddled two or more analysis units. The total number of unique sensitive parcels in the project area is 213 parcels.
[2] Defined as a sixth-order HUC with known HCP fish species present.
Source: DNRC (2008a).

TABLE 4.8-14. STREAM MILES AND FISH USE ON SENSITIVE PARCELS IN THE HCP PROJECT AREA

EIS Aquatic Analysis Unit	Total Stream Miles	Bull Trout	Westslope Cutthroat Trout	Columbia Redband Trout	One or More HCP Fish Species
Bitterroot	67.4	15.8	18.8	0.0	18.8
Blackfoot	42.8	7.5	14.2	0.0	14.2
Flathead Lake	7.7	0.0	3.0	0.0	3.0
Lower Clark Fork	0.0	0.0	0.0	0.0	0.0
Lower Kootenai	1.5	1.1	1.1	0.0	1.1
Middle Clark Fork	9.9	1.5	1.6	0.0	1.6
Middle Kootenai	9.7	2.3	2.7	1.2	2.7
North Fork Flathead	50.9	32.6	34.7	0.0	34.7
Rock Creek	1.3	0.1	0.1	0.0	0.1
Stillwater	123.2	61.1	61.0	0.0	61.1
Swan	42.8	19.9	21.6	0.0	21.6
Upper Clark Fork	14.1	0.3	2.0	0.0	2.0
Upper Kootenai	2.4	1.3	1.3	0.0	1.3
Upper Missouri	0.0	0.0	0.0	0.0	0.0
TOTAL	**373.5**	**143.5**	**162.2**	**1.2**	**162.3**

Source: DNRC (2008a).

tolerate a wider range of habitat conditions and have a correspondingly wider distribution. For example, the distributions of Kootenai River white sturgeon and torrent sculpin occur only in limited areas in the Kootenai River drainage. In contrast, rainbow trout have an extensive distribution within the HCP project and planning areas, because they can occupy a wide range of habitats and habitat conditions and are extensively stocked through the state hatchery program.

Fish resources are supported by river, stream, lake, and pond habitat, which includes the physical and chemical characteristics of both aquatic and associated upland habitats. However, these habitats (and associated fish communities) typically extend past the boundaries of individual land parcels, such that fish resources are typically categorized and/or quantified by individual watersheds or waterbodies rather than land ownership. The dispersed distribution of state-owned lands also results in fragmented ownership within these fish habitat areas, as well as a majority of the available fish habitat occurring on non-state-owned lands. Such fragmentation reduces the ability to coordinate the management of watershed- or landscape-scale protection programs, resulting in potentially inconsistent or incompatible land use practices within individual watersheds. This might reduce the efficiency and effectiveness of protection and conservation efforts within watersheds.

Because there is generally limited quantifiable information on fish population parameters throughout most of the state, it is more efficient and accurate to assess the effects of land use activities on specific habitat characteristics than on fish population parameters. Water quality parameters are frequently used as indicators of overall fish habitat quality, and can be systematically used over a wide range of habitat types. Water quality also indicates the health of the overall ecosystem, reflects land use activities, and generally responds quickly to changes in such activities.

In addition, some water quality standards are established specifically to meet fish habitat requirements, as in ARM 16.20.618 stipulating that "water quality must be suitable for propagation of salmonid fishes and associated aquatic life." Therefore, water quality protection through land use and watershed management activities directly protects fish and their habitat.

Land use activities such as agriculture, timber harvest, livestock grazing, residential and industrial development, and resource extraction (mining) can directly affect water quality and fish habitat through changes in runoff conditions. Such changes include increased runoff volumes and/or increased sediment, nutrient, and contaminant loading to rivers, streams, and lakes. Other land use activities affect fish resources by altering water quantity parameters through reservoir operations and water diversion systems. These changes can have both immediate and long-term impacts to fish resources and their habitat. Land use activities can also indirectly affect water quality and fish habitat through associated activities such as road construction and maintenance, irrigation practices, and non-point source water pollution activities.

In the simplest terms, the statewide distribution of fish can be partitioned based on the predominant aquatic habitat characteristics. A typical partitioning process uses general fish categories based on general water quality requirements. These categories are referred to as cold-, cool-, and warm-water species. Use of such broad classifications allows a number of fish species, with similar habitat requirements and potentially similar or overlapping distributions, to be grouped to assess potential project effects. While the definition of cold-water species is relatively consistent in the literature, the distinction between warm- and cool-water species is very inconsistent. Therefore, only two fish classifications (cold- and warm-water) are used to assess general fish habitat requirements across the HCP and non-HCP landscape, with the warm-water classification including both warm- and cool-water fish species.

Because all the salmonid (trout) species require clear, cold-water habitats, their distribution represents that of cold-water fish habitat. Mountain whitefish is one of the most widely distributed and abundant salmonid species in Montana. As such, the distribution of mountain whitefish can be assumed to represent the current extent of cold-water fish habitat in the state (DNRC 1996). Thus, the assumed distribution of cold-water fish habitat occurs primarily in the western half of the state. This distribution also generally corresponds to the planning area, such that much of the planning area is considered to be cold-water fish habitat.

Similarly, the majority of the non-planning area is generally considered warm-water fish habitat. Representative warm-water species include largemouth bass and goldeye (DNRC 1996). Despite these overall classifications, some cold-water species also exhibit limited distributions in areas classified as warm-water habitat, and some warm-water species also occur in cold-water habitat areas.

Of the 86 Montana fish species, 66 are known to occur in the HCP project area (Table E4-5 in Appendix E, EIS Tables). However, these species are not uniformly distributed across the entire planning area, with 58 species in the CLO area, 36 species in the NWLO area, and 21 species occurring within the SWLO area. The differences between land offices generally reflect the type and range of available fish habitat, with the CLO area apparently containing substantially greater warm-water fish habitat than either of the other two land offices.

4.8.3.1 HCP Fish Species

Three native trout species are included as HCP species: Columbia redband trout, westslope cutthroat trout, and bull trout. While all three are classified as sensitive species in the state of Montana, and have experienced substantial population declines compared to historical levels, only bull trout are listed under the ESA.

For the purposes of characterizing the affected environment in the EIS, the primary basis for determining HCP fish species presence was the 2003 NRIS database, based on fish population surveys completed by MFWP, USFWS, or other land management agencies and entities (Figure D-11 in Appendix D, EIS Figures). However, because DNRC recognizes that the known distribution layer is incomplete, DNRC assumed fish presence within additional areas. In perennial streams with known presence of HCP fish species (from the NRIS database), the analyses assumed that the occupied area extended upstream to the end of the perennial reach and connected perennial tributaries. Therefore, the final fish distribution GIS layers used for the EIS analyses are conservative by including known and presumed fish distribution.

<u>Bull Trout</u>

Population Status and Distribution

The bull trout (*Salvelinus confluentus*) in the contiguous United States was listed as threatened on November 1, 1999 (64 FR 58910-58933). Early rulemakings had listed DPSs of bull trout as threatened in the Columbia River, Klamath River, and Jarbidge River basins (63 FR 31647-31674, June 10, 1998, 63 FR 42757-42762, August 11, 1998, 64 FR 17110-17125, April 8, 1999). Bull trout are also ranked as an S2 SOC (imperiled because of rarity or other factors, making it very vulnerable to extinction throughout its range) in Montana by MFWP and MNHP, and as a sensitive species by the USFS.

In addition to a range-wide recovery strategy for bull trout, the USFWS also developed a draft recovery plan for specific recovery units, describing habitat conditions, recovery objectives and criteria, and specific recovery tasks for particular recovery units (USFWS 2002a). The overall objective of recovery planning is to ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed across the species' native range so that the species can be de-listed.

MNHP data provide the best available information on bull trout distribution in Montana (Figures D-12A through D-12C in Appendix D, EIS Figures). However, due to sampling limitations and the low densities of smaller isolated populations, the data might under represent the true statewide distribution of bull trout in headwaters or isolated drainages.

Bull trout historically occurred in major river drainages in the Pacific Northwest from northern California and Nevada to the headwaters of the Yukon River in Canada, throughout the headwaters of the Columbia River drainage, and eastward into the Saskatchewan River in Canada (Cavender 1978). They are widely distributed across their range, but their distribution tends to be patchy, even in pristine environments (Rieman and McIntyre 1993). Bull trout have been extirpated from many of the large rivers within their historical range, and in many watersheds, remaining bull trout tend to be small, resident fish isolated in headwater (second- to third-order) streams.

Genetic investigations indicate that Montana bull trout lie within the upper Columbia River DPS, where a high level of genetic diversity occurs between drainages, but little variation exists within the individual drainages (Williams et al. 1997). This suggests that each major river drainage in the upper Columbia River region contains its own unique strain of bull trout, whose continued existence is important to the species as a whole (Kanda et al. 1997).

Bull trout distribution, abundance, and habitat quality have declined range-wide (Thomas 1992; Rieman and McIntyre 1993; McPhail and Baxter 1996). USFWS (2002a) identified the main threats to bull trout as habitat fragmentation and degradation, passage barriers that isolate populations, competition and predation from non-native fishes, angling mortality, and effects resulting from the small and isolated population sizes. Specific land and water management activities that depress bull trout populations and degrade habitat include dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (USFWS 2002a).

Bull trout are native to the streams and rivers within the Columbia River basin in Montana, where they occur primarily in the Kootenai and Clark Fork River subbasins, west of the Continental Divide. They also occur in the Saskatchewan River subbasin, east of the Continental Divide. Within these subbasins, bull trout are found in several major river drainages, including the Blackfoot, Clark Fork, Swan, Flathead, and Kootenai Rivers (see Figures D-12A through D-12C in Appendix D, EIS Figures). In Montana, some resident headwater populations have become isolated or extirpated due to fish passage barriers. In addition, the migratory life history forms have lost access to large portions of their native habitat due to some of these fish passage barriers (e.g., Libby Dam).

The maintenance of migratory corridors for bull trout is essential to provide connectivity among local populations, and enables the re-establishment of extinct resident populations. If resident bull trout are extirpated or impacted by a disturbance to local populations or habitats, these populations cannot be replenished or the local habitat recolonized if limits to connectivity preclude migratory bull trout from entering the disturbed area (Rieman and McIntyre 1993).

Habitat Requirements

Bull trout have multiple life history strategies, including migratory forms, throughout their range (Rieman and McIntyre 1993). Resident and migratory forms may be found together, and either form may give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1993).

Of the four life history forms generally recognized for bull trout—resident (non-migratory), adfluvial (lake rearing), fluvial (migratory stream and river rearing), and anadromous (saltwater migratory) fish—all but the anadromous form exist in Montana. Resident fish usually spend their entire lives in smaller tributaries and headwater streams, while sub-adult and adult migratory forms live in tributary streams for several years before migrating to larger rivers (fluvial form) or lakes (adfluvial form). All of these life history forms spawn only in small (second- through fifth-order) tributary streams in Montana (Shepard et al. 1984).

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components particularly important to bull trout distribution and abundance include

- Cold water temperatures
- Suitable substrate and lack of fine sediment
- Habitat complexity
- Habitat connectivity.

Habitat features that directly contribute to these components include high levels of shade, undercut banks, and LWD; high-quality gravel riffles with low levels of fine sediments; stable and complex stream channels; and connectivity within and between drainages. Other important general habitat factors that may have a large influence on bull trout distribution in Montana (Weaver 2003, personal communication) are:

- **Stream flow.** Particularly late summer low flows that coincide with bull trout spawn timing
- **Stream gradient.** Three to 5 percent gradient is the maximum for bull trout spawning, with less than 2 percent preferable.

Bull trout are likely to occur in colder, higher-elevation, low- to mid-order watersheds having low road densities (Rieman et al. 1997; Frissell et al. 1995; Quigley and Arbelbide 1997). Among a variety of effect mechanisms related to road density, roads may contribute to stream sedimentation, and roads adjacent to streams can reduce the amount of riparian vegetation, which may result in increased stream temperatures. Water temperatures above 59° F are believed to limit bull trout distribution (Fraley and Shepard 1989; Rieman and McIntyre 1993), and this may partially explain why bull trout tend to exhibit patchy distributions within given watersheds. Small changes in temperature (1 or 2° F) can have potential negative effects on native fish, including bull trout, by altering habitat conditions so they favor displacement or invasion from a non-native species (Shepard 2003, personal communication).

Spawning habitat almost invariably consists of very clean gravel, often in areas of groundwater upwelling or cold spring inflow (Rieman and McIntyre 1993).

Bull trout typically spawn in areas affected by groundwater (Shepard et al. 1984; Fraley and Shepard 1989). These areas (such as the Flathead drainage) tend to remain as open water through the winter, thereby reducing the risk of redd de-watering or freezing during harsh winter conditions. Groundwater-affected areas also allow bull trout embryos to develop and emerge faster than they would in drainages with colder winter water temperatures (Weaver and Fraley 1991).

Egg incubation temperatures can range up to 46º F, although optimal temperatures for survival are in the range of 35 to 40º F (McPhail and Murray 1979; Goetz 1989). In-gravel incubation spans from 6 to 8 months, depending on water temperature. Hatching occurs in winter or late spring, and fry emergence occurs from early April through May (Rieman and McIntyre 1993).

Excessive sedimentation or substrate movement reduces bull trout production by increasing egg and juvenile mortality and reducing or eliminating habitat important to later life history stages (Fraley

and Shepard 1989; Brown 1992). Prime sources of egg and fry mortality include scouring of redds due to high flows, freezing during low flows, superimposition of redds (overlapping nests in areas of limited spawning habitat availability), or deposition of fine sediment or organic materials that smother eggs or fry (MBTSG 1998).

Two of the life history forms of bull trout in the upper Columbia River (fluvial and adfluvial) migrate as a normal part of their life cycle. Downstream migration affords access to denser forage, better protection from avian and terrestrial predators, and alleviates potential intra-specific competition or cannibalism in rearing areas (Schlosser 1991). However, migratory juvenile bull trout face a variety of natural and human-caused threats to their survival after they leave their natal tributaries.

Migratory bull trout can move large distances (more than 150 miles) among lakes, rivers, and tributary streams. They often congregate in large, slow pools to feed. After they reach larger rivers, bull trout can remain there for brief periods, or for as long as several years, before either moving into lakes or returning to tributary streams to spawn. During their river residency, bull trout commonly make long-distance annual or seasonal movements among various riverine habitats, apparently in search of foraging opportunities and refuge from warm, low-water conditions in mid-summer and ice in winter (Elle and Thurow 1994; Swanberg 1997).

Bull trout require migratory corridors that link seasonal habitats for all bull trout life histories. For example, in Montana, migratory bull trout make extensive migrations in the Flathead River system (Fraley and Shepard 1989), and resident bull trout in tributaries of the Bitterroot River move downstream to overwinter in tributary pools (Jakober 1995). The ability to migrate is important to the persistence of bull trout, as it facilitates gene flow among local populations and may help re-establish populations in an area where the local population of bull trout has been extirpated (Rieman and McIntyre 1993).

Corridor Needs

Habitat alteration has fragmented bull trout habitats, eliminated migratory corridors, and isolated populations in tributary headwaters (Dunham and Rieman 1999; Rieman and Dunham 2000). Migratory corridors allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbance. Maintenance of migratory corridors for bull trout are essential to provide connectivity among local populations, and enables the re-establishment of extinct populations (Saunders et al. 1991).

Lack of connectivity has been identified as a major threat to restoration of bull trout in several watersheds in Montana. Connectivity in and among these watersheds is obstructed by a variety of factors, including dams, diversions, culverts, barriers, de-watering, and stretches of unsuitable or inhospitable habitat. However, improving connectivity can also be detrimental to bull trout by allowing the introduction of species that can out-compete bull trout.

Key Biological Relationships

Introduced brook and brown trout threaten bull trout through competition for food and space, and possibly predation (Leary et al. 1993; MBTSG 1996a; Rieman and McIntyre 1993). In addition, hybridization between brook trout and bull trout has also been reported in Montana (MBTSG 1995a, b; MBTSG 1996b, c). These introduced species tend to mature at an earlier age, have a

higher reproductive rate, adapt better to degraded habitats, and tend to thrive in streams with higher water temperatures than bull trout. West of the Continental Divide, non-native lake trout also negatively affect bull trout in lakes by limiting foraging opportunities and reducing the distribution and abundance of migratory bull trout (Donald and Alger 1993; MBTSG 1996a). Non-native northern pike (*Esox lucius*) and introduced bass also have the potential to negatively affect bull trout (MBTSG 1996c).

Some introduced species, such as rainbow trout and kokanee, may benefit large adult bull trout by providing supplemental forage. However, introduction of non-native game fish can be detrimental due to increased angling and subsequent incidental catch and harvest of bull trout (Pratt 1992; MBTSG 1995c).

Bull Trout Core Area

A core habitat area represents the closest approximation of a biologically functioning unit for bull trout (USFWS 2002a). Core habitat is defined as habitat that contains, or if restored would contain, all of the essential physical elements to allow for the full expression of life history forms of one or more local populations of bull trout. Core habitat may include currently unoccupied habitat if that habitat contains essential elements for bull trout to persist or is deemed critical to recovery. Bull trout core habitat occurs primarily in the northern portion of the HCP project area in the Middle Clark Fork, Stillwater, Swan, and Upper Clark Fork EIS aquatic analysis units (Figure D-13 in Appendix D, EIS Figures; Table 4.8-15).

The core areas are further divided into primary and secondary core areas. The distinction between primary and secondary core areas is made not to infer a different level of importance for recovery purposes, but to indicate that a different set of recovery standards are needed for addressing population abundance relative to the landscape. Primary core areas are typically located in watersheds of major river systems, often contain large lakes or reservoirs, and have migratory corridors that usually extend 30 to 60 miles or more. Each primary core area includes several identified local populations of bull trout. In recovered condition, a primary core area is expected to support at least five local populations with 100 or more spawning adults and contain 1,000 or more adult bull trout. Secondary core areas are based in smaller watersheds and typically contain adfluvial populations of bull trout that are naturally isolated and have restricted spawning and rearing habitat extending only a few miles. This spawning and rearing habitat is normally upstream of a lake, which provides extensive rearing, foraging, and overwintering habitat. For portions of watersheds in Montana, the primary core areas are functionally equivalent to the Restoration/ Conservation Areas designated by the Montana Bull Trout Restoration Team (MBTRT 2000). The secondary core areas generally represent the waters referred to as “disjunct” by the Montana Bull Trout Scientific Group.

Recovery units are major units for managing recovery efforts. Factors considered in identifying recovery units include biological and genetic factors, political boundaries, and ongoing conservation efforts. Most recovery units consist of one or more major river basins, and may include portions of some mainstem rivers (e.g., Columbia and Snake Rivers) when biological evidence warrants

TABLE 4.8-15. ACRES OF HCP PROJECT AREA AND NON-HCP TRUST LANDS IN THE CLARK FORK AND KOOTENAI BULL TROUT RECOVERY UNITS BY EIS AQUATIC ANALYSIS UNIT

	Clark Fork Bull Trout Recovery Unit		Kootenai Bull Trout Recovery Unit	
EIS Aquatic Analysis Unit	Total Acres Within the HCP Project Area	Total Acres Within Non-HCP Trust Lands	Total Acres Within the HCP Project Area	Total Acres Within Non-HCP Trust Lands
Bitterroot	27,743	12,334	0	0
Blackfoot	56,528	11,225	0	0
Flathead Lake	10,470	8,723	0	0
Lower Clark Fork	4,185	308	0	0
Lower Kootenai	0	0	3,527	123
Middle Clark Fork	88,467	24,510	46	0
Middle Kootenai	18	0	28,749	2,413
North Fork Flathead	18,499	978	0	0
Rock Creek	4,592	2,138	0	0
Stillwater	87,304	14,333	17	0
Swan	44,613	910	0	0
Upper Clark Fork	47,173	27,221	0	0
Upper Kootenai	10	0	11,143	1,215
Upper Missouri	7	85	0	0
Total	**389,609**	**102,765**	**43,482**	**3,751**
% of Recovery Unit	**2.62**	**0.69**	**1.63**	**0.14**

Source: DNRC (2008a).

inclusion. Biologically, the recovery units consist of bull trout groupings for which gene flow was historically or is currently possible. There are three primary bull trout recovery units in Montana, the Clark Fork, Kootenai, and St. Mary River drainages.

There is an overall total of about 17,534,198 acres of bull trout core habitat in the Clark Fork and Kootenai Recovery Units, with about 85 percent (14,861,978 acres) of the core habitat occurring in the Clark Fork Recovery Unit (Table 4.8-16). Overall, trust lands represent only 3.1 percent of the Clark Fork and Kootenai Recovery Units, while the HCP project area represents only 2.5 percent (Table 4.8-16). However, the percentage of HCP project area land in each individual core area ranges between 0 and 53 percent in the Clark Fork Recovery Unit, and between 0 and 7.9 percent in the Kootenai Recovery Unit. The largest percentage of HCP project area land in the Clark Fork Recovery Unit occurs in the Upper Whitefish Lake (53 percent), Whitefish Lake (47.2 percent), Cyclone Lake (40.3 percent), and Upper Stillwater Lake (35.9 percent) core areas. However, HCP project area land consists of less than about 10 percent of the other Clark Fork Recovery Unit core areas and all of the Kootenai Recovery Unit core areas.

TABLE 4.8-16. ACRES OF HCP PROJECT AREA AND TOTAL TRUST LANDS, AS A PERCENTAGE OF BULL TROUT CORE AREAS WITHIN THE CLARK FORK AND KOOTENAI BULL TROUT RECOVERY UNITS

Bull Trout Recovery Unit	Bull Trout Core Area	Total Acres	Total Acres in HCP Project Area	Percent of Bull Trout Core Area (within Montana) as HCP Project Area	Total Acres on Trust Lands	Percent of Bull Trout Core Area (within Montana) on Trust Lands
Clark Fork	Akokala Lake	1,423	0	0.00	0	0.00
	Arrow Lake	5,090	0	0.00	0	0.00
	Big Salmon Lake	49,986	0	0.00	0	0.00
	Bitterroot River	1,627,046	27,427	1.69	39,738	2.44
	Blackfoot River	1,271,091	49,243	3.87	56,949	4.48
	Bowman Lake	27,731	0	0.00	0	0.00
	Cabinet Gorge Reservoir	233,323	772	0.33	772	0.33
	Cerulean, Quartz & Middle Quartz Lakes	15,082	0	0.00	0	0.00
	Clark Fork River (Section 1)	1,793,079	47,027	2.62	74,349	4.15
	Clark Fork River (Section 2)	1,266,844	19,326	1.53	31,566	2.49
	Clark Fork River (Section 3)	760,952	38,758	5.09	41,502	5.45
	Clearwater River & Lakes	211,316	7,990	3.78	11,509	5.45
	Cyclone Lake	6,616	2,669	40.33	2,669	40.33
	Doctor Lake	9,396	0	0.00	0	0.00
	Flathead Lake	2,195,786	40,280	1.83	60,352	2.75
	Frozen Lake	1,910	0	0.00	0	0.00
	Harrison Lake	13,791	0	0.00	0	0.00
	Holland Lake	7,233	0	0.00	0	0.00
	Hungry Horse Reservoir	1,001,245	0	0.00	0	0.00
	Isabel Lakes	1,273	0	0.00	0	0.00
	Kintla Lake	15,462	0	0.00	0	0.00
	Lake McDonald	104,965	0	0.00	0	0.00
	Lake Pend Oreille	1,138,750	0	0.00	0	0.00
	Lincoln Lake	1,657	0	0.00	0	0.00
	Lindbergh Lake	25,784	0	0.00	0	0.00
	Logging Lake	19,899	0	0.00	0	0.00
	Lower Flathead River	1,277,834	30,447	2.38	39,993	3.13
	Lower Quartz Lake	3,161	0	0.00	0	0.00
	Noxon Rapids Reservoir	372,615	2,784	0.75	3,092	0.83
	Rock Creek	569,326	4,592	0.81	6,714	1.18
	Swan Lake	436,105	44,695	10.25	45,605	10.46
	Trout Lake	5,283	0	0.00	0	0.00
	Upper Kintla Lake	15,596	0	0.00	0	0.00
	Upper Stillwater Lake	82,057	29,477	35.92	29,994	36.55
	Upper Whitefish Lake	10,041	5,322	53.01	5,322	53.01
	West Fork Bitterroot River	201,776	321	0.16	321	0.16
	Whitefish Lake	81,456	38,479	47.24	41,927	51.47
	Subtotal	**14,861,978**	**389,609**	**2.62**	**492,373**	**3.31**
Kootenai	Bull Lake	126,540	2,273	1.80	2,397	1.89
	Kootenai River	1,759,582	31,036	1.76	33,531	1.91
	Lake Koocanusa	780,869	9,760	1.25	10,837	1.39
	Sophie Lake	5,227	413	7.90	468	8.96
	Subtotal	**2,672,220**	**43,482**	**1.63**	**47,233**	**1.77**
	TOTAL	**17,534,198**	**433,091**	**2.47**	**539,606**	**3.08**

Sources: USFWS (2002a); DNRC (2008a).

Bull Trout Critical Habitat

On September 26, 2005, the USFWS published the final rule designating critical habitat for bull trout for the Klamath River, Columbia River, Jarbridge River, Coastal-Puget Sound, and Saint Mary-Belly River populations of bull trout (70 FR 56211-56311). In Montana, critical habitat for bull trout occurs within three critical habitat units: the Clark Fork, Kootenai, and St. Mary-Belly River basins (70 FR 56211-56311, September 26, 2005). These include 1,136 stream or shoreline miles in the Clark Fork River basin, 56 miles in the Kootenai River basin, and 37 miles in the St. Mary-Belly drainage. However, not all critical habitat occurs within the Montana state boundaries or within the EIS aquatic analysis units (Table 4.8-17). Critical habitat in the HCP project area is primarily concentrated in three analysis units (Stillwater, Swan, North Fork Flathead), accounting for 79 percent of the HCP project area critical habitat (Figure D-14 in Appendix D, EIS Figures). However, the HCP project area only contains 9 percent of the bull trout critical habitat in the overall planning area.

TABLE 4.8-17. MILES OF BULL TROUT CRITICAL HABITAT IN THE HCP PROJECT AREA AND NON-TRUST LANDS BY EIS AQUATIC ANALYSIS UNIT

EIS Aquatic Analysis Unit	HCP Project Area (Stream Miles)	Non-HCP Trust Lands (Stream Miles)	Non-trust Lands (Stream Miles)	Total Critical Habitat (Stream Miles)	Percent of Critical Habitat in the HCP Project Area[1]
Bitterroot	1.1	3.6	164.8	169.6	0.7
Blackfoot	5.4	8.1	141.1	154.6	3.5
Flathead Lake	0.0	0.0	3.9	3.9	0.0
Lower Clark Fork	0.0	0.0	29.0	29.0	0.0
Lower Kootenai	1.0	0.0	8.3	9.3	11.2
Middle Clark Fork	7.7	6.8	209.9	224.4	3.4
Middle Kootenai	1.6	3.5	21.0	26.0	6.1
North Fork Flathead	14.8	0.0	51.3	66.1	22.4
Rock Creek	1.6	1.9	71.9	75.3	2.1
Stillwater	34.6	1.6	3.3	39.6	87.5
Swan	22.8	0.0	26.6	49.4	46.1
Upper Clark Fork	1.2	1.4	111.4	114.0	1.0
Upper Kootenai	0.0	0.0	21.0	21.0	0.0
Upper Missouri	0.0	0.0	0.0	0.0	0.0
TOTAL	**91.8**	**26.9**	**863.6**	**982.3**	**9.3**

[1] Miles of critical bull trout habitat in the project area divided by the total critical habitat.
Source: DNRC (2008a).

Critical habitat designations are based on the best available information on known bull trout presence within the last 20 years, and areas with features essential to the conservation of the species and in need of special management protection. Critical habitat areas contain one or both of the following: (1) spawning, rearing, foraging, or over-wintering habitat to support essential existing bull trout local populations; and (2) movement corridors necessary for maintaining essential migratory life history forms of the species. Critical habitat consists of the width of the stream at the ordinary high water mark (OHWM). Although adjacent floodplains and riparian areas are not designated as critical habitat, it is recognized that land use activities within these areas can have

substantial effects on the physical and biological features of the designated aquatic habitat (70 FR 56211-56311, September 26, 2005).

Specific Risk Factors to Bull Trout

Although similar to all salmonids, bull trout tend to be particularly dependent on cool, clear water for spawning and rearing, as well as clean substrate for spawning. Land use activities that may adversely affect these required habitat elements include mining, road building, and forestry practices. In addition, competition and hybridization with non-native species is also a major threat to the maintenance and restoration of most bull trout populations. The isolation and fragmentation of bull trout populations by dams and road systems, and the relatively low population sizes in many areas, likely reduces the ability of bull trout populations to recover from natural and human-induced impacts.

Fisheries management risks include poaching, introduction of non-native species, and growing angler use of both rivers and lakes, resulting in incidental hooking and handling mortality. These risks also tend to increase as development increases in some locations, although the development location can be more of a concern than the magnitude of development.

Clark Fork Recovery Unit

The historical distribution of bull trout is relatively intact in the Clark Fork Recovery Unit, except for some headwater areas, but abundance has been reduced and some populations are highly fragmented.

The Clark Fork Recovery Unit is the largest and one of the most diverse recovery units in the species' range, and includes the following primary recovery core areas: the upper Clark Fork River, Rock Creek, Blackfoot River, Bitterroot River, lower Clark Fork River, Lake Pend Oreille, Priest Lakes and Priest River, Flathead Lake, Swan Lake, and Hungry Horse Reservoir. The secondary recovery core areas include the Clearwater River and associated chain of lakes, West Fork Bitterroot River upstream of Painted Rocks Dam, and 22 lakes in the Flathead Recovery Subunit.

Hydroelectric and irrigation dams interrupted established bull trout migration routes and affected habitat conditions, although some dams resulted in preventing the potentially negative interactions with non-native fish species, particularly lake trout and brook trout populations. The risk of core area and local population extirpation from isolation and fragmentation of habitat in the Clark Fork Recovery Unit is generally increasing, especially where bull trout populations are in decline.

In addition to the impacts of dams, past forestry practices have caused major impacts to bull trout habitat, including road construction, log skidding, riparian tree harvest, clearcutting, and splash dams. Because forestry was one of the primary landscape activities in the planning area, the impacts have been widespread. Specific impacts include increased sediment loading to area streams, increased peak flows, hydrograph and temperature modifications, reductions in in-stream woody debris, channel instability, and increased access by anglers and poachers. Many of these impacts are also the result of other road and transportation activities.

Some isolated areas in this recovery subunit have been impacted by grazing (particularly in the lower Flathead River portion of the unit, Thompson River, Elk Creek, Pilgrim Creek, and portions of the Bull River), but overall grazing is not one of the high-risk factors. However, water diversions

and use for livestock has had a substantial impact to bull trout in the upper portion of the Clark Fork Recovery Unit. The legacy of mining, particularly in the upper portions of the Clark Fork River drainage, will also continue to impact bull trout.

Increased human population growth in western Montana and northern Idaho may be one of the biggest threats to the recovery of bull trout in the recovery units. Angling (both legal and illegal) has directly impacted bull trout populations despite restrictive fishing regulations and substantial educational efforts. These issues are intensified in stream corridors where roads provide easy access to areas with adult fish.

Kootenai River Recovery Unit

Lake Koocanusa and the Kootenai River/Kootenay Lake complex have been designated as primary core areas, representing recovered status in the Kootenai River Recovery Unit. Secondary core areas in the Kootenai River Recovery Unit are Bull Lake and Sophie Lake. They each include one identified local population of bull trout. The bull trout in the Bull Lake core area are known to express a unique phenotypic trait (i.e., downstream spawning), and bull trout in the closed basin of Sophie Lake also represent a unique resource in the Kootenai River Recovery Unit. Perpetuating both populations is a high priority in this recovery unit.

The Kootenai River Recovery Unit forms part of the range of the Columbia River population segment. The Kootenai River Recovery Unit is unique in its international configuration, and recovery will require strong international cooperative efforts. Within the Kootenai River Recovery Unit, the historical distribution of bull trout is relatively intact. However, abundance of bull trout in portions of the watershed has been reduced, and remaining populations are fragmented. The Kootenai River Recovery Unit includes four core areas and about 10 currently identified local populations.

Libby Dam has been one of the most important factors affecting bull trout in the Kootenai River Recovery Unit. The completion of the dam in 1972 severed the migratory corridor between the upper Kootenai River watershed (Montana and British Columbia) and the lower Kootenai River basin in northern Idaho, which drains into Kootenay Lake in British Columbia. The dam blocks all upstream migration and essentially bisects the United States portion of the Kootenai River drainage into two reaches. The upstream reservoir section of Lake Koocanusa is isolated from a downstream riverine reach. The habitat in the riverine reach is dramatically altered as a result of Libby Dam and is characterized by unnatural flow patterns, water temperatures, and water quality parameters. These changes, combined with other impacts to the lower river habitat, led to chronic reproductive failure of Kootenai River white sturgeon (known to have historically inhabited the drainage only downstream of Kootenai Falls). In 1994, it was listed as an endangered species. Native burbot populations in the Kootenai River have also collapsed.

Forestry practices also rank as a high risk to bull trout in the Kootenai River Recovery Unit, largely because forestry is the dominant land use in the basin. Virtually all drainages supporting bull trout in the Kootenai River Recovery Unit are managed timberlands. Although current forestry practices have improved, the risk is still high because of the existing road system, mixed land ownership, lingering results of past activities, and inconsistent application of BMPs.

The Kootenai River drainage has a history of mining on both sides of the international border. Libby, Montana, and many other communities in the Kootenai River valley were located at their present sites due to mining interests. Several mines have caused site-specific impacts on local populations of bull trout, but widespread negative impacts to water quality (such as those occurring in the Clark Fork Recovery Unit) due to mining have not occurred in the Kootenai River drainage. There are several active and proposed mining operations in the watershed, some of large dimension.

Fisheries management risks include poaching, introduction of non-native species, and growing angler use of both the lake and river. Lake Koocanusa is currently the most heavily fished lake or reservoir in western Montana. Illegal harvest of bull trout has been well-documented in the Kootenai River Recovery Unit and is considered a high risk because of the traditional focus on well-known and limited spawning areas. Introduced species are widespread throughout the drainage, and the proliferation of brook trout is currently thought to present the greatest non-native species risk to bull trout because of the threat of hybridization. Angler misidentification of species and incidental take by anglers due to hooking mortality is a growing concern.

St. Mary - Belly River Recovery Unit

Population isolation and fragmentation are substantial risk factors for bull trout in the St. Mary River and Belly River drainages, although the presence of migratory life forms in the primary core areas results in diminished risk. Irrigation system impacts also remain as high-risk factors, particularly the Milk River Irrigation Project, which has caused entrainment of fish, disruption of migratory corridors, de-watering of in-stream habitat, and alteration of stream temperature regimes since its inception in about 1920.

Localized habitat impacts occur in some of the watersheds from forestry, livestock grazing, agriculture, mining, transportation corridors, and human development. These impacts are generally site-specific and less pervasive than the impacts due to the diversions.

Interactions (hybridization, competition, and predation) with non-native fish tend to reduce maintenance or recovery of bull trout populations. In addition, lake trout and northern pike, two species with the potential to compete with bull trout, are native in the St. Mary River drainage.

Illegal harvest of bull trout has been well documented in the St. Mary - Belly River Recovery Unit, and in the past has been a major mortality factor due to a traditional focus on well known and limited spawning areas. Forestry management has some potential to negatively affect bull trout habitat in the St. Mary - Belly River Recovery Unit, but is not considered a high risk overall. The low density of human occupation in the St. Mary River and Belly River drainages, along with a high percentage of public land, minimizes the potential impacts from development.

Westslope Cutthroat Trout

Population Status, Distribution, and Seasonal Presence

The USFWS reviewed the status of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and determined that a listing under the ESA was not warranted based on a 1999 status review (USFWS 1999a) as well as a 2003 updated status report prepared by the fish and game departments of the states of Idaho, Montana, Oregon, and Washington and the USFS (Shepard et al. 2003). However, the species is listed as an S2 SOC in the state of Montana by MFWP and MNHP, and as a sensitive species by DNRC, the USFS, and BLM.

The westslope cutthroat trout is one of 14 sub-species of cutthroat trout native to interior regions of western North America. The historical range of westslope cutthroat trout is the most geographically widespread among these inland cutthroat trout (USFWS 1999a). West of the Continental Divide, the sub-species is native to several major drainages of the Columbia River basin, including the upper Kootenai River drainage from its headwaters in British Columbia, through northwest Montana into northern Idaho; the Clark Fork River drainage of Montana and Idaho downstream to the falls on the Pend Oreille River near the Washington-British Columbia border; the Spokane River above Spokane Falls and into Idaho's Coeur d'Alene and St. Joe River drainages; and the Salmon and Clearwater River drainages of Idaho's Snake River basin.

East of the Continental Divide, the historical distribution of westslope cutthroat trout includes the headwaters of the South Saskatchewan River drainage (United States and Canada); the entire Missouri River drainage, upstream from Fort Benton, Montana, extending into northwest Wyoming; and the headwaters of the Judith, Milk, and Marias Rivers, which join the Missouri River downstream from Fort Benton.

Westslope cutthroat trout currently occupy about 33,500 stream miles, equivalent to 59 percent of their historical range of about 56,500 stream miles (Shepard et al. 2003). Genetically pure westslope cutthroat trout occur in approximately 10 percent of the currently occupied stream miles (Shepard et al. 2003). All populations of westslope cutthroat trout are recognized as a single population rather than being composed of DPSs (USFWS 1999a). Habitats of historical stocks of westslope cutthroat trout ranged from cold headwater streams to warmer, mainstem rivers (Shepard et al. 1984; Behnke 1992).

Today, self-sustaining westslope cutthroat trout stocks remain widely distributed throughout the historical range of the sub-species, but remaining stocks occur primarily in colder, headwater streams that are largely found on lands administered by federal agencies, particularly the USFS.

In Montana, westslope cutthroat trout are found in the Oldman, Missouri headwaters, lower Missouri, Kootenai, Clark Fork, and Flathead River drainages. Figures D-15A through D-15C (Appendix D, EIS Figures) show the westslope cutthroat trout distribution within the EIS aquatic analysis units in the HCP project area. The only substantive limitation of the current distribution map is the substantial amount of stream length not surveyed to-date (Table 4.8-18).

TABLE 4.8-18. CURRENT AND HISTORICAL DISTRIBUTION OF WESTSLOPE CUTTHROAT TROUT IN MAJOR RIVER DRAINAGES IN MONTANA

River Drainage	Drainage Area (Square Miles)	Historical Distribution (Stream Miles)	Surveyed Reaches (Stream Miles)	Current Distribution (Stream Miles)	Percent of Surveyed Miles Occupied
Oldman	671			Isolated	
Missouri Headwaters	14,034	18,634	6,290	2,279	36.2
Lower Missouri[1]	24,041	29,027	9,787	1,791	18.3
Kootenai	4,815	4,119	1,615	1,051	65.1
Clark Fork	13,188	16,667	5,847	5,166	88.4
Flathead	8,436	10,288	3,489	2,609	74.8

[1] River drainage outside the HCP project area.
Source: USFWS (1999a).

The distribution of westslope cutthroat trout within the major Montana river drainages (Table 4.8-18), based on the USFWS status review (USFWS 1999a), is as follows:

- **Oldman River.** Principal tributaries include the Belly and St. Mary Rivers, in north-central Montana. However, westslope cutthroat trout survive only as isolated stocks in a few headwater streams along the east boundary of Glacier National Park, north of St. Mary Lake.
- **The Missouri River headwaters.** Stream surveys have documented westslope cutthroat trout in about 340 tributaries or stream reaches, including the principal watersheds of the Red Rock, Beaverhead, Ruby, Big Hole, Jefferson, Boulder, Madison, and Gallatin Rivers.
- **The lower Missouri River.** Westslope cutthroat trout have been documented in about 617 tributaries or stream reaches in this drainage, including the upper Missouri, upper Missouri-Dearborn, Smith, Sun, Two Medicine, Teton, Judith, and Upper Musselshell Rivers and the Belt, Arrow, Flat Willow, and Box Elder Creeks.
- **The Kootenai River.** Westslope cutthroat trout have been documented in about 227 tributaries or stream reaches, distributed among five watersheds that include the upper Kootenai, Fisher, Yaak, lower Kootenai, and Moyie Rivers.
- **The Clark Fork River.** Westslope cutthroat trout have been documented in about 1,291 tributaries or stream reaches, among six primary watersheds, including Flint-Rock Creek, and the upper Clark Fork, Blackfoot, middle Clark Fork, Bitterroot, and lower Clark Fork Rivers.
- **The Flathead River.** Westslope cutthroat trout have been documented in about 676 tributaries or stream reaches among seven watersheds, including the North Fork Flathead, Middle Fork Flathead, South Fork Flathead, Stillwater, Swan, and Lower Flathead Rivers, and Flathead Lake.

Habitat Requirements

Westslope cutthroat trout exhibit three recognized life history forms that are distinguished only by migratory and rearing behavior: residential, fluvial, and adfluvial forms. Resident forms spend

their lives entirely in the natal tributaries; fluvial forms live and grow in larger rivers, and migrate upstream to spawn in smaller tributaries; and adfluvial forms mature in lakes, and migrate into lake tributaries to spawn and rear (Shepard et al. 1984; Rieman and Apperson 1989; Behnke 1992). All three life history types may occur in a single drainage (Bjornn and Liknes 1986; Rieman and Apperson 1989). Most adult fluvial or adfluvial fish return to either larger rivers or lakes after spawning, and most juveniles emigrate from tributary streams after 2 to 4 years (Rieman and Apperson 1989; Shepard et al. 1984). There is no evidence of genetic isolation of different life history forms, and migratory behavior may be based on social and environmental cues in conjunction with genetic codes (Shepard et al. 1984).

In addition to the seasonal movements related to spawning and rearing, westslope cutthroat trout often move in response to seasonal changes in habitat conditions and habitat requirements. Fluvial and adfluvial westslope cutthroat trout may migrate distances of over 60 miles in response to habitat needs (Bjornn and Mallet 1964; Liknes 1984); in particular, there can be considerable movement to find suitable overwintering pool habitat (Brown and Mackay 1995). Resident westslope cutthroat trout typically exhibit less extensive movement, although seasonal movements may occur in response to changing habitat requirements and conditions, particularly water temperatures. Although westslope cutthroat trout tend to exhibit limited movement within stream reaches with numerous pools, movement may be more extensive in stream reaches with few pools (Peters 1988; McIntyre and Rieman 1995).

Westslope cutthroat trout usually mature at 4 or 5 years of age and always spawn in streams. Spawning typically occurs between March and July, when water temperatures warm to approximately 50° F (Trotter 1987; Behnke 1992; McIntyre and Rieman 1995). Spawning habitat for westslope cutthroat trout occurs in low-gradient stream reaches with gravel substrate ranging from 0.08 to 3.0 inches in diameter, water depths near 0.7 feet, and mean water velocities from 1.0 to 1.3 feet per second (Liknes 1984; Shepard et al. 1984). Proximity to cover, such as overhanging stream banks, is an important habitat component for adult spawning fish. Fertilized eggs incubate for several weeks before hatching, with the actual time period inversely related to water temperature (Liknes 1984). Several days after hatching, westslope cutthroat trout fry (approximately 1 inch long) emerge from the gravel into the stream and disperse.

The survival of westslope cutthroat trout embryos can be affected by accumulations of fine sediment, which cause survival to be lower than that of other salmonid species (Irving and Bjornn 1984). Magee et al. (1996) reported low embryo survival (a mean of 8.5 percent) at high levels of fine sediment in the Taylor's Fork basin in the upper Missouri River drainage, but that recruitment was apparently not a limiting factor in the system. Ireland (1993) reported higher densities (0.6 to 28.8 fish per 120 square yards) of westslope cutthroat trout in the Taylor's Fork basin than streams in the upper Flathead basin (0.7 to 17.7 fish per 120 square yards), where stream substrates contained lower amounts of fine sediments (Shepard et al. 1984).

After they emerge from the spawning gravel, westslope cutthroat trout fry generally occupy shallow waters near stream banks and other low-velocity areas (e.g., backwaters, side channels) (McIntyre and Rieman 1995). Juvenile westslope cutthroat trout (3 to 5 inches) are most often found in pools and runs that have summer water temperatures of 42 to 60° F and a diversity of cover (Fraley and Graham 1981; McIntyre and Rieman 1995). Adult westslope cutthroat trout in streams are strongly associated with cold, high-gradient waters that have pools and cover (Shepard et al. 1984;

Pratt 1984; Griffith 1988; Peters 1988; Ireland 1993; McIntyre and Rieman 1995). During winter, adult westslope cutthroat trout congregate in pools (Brown and Mackay 1995; McIntyre and Rieman 1995), while juvenile fish often use cover provided by boulders and other large in-stream structures (Peters 1988; McIntyre and Rieman 1995). During the summer in lakes and reservoirs, adfluvial westslope cutthroat trout are often found at depths where temperatures are less than 60° F (McIntyre and Rieman 1995).

Westslope cutthroat trout primarily feed on macroinvertebrates, particularly immature and mature forms of aquatic insects, terrestrial insects, and, in lakes, zooplankton (Liknes and Graham 1988). This preference for macroinvertebrates occurs at all ages and in both streams and lakes. Westslope cutthroat trout rarely feed on other fishes (Liknes and Graham 1988; Behnke 1992).

Habitat use by westslope cutthroat trout is diverse, and there is no clear hierarchy of critical life requisites. In general, westslope cutthroat trout have habitat requirements typical of salmonid species, but are strongly associated with cold, often nutrient-poor, high-gradient waters having pools and cover (Shepard et al. 1984; Pratt 1984; McIntyre and Rieman 1995). Stream shading and riparian buffers, clean spawning gravels, low levels of fine sediments, backwaters, undercut banks, and LWD all contribute to cold water temperatures, enable the formation of pools, provide cover, and/or support different westslope cutthroat trout life stages.

There is also evidence that even small increases in stream water temperatures may afford a competitive advantage to non-native salmonids species such as brook trout, through displacement or invasion (Griffith 1972; De Staso and Rahel 1994; Novinger 2000). Other important habitat factors for westslope cutthroat trout include substrate stability, stream flow, and changes in flow timing. In addition, natural and artificial barriers strongly influence the distribution of some populations.

Corridor Needs

The current distributions of westslope cutthroat trout are frequently limited to tributaries with relatively high gradients and stream reaches above natural and artificial barriers. Under ideal conditions, removal of all artificial barriers would benefit westslope cutthroat trout populations by connecting habitats and populations. However, in some cases, it may be necessary to identify, monitor, and maintain existing barriers, or install new ones, to minimize the competition and/or hybridization with native and non-native salmonids (e.g., brook trout, rainbow trout, and Yellowstone cutthroat trout) (MFWP 1999, 2007a).

Key Biological Relationships

Historically, westslope cutthroat trout in the Columbia River basin shared habitats with several potentially predatory fish species, including northern pikeminnow (*Ptychocheilus oregonensis*), bull trout, Chinook salmon (*Onchorhynchus tshawytscha*), and rainbow trout (including steelhead). In the Missouri River basin, which westslope cutthroat trout have inhabited for 7,000 to 10,000 years (Behnke 1992), westslope cutthroat trout formerly coexisted with relatively fewer species of fish, all of them essentially non-predatory, such as Arctic grayling (*Thymallus arcticus*) and mountain whitefish (*Prosopium Williamsoni*). Inland redband trout (*Onchorhynchus mykiss*), sculpins (*Cottus* spp.), suckers (*Catostomus* spp.), dace (*Rhinichthys* spp.), and other minnows are fish species that may occur in streams with westslope cutthroat trout.

In addition to changes in habitat and direct competition with other fish species, hybridization with rainbow trout and Yellowstone cutthroat trout has led to substantial proportions of genetically introgressed stocks of westslope cutthroat trout in most regions of the subspecies' range. While MFWP (1999) reported that the majority of tested populations in the Clark Fork and Flathead Rivers (75 and 80 percent, respectively) were found to be 100 percent genetically pure, Hitt et al. (2003) found hybridization in 24 of 42 (57 percent) of Flathead River basin sites sampled between 1998 and 2001. In addition, Hitt et al. (2003) found rainbow trout introgression in 7 of 11 populations that were determined to be non-hybridized in 1984.

Research in the Kootenai River drainage indicated only 29 percent of the tested populations were genetically pure (MFWP 1999). The high degree of introgression in the Kootenai River system is of particular concern because hybridization between westslope cutthroat trout and inland redband trout, which are only found in the Kootenai River system, potentially impacts the genetic integrity of both species. In addition, MFWP indicates that genetically pure westslope cutthroat trout populations are found in only 3 percent of their native habitat in the upper Missouri River basin (MFWP 2007b).

Specific Risk Factors to Westslope Cutthroat Trout

As with all salmonids, westslope cutthroat trout require cool, clear water for spawning and rearing, as well as clean substrate for spawning. Land use activities that may adversely affect these required habitat elements include livestock grazing, mining, road building, and forestry practices. While existing regulations appear adequate to protect westslope cutthroat trout in most areas, the actual effectiveness of these regulations is dependent on appropriate funding and implementation. Although over utilization and whirling disease may present minor risks to westslope cutthroat trout in Montana, competition and hybridization with non-native species is likely the greatest existing threat to the maintenance and restoration of many westslope cutthroat trout populations (USFWS 1999a). The USFWS (1999a) also identified the primary land use risk factors within the major river drainages as

- **Oldman River.** While livestock grazing is a prominent risk factor affecting stream habitat conditions in the basin, this activity is generally limited in westslope cutthroat trout areas.

- **The Missouri River headwaters.** Principal land use risk factors include agricultural practices, mining, and forestry practices.

- **The lower Missouri River.** As with the upper Missouri River, the principal land use risk factors include agricultural practices, livestock grazing, mining, and forestry practices.

- **The Kootenai River.** Timber management activities, and the extensive associated road network, are the primary risk factors in this basin.

- **The Clark Fork River.** The principal land use risk factors in this basin include agricultural practices, livestock grazing, mining, and forestry practices. Mining effects are particularly evident in the Blackfoot River drainage, while water diversions, livestock grazing, and human development were identified as issues in the Bitterroot River watershed.

- **The Flathead River.** Timber management activities, and the extensive associated road network, are the primary risk factors in this basin. However, human development was also identified as a concern, particularly in the Flathead Lake area. The Flathead Lake basin also contains a particular threat from predation by non-native species.

Columbia Redband Trout

Population Status, Distribution, and Seasonal Presence

While the Columbia redband trout (*Oncorhynchus mykiss gairdneri*) is ranked as an S1 SOC (critically imperiled because of extreme rarity or because of some factor(s) of its biology making it especially vulnerable to extinction) in Montana by MFWP, and as a sensitive species by DNRC and the USFS, the USFWS determined that listing the species under the ESA was not warranted (65 FR 14932-14936, March 20, 2000).

The Columbia redband trout is a sub-species of rainbow trout (*O. mykiss*). Rainbow trout are widely distributed in western North America and segregated into three forms: (1) coastal rainbow trout west of the Cascade/Sierra Mountain divide, (2) interior Columbia River redband trout (Columbia redband trout), and (3) the Sacramento-San Joaquin redband trout (Behnke 1992). Historically, redband trout were widely distributed in fresh waters west of the Rocky Mountains from northern California to northern British Columbia, including habitats ranging from desert basins to high mountain coniferous forests (Behnke 1992). Columbia redband trout are native to the upper Klamath River basin, isolated interior basins of Oregon, and the Fraser and Columbia River drainages east of the Cascade Mountains extending upstream to barrier falls on the Pend Oreille, Spokane, and Snake Rivers (Allendorf et al. 1980; Behnke 1992).

Redband trout exhibit several life history forms, including anadromous (ocean migratory), adfluvial (lake migratory), fluvial (river migratory), and non-migratory resident forms (Lee et al. 1997). In addition, Lee et al. (1997) subdivided the resident redband trout into those that are sympatric or allopatric with the anadromous form (steelhead). Allopatric redband trout are those that evolved outside of the historical range of steelhead, whereas sympatric redband trout either occur within the steelhead range or were evolved from steelhead populations.

Columbia redband trout were the most widely distributed salmonids in the Columbia River basin, historically occurring in 73 percent of the subwatersheds (Lee et al. 1997). Only the allopatric form, which once occupied about 18 percent of all Columbia River subwatersheds, is native to Montana. Columbia redband trout remain the most widely distributed salmonids in the Columbia River basin, with sympatric and allopatric forms known or predicted to occupy 64 percent of their historical range, which is equivalent to 47 percent of the entire Columbia River basin (Lee et al. 1997). However, less is known about the current distribution of the different Columbia redband trout forms than of other salmonids. This is due to lack of information and the inability to differentiate juvenile steelhead, sympatric redband trout, and non-native strains of rainbow trout (Lee et al. 1997). Among allopatric Columbia redband trout, substantial populations occur in about 9 percent of the historical range and 18 percent of the current known distribution.

In Montana, Columbia redband trout only occur in the Kootenai River drainage and are the farthest inland population of Columbia redband trout in the Columbia River basin. Figure D-16 (Appendix D, EIS Figures) shows the distribution of Columbia redband trout in the HCP project area. The

historical distribution is believed to have extended upstream of Kootenai Falls near the present-day Libby Dam or the Fisher River (Muhlfeld 2003, personal communication). According to genetic surveys, historical Columbia redband trout populations were likely native to low-gradient, valley-bottom streams throughout the Kootenai River drainage (Knudsen et al. 2002; Muhlfeld 2003, personal communication).

The Kootenai River population of Columbia redband trout in Montana primarily consists of the resident form (Muhlfeld 1999). These resident Columbia redband trout are isolated in small patches of habitat, often upstream of barriers, and are distinguished from other rainbow trout populations in the Kootenai River watershed by lack of genetic introgression with non-native rainbow trout stocks (Muhlfeld 2003, personal communication). In general, the present distribution of Columbia redband trout in Montana is characterized by widely disconnected remnant populations of genetically pure stocks (Muhlfeld 2003 personal communication). These fish are largely restricted to some headwater areas, in large part due to the widespread introduction of hatchery rainbow trout, which has caused major genetic divergence among local Columbia redband trout populations (Allendorf et al. 1980; Muhlfeld 2003, personal communication).

Genetically pure populations of Columbia redband trout have been identified in Callahan Creek, Basin Creek, the upper north (British Columbia) and east forks of the Yaak River, upper Big Cherry Creek, Granite Creek, and portions of the upper Fisher River including Wolf, Pleasant Valley, Island, and Silver Butte Creeks (Allendorf et al. 1980; Huston 1995; Hensler 2004, personal communication). Populations of Columbia redband trout inhabiting Callahan Creek and the upper Yaak River drainage are isolated by barrier falls in each system. These remnant populations, which are spatially fragmented and isolated from genetic exchange, represent the most substantial remaining sources of native Columbia redband trout capable of re-establishing their historical distribution in Montana downstream of Kootenai Falls. Extensive ongoing genetic sampling is being conducted, which will aid in more accurately identifying the current distribution of genetically pure strains of Columbia redband trout in the Kootenai River basin (Muhlfeld 2003, personal communication).

The Kamloops strain of Columbia redband trout is native to Kootenay Lake in British Columbia but spawn upstream in Kootenai River tributaries, downstream from Kootenai Falls. The Kamloops strain attains a large body size due to their piscivorous diet of kokanee salmon (*Oncorhynchus nerka*) in the lake. Migratory fluvial and/or adfluvial components of the population may be undetectable due to hybridized populations inhabiting the lower portions of the Kootenai River drainage (Muhlfeld 2003, personal communication).

Habitat Requirements

Throughout their entire range, redband trout are found in a wide variety of habitat conditions that are often more extreme than conditions associated with other trout species (Lee et al. 1997). In particular, some redband trout populations are found in turbid and alkaline waters that range from near freezing to over 77° F in the deserts along the southern margin of the Columbia River basin. Although redband trout are adapted to a wider range of environmental conditions than other salmonids, some general observations can be made. Redband trout typically migrate to spawning areas in the spring, although migration timing is affected by water temperature and stream flow.

After spawning, resident redband trout maintain restricted home ranges until migrating to overwintering areas in the fall (Thurow 1990). Juveniles of migratory forms typically move downstream to lakes or rivers after 1 to 3 years in natal streams. As with other salmonid species, redband trout abundance has been strongly correlated with riparian cover components, including undercut banks, LWD, and overhanging vegetation (Lee et al. 1997). It is also generally assumed that populations within streams and rivers rely heavily on aquatic and terrestrial invertebrates as food sources (Lee et al. 1997).

In Basin and Callahan Creeks, fourth-order tributaries of the Kootenai River, juvenile and adult redband trout strongly preferred pool habitat and avoided riffles (Muhlfeld et al. 2001a). They typically selected microhabitat with depths less than or equal to 1.3 feet, and low-to-moderate water velocities (less than or equal to 1.6 feet per second). Age-0 (young-of-year) redband trout selected slower (less than or equal to 0.3 feet per second) and shallower (less than or equal to 0.7 foot) habitat located along stream margins. Run habitats were also used by juveniles and adults, in proportion to habitat availability, but were used more than expected by age-0 fish. In general, it was determined that low-gradient, mid-elevation reaches with an abundance of complex pools were critical areas for the production of redband trout (Muhlfeld et al. 2001a). During the fall and winter, adult redband trout occupied small home ranges and utilized deep pools dominated by cobble and boulder substrate and/or LWD (Muhlfeld et al. 2001b).

Corridor Needs

Due to the spatially fragmented current distribution of redband trout in headwater stream areas, removal of all artificial barriers might benefit redband trout populations by providing connection among habitats and populations. However, redband trout are also restricted to headwater areas due to the widespread introduction of hatchery rainbow trout below fish passage barriers, which has caused major genetic divergence among local redband trout populations (Knudsen et al. 2002; Muhlfeld 2003, personal communication). Therefore, existing barriers should be identified and monitored to determine the potential effects of barrier removal or maintenance of redband trout stocks.

Where necessary, new barriers may even be warranted to minimize or prevent impacts to redband trout populations through competition and/or hybridization with native and non-native salmonids (such as rainbow trout, brook trout, and westslope cutthroat trout). However, the effects of such actions on other native fish species that occupy headwater habitats (e.g. bull trout and westslope cutthroat trout) must also be considered.

Key Biological Relationships

In the Columbia River basin, redband trout historically shared habitats with several potential predatory fish species, such as northern pikeminnow, bull trout, Chinook salmon, and coastal rainbow trout (including steelhead). Hybridization and competition with other fish species, particularly introduced species, are biotic factors influencing the status of redband trout populations. In general, introduced fish species create risks of genetic introgression, competition for food and space, predation, and increased exposure to disease (Lee et al. 1997).

In particular, there is concern that the Kootenai River basin redband trout population is at risk of extinction. Widespread introductions of non-native trout, primarily coastal rainbow trout and eastern brook trout, have lead to intensive competition, species replacement, and hybridization with

these non-native stocks (Muhlfeld 2003, personal communication). The introduction of non-native trout above geologic barriers or in adjacent drainages poses a severe threat to the genetic purity and population persistence of isolated populations of redband trout.

Specific Risk Factors to Columbia Redband Trout

The Kootanai River population of Columbia redband trout is the only rainbow trout native to Montana, and is the farthest inland distribution of the sub-species. As such, the population is considered to be at high risk due to hybridization and competition with non-native species, habitat fragmentation, and habitat degradation (American Fisheries Society [AFS] 2008). Habitat fragmentation and degradation problems are the result of land management factors, dam and water diversion facilities, and floodplain development. The land management factors include road construction and maintenance, timber harvest, and livestock grazing.

Forestry practices are of concern because forestry is the dominant land use in the basin. Although current forestry practices have improved, the risk is still high because of the existing road system, mixed land ownership, lingering results of past activities, and inconsistent application of BMPs. The Kootenai River drainage has a history of mining, which likely impacted the population and distribution of redband trout.

4.8.3.2 Special Status Species

In addition to the three HCP fish species (Columbia redband, westslope cutthroat, and bull trout), there are 18 other special status fish species known or suspected to occur in the HCP project area (Table E4-6 in Appendix E). Of these 18 species, 11 are listed as SOC by MFWP, and the other seven have the potential of becoming SOC. While these species occur or may occur in the planning area, several have limited distributions and might not occur within or near HCP project area lands. These species of concern are described in the following subsections.

<u>Species of Concern</u>

Montana SOC are native animals breeding in the state that are considered to be “at risk” due to declining population trends, threats to their habitats, and/or restricted distribution.

Arctic Grayling

The fluvial or river-dwelling Arctic grayling population in the upper Big Hole River represents the last remnants of this native in the contiguous United States. This species is found primarily in small, cold, clear lakes with tributaries suitable for spawning that are scattered through western Montana (both east and west of the Continental Divide).

Decline of fluvial Arctic grayling throughout their native range is attributed to four factors: (1) habitat degradation, (2) introduction of non-native salmonids, (3) climatic change, and (4) exploitation by anglers (AFS 2008). The distribution of Arctic grayling in the Big Hole basin suggests that they are displaced by non-native brown, brook, and rainbow trout.

The lake-dwelling form of grayling, which is typically stocked, is fairly common in 30 or more lakes across the western half of the Montana. These lake fish are genetically, but not visibly, different from the native fluvial grayling. Grayling are spring spawners and broadcast their eggs

over a gravel bottom in moving streams. They are generalists, eating a variety of aquatic invertebrates.

Blue Sucker

The blue sucker was listed by the USFWS as a Category 2 species in 1994, and listed as an SOC by the State of Montana in 1996. This species may be susceptible to population declines in Montana due to its longevity, relatively low recruitment rate, migratory life history, and reliance on high flows in tributary streams for spawning. Blue suckers have been adversely affected by habitat changes, particularly those caused by large dams that block passage to spawning grounds, alter streamflow, and eliminate peak flows that initiate spawning runs. Dams also discharge cold, clear water as opposed to the warm, turbid waters in which these species evolved. Current monitoring information indicates the populations are in stable condition.

The only documented occurrence of blue sucker in the planning area is downstream of Morony Dam in the Missouri River and downstream of the Tiber Dam in the Marias River. These two areas consist of about 10 miles of mainstem habitat that might support blue sucker. However, they are unlikely to occur in the HCP project area because there are no HCP project area lands in these general areas.

Northern Redbelly X Finescale Dace

The northern redbelly X finescale dace hybrid is designated as a species of special concern in Montana, primarily due to its limited distribution. They prefer quiet water habitat in beaver ponds, bogs, and clear streams, although finescale dace are also found in larger lakes and reservoirs. The distribution is relatively unknown in the planning area, but may occur along with the small isolated populations of northern redbelly dace.

Paddlefish

The paddlefish is a long-lived game fish with low reproduction rates, making them susceptible to the effects of habitat loss and recreational harvest. The greatest threat to paddlefish is loss of spawning habitat. Habitat includes slow or quiet waters of large rivers or impoundments. In addition, they tolerate, or perhaps seek, turbid water (Holton 2003). They spawn on the gravel bars of large rivers during spring high water. While paddlefish may occur in the planning area, they are unlikely to occur in the HCP project area because there are no HCP project area lands in proximity to where paddlefish may occur.

Pearl Dace

The pearl dace is native to eastern and northern drainages in Montana. Typically found in small, cold-water tributaries north of the Missouri River, from Glacier National Park to the North Dakota border. Because there are no HCP project area lands in this area, pearl dace may occur in the planning area, but not in the HCP project area.

Sauger

The sauger is a native game fish that might occur in limited areas of the planning area, but not in the HCP project area. Sauger inhabit the larger turbid rivers and the muddy shallows of lakes and reservoirs, although it is primarily a river fish. They exhibit particularly long migrations in the Yellowstone and Missouri Rivers.

Spoonhead Sculpin

The spoonhead sculpin is a native species found only in the St. Mary and Waterton River drainages of Glacier National Park. They occur in the planning area, but not within the HCP project area. They inhabit deep lakes as well as streams and provide forage for lake trout, burbot, and other species.

Torrent Sculpin

The torrent sculpin is found only in the fast headwater streams of the Kootenai River drainage of northwest Montana. Torrent sculpin might occur in a small portion of the HCP project area, although most of Kootenai River in Montana occurs within the Kootenai National Forest. These fish are typically found in the riffles of cold, clear streams, but are also taken in lakes.

Trout-Perch

Trout-perch is a non-game fish species native to the northern drainages in Montana and, because of their limited distribution, have been designated a species of special concern. It is an important forage fish in some North American lakes but of minor consequence in Montana.

The entire known range of trout-perch in Montana is within Glacier National Park and the Blackfoot Indian Reservation. As such, they occur in the planning area but not in the HCP project area. They prefer shoals of lakes and deep pools in streams, over clean sand, gravel, or rubble substrate. Trout-perch are sensitive to pollution and sedimentation associated with agriculture, channelization, and warm water temperatures.

White Sturgeon

The Kootenai River white sturgeon population was listed as endangered under the ESA (59 FR 45989, September 6, 1994), due to a lack of juvenile recruitment to the population since the mid-1960s. Almost no recruitment occurred after Libby Dam began regulating flows in the Kootenai River in 1972 (USFWS 1999a).

The population is landlocked in Montana and lives in large cool rivers (Kootenai River). Their range extends from Kootenai Falls (Montana), located about 50 river kilometers (31 river miles) downstream of Libby Dam, to Corra Linn Dam at the outlet from Kootenay Lake (British Columbia). Therefore, white sturgeon might occur in a small portion of the HCP project area, downstream of Kootenai Falls, although most of this area is within the Kootenai National Forest. A natural barrier at Bonnington Falls downstream of Kootenay Lake isolates the Kootenai River white sturgeon from other Columbia River populations.

Recovery of the Kootenai River white sturgeon population is contingent upon re-establishing natural recruitment, minimizing additional loss of genetic variability, and successfully mitigating biological and habitat alterations that continue to harm the population. Initial empirical white sturgeon research suggested that reduced spring flows, unnatural flow fluctuations, and altered thermal regime caused by Libby Dam operation may have interrupted spawning behavior and recruitment. More recently, along with altered physical habitat conditions, a suite of post-fertilization early life mortality factors (embryo suffocation, predation on early life stages, and resource limitation) and possible intermittent female stock limitation have been reported as possibly contributing to observed recruitment failure for Kootenai River white sturgeon.

Yellowstone Cutthroat Trout

The Yellowstone cutthroat trout is one of two cutthroat trout sub-species in Montana, and as the name implies, is native to the Yellowstone River drainage of southwest and south-central Montana. Originally their range was as far downstream as the Tongue River, but today pure, un-hybridized populations are limited to some headwater streams and Yellowstone National Park. Yellowstone cutthroat trout are a popular game fish, and are used extensively for mountain lake stocking on the east slope of the Rocky Mountains and in the Absaroka-Beartooth Wilderness. The USFWS published a determination of "not warranted" finding for Yellowstone cutthroat (71 FR 8818-8831, February 21, 2006).

The complex life history behavior of many Yellowstone cutthroat trout populations (similar to bull trout) requires movement among diverse habitats, and disruptions in habitat quality or availability may reduce their diversity or lead to extinction of isolated populations.

The presence of non-native fish species is considered the greatest threat to the persistence of Yellowstone cutthroat trout, as well as the widespread stocking of non-indigenous populations of Yellowstone cutthroat trout (AFS 2008). Other factors affecting Yellowstone cutthroat trout include irrigation, dam and culvert barriers, poor reservoir habitat, river channelization and riprap, grazing, mining, logging, and road building. Unfortunately, most remaining populations in Montana are isolated and are at risk of extinction from natural and human-caused events (AFS 2008). The broad stocking program throughout western Montana indicates that Yellowstone cutthroat trout likely occur within and near HCP project area parcels.

Potential Species of Concern

Potential SOC are species for which current, often limited, information suggests potential vulnerability or for which additional data are needed before an accurate status assessment can be made.

Brassy Minnow

This native species occurs east of the Continental Divide, with only spotty distribution in the planning area. However, there is no indication that they occur on or near any HCP project area lands. The brassy minnow prefers clear, slow streams but have occasionally been taken in larger rivers with high turbidities and in lakes. These fish tend to be abundant in habitats with few predators, as they seem to be very vulnerable to fish predation.

Brook Stickleback

The brook stickleback is native east of the Continental Divide in northeastern Montana. However, there are also several isolated populations within the planning area, such as Tiber Reservoir and Swan River. As a result, it is likely that they occur in small portions of the HCP project area. Sticklebacks live in slow streams and lakes with submerged plants, and they are forage fish for other predatory fishes.

Burbot

The burbot (ling) is native to most of Canada and northern United States, and it is usually found in larger streams and cold, deep lakes and reservoirs in Montana. Within the planning area, burbot

occur in the northwest; southwest portions of the state; and the Missouri, Teton, and Marias Rivers. As a result, they are expected to occur within or near HCP project area parcels.

Northern Redbelly Dace

The northern redbelly dace is native to Montana, and found in small, clear, plains streams and ponds. The northern redbelly dace hybridizes with its close relative, the finescale dace. Northern redbelly dace are found in the lower Missouri River drainage and in a small grouping of tributaries in the upper Missouri River. As a result, they may occur in the planning area but are unlikely to occur in the HCP project area.

Plains Minnow

The plains minnow is native to Montana, and appears to prefer large streams, with sand or silt substrate, over rocky creeks and impoundments. They are found in the same major drainages and even at the same sites as the western silvery minnow. While the majority of the distribution occurs in eastern Montana, the distribution might extend into the Teton River. Thus, although plains minnow may occur in the planning area, they do not occur in the HCP project area (i.e., no HCP project area lands occur in this drainage).

Pygmy Whitefish

Pygmy whitefish are native to clear, cold lakes of northwest Montana, particularly around the Flathead River drainage. Therefore, pygmy whitefish likely occur within or near HCP project area parcels. This species is an important forage fish, especially for lake and bull trout, and live in the same deepwater habitat as lake whitefish.

Shorthead Sculpin

Shorthead sculpin occupy cold, swift riffle reaches of small high-elevation streams, primarily in the Flathead River drainage. As a result, they likely occur in only a small portion of the HCP project area. They spawn primarily in April by depositing their adhesive eggs in clusters on the undersides of rocks. After hatching, the larvae become benthic dwellers, feeding primarily on aquatic insects.

<u>Special Status Species Specific Risk Factors</u>

Many of the special status fish species in western Montana are subject to the same factors that affect the HCP fish species. These include changes in the natural hydrograph and water temperatures from dams, water diversion projects, and forest management practices. Increased siltation and decreased water quality occur from land use practices, particularly range, mining, forest, and transportation management activities. Habitat fragmentation from natural and man-made passage barriers and changes in in-stream habitat from channel and streambank modifications (channelization, riparian vegetation removal, and riprap stabilization), as well as overharvest from legal and illegal fishing, and the introduction of non-native fish species also contribute to the biological integrity of these sensitive fish species populations.

4.8.3.3 Other Fish Species

Fish species are often generally characterized as cold-, cool-, or warm-water species based on their overall habitat requirements. Using such general classifications provides a mechanism for assessing the potential effects of the proposed HCP on fish and aquatic habitat without needing to address a

large number of individual species. For assessing the potential effects of the HCP, the overall fish communities are grouped as either cold-water or warm-water species, with cool-water fish included under the warm-water classification. As such, the cold-water species generally require similar habitat conditions as the HCP fish species, and they are most predominant in western Montana. In contrast, the warm-water species tend to occur in a broader range of habitats, and they also tend to occur east of the Continental Divide.

Cold-water Fish Species

Salmonids (salmon, trout, chars, whitefishes, and graylings) frequently serve as indicator species for cold-water habitat quality, due to their sensitivity to environmental conditions, diverse life stage habitat requirements, position as top aquatic predators, and high value to the public. They require cold, clean water with high levels of dissolved oxygen for survival and growth, and clean, stable, and permeable gravel substrate for spawning and egg incubation. Their persistence depends on properly functioning ecosystem components (biological, chemical, and physical), and healthy populations are frequently associated with properly functioning cold-water ecosystems (i.e., having high native fish and invertebrate diversity). Therefore, the presence of native species indicates high ecological integrity within a system. Because the HCP fish species are cold-water species, the discussions related to the HCP fish species would generally apply to the other species in this category.

The dominant cold-water fish species in the state are rainbow, brown, and brook trout, although none of these are native to the state. Their dominance is due in large part to being more tolerant to habitat conditions and to their ability to hybridize with, or out-compete, some of the native species. The relatively small populations of the HCP fish species place them at particular risk from these factors.

Human activities frequently modify natural watershed processes (i.e., hydrologic, sediment, thermal, and nutrient regimes), which can degrade salmonid habitat quantity, quality, and connectivity over time. Some of the major human activities that modify watersheds and degrade habitat include roads, timber harvest, mining, and livestock grazing. These activities are discussed in detail above, in Section 4.8.3.1 (HCP Fish Species).

Warm-water Fish Species

For this EIS, warm-water and cool-water fish species have been combined to represent the group species that are not generally confined to the cold-water habitats occupied by trout. While many of these species are solely or primarily located in eastern Montana, several exhibit relatively large distributions across the state. Other statewide assessments have used largemouth bass and goldeye to represent warm-water fishes (DNRC 1996, 2004c). The distribution of goldeye is limited to locations east of the Continental Divide, and primarily to large mainstem rivers. They tolerate and seem to prefer turbid habitat and tend to avoid cold-water habitat. Largemouth bass exhibit a wider distribution than goldeye, primarily because they occur in many lakes throughout the state. Thus, goldeye and largemouth bass represent warm-water species that occur in rivers and lakes.

While warm-water species can also be affected by the same land use factors that affect the cold-water species, they typically tolerate a wider range of habitat conditions, particularly with regard to temperature and turbidity.

4.8.4 ENVIRONMENTAL CONSEQUENCES

The potential effects on fish and other aquatic resources in the planning and HCP project areas are reflected in the potential changes in aquatic habitat conditions due to the forest management activities. The emphasis for assessing the environmental consequences of the four EIS alternatives is through the quantitative and qualitative changes in key aquatic habitat parameters as they relate to supporting the HCP fish species and other aquatic species. The alternatives analysis focuses on habitat parameters because these parameters are often directly affected by land management activities, and they can typically be measured and monitored more effectively than biological parameters (e.g., fish population size). While there are few instances where a land management activity could cause a direct or measurable effect on an individual or population of fish, such effects are more likely to occur to habitat parameters.

In addition to the limited ability to effectively measure or monitor general biological parameters, there is often a limited basis for accurately assessing habitat parameters for individual fish species. This is particularly true for the three HCP fish species, which all have similar habitat requirements. In addition, the effects on habitat of the different alternatives will vary depending on existing site-specific conditions. For example, an area with marginally acceptable water temperature conditions for supporting the HCP fish species, due to previous land management activities, is likely to be affected to a greater extent by additional temperature impacts than an area with an undisturbed water temperature regime.

While the alternative comparisons are restricted primarily to the potential effects on aquatic habitat parameters, the link to the different species can be made by quantifying the location or extent of the effects of an alternative. For example, upgrading a culvert identified as a fish passage barrier would enhance conditions for all the fish species occurring in the drainage that would benefit from improved passage conditions. However, if only one of the HCP fish species occurs in that particular drainage there would be no benefit to the other two species. The potential benefit would also vary by how much available habitat is provided by upgrading the culvert. Therefore, it is impractical to compare the alternatives based on the potential effects to the individual species, or changes in species population levels. In this case, the alternative analysis focuses on the rate of problem culvert upgrades and the mechanism for selecting particular culverts for upgrading, as a way to differentiate the alternatives without attempting to assign a quantifiable benefit.

The four primary habitat components examined in this analysis are sediment delivery, stream temperature, in-stream habitat complexity, and connectivity among sub-populations of fish species. Additional habitat components considered include stream channel stability, form, and function and microclimate. The potential additive effects of these components on aquatic habitat and fish resources are examined in Chapter 5 (Cumulative Effects).

Another advantage of using habitat components as the basic unit for alternative comparison is that these components represent meaningful ecological endpoints with known relationships to the fish species they support. For example, the evaluation of a DNRC activity, such as grazing management practices, will involve an evaluation of the potential alteration or loss of riparian vegetation, physical damage to stream banks, maintenance of channel stability, and channel morphological characteristics. These factors affect both the quality and the quantity of available fish habitat, including water temperature, substrate characteristics, pool-riffle ratios, and water depth.

4.8.4.1 Alternative Analysis Approach

The comparison of alternatives relies on modeling evaluations or qualitative assessments (depending on whether quantitative data are available or measurable) to identify the most likely direct and indirect effects of forest management activities on individual aquatic habitat factors. These discussions focus on the likely differences between the effects of existing forest management protocols stipulated by existing laws and regulations (no-action alternative), and the three different action alternatives. To minimize redundancy and improve comparative discussions between the four alternatives, we analyzed the alternatives by habitat factor.

The assessment of the riparian habitat component compares the potential effects of the different DNRC riparian timber harvest strategies on in-stream habitat conditions, relative to the needs of fish species. The assessment is designed to determine if important riparian functions are maintained at levels necessary to provide suitable habitat for the conservation of the HCP fish species. The evaluations are based on scientific research on riparian buffer widths required to maintain adequate levels of buffer function, including LWD recruitment potential, retaining adequate levels of shade, and maintaining streambank stability necessary to provide habitat suitable for supporting fish.

The riparian harvest activities conducted under the four alternatives are expected to variably affect riparian functions relative to temperature; sedimentation; habitat capacity; and channel form, function, and stability. Riparian forest modeling was used to compare LWD recruitment and shading by alternative among a representative set of riparian stand types within the HCP project area.

While sediment filtration is also an important riparian function, a detailed discussion of this subject is included under the sediment habitat component, for which the primary basis for alternative comparison was an assessment of road-generated sediment production and delivery, particularly relative to roads adjacent to streams that support, or potentially support, fish.

To assess the fish connectivity habitat component, the alternatives were compared as to the number of potential fish barriers that prevent or impede fish migration upstream or downstream of road-stream crossings. This comparison involves extrapolating existing fish passage structure inventory data through time for each alternative and comparing the relative rate of fish passage improvement projects between alternatives. In addition, differences in fish passage designs between the alternatives were evaluated.

The CWE assessment compares the ability of the various alternatives to minimize or eliminate the collective aquatic impacts that specifically affect watershed-level resource features, including water yield, flow regimes, channel stability, and in-stream and upland sedimentation due to surface erosion and mass wasting. However, CWE result from the collective influence of multiple independent management variables within a watershed, thereby making it extremely difficult to independently differentiate and measure individually. However, the evaluation of the overall effects of the other habitat components discussed above is expected to provide an indication of the cumulative effects of the different alternatives. The implementation of management and conservation actions relative to these various habitat components is also expected to have a compounding influence on the habitat associated with fish. For example, improving in-stream habitat conditions, along with improvements in the connectivity to that habitat, is expected to have

an additive effect on fish species, which might not be entirely accounted for under the analysis for any one habitat component.

For some alternatives, the rate or scale of improvement in specific habitat components would be enhanced by the use of adequate effectiveness monitoring procedures, which would address both the implementation process and the effectiveness of individual habitat management strategies. Monitoring results would provide DNRC with the information required to effectively improve the implementation process in the future, resulting in greater cumulative gains in habitat quality.

4.8.4.2 Direct and Indirect Effects

The direct and indirect effects of the alternatives are assessed relative to existing and projected future aquatic habitat conditions (equivalent to the habitat conditions under Alternative 1). As indicated above, using habitat components to differentiate the alternatives is more practical and often more accurate than assessing biological parameters. There is ample scientific literature relating land-management- and timber-harvest-related activities to direct and indirect effects on the key individual components of aquatic habitat. There is also much literature that relates changes in habitat to direct effects on fish species. On the other hand, detailed information of the site-specific distribution and precise life history requirements of individual fish species, populations, and sub-populations within the project area is generally partially or completely lacking. Therefore, the habitat component approach is used to analyze effects on fish species, and to compare the effects between the various alternatives. In addition, the integral components of the proposed HCP aquatic conservation strategies consist of biological goals, conservation strategies, and specific conservation commitments. The proposed HCP conservation strategies were specifically developed to avoid, minimize, or mitigate potential impacts to the three HCP fish species as a result of forest management activities in the project area, and provide a comparative benchmark to assess differences between alternatives.

For all of the alternatives, DNRC will continue to collaborate with resource agencies and other stakeholders through participation in conservation agreements to conserve and protect the HCP fish species. These agreements include the *Westslope Cutthroat Trout Conservation Agreement and Memorandum of Understanding* and *Restoration Plan for Bull Trout in the Clark Fork River Basin and Kootenai River Basin, Montana*.

<u>Sediment Production and Delivery to Streams</u>

Forest management activities can increase the amount and rate of surface erosion and landslides by disturbing soils and vegetation, reducing the interception and infiltration of precipitation, and increasing surface runoff into streams (Swanson et al. 1987). Landslides are a minor source of sediment delivery within the HCP project area, while the two primary activities affecting sediment delivery within the HCP project area are roads and timber harvest (see Section 4.5.1, Geology and Soils – Affected Environment). Increased sediment yield from these forest management activities can increase sediment delivery to downgradient streams, lakes, and wetlands where it can negatively affect aquatic resources (Bisson et al. 1987). Forest practices can also affect streambank erosion by increasing surface water runoff rates and reducing the riparian vegetation density, which provides stabilizing effects on the stream banks.

Although a number of forest management activities can affect sediment delivery to streams, the primary mechanisms are associated with forest roads. This includes surface water runoff directly into streams at road crossings and indirectly through roadside ditches or downgradient transport, as well as increased erosion at road crossings associated with culverts (particularly from culvert failures or culvert installations or replacements). The other sediment delivery routes (i.e., timber harvest in riparian zones) are generally minimized through the implementation of SMZ regulations, which restrict activities in proximity to streams, thereby allowing natural filtration to minimize sediment delivery to the streams. Because of the substantial potential for sediment delivery associated with forest roads, this was the primary focus of the modeling effort to differentiate the alternatives.

Increased sediment loading to streams can result in the degradation of salmonid spawning and early rearing habitat (Bjornn et al. 1977; Cederholm et al. 1981; Plum Creek 2000), due to the accumulation of fine sediments. Increased sediment loading can also lead to increased turbidity, which can reduce the overall rearing habitat quality for juvenile salmonids and other native fishes.

Road Surface Sediment Production

The construction, use, and maintenance of forest roads are identified as primary sources of sediment delivery to streams and watersheds (Plum Creek 1999). Increased sediment delivery can directly and indirectly affect the HCP fish species, and other aquatic species sensitive to the effects of sediment loading. For example, many fish species, including the HCP aquatic species, are particularly dependent on gravel spawning habitat with a low incidence of fine-grained material. Fine-grained sediments tend to fill interstitial spaces in the substrate and interfere with the flow of water and oxygen through the gravel, and thereby reduce the survival rates of eggs. As a result, this is a primary issue for roadways built close to surface waters (within 300 feet), and particularly those that support sensitive fish species. The proximity of a road and stream limits the intervening distance to effectively infiltrate the runoff and deposit transported sediment.

Existing roads are a major source of sediment within the planning area. There are approximately 4,570 miles of existing road located on trust lands within the planning area, with approximately 2,646 miles of road in watersheds supporting HCP fish species in the HCP project area (see Table 4.8-7). However, only a limited number of these roads have been inventoried for sediment delivery potential or drainage problems (DNRC 2006d). GIS analysis indicates that about 700 miles (27 percent) of the existing roads on HCP project area lands are located within 300 feet of a stream, although only about 9 percent of these road miles are within 300 feet of known HCP fish species streams. Road densities also vary by aquatic analysis unit, ranging from 1.7 to 5.5 mi/mi^2, with an overall average of 3.1 mi/mi^2. However, the average road density within 300 feet of a stream is about 0.8 mi/mi^2, and road density within 300 feet of a HCP fish species stream is only about 0.3 mi/mi^2.

DNRC has inventoried approximately 430 miles of roads to identify major and minor road problems and general maintenance needs. This represents about 16 percent of the roads within the HCP project area and provides a statistically significant sample of road problems that commonly occur on trust lands (DNRC 2008h). Although a total of 12.5 miles of road (3 percent of all inventoried roads) were identified as problem segments (segments with a moderate or high risk of increased sediment delivery), the sediment modeling for this assessment assumed a more conservative estimate (6 percent), to compensate for the relatively small proportion of roads inventoried.

Because the DNRC road inventory focused specifically on potential problem areas, the proportion of inventoried roads within 300 feet of streams was substantially greater than the estimate for the entire HCP project area (27 percent). In particular, 46 percent of the inventoried problems were related to culvert crossings, of which the primary problems included alignment/grade (24 percent), capacity/plugged (28 percent), and energy control/armoring (20 percent). About another 46 percent of all inventoried problems were associated with inadequate road surface drainage, including drain dips (14.6 percent) and relief CMPs (19.5 percent). Within these two categories, the most common problems were inadequate capacity for relief CMPs, due to plugged inlets or improper sizing, and ineffective drain dips (DNRC 2006d).

Based on the distribution of the inventoried road problems, the comparison of alternatives on sediment production focused on surface runoff and road-stream crossings. The Water Erosion Prediction Project (WEPP) model was determined to be the best tool to quantitatively evaluate surface runoff and BMP applications, which vary by alternative, and the effect on sediment delivery for these identified problems. The WEPP model estimated sediment production and delivery from commonly observed problem road segments (see DNRC 2008a for details on the modeling). The modeling was applied to the specific conditions within the road network on trust lands, allowing a comparison of the relative rates of sediment production in each EIS aquatic analysis unit in the HCP project area, by alternative.

Common road parameters of grade, road width, and road segment length were calculated from available data and used as standard road geometries in all scenarios. Understanding that steeper road segments typically generate more sediment than moderate- or low-grade roads and that a wide range of road grades exist on HCP project area lands, three road grades (5 percent, 10 percent, and 15 percent) were used in the modeling, each representing distinct road grade ranges (0 to 7.5 percent, 7.6 to 12.5 percent, and 12.6 to 17.5 percent). These three ranges account for about 89 percent of all road segments within the HCP project area (DNRC 2008h).

The modeling used two soil types based on predominant classifications identified through road inventories, which indicate about 65 percent coarse material (gravelly loam to very gravelly silt-loam), and 22 percent fine material (silt loam) (NSSC 1995). The standard modeled road segment had a flat cross section without any inboard ditch or drainage features. These model runs establish background conditions that other BMP application scenarios could be compared against. The results of the model were weighted, based on the site-specific conditions (road grade, soil types, etc.) within each of the individual EIS aquatic analysis units within the planning area. The weighting was assigned based on a combination of road inventory data and local knowledge and/or best professional judgment of the road conditions on trust lands.

The differences between the alternatives are primarily related to implementation schedules of BMPs to correct existing problem road segments. Therefore, the analysis modeled various BMP application scenarios to represent existing and future road conditions under each alternative. To achieve this comparison, the model decreased the linear extent of contributing road surface area by incorporating road surface drainage features such as cross drains or drive-through drain dips. The model scenarios provide a solid base to qualitatively describe DNRC's sediment reduction plans over the time scale of HCP implementation. The modeling also evaluated various sediment buffer widths (5 to 300 feet) to evaluate sediment filtration effectiveness, the influence of road relocations, and the effectiveness of constructed buffers such as slash filter windrows.

Because the existing inventory data are expected to represent the overall condition of all roads in the HCP project area, this will provide the basis for identifying the distribution and frequency of the various road problems on trust lands. While all of the alternatives would address these road problems to effectively reduce sediment delivery to area streams, the problems would be corrected at various rates and priorities, depending on the alternative.

Overall, the upgrades and BMP applications on existing problem road segments were estimated to have a large effect on reducing sediment production from road surfaces by an average of about 90 percent, if all problem road segments were upgraded, for each of the alternatives (Table 4.8-19). This value is consistent with field experiments and other published values in the literature (USFHA 1979; Burroughs and King 1989; Rashin et al. 2006; Sugden 2007). Particularly important considerations for sediment reduction are the buffer size between roads and streams and road gradient.

TABLE 4.8-19. COMPARISON OF THE ESTIMATED SEDIMENT PRODUCTION (WITH AND WITHOUT APPROPRIATE BMPS) BASED ON EXPECTED ROAD MILES AT THE END OF THE 50-YEAR PERMIT TERM, BY ALTERNATIVE AND EIS AQUATIC ANALYSIS UNIT

Alternative	Bitterroot	Blackfoot	Flathead Lake	Lower Clark Fork	Lower Kootenai[1]	Middle Clark Fork	Middle Kootenai	North Fork Flathead[1]	Rock Creek	Stillwater[1]	Swan[1]	Upper Clark Fork[1]	Upper Kootenai	Upper Missouri	Total
Total Sediment Potential (Tons/Year)															
Alt. 1	98	156	34	7	17	237	92	86	8	370	289	350	35	177	**1956**
Alt. 2	98	155	34	7	18	217	91	80	8	370	288	348	35	176	**1925**
Alt. 3	97	153	33	6	17	209	87	85	8	366	287	341	31	175	**1896**
Alt. 4	98	155	34	7	18	235	91	80	8	370	288	348	35	176	**1943**
Predicted Sediment Production with BMPs (Tons/Year)															
Alt. 1	37	43	11	2	4	59	20	19	3	84	63	122	8	65	**540**
Alt. 2	37	43	10	2	4	59	19	18	3	84	63	121	8	65	**536**
Alt. 3	37	42	10	1	4	57	19	19	3	83	63	119	8	65	**528**
Alt. 4	37	43	10	2	4	63	19	19	2	84	63	121	8	65	**541**
Percent Sediment Reduction with BMPs (%)															
Alt. 1	62	72	70	77	75	75	79	78	68	77	78	65	77	63	**72.6**
Alt. 2	62	72	70	77	78	73	79	78	68	77	78	65	77	63	**72.6**
Alt. 3	62	72	70	77	78	73	79	78	68	77	78	65	75	63	**72.5**
Alt. 4	62	72	70	77	78	73	79	76	71	77	78	65	77	63	**72.7**

Note: Estimates are summarized for each aquatic analysis unit, as well as the percent reductions resulting from BMP implementation (DNRC 2008h).
[1] Aquatic analysis units in high precipitation regions.

The highest sediment production values occur in aquatic analysis units with the highest precipitation, and sediment production rates ranged from 1.62 to 7.32 pounds per linear foot of road (DNRC 2008h). Applying these sediment production rates to the estimated problem road segments within each aquatic analysis unit results in a range of 7 to 407 tons per year of sediment production,

with an average of 137 tons per year over all aquatic analysis units (Table 4.8-19). While the total sediment produced and the percent reduction rates are similar for all four alternatives at the end of the 50-year Permit term, the alternatives differ by the rate that the roads are inventoried, prioritized, and upgraded. As a result, alternatives that upgrade problem roads faster would have a greater cumulative sediment reduction effect over 50 years, despite similar total upgraded road miles at the end of the Permit term.

Because the number of road miles that underwent upgrades and BMP improvements by the end of the Permit term would be similar under all alternatives, the primary difference regarding road surface sediment production between alternatives involves the amount of new road construction and the rate of BMP improvement. The amount of new road constructed in each aquatic analysis unit over the 50-year Permit term was estimated using the proportion of HCP project area lying within each aquatic analysis unit. In addition to the new roads, other existing roads would be reclaimed during the 50-year period. Thus, the actual or net increase in roads for each aquatic analysis unit was estimated by subtracting the amount of reclaimed road from the amount of new road construction, and adding this to the existing roads to estimate the total roads (Table 4.8-20).

The alternatives all have generally similar increases in road miles over the Permit term, ranging from a low of 747 miles (Alternative 3) to a high of 834 miles (Alternative 1). Similar extrapolations estimated the amount of total roads within 300 feet of streams, most of which are also associated with stream crossings. The total number of stream crossing at 50 years, was estimated using the total projected roads and the existing proportion of stream crossings to road miles.

Road Surface Sediment Production at Road-Stream Crossings

In addition to the long-term delivery of sediment to planning area streams from road runoff, the DNRC road inventory indicates there is also a substantial potential for direct sediment delivery at stream crossings, particularly due to culvert failures. Culverts fail primarily due to rainfall events that produce stream flows exceeding the hydraulic capacity of the culvert. This leads to circumstances where the integrity of the road prism is jeopardized by excessive erosional forces. A culvert failure would result in substantial erosion effects on the road prism and the immediate surrounding area. The probability of such failures is greater for problem stream crossings as compared to appropriately constructed crossings.

Of the 2,258 estimated stream crossings in the HCP project area, about 24 percent (550) occur on perennial streams, and 20 percent (458) occur on streams that support at least one HCP fish species (see Table 4.8-8). DNRC inventoried 384 road crossings and identified 38 percent (132) problem sites. Site-specific data from the problem sites were then used to calculate the probability of culvert failures in these locations over the 50-year Permit term (DNRC 2007e). The large sample size and wide spatial distribution of the problem sites allows application of the results across DNRC ownership. This evaluation also estimated the volume of sediments that would be delivered to the streams at each crossing should a catastrophic failure occur. The analysis used a simple runoff model to estimate the probability and recurrence interval of storm events large enough to exceed the hydrologic capacity of the existing culvert at each site. Analysis of the results indicate an average failure probability (over the Permit term) of 45 percent for high-risk stream crossings, with an average at-risk sediment volume of about 70 cubic yards (DNRC 2007e). However, these estimates are considered conservative because they are based on the probability of exceeding the carrying

capacity of the culvert under recurrent storm events, which does not necessarily correlate to catastrophic failure.

TABLE 4.8-20. EXISTING ROAD MILES AND ROAD DENSITY, ROAD MILES AND ROAD DENSITY WITHIN 300 FEET OF STREAMS, AND STREAM CROSSINGS IN THE HCP PROJECT AREA, COMPARED TO THE ESTIMATED INCREASES IN THESE PARAMETERS AT THE END OF THE 50-YEAR PERMIT TERM, BY ALTERNATIVE AND AQUATIC ANALYSIS UNIT

Alternative	Bitterroot	Blackfoot	Flathead Lake	Lower Clark Fork	Lower Kootenai	Middle Clark Fork	Middle Kootenai	North Fork Flathead	Rock Creek	Stillwater	Swan	Upper Clark Fork	Upper Kootenai	Upper Missouri	Total
Existing Miles of Road and the Net Increase by Alternative															
Existing	210.1	386.1	81.4	11.4	12	447.5	183.9	69.1	13.2	382.6	258.9	195.4	95.1	298.8	**2,645.5**
Alt. 1	24.0	105.6	18.8	10.6	8.5	192.3	57.4	14.8	11.3	33.7	78.5	106.6	18.8	152.7	**833.7**
Alt. 2	23.4	103.0	17.9	10.2	8.2	185.6	54.9	15.1	11.1	33.8	78.1	104.5	17.8	149.6	**813.2**
Alt. 3	21.6	95.8	14.6	8.9	7.1	162.7	46.0	13.5	10.5	29.1	76.6	98.5	14.4	147.7	**747.0**
Alt. 4	23.4	103.0	17.9	10.2	8.2	185.6	54.9	15.1	11.1	33.8	78.1	104.5	17.8	149.6	**813.2**
Existing Road Density and the Net Increase by Alternative															
Existing	4.85	4.37	4.96	1.75	2.18	3.24	4.10	2.39	1.83	2.80	3.71	2.65	5.47	1.66	**3.09**
Alt. 1	0.55	1.20	1.15	1.64	1.55	1.39	1.28	0.51	1.57	0.25	1.13	1.45	1.08	0.85	**0.97**
Alt. 2	0.54	1.17	1.09	1.57	1.49	1.34	1.22	0.52	1.54	0.25	1.12	1.42	1.02	0.83	**0.95**
Alt. 3	0.50	1.08	0.89	1.37	1.29	1.18	1.02	0.47	1.46	0.21	1.10	1.34	0.83	0.82	**0.87**
Alt. 4	0.54	1.17	1.09	1.57	1.49	1.34	1.22	0.52	1.54	0.25	1.12	1.42	1.02	0.83	**0.95**
Existing Miles of Road within 300 Feet of Streams and the Net Increase by Alternative															
Existing	76.9	100.5	19.1	1.7	2.0	136.3	47.6	13.1	3.4	90.7	54.7	54.3	25.1	75.0	**700.4**
Alt. 1	2.1	10.0	1.6	2.0	1.1	38.5	9.0	3.3	2.7	3.2	18.3	23.4	1.2	26.0	**142.2**
Alt. 2	1.9	9.3	1.3	2.0	1.0	36.3	8.1	1.3	2.6	1.2	8.6	22.7	0.8	24.8	**122.0**
Alt. 3	1.3	7.0	0.2	1.6	0.7	28.6	5.1	1.0	2.4	0.5	8.3	20.7	-0.4	24.4	**101.4**
Alt. 4	1.9	9.3	1.3	2.0	1.0	36.3	8.1	1.3	2.6	1.2	8.6	22.7	0.8	24.8	**122.0**
Existing Road Density within 300 Feet of Streams and the Net Increase by Alternative															
Existing	1.78	1.14	1.16	0.26	0.36	0.99	1.06	0.45	0.47	0.66	0.78	0.74	1.44	0.42	**0.82**
Alt. 1	0.05	0.11	0.10	0.31	0.19	0.28	0.20	0.11	0.37	0.02	0.26	0.32	0.07	0.14	**0.17**
Alt. 2	0.04	0.10	0.08	0.30	0.19	0.26	0.18	0.04	0.37	0.01	0.12	0.31	0.05	0.14	**0.14**
Alt. 3	0.03	0.08	0.01	0.25	0.13	0.21	0.11	0.03	0.33	0.00	0.12	0.28	-0.02	0.14	**0.12**
Alt. 4	0.04	0.10	0.08	0.30	0.19	0.26	0.18	0.04	0.37	0.01	0.12	0.31	0.05	0.14	**0.14**
Existing Stream Crossings and the Net Increase by Alternative															
Existing	204	323	78	7	5	423	180	60	11	303	169	177	99	219	**2,258**
Alt. 1	8	41	7	6	3	120	31	9	7	13	51	71	6	80	**453**
Alt. 2	8	39	6	5	2	113	28	5	7	11	42	69	4	78	**417**
Alt. 3	6	33	3	4	2	92	19	9	7	12	50	63	0	77	**377**
Alt. 4	8	39	6	5	2	113	28	5	7	11	42	69	4	78	**417**

Source: DNRC (2008a).

Road Surface Sediment Delivery

Sediment delivery from roads adjacent to streams is reduced through the physical structure provided by riparian vegetation, which slows water and mechanically filters and stores fine sediment (Beschta 1989; Bilby 1984; Sullivan et al. 1987; Everett et al. 1994). Riparian forests can filter up to 90 percent of the sediment from the uplands, and there is a demonstrated direct relationship between buffer width and buffer effectiveness (FEMAT 1993). Buffer widths tend to be problematic for legacy roads, which were typically constructed adjacent to streams with numerous stream crossings. Current road construction practices regulate road location and design to minimize such impacts to streams and this practice would continue under any of the alternatives. For roads with inadequate available buffer area, DNRC can typically mitigate effects through road relocation or simulating buffers by constructing slash filter windrows. This practice is particularly effective near stream crossings where the road runoff cannot drain to adequate filtration prior to reaching the stream crossing. Empirical studies indicate that correctly applied slash filter windrows can provide significant (75 to 85 percent) sediment filtration effectiveness, which is similar to the estimated filtration provided by buffers between 100 and 300 feet (Table 4.8-21) (Burroughs and King 1989).

TABLE 4.8-21. ESTIMATES OF AVERAGE PERCENT SEDIMENT REDUCTION FROM THE FILTRATION CAPABILITIES OF DIFFERENT SIZE BUFFERS FOR THREE ROAD GRADES

	Road Grade		
Filtration Buffer Width	**5 Percent**	**10 Percent**	**15 Percent**
300 feet	85.0 - 87.9%	88.6 - 93.1%	91.3 – 95.1%
100 Feet	73.5 – 79.1%	77.9 – 86.3%	82.2 – 89.9%
50 feet	61.4 – 66.1%	64.3 – 75.5%	70.0 – 80.9%
5 Feet	17.6 – 17.7%	18.0 – 23.7%	21.2 – 35.7%

Source: DNRC (2008h).

Grazing

The potential effects of grazing on sediment delivery to area streams can occur through the loss of riparian vegetation, physical damage to stream banks, changes to channel stability and channel morphological characteristics, and reductions in the diversity and health of riparian plant communities. Approximately 163 of the 391 parcels (42 percent) of classified forest trust land in the HCP project area that currently have grazing licenses, have stream segments known to support at least one of the HCP fish species (Table 4.8-5). These 163 parcels contain approximately 82 miles of stream supporting bull trout, 121 miles of stream supporting westslope cutthroat trout, and 4 miles of stream supporting Columbia redband trout (Table 4.8-6).

The number of grazing parcels in the HCP project area varies substantially by EIS aquatic analysis unit. As a result, the potential benefits to HCP fish species would tend to vary in a similar manner. For example, about 30 percent of the total grazing license parcels in the HCP project area occur in the Middle Clark Fork analysis unit, as does 34 percent of the parcels containing any HCP fish species. In addition, the Blackfoot analysis unit contains about 22 percent of the grazing license parcels and 25 percent of the parcels with any HCP fish species. The other 12 units contain less than about 13 percent of the parcels with HCP fish species. Therefore, improvements in grazing

parcel management would likely provide the greatest benefits to the HCP fish species in the Middle Clark Fork and Blackfoot EIS aquatic analysis units.

The primary differences between the alternatives regarding the effects of grazing activities, is the implementation of informal or formal training for DNRC staff on grazing license administration and the frequency of monitoring for grazing effects.

Timber Harvest Site Preparation and Slash Treatment

The potential effects of timber harvest activities on sediment delivery to streams occur primarily through soil disturbance and subsequent erosion. The existing SMZ Law and rules, ARMs, Montana Forestry BMPs, and DNRC forest management policies are generally effective at minimizing the soil disturbance activities (DNRC 2005b). In addition, existing harvest methods and procedures minimize soil disturbance, and existing riparian buffers provide adequate filtration of sediments.

Gravel Pits

The construction of forest management roads sometimes requires a source of road bed material in the vicinity. As a result, gravel pits and borrow sites are developed at various locations to supply this material. The exposed surface area of these pits could result in excessive sediment delivery to area streams if appropriate BMPs are not implemented. In general, most gravel operations associated with DNRC forest management road construction are relatively small borrow sites where native materials are excavated and used as fill or surfacing material without further processing, although some sites operate as sorting facilities where material such as pit run and gravel are processed and stockpiled.

Borrow sites are generally associated with road cuts and involve less than 0.1 acre of additional disturbance. While borrow sites may expand the effects of roadway development and disturb a greater area than a normal road segment, the effects are usually localized and adequately addressed with current BMP standards, as well as the existing SMZ Law and Forest Management ARMs.

There are currently 10 gravel operations on the Stillwater Unit with DEQ opencut mining permits, including two active and two undeveloped sites, and a number of inactive or reclaimed sites (DNRC 2007g). There are also two active operations on the Swan Unit. One is used both for pit run and gravel processing, with ongoing operations limited to 1 acre at any one time. The other pit is leased by the U.S. Department of Transportation (DOT) with some limited DNRC use. A third operation in the Swan Unit has been exhausted and reclaimed. However, some material has been stockpiled there that is periodically used by DNRC for its forest management road system. The Swan is also in the early reconnaissance stages of locating another future large gravel operation on the west side of Highway 83. There is also one small third-party pit within the Plains Unit, and a small inactive pit near Lynch Creek. The Libby Unit has about six small pits under permit to third parties, one of which is occasionally used by DNRC for small operations of up to 10 loads.

There are currently no large gravel operations on the SWLO that are used exclusively by DNRC, as recent trends involve ordering gravel and rock from private sources for delivery to the DNRC project sites. There are also no active gravel pits on HCP project area scattered parcels within the CLO. Borrow sites are used for culvert installations or road maintenance. The primary sources of gravel are located in the valley on non-HCP parcels. If a timber sale is proposed on an HCP project

area parcel, a gravel pit may be developed near the project if suitable material is available, or it may be hauled from a pit in the valley that is located on a non-HCP parcel.

Alternative 1 (No Action)

Forest road conditions and sediment delivery problems will improve over time under Alternative 1, primarily through the implementation of current road management practices and application of sediment BMPs on new roads and gradually abandoning or upgrading existing roads. These measures already provide a large degree of conservation to HCP fish species and provide an effective means for minimizing sediment delivery to streams. However, improvements to existing roads would only occur as these roads are needed to achieve timber harvest objectives. As such, there would be no particular prioritization based on the extent or degree of problem areas related to sediment delivery rates to streams. As a result, the road conditions and sediment delivery problems would vary among watersheds, and thereby inconsistently influence fish populations within these watersheds.

While new road construction projects would use current design specifications and incorporate appropriate BMPs, they would still likely result in some additional deterioration of stream habitat, and improving existing roads would not necessarily result in correcting the most problematic roads, or the ones affecting fish-bearing streams. Therefore, overall conditions in the HCP project area are expected to remain similar to existing conditions or degrade slightly, until a substantial number of existing problem roads are eventually upgraded to current standards. This would result in some road surfaces continuing to drain directly to fish-bearing streams, including those supporting HCP fish species. As such, it is unclear how the expected changes in sediment delivery would affect fish and other aquatic species.

At the end of the 50-year Permit term, Alternative 1 would result in a net increase in road miles, ranging from 8.5 miles in the Lower Kootenai aquatic analysis unit, to about 192 miles in the Middle Clark Fork unit (Table 4.8-20). Overall, Alternative 1 would result in the largest net increase in the road system (about 834 miles) of any of the alternatives. This equates to a 32 percent increase in road miles within the project area after 50 years, with about a 20 percent increase (142 miles) in the road miles occurring within 300 feet of streams. The number of road-stream crossings would also increase by about 20 percent to 453 crossings. The estimated road densities at 50 years would also vary by aquatic analysis unit, ranging between 0.25 and 1.64 mi/mi^2.

The varying stipulations for buffer widths provided under the four alternatives would result in different sediment reduction potential (Table 4.8-19) (DNRC 2008h). Under Alternative 1, timber harvest is allowed in the SMZ buffer (50 to 100 feet wide) of 50 percent of trees greater than or equal to 8 inches dbh or 10 trees per 100-foot segment, whichever is greater. Along with the retained trees, shrubs, and sub-merchantable trees, there is also limited restriction to harvest directly adjacent to streams, but no requirement for a no-cut buffer. Based on the ability of even a relatively narrow riparian buffer to effectively intercept and infiltrate water and sediment, and the removal of stream-side legacy roads over time under Alternative 1, there would be an overall reduction in sediment delivery by the end of the Permit term as compared to existing conditions, as well as a relatively steady rate of improvement over time (Table 4.8-19). Overall habitat conditions for fish, including HCP fish species, are expected to be maintained or slightly improved.

Alternative 1 would implement grazing management standards and numeric criteria established in the SFLMP to determine initial stocking rates and acceptable levels of riparian use and streambank impacts. DNRC would also evaluate grazing licenses midterm between license renewal inspections. Thus, Alternative 1 is not expected to present an increased risk of adverse effects if existing grazing management activities continue through the Permit term. Similarly, because existing timber harvest site preparation and slash treatment procedures are generally effective at minimizing in-stream sedimentation effects from these activities (DNRC 2004e), no substantial adverse effects to fish habitat or aquatic species are expected in either the short or long term.

In addition, all gravel pits and borrow sites would be operated according to existing rules and regulations, with no specific restrictions on the number of active sites. Therefore, no increased risk of sediment delivery should occur over time from Alternative 1 compared to existing conditions.

In summary, Alternative 1 would continue existing DNRC policies and procedures in regard to existing and new roads, riparian buffers, grazing practices, timber harvest site preparation and slash treatment, and gravel pits, which all can affect sediment production and in-stream delivery to various levels. Compared to current conditions, however, Alternative 1 would not result in substantial changes or increases in the potential to adversely affect fish habitat or fish species. In addition, some of these policies and procedures (i.e., relocation of stream-side legacy roads and placement of new roads away from streams) would result in less overall sediment delivery, so fish habitat functions affected by sedimentation would be expected to improve somewhat over the long term.

Alternative 2 (Proposed HCP)

The sediment delivery reduction conservation strategy was designed to meet three specific management objectives for HCP fish species: (1) reduce the potential for in-stream sedimentation levels, (2) manage for levels of in-stream habitat complexity, and (3) maintain stream channel stability and channel form and function. As discussed above, the primary source of sediment delivery on forested trust lands is believed to be forest roads. Therefore, the HCP conservation strategy focuses on road management to benefit the HCP fish species and other aquatic resources. This includes inventorying all roads on forested trust land parcels in westslope cutthroat trout and Columbia redband trout watersheds within 20 years of HCP implementation, and all roads in watershed supporting bull trout within the first 10 years (commitment AQ-SD2). The comprehensive inventories would allow DNRC to minimize the number of open roads, ensure existing and new roads meet current standards, and prescribe that these roads incorporate site-specific BMPs and mitigation measures designed to minimize sediment production and delivery.

Alternative 2 would be similar to Alternative 1 for the construction of all new roads, as they would be constructed using current design practices, specifications, and BMPs to design efficient and environmentally sound forest roads (commitment AQ-SD3). The overall reductions in sediment delivery would be the same as those estimated under Alternative 1 by the end of the 50-year Permit term (Table 4.8-19). However, Alternative 2 would generally provide greater benefits to fish and aquatic habitat than Alternative 1 because of mandated rates of road inventory and corrective actions, and because fewer net miles of road would be added within the HCP project area. In addition, HCP aquatic species would benefit not only from a faster rate of problem identification and correction, but problem roads would be corrected based on a priority list, such that the roads having the greatest effects on streams occupied by HCP fish species would be corrected first (commitment AQ-SD2). Under this commitment, all high-risk sites in bull trout watersheds would

be corrected within the first 15 years and within 25 years for westslope cutthroat trout and Columbia redband trout watersheds. This would result in the most substantial problem areas, and specifically those affecting HCP fish species, being corrected substantially earlier than expected under Alternative 1.

In addition to correcting problem roads sooner than Alternative 1, Alternative 2 would incorporate the inventory information to identify HCP fish species streams, which would facilitate the implementation of additional avoidance, minimization, and protection measures in the vicinity of these streams (i.e., reducing stream crossings, minimizing road construction, and maximizing buffer capacities). As a result, Alternative 2 is expected to reduce the overall sediment delivered to HCP fish species streams, over the course of the Permit term, as compared to Alternative 1.

The HCP process also ensures adequate review of proposed timber harvests by DNRC water resource specialists to minimize the potential delivery of sediments to streams, particularly those that support HCP fish species (commitment AQ-SD4). This includes (1) identifying site-specific harvest techniques in areas potentially affecting HCP fish species habitat; (2) designing and implementing site-specific road standards, contract specifications, BMPs, and other mitigation measures; and (3) providing adequate adaptive management feedback through implementation and effectiveness monitoring. Monitoring activities include quantitative assessments of the effectiveness of BMPs and other mitigation measures, BMP audits, and contract administration inspections.

The riparian harvest requirements for Alternative 2 require a 25-foot no-harvest buffer around Tier 1 streams and the potential for expanding the 50 percent tree retention buffer to include the floodprone riparian area to accommodate stream channel migration (commitment AQ-RM1). Because the riparian buffer would be wider and denser than under Alternative 1, Alternative 2 is expected to reduce sediment delivery to streams, particularly Tier 1 streams that contain HCP fish species (FEMAT 1993) (Table 4.8-21). It would also benefit other HCP species and other aquatic species by riparian harvest components that include harvest restrictions for CMZs, extended RMZs, and a restriction on the total riparian area in non-stocked or seed/sapling structural stages. The protection for Tier 2 and 3 streams would be similar to those for Alternative 1.

Alternative 2 includes several allowances for salvage harvest of disease- or insect-infested trees from within the 25-foot no-harvest buffer on Tier 1 streams, and for salvage harvest of fire-killed trees to exceed the normal 50 percent retention requirement in that portion of a Tier 1 RMZ outside the 25-foot no-harvest buffer. Alternative 2 also allows for the management of a portion of the total Tier 1 RMZ acreage using harvest prescriptions designed to meet the minimum retention tree requirement of the SMZ Law.

These allowances are limited in extent and scope and are not expected to have substantial effect on sediment delivery in HCP project area streams. For example, salvage allowances would be limited to harvest affecting less than 20 acres of RMZ, and the portion of RMZ managed down to the requirement of the SMZ Law would not exceed 15 percent of total Tier 1 RMZ area within each DNRC administrative unit.

The limited amount of RMZ area managed under these allowances would still be subject to the requirements of the SMZ Law; therefore, it is expected to have effects similar to those described under Alternative 1. In addition, salvage harvest conducted under these allowances would also be

required to retain a minimum of 10 trees per 100 feet of stream within the first 25 feet of RMZ. Salvage harvest would also be required to retain all streambank trees and all downed trees lying within the stream channel or embedded within the stream bank.

DNRC would design and implement site-specific BMPs and other mitigation measures to reduce the risk of sediment delivery from all gravel pits to streams affecting HCP fish species (commitment AQ-SD5). A DNRC water resource specialist would make recommendations that would be integrated into the development of contract specifications, permits, and Plans of Operations (as required under ARM 17.24.217).

In addition to the existing grazing inspection and monitoring program, DNRC would use these data as a coarse filter to identify potential problem areas, then develop a process and timeline for verifying and prioritizing the problems affecting aquatic habitat, develop and implement corrective actions, and follow up with implementation and effectiveness monitoring (commitment AQ-GR1). In addition to the grazing management rules and regulations, Alternative 2 establishes specific numerical guidelines for riparian zone utilization and streambank disturbance levels. This approach is expected to minimize the loss of riparian vegetation and physical damage to stream banks, maintain channel stability and channel morphological characteristics, and promote diverse and healthy riparian plant communities. As a result, Alternative 2 is expected to provide a more comprehensive and coordinated approach to minimizing grazing effects on fish habitat and species, compared to Alternative 1.

In summary, Alternative 2 would improve on existing DNRC policies and procedures through HCP conservation strategies that specifically apply to existing and new roads, riparian buffers, grazing practices, timber harvest, site preparation and slash treatment, and gravel pits, which all can affect sediment production and in-stream delivery to various levels. As compared to Alternative 1, the proposed HCP is expected to result in moderate to substantial short-term and long-term improvements in the sediment aquatic habitat component, which in turn would benefit all fish species. In addition, because of the tiered approach based on the sediment problem inventory and correction process established in the HCP sediment conservation strategy, aquatic habitat utilized by HCP fish species would likely benefit the most, although other aquatic species occupying these areas would also benefit from reduced sediment delivery to the area streams.

Alternative 3 (Increased Conservation HCP)

In general, Alternative 3 includes the same sediment reduction conservation commitments as Alternative 2, but would implement the commitments more quickly than Alternative 2. This includes completing the existing road inventory about twice as fast as Alternative 2 (5 years for bull trout watersheds and 10 years for the other HCP fish species watersheds). The corresponding corrective actions would be implemented at least 25 percent quicker than Alternative 2, including within 10 years for bull trout watersheds and 20 years for westslope cutthroat trout and Columbia redband watersheds. Specifically, because BMPs would be applied to existing problem road areas, large decreases in the amount of road-based sediment production and delivery would occur over relatively short time periods (Table 4.8-19). Additionally, Alternative 3 would provide greater benefit to fish and aquatic habitat than Alternatives 1 and 2, because fewer net miles of road would be added within the HCP project area (Table 4.8-20).

The sediment delivery rates resulting from Alternative 3 would be similar for all the alternatives. However, the faster implementation of problem road corrections would result in greater overall reductions in cumulative sediment delivery over the course of the Permit term than either Alternative 1 or Alternative 2. Because Alternative 3 would also prioritize problem roads in HCP fish species watersheds, greater reductions in overall sediment delivered to these streams would occur, compared to the other alternatives.

Alternative 3 expands the no-harvest buffer to encompass the entire RMZ, with the potential to include the entire floodprone width in some instances. Because this buffer would be substantially wider and typically denser than the other alternatives, Alternative 3 would likely reduce sediment delivery by a greater amount in streams that contain HCP fish species, providing a greater benefit to all three HCP fish species (FEMAT 1993) (Table 4.8-19). It would also benefit other aquatic species and other HCP species by incorporating riparian harvest components that include greater harvest restrictions for CMZs and a requirement of USFWS approval for any salvage harvest allowances.

Management of gravel pits and grazing activities would be similar to Alternative 2, although Alternative 3 would increase the frequency of monitoring for grazing effects from once every 5 years to annually and would include measurable targets for monitoring following implementation of corrective actions. This would result in a greater assurance that the grazing strategy was successful in minimizing sediment inputs and that grazing problem areas were promptly and successfully addressed

In summary, Alternative 3 would improve on the specific Alternative 2 conservation strategies as applied to existing and new roads, riparian buffers, grazing practices, timber harvest site preparation and slash treatment, and gravel pits, which all can affect sediment production and in-stream delivery to various levels. As compared to both Alternatives 1 and 2, Alternative 3 would result in moderate to substantial short-term and long-term improvement in the sediment aquatic habitat component, which in turn would benefit all fish species. In addition, because of the tiered approach of the sediment problem inventory and corrective actions, aquatic habitat utilized by HCP fish species would likely benefit the most, although other fish species also occupy these areas as well.

Alternative 4 (Increased Management Flexibility HCP)

Alternative 4 includes the same conservation commitments as Alternative 2, but would generally implement the commitments more slowly. This includes completing the existing road inventory about 25 percent more slowly than Alternative 2 (15 years for bull trout watersheds and 25 years for the other HCP fish species watersheds). The corresponding corrective actions would be implemented on a project-by-project basis, similar to Alternative 1. Management of gravel pit and grazing activities would be similar to Alternative 2. Based on these factors, Alternative 4 would likely result in a greater short- and long-term improvement in the sediment aquatic habitat component than Alternative 1, but less improvement than Alternatives 2 and 3.

Alternative 4 provides a 25-foot no-harvest buffer around Tier 1 streams, although the 50 percent tree retention provision would only extend for an additional 25 feet. Because of the relative buffer width and density, it would result in a greater improvement in sediment filtration than Alternative 1, but less improvement than Alternatives 2 and 3. Alternative 4 also includes the same salvage harvest allowances that are included in Alternative 2. These allowances are not expected to substantially affect levels of sediment delivery to streams.

In summary, Alternative 4 has similar strategies addressing sediment production and delivery as Alternative 2, although the specific commitments are somewhat less robust and allow implementation to extend for a somewhat longer timeframe. Overall, Alternative 4 would have a positive effect on the sediment habitat component, which would benefit fish and other aquatic species. This improvement would be greater than Alternative 1, but less than Alternatives 2 and 3.

Summary of Sediment Impacts

Based on differences in the commitments for road inventory and problem resolution, the density and width of riparian buffers, and the monitoring and adaptive management strategies for grazing, Alternative 3 would provide the greatest potential benefit to fish habitat and aquatic species, particularly in the short term. The potential benefits would decrease sequentially for Alternatives 2, 4, and 1, respectively. However, even under Alternative 1, the baseline condition for sediment would be expected to improve in the long-term (Table 4.8-19), although the rate of improvement would be slower than for the other alternatives in the short term. In addition, any risk of adverse effects from Alternative 1 would apply equally to all fish species, including HCP aquatic species, while the risk for HCP fish species from the other alternatives is reduced because the conservation commitments for Alternatives 2 through 4 focus inventory and corrective actions on watersheds that contain the HCP fish species. However, the difference between alternatives would diminish over time, and by the end of the Permit term, the habitat component of sediment production and delivery under Alternative 1 would be relatively equivalent to all other alternatives. Despite this expected equivalency at the end of Permit term, the action alternatives would reduce sediment production and delivery rates sooner than Alternative 1, resulting in greater cumulative benefits during the entire Permit term.

Habitat Complexity

Habitat complexity is influenced by a variety of factors related to timber harvest and forest management activities. In this instance, the term specifically refers to aquatic habitat, although upland factors also have a direct and indirect influence on the aquatic environment. In addition to sediment loading (described above), the other primary influencing factors are LWD recruitment, canopy cover (shading), streambank stability, channel form and function, and flow regimes.

Reducing LWD input to a stream by harvesting potential streamside recruitment material, may affect fish habitat by causing or contributing to channel instability, reducing in-stream habitat complexity, and influencing channel form and function. The potential recruitment of LWD to stream channels from adjacent forest stands is generally limited to an area located within a width less than or equal to the 100-year site index tree height as measured from the edge of the stream channel. As a consequence, rates of LWD recruitment typically vary considerably between localities and physiographic regions. Within each physiographic region, in-stream LWD counts can be compared to broad descriptions of channel characteristics, including bankfull width, gradient, and Rosgen channel type.

The LWD recruitment modeling was adapted from the RAIS model (Welty et al. 2002), which was originally developed to model LWD recruitment and shade in forested systems on the western slopes of the Cascade Mountains. In order to incorporate site-specific physical stand characteristics for forested sites specific to western Montana forests, some components of the original RAIS model were modified (Larix Systems 2007). The RAIS (v3) model (Welty et al. 2002) was used to model

shade conditions in the HCP project area. The RAIS model was used because it runs the forest growth simulator independent of the wood recruitment and shade models, allowing the use of any suitable growth model. Also, the model predicts both shade production and LWD recruitment and has a built-in three-dimensional visualization feature. In addition, the RAIS model was previously used by Plum Creek and Washington Department of Natural Resources to model LWD recruitment in their HCPs.

Model input consisted of Forest Vegetation Simulator (FVS) tree lists for five representative stand types (Beaver, Dingley, Gird, South Lost, and Swede Creeks) projected for the four alternatives. See Section 4.8.2.2 (Habitat Complexity) for physical descriptions of the representative stand types (Figures 4.8-6 through 4.8-10). The LWD recruitment and shade simulations used these data to analyze all combinations of stand types and alternatives (5x4 analyses) over three Rosgen stream channel types that are representative of stream channels occurring in the planning area. Each simulation was run over a period of 100 years.

For the purpose of RAIS modeling, model inputs for the physical characteristics (stream width, slope, etc.) of streams within the planning area were based on three Rosgen stream channel types. Based on a data analysis of the Rosgen stream-typing from existing watershed inventories, Rosgen B channel types are the most common channel type within the planning area, representing about 55 percent of stream channels on trust lands. Rosgen A channels represent an additional 25 percent, and Rosgen D, E, F, and G channel types combined constitute the remaining 20 percent.

The RAIS model also incorporates average bankfull widths and riparian buffer slopes and channel gradients. Average bankfull widths were calculated for the three Rosgen stream channel classifications modeled, based on actual survey data gathered by DNRC during recent watershed inventories. Representative riparian buffer slopes and channel gradients were calculated based on the representative geometry of the respective Rosgen channel types. The LWD simulations evaluated wood recruitment within the OHWM of the identified stream segments as a step-wise function. For each 10-year time interval (step), the amount of wood in the stream was a function of the in-stream wood in the previous time step, plus the amount subsequently recruited from the adjacent forest, minus the amount depleted through decay or transport since the previous time step (Welty et al. 2002). The modeled changes in LWD recruitment potential provide comparisons between the four alternatives, as well as relative to a target recruitment level. These LWD targets were developed by analyzing reference LWD frequencies in unmanaged stands located on USFS land, stratified by Rosgen stream class and physiographic region. DNRC performed statistical analyses on the data, to quantify LWD targets based on reference conditions in unmanaged stands. LWD targets range from 1 to 74 pieces per 1,000 feet of channel, depending on channel type and physiographic location.

Initial LWD frequencies were based on an analysis of in-stream LWD frequencies within managed DNRC lands gathered during recent stream surveys and watershed inventories. The initial LWD levels varied for the three simulated Rosgen channel types (see Section 4.8.2.2, Habitat Complexity). Initial LWD levels were established for each stream channel type to facilitate the modeling exercise, even though LWD levels are highly variable and closely tied to the associated riparian stand conditions (Teply et al. 2007; Light et al. 1999).

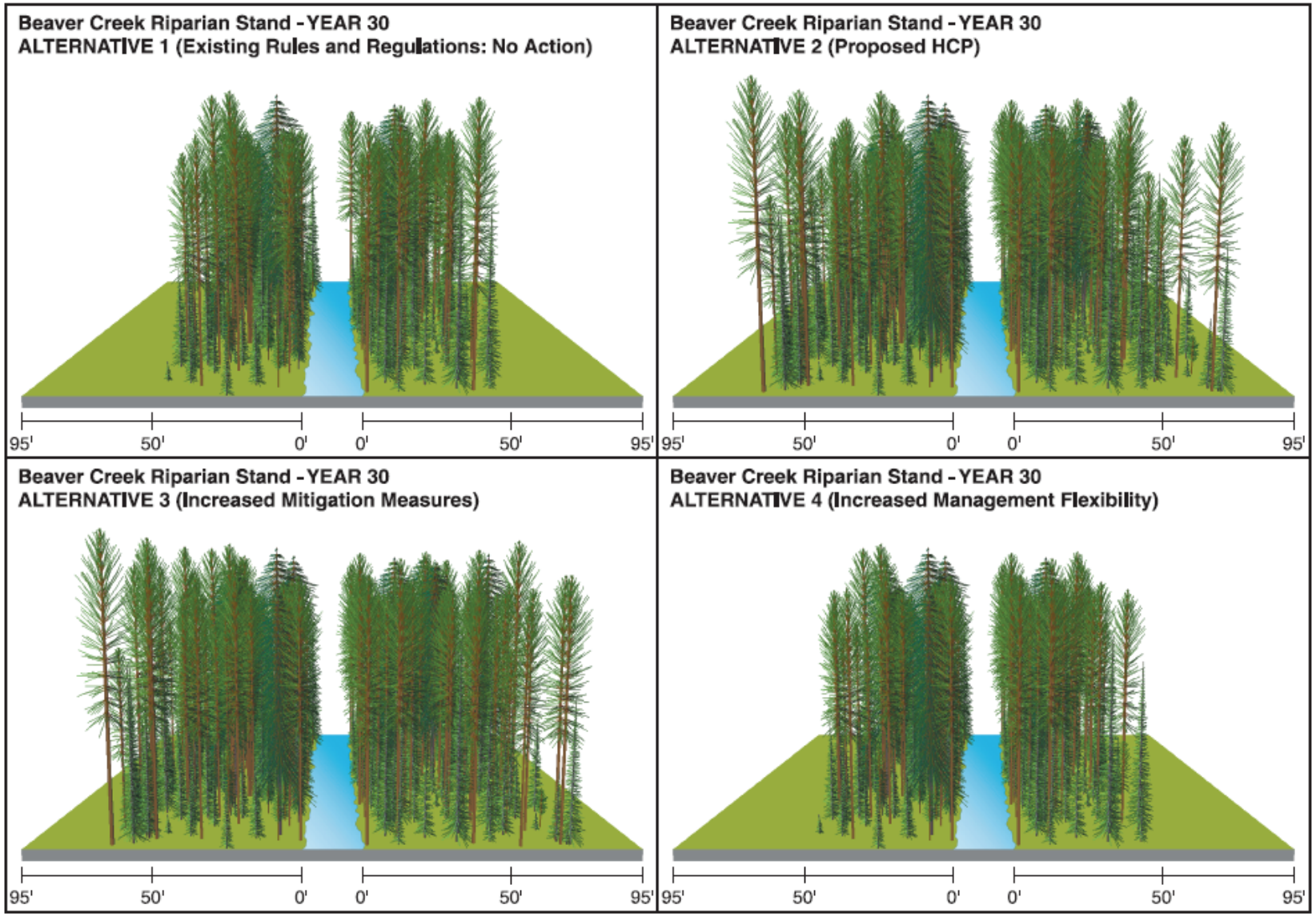


FIGURE 4.8-6. STAND VISUALIZATIONS OF RIPARIAN AREAS AT YEAR 30 UNDER ALL ALTERNATIVES FOR THE BEAVER CREEK STAND TYPE

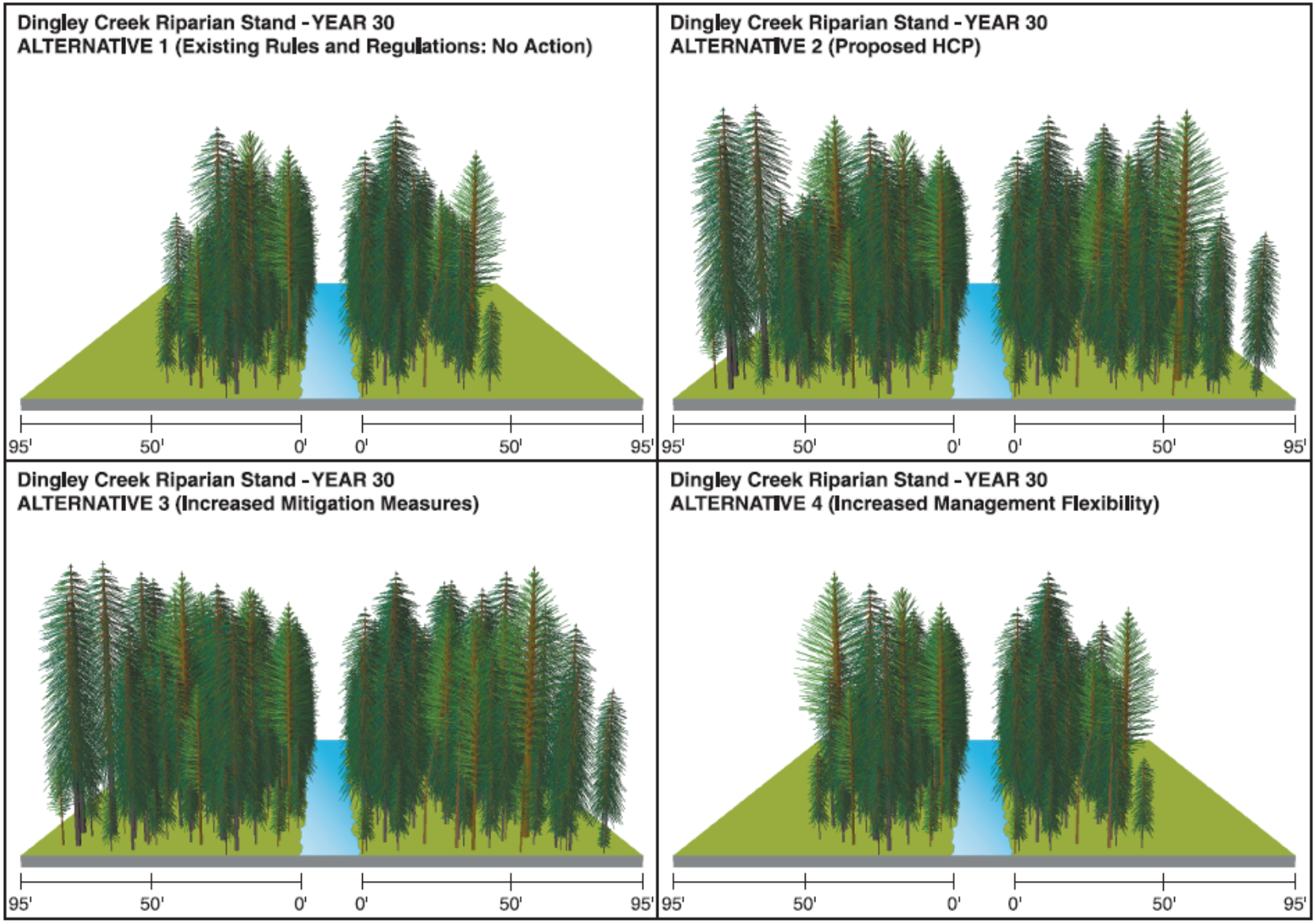


FIGURE 4.8-7. STAND VISUALIZATIONS OF RIPARIAN AREAS AT YEAR 30 UNDER ALL ALTERNATIVES FOR THE DINGLEY CREEK STAND TYPE

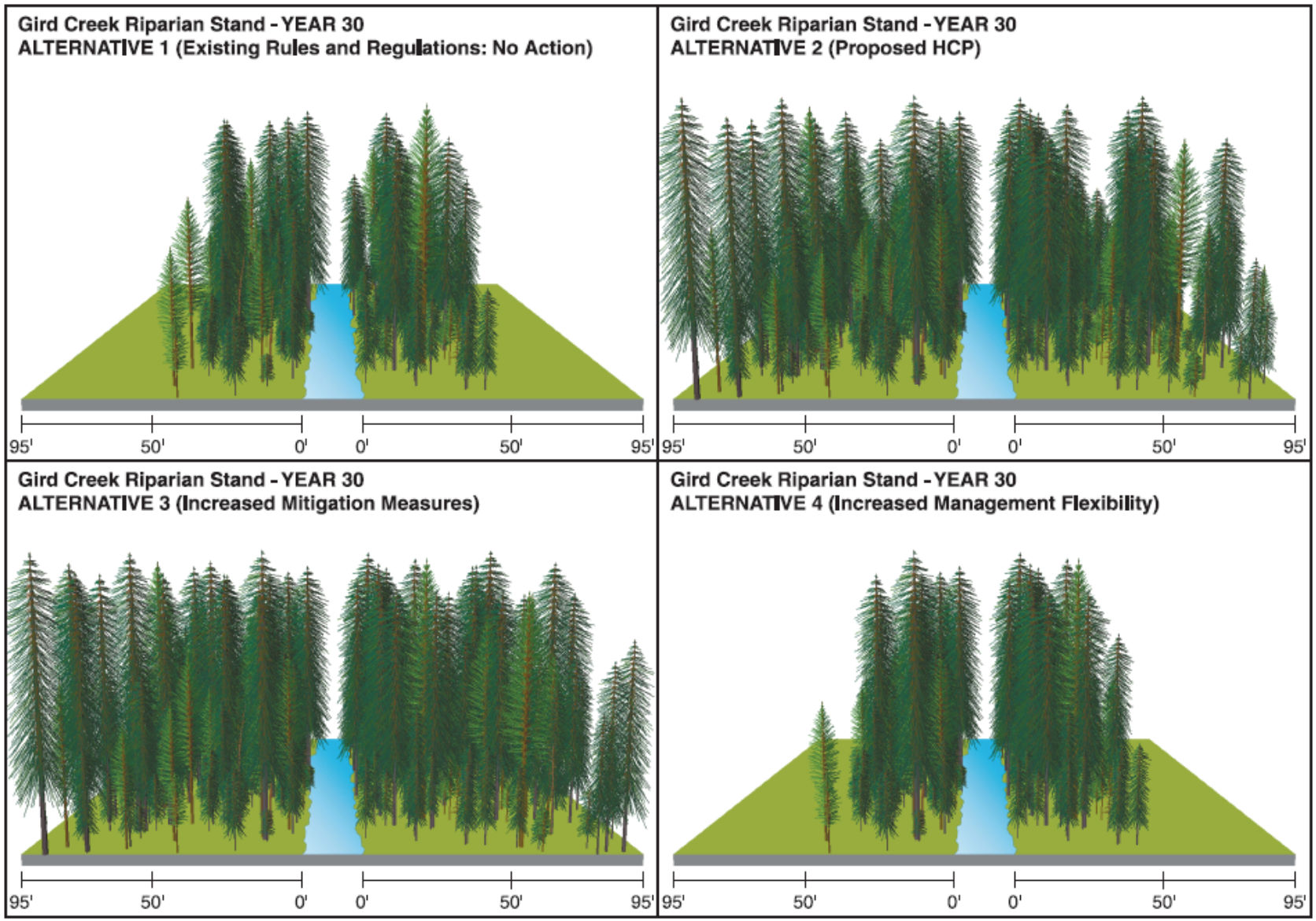


FIGURE 4.8-8. STAND VISUALIZATIONS OF RIPARIAN AREAS AT YEAR 30 UNDER ALL ALTERNATIVES FOR THE GIRD CREEK STAND TYPE

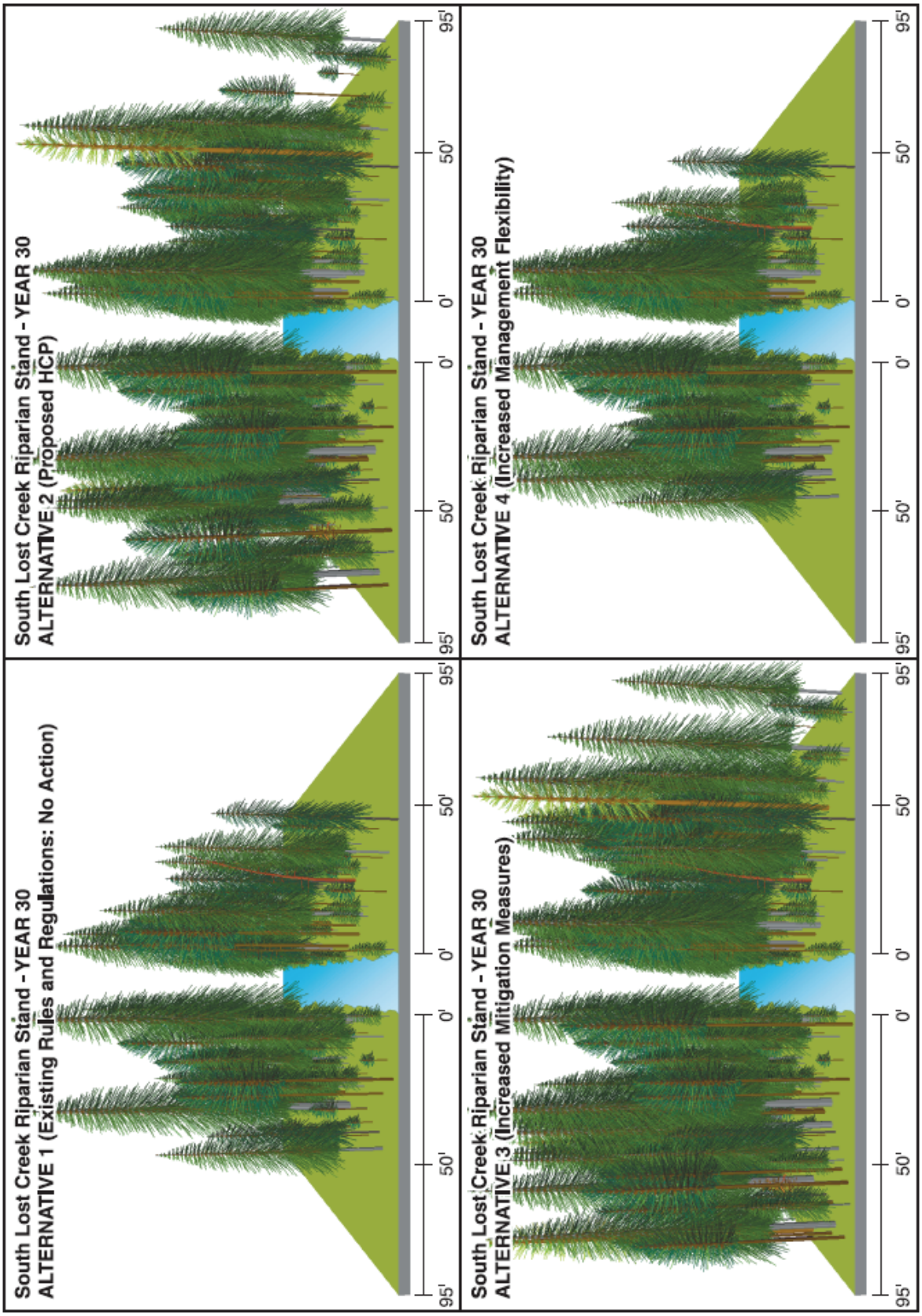


FIGURE 4.8-9. STAND VISUALIZATIONS OF RIPARIAN AREAS AT YEAR 30 UNDER ALL ALTERNATIVES FOR THE SOUTH LOST CREEK STAND TYPE

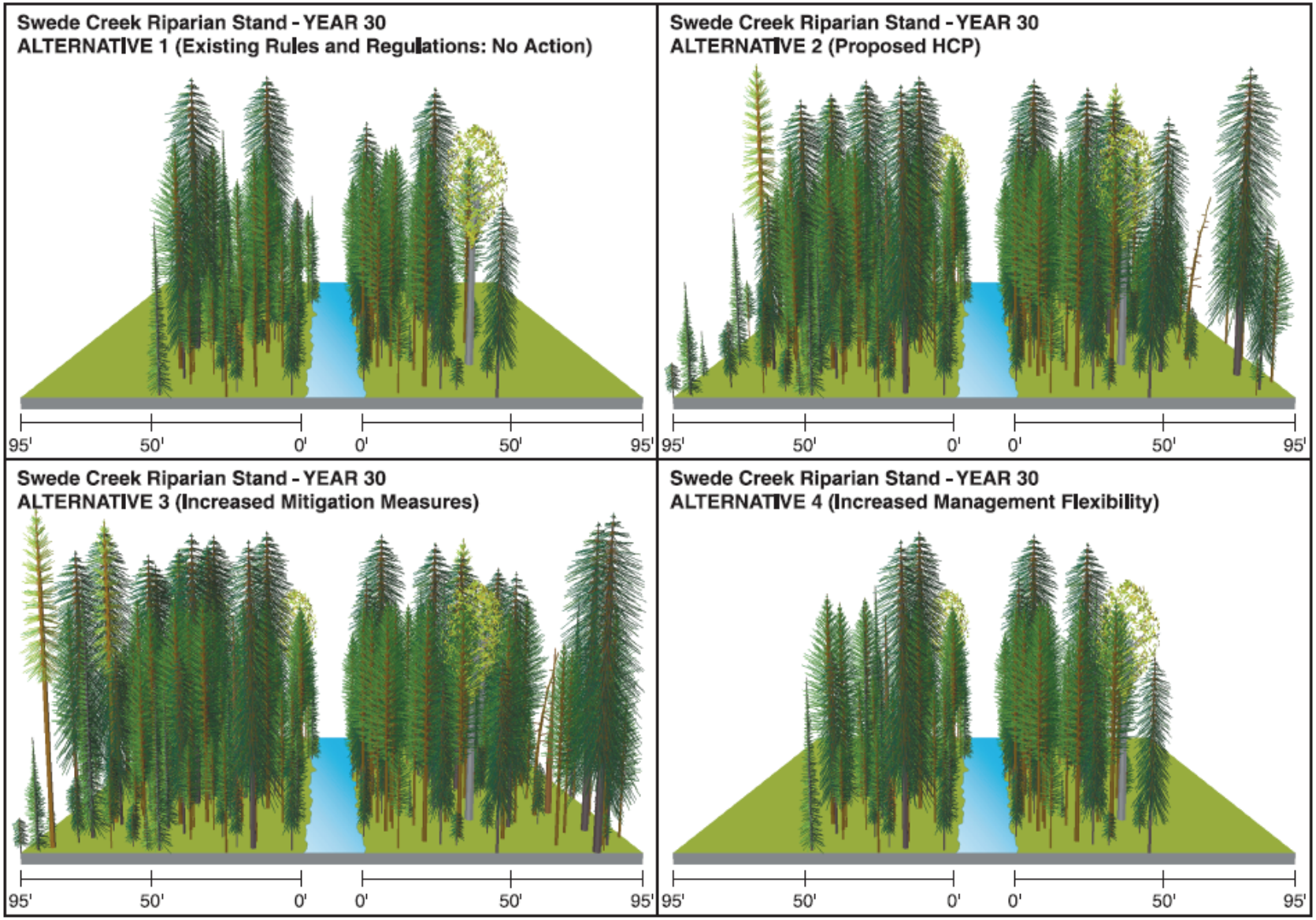


FIGURE 4.8-10. STAND VISUALIZATIONS OF RIPARIAN AREAS AT YEAR 30 UNDER ALL ALTERNATIVES FOR THE SWEDE CREEK STAND TYPE

The RAIS model simulates tree mortality and subsequent windthrow, but does not include recruitment resulting from streambank erosion, mass wasting, floods, or fire. The FVS was used to predict stand characteristics, and tree lists generated for each 10-year step were used to provide estimates of tree fall from mortality. As a result of the assumptions made regarding recruitment and depletion parameters, the modeling is believed to underestimate the number and variability of LWD pieces recruited to and retained in the modeled streams. Such an understanding of the relatively conservative model assumptions is critical for interpretation of results.

Alternative 1 (No Action)

Under existing laws and regulations, harvest conducted within the riparian zone must retain all bank edge trees and enough other trees to ensure adequate potential LWD recruitment to fish-bearing streams. Adequate LWD recruitment levels are defined under the ARMs as those that maintain channel form and function. The root systems of trees located near stream banks provide channel stability and potential in-stream habitat. Harvest and removal of such trees may increase the potential for bank erosion and decrease channel stability.

Despite the contribution to channel stability and habitat diversity, there is no specific standard pertaining to LWD recruitment under existing laws and regulations. As a result, the LWD recruitment estimates for the three modeled Rosgen stream channel types indicate that Alternative 1 typically results in relatively low LWD recruitment levels throughout a substantial portion of the 100-year period modeled for the five stand types representing the various physiographic regions within the planning area (Figures 4.8-11 through 4.8-13). Under Alternative 1, in-stream LWD levels decrease for all stand types during the early portion of the modeled period, although LWD recruitment potential generally increases during the later portion of the modeled period (typically after 25 to 50 years). This decrease is due to the removal of up to 50 percent of trees within the SMZ, including trees directly adjacent to the stream channel. The majority of recruited LWD occurs within this zone. Also, under Alternative 1, relatively intense harvest can occur in the RMZ portion of the riparian area (from the edge of the SMZ [50 to 100 hundred feet from stream edge] out to the 100-year site index tree height), which can also serve to recruit LWD.

Despite having initially decreasing LWD levels, Alternative 1 typically exceeds the identified LWD target levels for most of the scenarios modeled (Figures 4.8-11 through 4.8-13). The only exceptions were the A and B stream channel types under the Swede Creek and South Lost Creek stand type scenarios, and A and C channel types under the Dingley Creek stand type scenario. However, both of these scenarios indicate LWD levels exceeding the target levels after about 50 to 70 years. Furthermore, trends show an increasing or stable in-stream LWD level by the end of the 100-year modeling period for all modeled scenarios. This is likely due to increased tree growth in the SMZ and RMZ due to increases in open canopy from the greater riparian harvest expected under Alternative 1.

These data indicate that the existing laws and regulations are generally effective at maintaining adequate LWD levels within most stand and stream channel types. These results are consistent with a number of researchers that found that a substantial portion of LWD recruitment occurs from trees very near the stream banks (McGreer 1994; McDade et al. 1990; and Robison and Beschta 1990). In particular, Murphy and Koski (1989) found that about 50 percent of the LWD recruitment was from streambank trees. Also, LWD recruitment from windthrow and bank erosion can be important

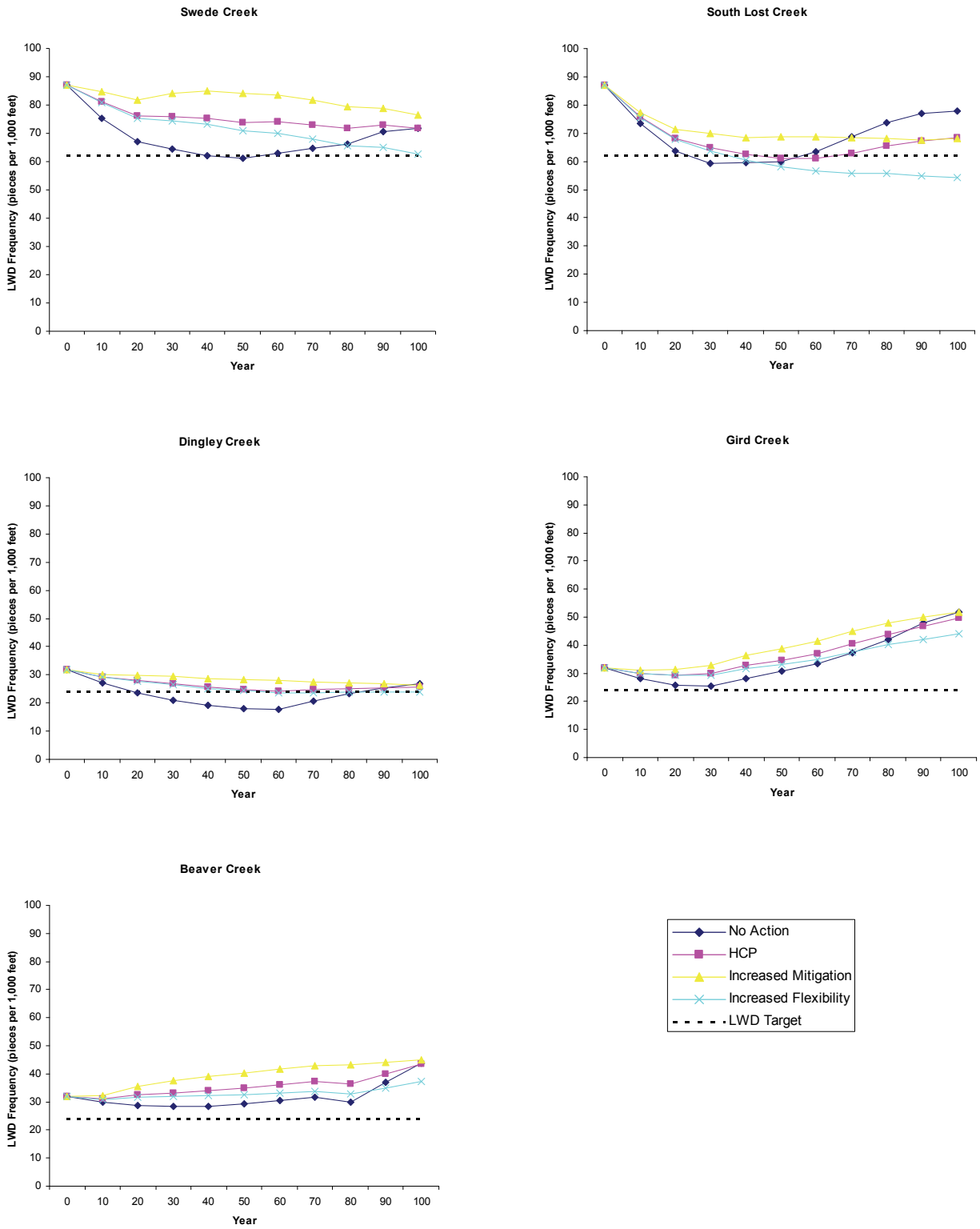


FIGURE 4.8-11. MODELED IN-STREAM LWD FREQUENCIES (IN PIECES LWD PER 1,000 FEET) OF VARIOUS STAND TYPES IN ROSGEN CLASS A STREAMS BY DECADE

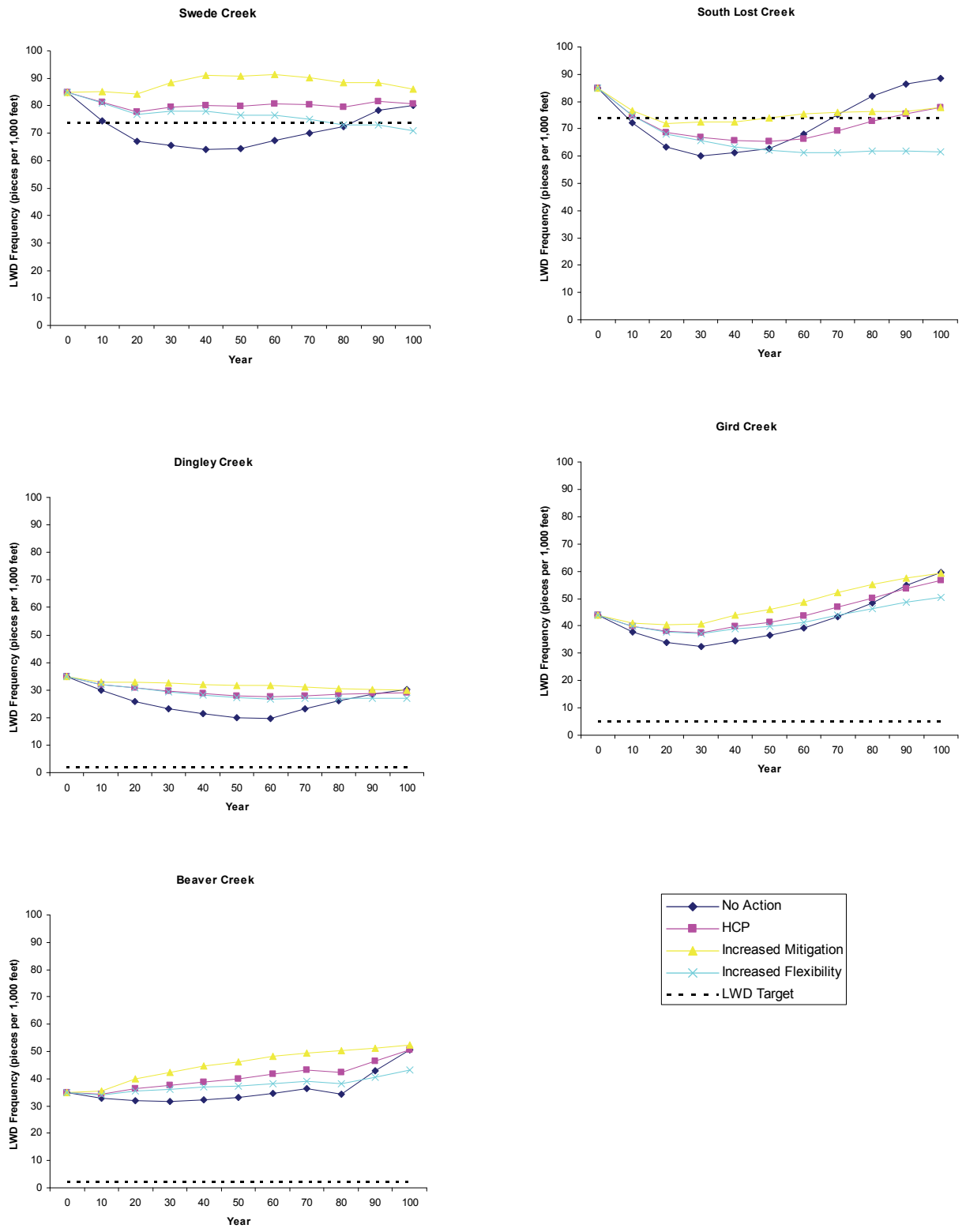


FIGURE 4.8-12. MODELED IN-STREAM LWD FREQUENCIES (IN PIECES LWD PER 1,000 FEET) OF VARIOUS STAND TYPES IN ROSGEN CLASS B STREAMS BY DECADE

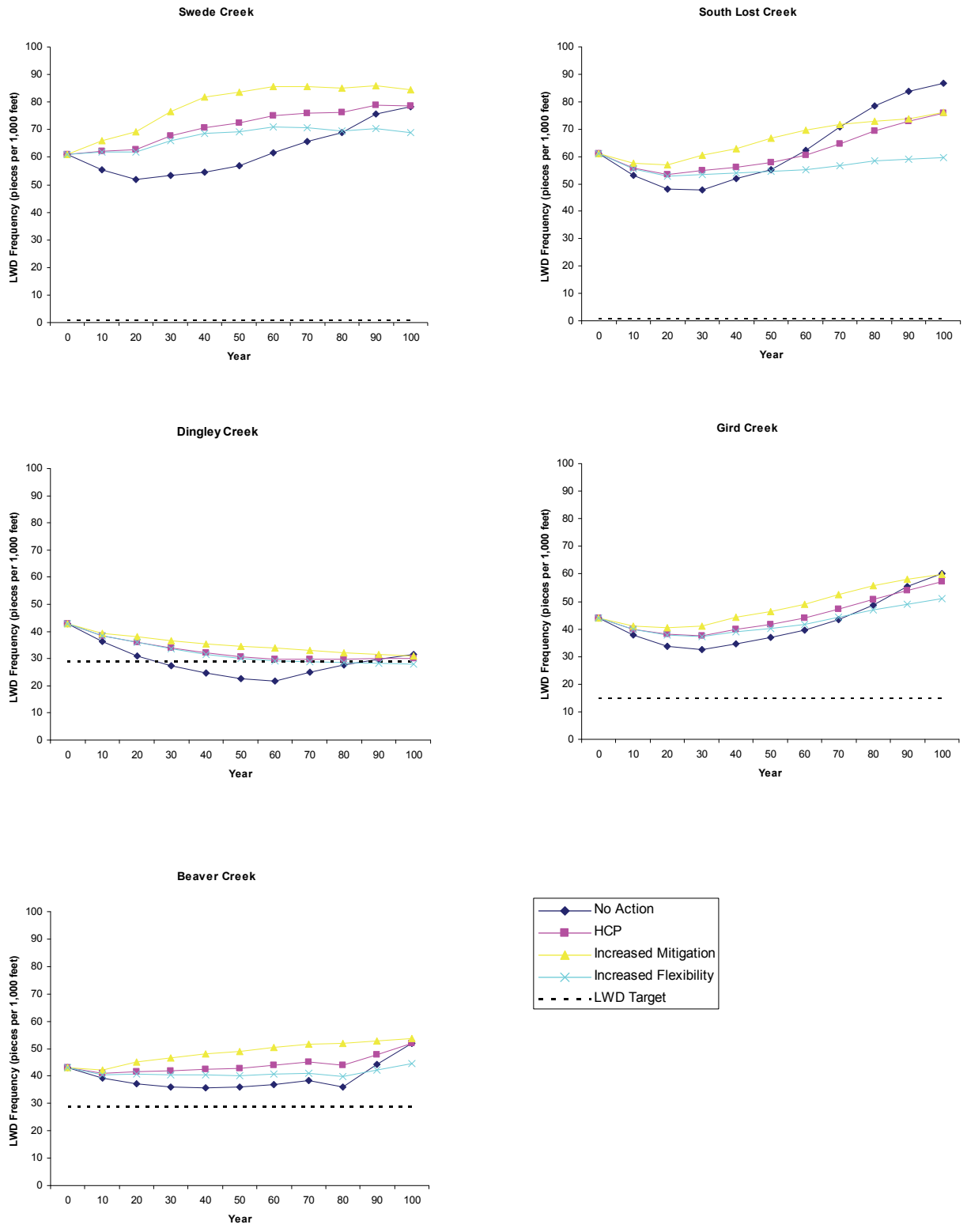


FIGURE 4.8-13. MODELED IN-STREAM LWD FREQUENCIES (IN PIECES LWD PER 1,000 FEET) OF VARIOUS STAND TYPES IN ROSGEN CLASS D, F, AND G STREAMS BY DECADE

sources of in-stream LWD. Because the model did not assume the contribution of LWD from these sources, the results may underestimate the total amount of in-stream LWD provided.

Maintaining adequate LWD recruitment levels is expected to support other stream channel form and function characteristics relative to fish habitat. The recruitment of wood provides complex in-stream habitat for fish by providing cover and organic material to the stream to maintain invertebrate production. Wood also adds channel roughness to reduce water velocities and allow flows to variably scour portions of the stream to form pools and undercut banks to increase the amount of available habitat for fish production.

Although Alternative 1 is expected to maintain adequate stream form and function characteristics, there would be no assurances of species conservation. This alternative provides no mechanism for adaptive management, which would allow changes in timber harvest prescriptions, without specific changes in the existing laws and regulations.

Alternative 2 (Proposed HCP)

In contrast to Alternative 1, Alternative 2 would result in generally greater LWD frequency estimates throughout most of the 100-year period modeled for Tier 1 streams. However, these frequency estimates tended to be similar to Alternative 1 toward the end of the 100-year modeling period, as discussed above. This pattern was similar for all stream channel and stand types modeled, except for the South Lost Creek stand type (Figures 4.8-11 through 4.8-13).

Alternative 2 also has less of an initial decrease of in-stream wood, likely due the influence of the 25-foot no-harvest buffer directly adjacent to the stream channel and relatively less intense harvest out to the 100-year site index tree height for Tier 1 streams (commitment AQ-RM1). Alternative 2 also has harvest restrictions for CMZs, extended RMZs, and a restriction on the total riparian area in non-stocked or seedling/sapling structural stages (commitment AQ-RM1). With the exception of the South Lost Creek stand type associated with Rosgen A and B stream channel types, all of the modeled scenarios exceeded the LWD target levels throughout the 100-year modeling period for Alternative 2. The estimated period that these two exceptions would not meet the target levels is between 25 and 75 years of HCP implementation, although the trend for in-stream LWD in this scenario is positive after year 30. Similar to Alternative 1, LWD levels show a generally increasing or stable in-stream LWD level by the end of the 100-year modeling period, although tree growth within the riparian zone is likely slower, due to canopy closure conditions that offer less light penetration (Figures 4.8-11 through 4.8-13).

Alternative 2 contains several allowances for salvage harvest of disease- or insect-infested trees from within the 25-foot no-harvest buffer on Tier 1 streams, and salvage harvest of fire-killed trees to exceed the normal 50 percent retention requirement in that portion of a Tier 1 RMZ outside the 25-foot no-harvest buffer. Alternative 2 also allows for the management of a portion of the total Tier 1 RMZ acreage using harvest prescriptions designed to meet the minimum retention tree requirement of the SMZ Law.

These allowances are limited in extent and scope and are not expected to have a substantial effect on LWD recruitment on streams within the HCP project area. For example, salvage allowances would be limited to harvest affecting less than 20 acres of RMZ, and the portion of RMZ managed down to

the requirement of the SMZ Law would not exceed 15 percent of total Tier 1 RMZ area within each DNRC administrative unit.

The limited amount of RMZ area managed under these allowances would still be subject to the requirements of the SMZ Law; therefore, it is expected to have effects similar to those described under Alternative 1. In addition, salvage harvest conducted under these allowances would also be required to retain a minimum of 10 trees per 100 feet of stream within the first 25 feet of RMZ. Salvage harvest would also be required to retain all streambank trees and all downed trees lying within the stream channel or embedded within the stream bank.

As discussed above under Alternative 1, increased LWD recruitment is expected to increase in-stream fish habitat and/or improve existing habitat by increasing its complexity. The increased wood is also expected to improve the overall form and function of the stream channels, compared to existing conditions. In addition to the increased fish conservation potential, Alternative 2 also provides an adaptive management process to measure the effectiveness of the strategy to meet meaningful LWD targets and to ensure appropriate changes in management to help to meet the conservation objectives of the proposed HCP. While the proposed HCP includes conservation commitments to maintain LWD in Tier 1 streams, the commitments for Tier 2 and 3 streams would be provided by existing regulations. Therefore, no differences are expected for LWD levels in Tier 2 and 3 streams from those expected for Alternative 1.

Alternative 3 (Increased Conservation HCP)

The in-stream LWD frequency estimates for Alternative 3 are generally greater throughout most of the 100-year modeling period than either Alternative 1 or 2 (Figures 4.8-11 through 4.8-13). Alternative 3 also meets the established LWD target levels for all channel and stand type combinations analyzed, with the exception of the B stream channel type under the South Lost Creek stand type scenario. As expected, the modeling results suggest that Alternative 3 would have the greatest increase in LWD frequency (or the lowest decrease in frequency) during the Permit term, as compared to Alternatives 1 and 2. In addition, the LWD frequencies for all modeled scenarios under Alternative 3 are greater at the end of the Permit term than Alternatives 1 or 2. However, as indicated above, a number of the modeled scenarios indicate similar LWD frequencies between alternatives at 100 years, with Alternative 1 at a higher LWD frequency at the end of the 100-year modeling period than Alternative 3 for some scenarios. The modeled LWD results for Alternative 3 are likely due to a wide (out to the 100-year site index tree height) no-harvest buffer, which would encourage maximum LWD recruitment in the short term, but would slow recruitment somewhat in the long term due to closed canopy conditions expected to reduce tree growth (Figures 4.8-11 through 4.8-13).

As discussed earlier, increases in LWD recruitment would be expected to improve in-stream habitat conditions, compared to either Alternative 1 or the other action alternatives in Tier 1 streams. However, no differences are expected for LWD levels in Tier 2 and 3 streams from those expected for Alternative 1. In addition, this alternative would provide the same adaptive management benefits identified above for Alternative 2.

Alternative 4 (Increased Management Flexibility HCP)

Modeled LWD estimates for Alternative 4 generally decrease over much of the modeled period. While these estimates are greater than Alternative 1, they are lower than Alternatives 2 or 3

throughout the Permit term. This alternative results in the lowest recruitment level of all the alternatives at year 100, for all modeled scenarios (Figures 4.8-11 through 4.8-13). Despite these comparatively low LWD frequencies, the LWD levels typically exceed the target levels (except for the A and B channel types under the South Lost Creek stand type).

These differences in short-term rates of in-stream wood (higher than Alternative 1, but not as high as Alternatives 2 and 3) versus those in the long term (less than Alternatives 1 through 3), are likely due to the combination of a 25-foot no-harvest buffer and relatively greater harvest in the remainder of the SMZ compared to the other action alternatives. In most cases, these riparian buffers would contribute to adequate in-stream LWD conditions, although these levels decline somewhat in years 50 to 100 due to a larger-scale removal of trees out to the 100-year site index tree height (Figures 4.8-11 through 4.8-13). In addition, this alternative does not apply the same adaptive management benefits identified above for Alternatives 2 and 3.

As discussed earlier, the differences in LWD recruitment between the alternatives would occur for Tier 1 streams. However, no differences are expected for LWD levels or recruitment in Tier 2 and 3 streams, as these functions would continue to be provided by existing regulations.

Summary

Overall, the modeling results indicate that all alternatives are generally effective at maintaining the key riparian function of in-stream LWD at a level that provides for fish conservation, including the HCP aquatic species. In most scenarios, all alternatives meet the established LWD targets based on actual data from unmanaged stands (Figures 4.8-11 through 4.8-13). However, there were differences between the alternatives for in-stream LWD frequencies over the Permit term, with Alternative 3 providing the greatest LWD levels, and sequentially decreasing for Alternatives 2, 4, and 1. These results are likely due to differences in the amount of initial riparian harvest immediately adjacent to the stream banks versus harvest extending to the 100-year site index tree height.

Most of the scenarios and alternatives analyzed for LWD frequencies indicate a generally declining trend through the first 10 to 50 years and a typically increasing or stable trend over the later part of the modeling period. This suggests that the depletion rate is exceeding the recruitment rate, and that all of the alternatives result in some reduction in the LWD loading potential due to varying harvest activities within the 100-year site index tree height. However, it should be noted that for LWD recruitment, Alternative 3 is effectively a “non-management” option because no harvest would occur within the 100-year site index tree height of Tier 1 streams. As expected, Alternative 1 generally resulted in lower LWD frequencies during the Permit term, while Alternative 3 tended to provide the highest frequencies.

Despite generally declining LWD recruitment during the early portion of the modeling period, the results for most of the channel and stand type combinations suggest that recruitment levels would likely be similar, or even slightly greater for Alternative 1 after 100 years as compared to some of the other alternatives (Figures 4.8-11 through 4.8-13). This pattern is particularly evident for the South Lost Creek stand type, which shows a substantially higher LWD recruitment potential after about 80 years for Alternative 1 versus the other alternatives. This pattern is also consistent across all three channel types with this stand type. The relatively consistent recovery of LWD during the later years of Alternative 1 is likely the result of increased tree growth within the SMZ resulting

from opening up the canopy through the thinning process, allowing additional recruitment of wood from riparian areas.

Based on the model assumptions, particularly the assumption that decadence alone produces LWD, the LWD frequency rates for all alternatives are likely somewhat conservative, as windthrow, bank erosion, and insect damage and disease can all contribute significantly to LWD recruitment. Furthermore, the model runs did not incorporate the CMZs, which would in some cases expand the no-harvest and partial-harvest riparian buffer even farther from the stream channel for the action alternatives. This would likely result in higher LWD frequencies at some locations, at least over the Permit term.

All of the action alternatives have some mechanisms for adaptive management, including monitoring, while Alternative 1 would not allow changes in timber harvest prescriptions, without specific changes in the existing laws and regulations. Therefore, although all of the alternatives are expected to maintain adequate stream form and function characteristics, the action alternatives would better ensure in-stream LWD levels to support native fish species. Also, because riparian buffer widths for these alternatives is greatest in situations where HCP aquatic species are present, these species would have an increased assurance of properly functioning LWD conditions.

Stream Temperature and Shading

Riparian vegetation has a direct influence on stream water temperature, particularly where the vegetation overhangs the water surface. The principal source of heat for small mountain streams is direct solar radiation striking the surface of the water (Moore et al. 2005); therefore, streamside canopy cover and shading have a primary influence on stream water temperatures. Harvesting trees near a stream may reduce the canopy cover and associated shade provided to a stream by that canopy. In addition, decreased canopy cover tends to cause lower winter stream temperatures, potentially reducing fish habitat by causing earlier, more extensive, and longer periods of ice formation.

The overall effectiveness of stream channel shading is a function of riparian stand type, riparian stand structure, channel incision angles, side-slope gradients, channel processes, disturbance regimes, and climatic or elevation factors associated with different physiographic regions. Therefore, the expected amounts of shading found within stream networks throughout western Montana are considerably variable. In addition to this variability, the effectiveness of various widths of riparian buffer in providing shade to streams is closely tied to the 100-year site index tree height.

The value of riparian buffers in mitigating stream temperatures has been recognized for several decades. Brown (1971) noted that on very small streams, adequate shade may be provided by brush species. Rishel et al. (1982) demonstrated that buffer strips help moderate stream temperatures following clearcutting in forests, and Dent and Walsh (1997) found that the 7-day maximum and average stream temperatures decreased as stream buffer width increased.

Simulation of stream shading processes was modeled using the RAIS model (Welty et al. 2002). This model predicted total shade (percent blocking solar radiation) for the same stand and stream channel types used for LWD simulation described above. As with the LWD simulations, consistent

riparian zone widths improved comparability of results. However, shade from hardwood, brush, and adjacent commercial forest were not considered, nor was site topography (including slope). Simulations did vary by stream channel type, primarily via the differing channel widths associated with the channel type, and the stream areas to be shaded by the riparian stand. The modeled stream widths were based on DNRC watershed inventory data and stratified by Rosgen channel type classifications. Average stream widths were 7.2 feet for Rosgen Type A streams, 16.8 feet for Rosgen Type B streams, and 51.5 feet for the same combined Rosgen channel types of D, F, and G, as discussed for the LWD recruitment modeling.

Shade targets were set based on the existing pre-harvest shade levels. Although the relationship between shade and temperature is not well-defined and is influenced by multiple local factors (elevation, topography, etc.), Washington State Timber, Fish, and Wildlife (1990) program data indicates that in medium-elevation stands (1,000 to 2,300 feet) a 15 percent reduction in shade, on average, will result in a 1.0 to 1.5^{o} C (1.8 to 2.7^{o} F) increase in maximum stream temperature. In addition, the minimum post-harvest stream shading level of 45 percent (2,300-foot elevation stands) to 70 percent (1,000-foot elevation stands) is generally adequate to ensure that stream reaches meet water quality parameters for salmonids.

Using the pertinent literature and comparison to a no-harvest or unmanaged prescription, the data are expected to show that (1) the percent decrease in shade is relatively small under Alternative 1 (e.g., less than 15 percent[1]), and (2) this percent decrease is unlikely to adversely increase stream temperatures. The advantage of this analysis approach is that it is relatively simple and may show the harvest prescriptions are all similar in maintaining adequate levels of shade. Disadvantages include the lack of definitive and detailed information on the shade and temperature relationship.

Alternative 1 (No Action)

Under existing laws, harvest activities conducted within the combined SMZ and RMZ are not required to maintain a no-harvest buffer, but must retain all bank edge trees and retain enough other trees to ensure adequate levels of shade, which is defined as the ability to maintain natural temperature ranges. Sugden and Steiner (2003) studied 10 sites in western Montana, harvested under Montana's SMZ regulations, and found no statistically significant increases in stream temperatures compared to pre-harvest conditions. Although limited, these data suggest that Montana's current SMZ regulations are adequate to maintain stream temperature regimes, at least in some instances.

Although the existing regulations appear to be adequate to maintain stream temperatures, the modeling results indicate that a distinct initial decrease in stream shading would occur for all channel and stand types immediately after harvest under Alternative 1 (Figures 4.8-14 through 4.8-16). About half of the modeled scenarios for this alternative also result in the shade levels at

[1] Washington State Timber, Fish, and Wildlife (1990) program data indicates that in medium-elevation stands (300 to 700 meters) a 15 percent reduction in shade, on average, will result in a 1.0 to 1.5^{o} C increase in maximum stream temperature and that a minimum post-harvest stream shading level of 45 percent (700-meter elevation stands) to 70 percent (300 meter elevation stands) is generally adequate to ensure these stream reaches meet Washington State water quality parameters for salmonids.

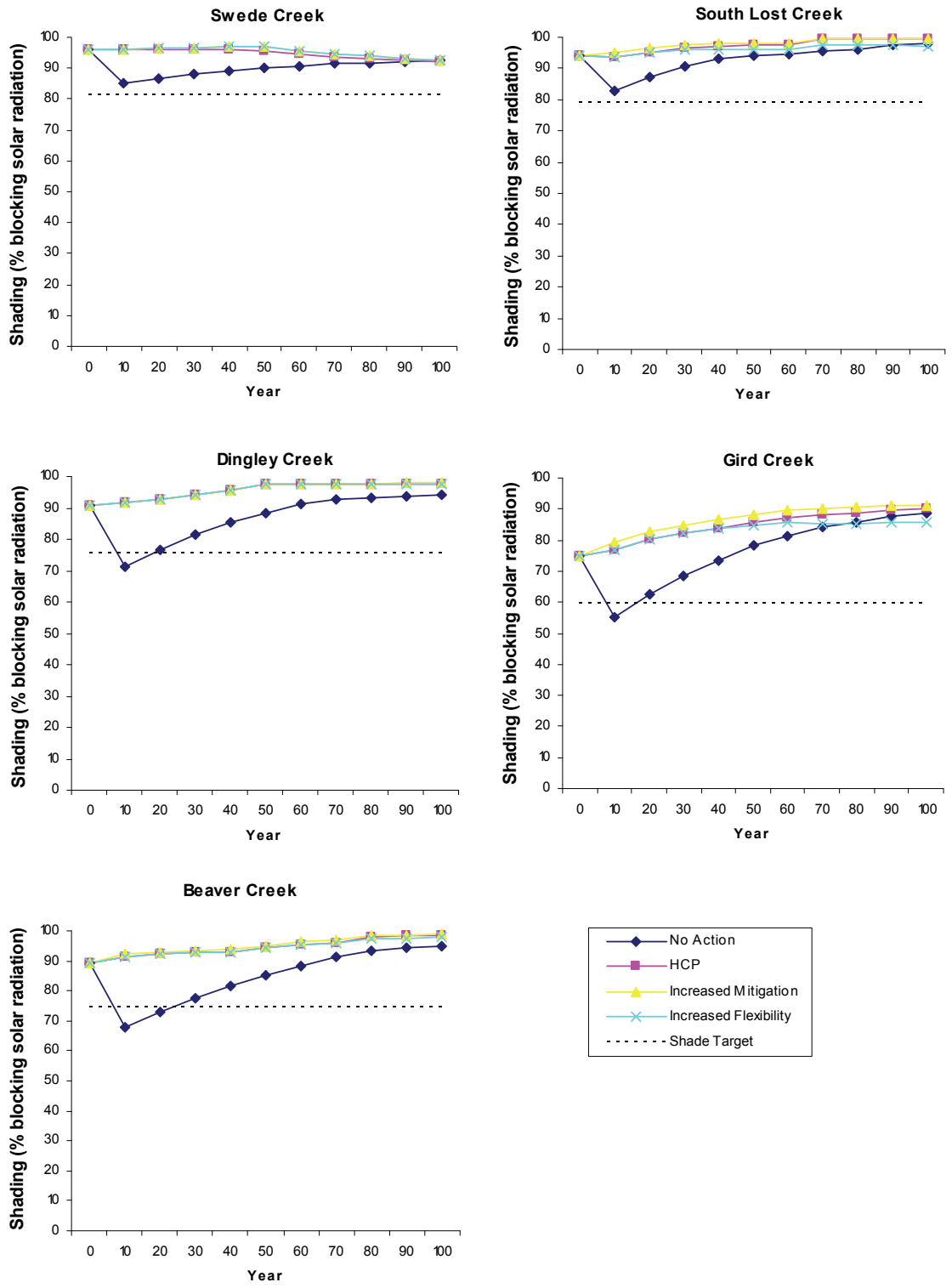


FIGURE 4.8-14. MODELED IN-STREAM SHADING (PERCENT BLOCKING SOLAR RADIATION) OF VARIOUS STAND TYPES IN ROSGEN CLASS A STREAMS BY DECADE

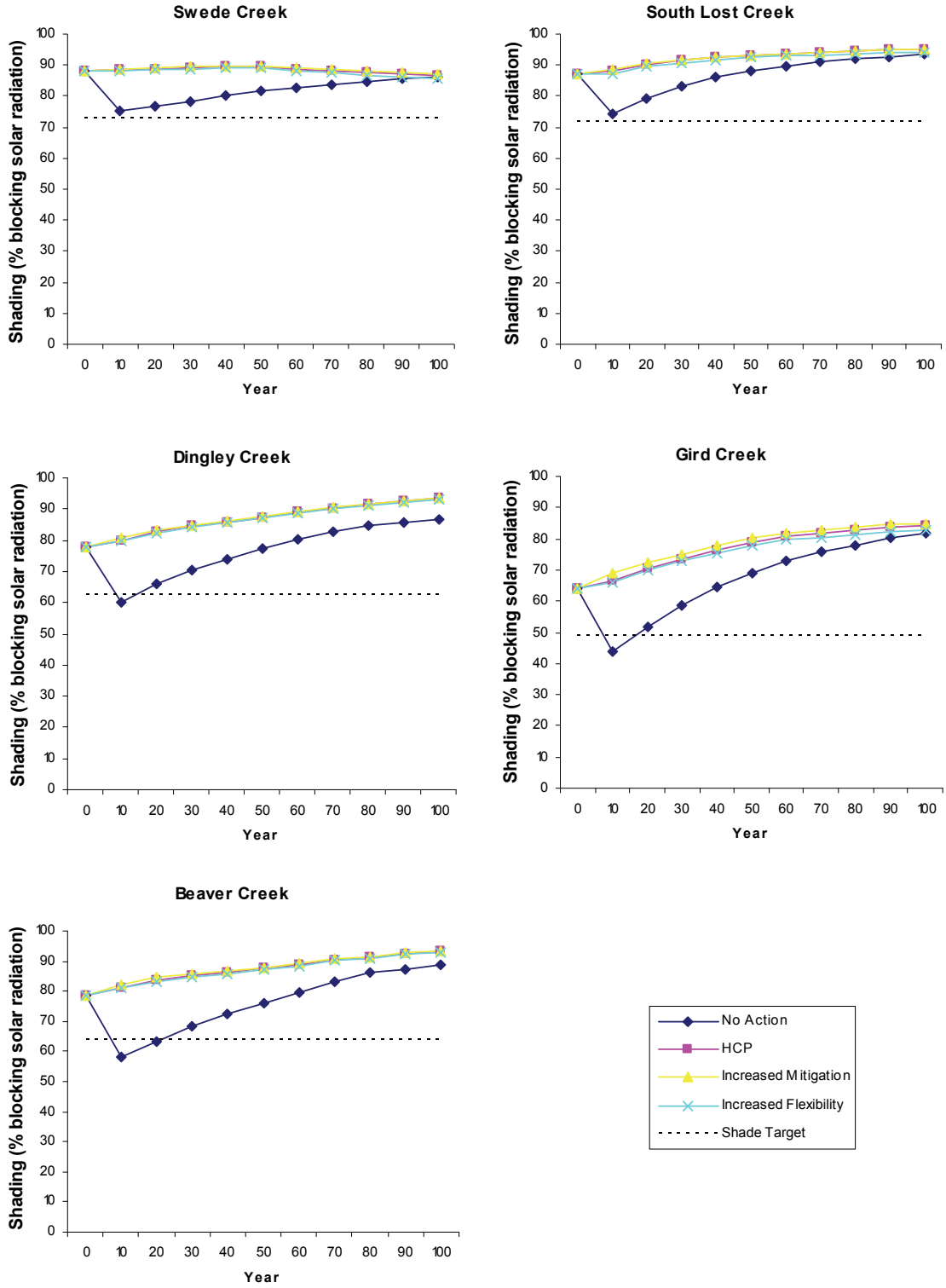


FIGURE 4.8-15. MODELED IN-STREAM SHADING (PERCENT BLOCKING SOLAR RADIATION) OF VARIOUS STAND TYPES IN ROSGEN CLASS B STREAMS BY DECADE

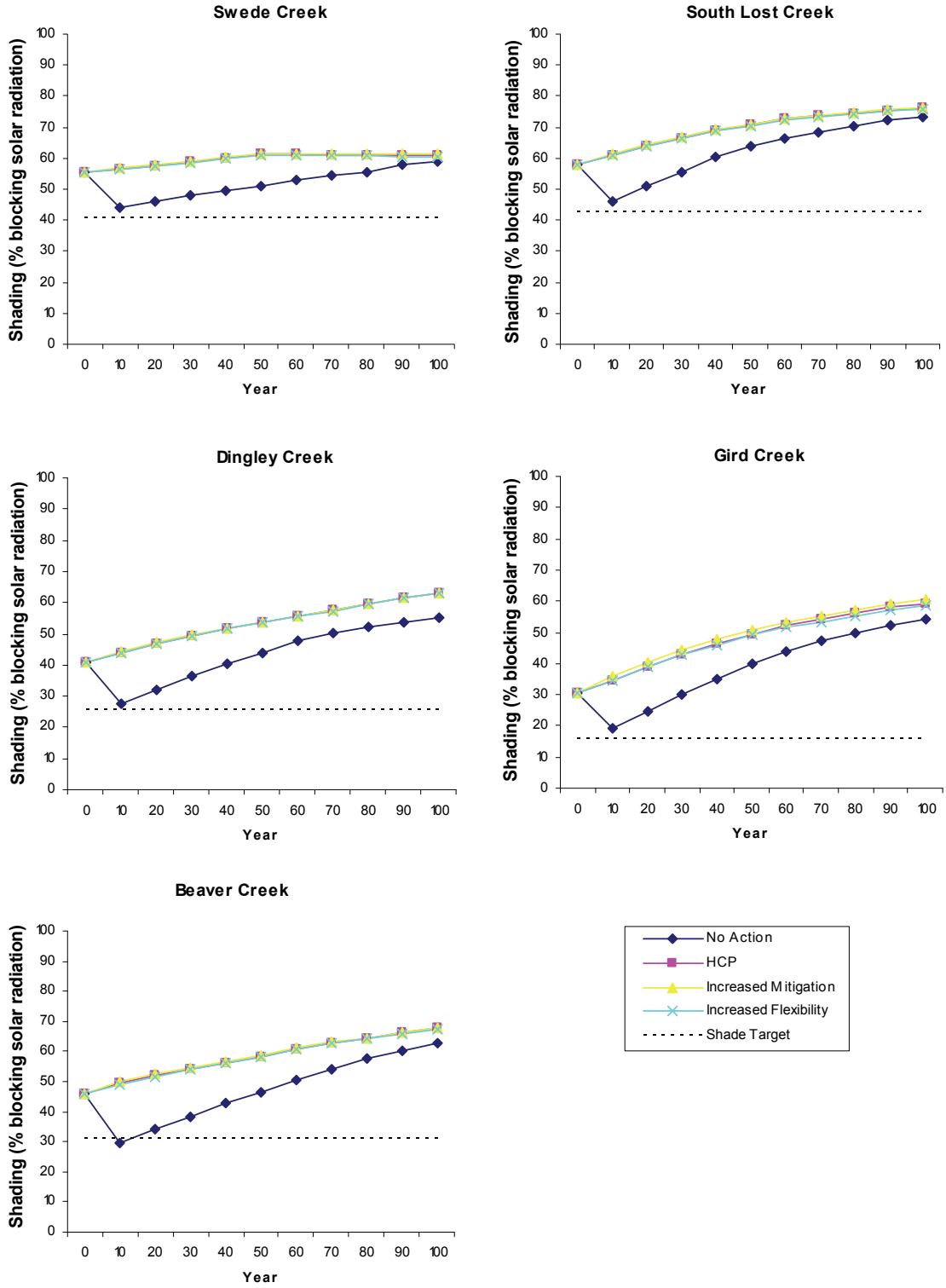


FIGURE 4.8-16. MODELED IN-STREAM SHADING (PERCENT BLOCKING SOLAR RADIATION) OF VARIOUS STAND TYPES IN ROSGEN CLASS D, F, AND G STREAMS BY DECADE

10 years being below the established shade target levels. The decreased shading would occur because existing regulations allow some harvest within the SMZ and RMZ immediately adjacent to the stream, thereby reducing riparian forest densities and shade levels. This is supported by the findings of Castelle and Johnson (2000) that the maximum shade to a stream was achieved within 50 to 100 feet of the stream channel.

For most modeled scenarios, the amount of stream shade under Alternative 1 remains below pre-harvest levels until about year 50 to 70 (after the Permit term). However, despite the initial decrease in shading, Alternative 1 shade levels steadily increase over time, and exceed the target levels by about year 30, for all model scenarios. These shade improvements occur at a relatively fast rate for Alternative 1 because the riparian forest densities are reduced due to SMZ and RMZ harvest, which provides greater light penetration and increased understory growth, increased vegetated structural heterogeneity, and faster tree growth (Anderson et al. 2007).

The reduced shading resulting from Alternative 1 could result in a corresponding increase in summer water temperatures and/or cooler winter conditions, although the extent of any potential measurable temperature changes (if any) is unknown. Based on other studies (Washington State TFW 1990; Sugden and Steiner 2003), it can be assumed that any temperature increase would be relatively small (i.e., less than 1.5^{o} C [2.7^{o} F] maximum temperature increase), if not unmeasurable. The shade modeling results suggest that the greatest potential for temperature effects would most likely occur within the first decade, and gradually diminish throughout the modeling period, taking about 50 to 70 years to return to the pre-harvest baseline conditions.

Alternative 2 (Proposed HCP)

On average, the riparian timber harvest conservation commitments provided by Alternative 2 are expected to result in the retention of about 80 percent of the trees and shrubs in the RMZs of Tier 1 streams, including full retention in the 25-foot no-harvest buffer. As a result, the direct and indirect effects on stream shading are expected to be measurably reduced compared to Alternative 1. In all scenarios modeled, the shade levels resulting from the implementation of the Alternative 2 increased or were maintained throughout the Permit term (Figures 4.8-14 through 4.8-16).

In most of the scenarios modeled, the shade levels resulting from the implementation of Alternative 2 tend to increase slightly over time (Figures 4.8-14 through 4.8-16). The exceptions are the Swede Creek stand type for the A and B stream channel types, where there was only a slight decrease in shade over time. In contrast, after the initial post-harvest decrease in shade levels for Alternative 1, there was a gradual increase through the end of the 100-year modeling period for all stand and channel types. However, for all model scenarios over the entire modeling period, Alternative 2 provided equal or greater in-stream shade than did Alternative 1. In addition, all of the scenarios evaluated for Alternative 2 indicate shade levels at least 10 percent greater than the established target levels.

Alternative 2 contains several allowances for salvage harvest of disease- or insect-infested trees from within the 25-foot no-harvest buffer on Tier 1 streams, and salvage harvest of fire-killed trees to exceed the normal 50 percent retention requirement in that portion of a Tier 1 RMZ outside the 25-foot no-harvest buffer. Alternative 2 also allows for the management of a portion of the total Tier 1 RMZ acreage using harvest prescriptions designed to meet the minimum retention tree requirement of the SMZ Law.

These allowances are limited in extent and scope and are not expected to have a substantial effect on stream shade and stream temperatures within the HCP project area. For example, salvage allowances would be limited to harvest affecting less than 20 acres of RMZ, and the portion of RMZ managed down to the requirement of the SMZ Law would not exceed 15 percent of total Tier 1 RMZ area within each DNRC administrative unit.

The limited amount of RMZ area managed under these allowances would still be subject to the requirements of the SMZ Law; therefore, it is expected to have effects similar to those described under Alternative 1. In addition, salvage harvest conducted under these allowances would also be required to retain a minimum of 10 trees per 100 feet of stream within the first 25 feet of RMZ. Salvage harvest would also be required to retain all streambank trees and all downed trees lying within the stream channel or embedded within the stream bank.

Based on the shade analysis, the stream temperatures are not expected to measurably increase from direct solar input, or indirectly from the moderate changes in microclimate or soil temperature expected to occur from the selective harvest regimes used by DNRC. Although the analyses of Alternative 2 typically indicate increasing shade levels throughout the modeled period, this situation applies specifically to Tier 1 (stream reaches supporting or potentially supporting the HCP fish species). For all other streams, including reaches of HCP fish streams that do not directly support these fish species, the management commitments would be the same as those identified under Alternative 1. Thus, the existing SMZ and RMZ harvest regulations would apply to these riparian areas. As a result, additional protection would be provided to stream reaches currently or potentially supporting the HCP fish species, and current levels of protection would continue to occur for the other streams through the implementation of existing regulations.

Under Alternative 2, there would be a greater potential for short-term temperature effects in Tier 2 and 3 streams, compared to Tier 1 streams. However, the overall effects are expected to be less than for Alternative 1 due to the increased harvest restrictions on Tier 1 streams (commitment AQ-RM1) and the same protection levels for all other streams as Alternative 1. In addition, Tier 2 and 3 streams tend to be smaller headwater streams that can be effectively shaded by shrubs and brush, which would recover substantially quicker than the taller trees required to shade larger stream reaches. While Alternative 2 emphasizes the protection of HCP fish species, the conservation commitments would also benefit other fish species occupying the same habitat.

In addition to merely providing a mechanism for improving shade conditions in riparian areas, Alternative 2 includes stream temperature monitoring to verify the effectiveness of this conservation commitment (AQ-RM1). Under the HCP riparian timber harvest conservation strategy, DNRC would monitor stream temperatures to ensure that riparian harvest prescriptions maintain suitable shade and stream temperature regimes (less than a 1° C [1.8° F] increase from baseline conditions) in Tier 1 steams. In most cases, a change in stream temperature of less than 1° C (1.8° F) would not adversely affect HCP fish species, particularly where upstream maximum temperatures are within the acceptable peak seasonal temperature range for the HCP fish species (less than 15° C [59° F]). In addition, the 1° C (1.8° F) temperature change threshold is generally appropriate given the accuracy of stream temperature monitoring equipment, the natural variability inherent within any given stream reach, and the ability to statistically differentiate significant differences in stream temperatures with a limited sample size.

The results of the monitoring efforts are expected to provide substantial indications that the aquatic conservation strategy is effective at maintaining the key riparian functions influencing fisheries habitat at a level that provides conservation of HCP fish species and protection of other native aquatic species.

As discussed above, the proposed HCP includes conservation commitments to maintain stream temperatures in Tier 1 streams, but would rely on existing regulations for Tier 2 and 3 streams (commitments AQ-RM2 and 3). While this is still a benefit to the HCP fish species, there is some potential for effects in the upper watersheds to measurably alter downstream conditions. However, streams in the upper watersheds are typically small enough to be protected (shaded) by low-level vegetation (i.e., shrubs and saplings). This type of vegetation would recover relatively quickly after a disturbance from forest management activities to restore adequate shade conditions.

As with other components of the proposed HCP, if the monitoring results indicate any deficiencies or inadequacies, DNRC would collaborate with the USFWS within the adaptive management framework to devise and implement alternative conservation commitments that would meet the management objectives and biological goals of the proposed HCP.

Alternative 3 (Increased Conservation HCP)

The shade modeling results for Alternative 3 are generally very similar to those for Alternative 2. Although Alternative 3 would provide slightly more shade for each time step interval, in most cases this increase is negligible (less than 1 percent) and in no cases is it greater than 4 percent (see Figures 4.8-14 through 4.8-16). These results indicate that the additional timber harvest restrictions provided by Alternative 3 do not substantially affect the stream shading characteristics of the RMZs of Tier 1 streams. Therefore, Alternative 3 is not expected to substantially improve water temperature conditions, compared to Alternative 2, for streams supporting HCP fish species, although it would improve conditions relative to Alternative 1. It should be noted however, that the no-harvest requirement within the 100-year site index tree height of a stream under Alternative 3 is comparable to a “no-management” scenario in regard to stream temperature. Shading and water temperature conditions for other streams (Tier 2 and 3) adjacent to the timber harvest units would likely be similar to existing conditions due to the continued application of existing RMZ regulations. In addition, these streams are typically small enough to be protected (shaded) by low-level vegetation (i.e., shrubs and saplings), so the additional riparian protection provided by Alternative 3 is not expected to provide substantial differences in temperature conditions compared to the other alternatives. The monitoring and adaptive management provisions of the proposed HCP would also apply to this alternative, and provide a mechanism to evaluate the adequacy of this alternative to maintain stream water temperatures.

Alternative 4 (Increased Management Flexibility HCP)

The shade modeling results for Alternative 4 are generally very similar to those for Alternatives 2 and 3 (Figures 4.8-14 through 4.8-16). The modeling results indicate that the 25-foot no-harvest buffer component incorporated in all three of these alternatives is the primary factor in maintaining stream shade, and that management activities outside of this zone do not appear to substantially affect the shading characteristics of the riparian corridor. Because it is assumed that water temperatures are primarily affected by riparian shade, the potential temperature effects of Alternative 4 would be similar to the other action alternatives. Also similar to the other action alternatives, the monitoring and adaptive management provision in Alternative 4 would allow the

evaluation of the adequacy of this alternative to maintain stream water temperatures. Because there are no specific commitments for Tier 2 and 3 streams for any of the action alternatives, the water temperatures in these streams are expected to be similar to Alternative 1.

Summary

Overall, the modeling results indicate that all three action alternatives are similarly effective at maintaining the key riparian function of shading and stream temperature at a level that provides for the conservation of fish, including HCP aquatic species. Stream shading under Alternative 1 is substantially decreased by initial harvest, with decreases in stream shading in the first decade following harvest ranging from 11 percent to 20 percent, depending on the scenario. Although Alternative 1 stream shading showed a gradual increase through the end of the modeling period, the level of shading never exceeded the shade levels of the action alternatives.

Based on the projected levels of shading, none of the action alternatives would result in a measurable negative effect on maximum summer or minimum winter stream temperatures. While the HCP fish species would likely benefit more from these action alternatives, because of the specific conservation commitments for Tier 1 streams, these alternatives also would be expected to protect other aquatic species. In addition, the action alternatives all have monitoring and adaptive management provisions that Alternative 1 lacks. These features would allow appropriate adjustments to the conservation strategy, based on the adequacy of these alternatives to maintain stream water temperatures. Conversely, the reduced shading resulting from Alternative 1, particularly in the first decades following timber harvest, may result in a corresponding increase in summer water temperatures and/or cooler winter conditions, although the likely magnitude of any such change would be relatively small.

Connectivity

A primary aspect of maintaining adequate fish connectivity is the proper installation, maintenance, and periodic replacement of culverts. An evaluation of fish passage conditions found 124 known culvert barriers to fish passage on trust lands[2]. Of these, 106 (85 percent) occur on streams supporting HCP aquatic species and 18 (15 percent) occur on other streams (DNRC 2006h) (Table 4.8-12). The evaluation also indicated that the oldest culvert was about 50 years old, although the estimated functional life of a culvert is about 35 years. Replacing these culverts every 35 years would result in a baseline average of about 3.5 culvert replacements per year (124 culverts in 35 years). Using the proportion of HCP to non-HCP fish species passage sites described above (0.85 HCP fish species sites), this replacement rate would result in replacing culverts at about 3.0 HCP fish species passage sites per year.

[2] Culvert inventory data current as of March 2005.

In addition, as the average lifespan of culverts is estimated at 35 years, there is an identified need to regularly replace culverts before they fail. A separate DNRC road inventory classified 132 culverts on 430 miles of road as having moderate or high risk of failing. Of these potential problem sites, about 38 percent would be likely to be replaced due to fish passage concerns (i.e., insufficient capacity or structure damage).

Despite the increased efforts to improve habitat and connectivity conditions for native trout species throughout western Montana, other factors may be minimizing the potential gains. Some bull trout populations were depressed in drainages with no physical barriers to migratory fish, suggesting that other downstream mortality factors, such as predation or temperature, may be playing a bigger role in the extirpation of those stocks (Nelson et al. 2002). Efforts to improve connectivity are intended to reestablish adequate fish access to historical habitat areas by removing or modifying man-made structures. However, this also increases the risks of introducing or spreading diseases and non-native fish into areas currently unaffected by these factors.

Alternative 1 (No Action)

While the existing rules and regulations are directly or indirectly applicable to fish connectivity, the existing strategy does not identify a clear and detailed set of standards for providing or enhancing connectivity. However, the current regulations are intended to ensure fisheries connectivity for all species and life stages. Although there are no specific design criteria regulations or formal commitments, DNRC currently uses a standard of emulating the natural streambed form and function when installing or replacing road culverts. This is expected to provide adequate fish passage conditions to adult and juvenile bull trout, westslope cutthroat trout, and Columbia redband trout over a range of low to bankfull flow levels.

Habitat connectivity would gradually improve under Alternative 1, as blocking road culverts are repaired or replaced when existing roadways are upgraded to facilitate trust land management activities. These upgrades would only occur as particular roads, or sections of roads, would be required to conduct these management activities. The upgrades would comply with existing regulations, laws, and appropriate recovery plans. However, they would not necessarily follow a comprehensive, coordinated, and effective conservation or recovery plan for the HCP fish species populations.

Problem culverts would be upgraded according to existing regulations and established BMPs. While this will likely include the continuation of the existing DNRC design protocols for providing adequate fish passage conditions over a range of flows (including bankfull with) and for a wide range of species and life stages, there would be no specific assurances of where and when these improvements would occur. Therefore, there would likely be sporadic and dispersed improvements in fish passage conditions and/or species distribution throughout the HCP project area.

In addition to improving fish passage conditions on existing roads, all new roads would be constructed to these same design standards, thereby minimizing new restrictions to the distribution and movement of fish in the future. However, there would be no particular emphasis or strategy for improving connectivity for bull trout, westslope cutthroat trout, and Columbia redband trout, or on streams occupied by these species. Therefore, correcting existing connectivity problems would be just as likely to occur on streams containing HCP fish species as on other fish-bearing streams, so some populations of HCP fish species currently affected by connectivity restrictions would continue

to be affected for some undetermined time. Given the average useful lifespan of culverts (estimated at about 35 years), connectivity restrictions could extend for several generations of fish.

Alternative 1 would continue existing policy, which would result in a replacement rate of about 3.0 culverts per year on HCP fish species streams (Table 4.8-22). However, this schedule does not necessarily ensure that the most problematic culverts would be replaced first. Similarly, there would be no prioritization for replacing culverts that block or restrict access for the HCP fish species, or that would open up the largest habitat reaches for these species.

TABLE 4.8-22. ESTIMATED TIMEFRAME AND AVERAGE YEARLY REPLACEMENT RATE OF CULVERTS WITHIN THE HCP PROJECT AREA FOR ALL ALTERNATIVES

Alternative	Estimated Culvert Replacement Rate for All Known Barrier Culverts on Streams with HCP Fish Species in HCP Project Area (Number per Year)1	Estimated Timeframe to Replace All Known Barrier Culverts on Streams With HCP Fish Species in HCP Project Area (Years)	Estimated Culvert Replacement Rate for High-risk Culverts in HCP Project Area (Number per Year)	Estimated Timeframe to Replace All High-risk Culverts in HCP Project Area (Years)
Alternative 1	~3.0[1]	~35[1]	Unknown	Unknown
Alternative 2	3.5[2]	30[2]	9.5[4]	25[4]
Alternative 3	5.3[3]	20[3]	11.9[5]	20[5]
Alternative 4	~3.0[1]	~35[1]	Unknown	Unknown

[1] Based on the average (35-year) culvert lifespan, although the actual replacement schedule is unknown.
[2] Replacements completed in 15 years for bull trout streams and 30 years for westslope cutthroat trout or redband trout streams.
[3] Replacements completed in 10 years for bull trout streams and 20 years for westslope cutthroat trout or redband trout streams.
[4] Replacements completed in 15 years for bull trout streams and 25 years for westslope cutthroat trout or redband trout streams.
[5] Replacements completed in 10 years for bull trout streams and 20 years for westslope cutthroat trout or redband trout streams.
Source: DNRC (2006h).

In addition, Alternative 1 does not contain specific commitments to inventory or address road-stream crossing problems in the HCP project area. Therefore, although these problems are documented to exist, no estimate of the timeframe for problem identification or correction can be made for Alternative 1.

Furthermore, Alternative 1 does not provide specific monitoring or adaptive management programs. As a result, the culvert replacement project would be implemented using the most recent BMPs, with the assumption that adequate effectiveness was achieved. This alternative assumes that each culvert would be replaced, about once every 35 years, unless it failed due to hydrologic insufficiencies. Eventually, this alternative would likely restore connectivity for the HCP fish species, but there is considerable uncertainty of how effective this would be for the recovery or conservation of these species because there would be no specific coordination with species recovery plans.

Alternative 2 (Proposed HCP)

In addition to applying all existing stream crossing regulations, as in Alternative 1, Alternative 2 would conduct and update ongoing DNRC fish passage assessments within the HCP project area, specifically targeting those areas with known and presumed HCP fish species habitat (commitment

AQ-FC3). These data would allow prioritization of road-stream crossing improvements for streams with HCP fish species based on existing levels of connectivity, HCP fish species status, and population conservation goals (commitment AQ-FC4).

This alternative includes additional mitigation measures to minimize impacts to HCP fish species habitat resulting from construction associated with site improvements. This prioritization would lead to completing the connectivity improvements within 15 years for bull trout streams and 30 years for streams with westslope cutthroat trout or Columbia redband trout, with some allowances (commitments AQ-FC5, 6, and 7). This commitment includes a consistent timetable for progressive improvements to meet fish passage standards at all problem crossings on HCP fish species streams. This timetable would result in a culvert replacement rate of about 3.5 per year. While this is slightly greater than the rate expected under Alternative 1, the HCP fish connectivity commitments would ensure that the most problematic culverts would be improved first, thus improving connectivity for all HCP aquatic species within a defined timeframe.

The HCP commitments provide assurances that the problem culverts would be corrected in a more timely manner than Alternative 1, resulting in a longer period for fish to re-populate upstream areas previously blocked or restricted, as compared to Alternative 1. This improved connectivity is expected to reduce the isolation of potentially non-viable sub-populations and the associated risks of extinction.

The other HCP conservation strategies, including the sediment reduction conservation strategy, also would help to improve connectivity within the HCP project area. Under Alternative 2, there are specific commitments on timeframes for the identification and correction of road-stream crossings with a high risk of sediment delivery (commitment AQ-SD2). Because no such commitments apply to Alternative 1, an alternatives comparison of improvement rates for the at-risk road-stream site improvements cannot be directly made, although Alternative 2 would result in a substantially faster rate of improvement, due to the associated sediment reduction conservation strategy commitments.

The riparian timber harvest conservation strategy also would help to maintain quality fish habitat conditions in the HCP project area, and the fish connectivity conservation strategy would increase or improve fish access to these areas, thus allowing increased access of HCP aquatic species to improved habitat areas to support them. Alternative 2 also includes a fish connectivity monitoring and adaptive management commitment, which is in addition to those described under Alternative 1.

To verify that the road crossing improvements adequately provide the connectivity conditions necessary for viable HCP fish populations, DNRC would conduct post-installation effectiveness monitoring at improved road crossings on known or suspected HCP fish species streams, depending on the type of new structure. The monitoring schedule would include assessments at 2, 5, and 10 years following structure installation, as well as inspections after large flood events.

Alternative 2 also incorporates adaptive management practices by using the best available technology and research to assess connectivity at existing road-stream crossings, by re-evaluating site prioritization status, and continuing to evaluate new installation methods or techniques for providing connectivity. As part of adaptive management, DNRC would commit to prescribed actions to correct deficiencies if a new installation fails to emulate the streambed form and function

(as determined by post-installation effectiveness monitoring), as well as a reporting schedule with the USFWS to review and discuss HCP fish connectivity issues.

Alternative 3 (Increased Conservation HCP)

This alternative is similar to Alternative 2, except that it would complete connectivity improvements within 10 years for known or suspected bull trout streams and 20 years for westslope cutthroat trout and Columbia redband trout streams, with some allowances. Because this increased rate of fish passage improvements would result in a replacement rate of about 5.3 culverts per year on HCP fish species streams, a longer time period would be provided for fish populations to re-colonize blocked habitats and for enhancement of isolated fish populations. Therefore, Alternative 3 would provide a somewhat greater benefit to the connectivity habitat component.

In addition, this alternative includes commitments governing the identification and correction of road-stream crossings with a high risk of sediment delivery. Similar to Alternative 2, Alternative 3 would also incorporate effectiveness monitoring and adaptive management practices.

Alternative 4 (Increased Management Flexibility HCP)

This alternative would replace culverts on a project-by-project basis, with no specific commitments to preferentially address culverts on HCP fish species streams and no commitments for the correction of road-stream crossings with a high risk of sediment delivery. Therefore, the results of this alternative are expected to be the same as Alternative 1.

Summary

The overall timeframes and rates for culvert replacement vary between the alternatives. Alternatives 2 and 3 contain specific commitments for replacing known barrier culverts and to correct identified high-risk road-stream crossings, while Alternatives 1 and 4 do not. In addition, Alternatives 2 and 3 contain effectiveness monitoring and adaptive management components, to ensure that desired levels of connectivity are being achieved. Therefore, Alternative 3, which would correct connectivity problems at a faster rate, would benefit fish passage to the greatest degree, especially for the HCP aquatic species. Alternative 2 would also improve connectivity, but at a slightly lower rate than Alternative 3.

Alternatives 1 and 4 would continue to implement existing DNRC policies and procedures with no specific commitments to preferentially address culverts on HCP fish species streams and no commitments for the correction of road-stream crossings with a high risk of sediment delivery. Although it is expected that these alternatives would eventually restore connectivity for the HCP and other fish species, there is considerable uncertainty as to how effective this would be for the recovery or conservation of the HCP fish species because there would be limited prioritization of fish passage barriers and little specific coordination with species recovery plans.

Other Habitat Factors

In addition to the effects on habitat complexity and stream temperature and shading, riparian areas perform a variety of ecological functions, including regulating the exchange of energy, nutrients, and organic matter to streams (Swanson et al. 1982; Gregory et al. 1997). Due to the multiple ecological functions provided by riparian areas, any physical changes to riparian habitat are expected to have a corresponding influence on these functions. Microclimate, particularly solar

radiation and air temperature near the ground surface, is very sensitive to changes in canopy cover and is highly variable in time and space (Chen et al. 1999). Anderson et al. (2007) also observed that microclimate gradients were strongest within about 30 feet (10 meters) of the centerline of headwater streams, forming a distinct area of stream influence within the broader riparian corridors. Chen et al. (1999) found that the distance from the edge of a harvest area to where microclimate alterations could be detected varied from tens of feet for a variable such as soil moisture to hundreds of feet for wind velocity. However, this evaluation did not specifically address microclimate changes in riparian habitats.

Establishing or maintaining access roads has the potential to increase recreational fishing pressure, poaching, and introductions of non-native fish species. These activities could adversely affect native fish populations, including the three HCP fish species. Fishing and poaching activities could directly affect these fish populations through the intentional or unintentional removal of fish and incidental hooking or handling mortality. The introduction of non-native species could lead to indirect effects, such as increased competition for resources (e.g., food, rearing habitat, etc.), or more direct effects from increased predation.

A stream and its floodplain comprise a dynamic environment where the floodplain, channel, and bedforms evolve through natural processes that erode, transport, sort, and deposit alluvial materials (Rosgen 1996). Stable streams migrate across the landscape slowly over long periods of time while maintaining their form and function. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Land use changes in the watershed and channelization can alter these processes, leading to large adjustments in channel form (i.e., extreme bank erosion or incision) before a new equilibrium is achieved. Riparian vegetation helps maintain channel form and in-stream habitat through the restriction of sediment input or slowing of sediment moving through the system. The presence of LWD also affects channel forming processes by adding hydraulic roughness (Bilby and Ward 1989).

Alternative 1 (No Action)

As indicated above under the riparian shade discussions, existing laws do not require a no-harvest buffer in riparian areas, except to retain all bank edge trees and enough other trees to ensure adequate levels of shade to maintain natural temperature ranges. Although the existing regulations appear to be adequate to maintain stream temperatures, the modeling results indicate that a substantial initial decrease in stream shading would occur for all channel and stand types under Alternative 1 (Figures 4.8-14 through 4.8-16). These changes suggest that corresponding changes to the ecological functions affected by the integrity and condition of the riparian zone could also occur. This would include effects on microclimate and stream form and function.

It is expected that those habitat factors that are affected directly or indirectly by shade should respond to the gradual changes in shade characteristics estimated over time. However, it is uncertain whether all the factors would respond and recover at the same rate as the shade recovery process, as they can be influenced by a broader area than just the riparian zone. For example, hydrologic characteristics are influenced by the conditions throughout the watershed, with correspondingly less influence from riparian conditions. Changes in flow regime affect a broad range of in-stream habitat conditions, as well as the potential for natural riparian processes to maintain the habitat.

Alternative 1 does not contain monitoring requirements or adaptive management practices as applied to the aquatic habitat components (in-stream LWD, stream temperature, sediment production and delivery, etc.) that support and influence the maintenance of microclimate and channel form and function. Therefore, there is some risk under Alternative 1 that existing policies and procedures are not adequate to support these other important habitat components, but there is no specific mechanism to identify and correct these problems.

Alternative 1 is expected to result in an overall improvement in habitat conditions for HCP aquatic species and other native aquatic and terrestrial species associated with the riparian habitat. The continued implementation of current forest management practices, including road construction practices, would gradually improve the conditions in the HCP project area that resulted from activities conducted prior to enactment of the current regulations. The existing regulations regarding forest management activities are generally effective at maintaining the ecological functions and characteristics of the aquatic habitat, particularly in comparison to historical practices, which have caused substantial degradation of aquatic habitat. As with the other habitat considerations discussed above, Alternative 1 would implement these current forest management practices as specific needs occur. As a result, there would be no overall implementation strategy to prioritize or maximize the benefits to the HCP fish species or their habitat.

Alternative 2 (Proposed HCP)

While secondary functions such as nutrient loading, chemical filtering, and microclimate are not specifically addressed in the overall conservation strategy objectives, they are addressed indirectly through the commitments contained in the riparian timber harvest conservation strategy. As indicated by the shade modeling, maintaining the integrity of SMZs and RMZs is likely to also reduce the effects of timber harvest on other riparian and stream habitat factors, such as microclimate. Most of the results from the shade modeling scenarios suggest that the implementation of the proposed HCP commitments would result in a slight increase in shade over time (Figures 4.8-14 through 4.8-16). The exceptions were for the Swede Creek stand type for the A and B stream channel types, where there is a slight decrease in shade over time. This, along with the LWD modeling results, suggests that the proposed HCP commitments would be likely to maintain healthy and diverse riparian corridor habitat conditions. As a result, the riparian ecosystems adjacent to harvest management areas are expected to be enhanced compared to existing conditions, particularly adjacent to Tier 1 streams.

In addition to the no-harvest buffer zones adjacent to Tier 1 streams, further impact reductions would also occur through the expansion of RMZs to accommodate stream channel migration (commitment AQ-RM1). As a result, at least 80 percent of all trees, shrubs, and other ground cover would be retained within the RMZs of Tier 1 streams, which is expected to substantially minimize the potential direct or indirect effects on the riparian microclimate. Important microclimate factors include soil moisture and temperature (Heithecker and Halpern 2006; Brosofske et al. 1997; and Davies-Colley et al. 2000).

The allowances included in Alternative 2 for salvage harvest of diseased- or insect-infested trees and fire-killed trees are limited in scope and extent and, therefore, are not expected to substantially affect these riparian functions.

Similarly, the proposed HCP commitments are also expected to maintain other riparian functions, such as nutrient loading and chemical and physical filtering processes. The bulk of organic nutrient loading and riparian filtering processes occur within the 100-year site index tree height of a stream (Castelle and Johnson 2000). Therefore, the no-harvest buffer requirement around Tier 1 streams would be expected to provide greater protection of these functions, compared to the existing regulations, which do not include a no-harvest buffer provision within the RMZ.

The commitments for riparian harvest, including the establishment of CMZs where appropriate, would also generally maintain those processes that contribute to stability in channel form and function. Also, under Alternative 2, the amount of LWD recruitment and associated in-stream woody debris would be sufficient to maintain channel form and function (see Section 4.8.2.2, Habitat Complexity).

Alternative 2 contains monitoring requirements or adaptive management practices as applied to the aquatic habitat components (in-stream LWD, stream temperature, sediment production and delivery, and connectivity) that support and influence the maintenance of microclimate and channel form and function. Therefore, as compared to Alternative 1, there is substantially greater assurance that these habitat components would continue to function at an appropriate level to support the functions necessary to provide quality fish habitat.

As discussed previously for the other habitat parameters, forest management activities adjacent to Tier 2 and 3 streams would follow existing regulations. As such, the effects of these activities on microclimate and other ecological functions, as they relate to fish habitat in these streams, would likely remain similar to Alternative 1.

Alternative 3 (Increased Conservation HCP)

Because the shade and LWD modeling results for Alternative 3 are generally very similar to those for Alternative 2, the effects on those habitat components that maintain microclimate and channel form and function are also expected to be similar. These conditions and functions are expected to be enhanced compared to Alternative 1, and are also likely to be slightly enhanced compared to Alternative 2. Alternative 3 would result in maintaining a larger riparian corridor than Alternative 2, which is expected to further insulate the immediate stream channel corridor from environmental changes occurring within the harvest area, or as a direct or indirect result of such harvests. In addition, Alternative 3 also provides for the establishment of CMZs, which help maintain stability in channel form and function, and monitoring and adaptive feedback mechanisms to ensure relevant habitat components are functioning at a level to support the functions necessary to provide fish habitat.

As with Alternative 2, the effects of Alternative 3 on Tier 2 and 3 streams are expected to be similar to Alternative 1 because forest management activities would follow existing regulations.

Alternative 4 (Increased Management Flexibility HCP)

As with Alternatives 2 and 3, Alternative 4 is expected to result in improved conditions in those habitat components that maintain microclimate and channel form and function, compared to Alternative 1. However, it is uncertain whether these factors would be substantially different from Alternatives 2 or 3. If differences were to occur, they would be relatively minor in scale, with

Alternative 4 providing slightly less enhancement of these functions than would Alternatives 2 and 3.

Summary

Overall, all of the alternatives would likely provide adequate aquatic habitat conditions, and in the long term, maintain properly functioning channel form and function and microclimate conditions.

However, the three action alternatives would likely provide for better conditions within streams that support HCP fish species. Alternatives 2 through 4 provide more stringent commitments pertaining to riparian harvest, LWD, connectivity, and sediment production in areas that could affect streams that support the HCP fish species. As such, these alternatives would likely provide greater support for these habitat components than Alternative 1. In order, Alternatives 3 and 2 would be most likely to maintain or improve microclimate and channel form and function conditions, followed by Alternative 4, although it is not known if significant differences between the action alternatives would result.

4.8.4.3 Effects of the Transition Lands Strategy and Changed Circumstances Process on HCP Fish Species

The action alternatives all include a transition lands strategy to address the movement of trust lands into and out of the HCP project area, as well as procedures for addressing changed circumstances that can be reasonably anticipated and planned for by DNRC and the USFWS. Potential effects on HCP fish species from actions that would be taken by DNRC as part of the transition lands strategy or changed circumstances process are discussed along with the terrestrial HCP species in Sections 4.9.5 (Wildlife and Wildlife Habitat – Effects of the Transition Lands Strategy) and 4.9.6 (Wildlife and Wildlife Habitat – Effects of the Changed Circumstances Process).

4.8.4.4 Summary of Effects by Alternative

As discussed in the introduction to this resource section, the potential effects on fish and other aquatic resources in the planning area and HCP project areas are represented by the potential changes in aquatic habitat conditions resulting directly or indirectly from forest management activities. Specifically, the alternative were assessed for potential effects on four primary habitat components, sediment delivery, stream temperature, in-stream habitat complexity, and connectivity among sub-populations of fish species. These components are vital components of a healthy aquatic ecosystem, and provide the physical, biological, and chemical functions necessary to support viable fish populations. The explicit linkages between in-stream and riparian habitat conditions allow comparisons of the various individual and cumulative effects of the alternatives on these primary habitat components. This also allows an assessment of the relative magnitude and type (positive or negative) of influence on fish populations within the planning area, including the HCP aquatic species.

Overall, the alternative analysis indicates that all of the alternatives are generally effective at maintaining the key habitat components at a level that provides for the healthy fish populations, including the HCP aquatic species. However, there are some substantial differences between the alternatives (Table 4.8-23). Most significant is the general differences between the three action alternatives and the no-action alternative. For most instances, Alternative 1 provides the smallest

degree of improvement in the individual habitat components during the Permit term. In some cases, such as stream temperature and shading, Alternative 1 could lead to some negative short-term effects on fish populations, although the magnitude of any such effect would be relatively small. In addition, any risk of effects from Alternative 1 would apply equally to all fish species, including HCP aquatic species, because the existing policies, procedures, and corrective actions are not prioritized for any particular species. However, Alternative 1 would still maintain or slightly improve habitat conditions that would support native cold-water and warm-water fish populations.

TABLE 4.8-23. OVERALL RANKING OF THE ALTERNATIVES BY HABITAT COMPONENT

Habitat Component	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Sedimentation[1]	4	2	1	3
LWD Frequency	4	2	1	3
Shade and Temperature[1]	4	2	1	3
Connectivity[1]	3	2	1	3
Other Habitat Factors	3	2	1	3
Cumulative Effects[2]	3	2	1	3
Overall Ranking	**4**	**2**	**1**	**3**

Ranking values are based on expected positive effects, with 1 = most benefit, 4 = least benefit.
[1] These habitat components show the greatest differences between the no-action and action alternatives.
[2] Cumulative effects, when considered with other past, present, and reasonably foreseeable future actions of other entities, are discussed in detail in Chapter 5 (Cumulative Effects).

All of the action alternatives have a greater potential to improve aquatic habitat conditions, based either on overall scale or rate of change. In addition, the action alternatives have some specific mechanisms for monitoring and adaptive management to help to ensure proper implementation and effectiveness of the various conservation strategies. The risk of adverse effects to HCP aquatic species is reduced with the action alternatives, compared to Alternative 1.

Although the action alternatives would all benefit aquatic species, including the HCP aquatic species. Alternative 3 would provide the greatest potential benefits, followed by Alternatives 2 and 4. This is generally due to an increased rate of conservation commitment implementation under Alternative 3. In the case of those habitat components affected by riparian buffer width (stream temperature and LWD frequencies), Alternative 3 is roughly equivalent to a “no management” alternative in areas adjacent to HCP aquatic species habitat. This alternative would provide for the maximum levels of LWD recruitment and shade within the riparian zones of the HCP project area, unless LWD frequency was increased through the active placement of LWD through tree falling or manual installation.

The cumulative effects of DNRC forest management activities on HCP fish species habitat are expected to decrease to some degree for all of the alternatives, over the 50-year Permit term. Based on the expected results of specific commitments, the action alternatives would be slightly more successful at minimizing cumulative effects of DNRC actions on the HCP project area. However, considering all land uses and current actions within the planning area, no significant adverse cumulative effects are anticipated under any of the alternatives.

4.8.4.5 Effects on Bull Trout Critical Habitat

When designating critical habitat, the known physical and biological features (primary constituent elements or PCEs) essential to the conservation of the species are identified. All areas designated as critical habitat for bull trout are occupied, within the species historic range, and contain sufficient PCEs to support at least one life history function.

Based on the current life history, biology, and ecology information of bull trout, the USFWS has identified the bull trout's PCEs (70 FR 56211-56311, September 26, 2005). The following are the PCEs for bull trout: 1) stream temperatures from 32 to 72° F; 2) complex stream channels influenced by large woody debris, pools, and undercut banks that result in various depths, velocities, and instream habitat structures; 3) substrates of sufficient size, amount, and composition for juvenile and egg survival; 4) natural stream flows or artificial flows that are regulated in order to support bull trout; 5) springs, seeps, and groundwater sources, and subsurface flow that contributes to the water quantity and quality as a cold water source; 6) migratory corridors that support unimpeded movement between spawning, rearing, foraging, and over-wintering areas; 7) adequate food base of terrestrial and aquatic insects and forage fish; and 8) permanent water sufficient to provide the quality and quantity for normal reproduction, growth, and survival and 9) few or no predatory, interbreeding, or competitive nonnative species present.

The analysis provided above considers the effects of the proposed action – implementation of the HCP – on the key habitat factors for bull trout. These key habitat factors can be linked to the PCEs for critical habitat. Therefore, adverse effects on PCEs are likely to result where adverse effects are anticipated for key habitat factors. For this analysis, adverse effects are anticipated for sediment and connectivity key habitat factors. Despite implementation of the HCP commitments, increased sediment levels may occur from the surface of existing roads that are within 300 feet of a stream containing HCP fish species as well as sediment produced at road-stream crossings. This in turn, may generate adverse effects on PCEs 2 and 3. Relative to connectivity, adverse effects associated with 106 fish passage culvert barriers have been identified within the HCP project area. While the HCP commitments require replacement of barriers with passable culverts, the timeframe for these replacements may result in adverse effects continuing for a period of 15 years. This in turn, may generate adverse effects on PCEs 6 and 9.

For the other key habitat factors (stream temperature, habitat complexity, and other habitat factors) and associated PCEs (1, 4, 5, 7, and 8), no adverse effects are anticipated.

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4.9 WILDLIFE AND WILDLIFE HABITAT

4.9.1 INTRODUCTION

The planning area provides a wide variety of habitats, from open grasslands and alpine areas to woodlands and dense forests. Approximately 407 species of wildlife are known or expected to occur in the area, including 91 mammals, 289 birds, 12 amphibians, and 15 reptiles (Table E4-7 in Appendix E, EIS Tables). Following a summary of current management direction for wildlife and wildlife habitat in the EIS planning area and HCP project area (Section 4.9.2 Regulatory Framework), this section examines existing conditions and effects of the alternatives on wildlife resources. These analyses are presented for the two HCP species, transition lands, changed circumstances, and other wildlife species in Section 4.9.3 (Grizzly Bears), Section 4.9.4 (Canada Lynx), Section 4.9.4.3 (Effects of the Transition Lands Strategy), Section 4.9.4.4 (Effects of the Changed Circumstance Process), and Section 4.9.5 (Other Wildlife Species). Evaluation criteria are used to assess and compare the effects of the alternatives at the landscape level both in the short term and the long term, focusing on direct and indirect effects.

Data are presented at the planning area scale to provide a landscape-level context from which to assess the relative importance of forested trust lands and the HCP project area to wildlife species and habitats. For the HCP project area, acreage values of various habitat components are generally described using the DNRC land office as a unit of analysis, with more detailed unit office information available in the wildlife tables provided in Appendix E. Where analysis at a finer scale is relevant (e.g., grizzly bear recovery zones and bear management units), data are presented at different analysis units.

Sources of information for analyses in this section include communications with local and regional biologists, GIS data from DNRC and other sources, hunting and trapping data from MFWP, and literature review. Numerous analyses were performed to evaluate existing wildlife habitat in the HCP project area, on DNRC lands in the planning area not included in the HCP, and in some instances, other ownerships in the planning area. The analyses conducted include assessments of linkage areas, lynx habitat mapping, road densities in the future, the amount of grizzly bear hiding cover, the availability of bald eagle habitat, and wolf pack activity. Information on methodologies used for GIS analyses and tables providing additional information on existing wildlife and habitat conditions are included in the *Supporting Documentation for the HCP Wildlife Analysis* (DNRC 2008i), which is available on the project website at: http://www.dnrc.mt.gov/HCP/default.asp.

Lastly, during development of the HCP, species accounts were prepared for the covered species. The accounts are a review and compilation of all relevant and current scientific information in a synthesis document for each species. Applicable information for this EIS was drawn from those species accounts, which are available on DNRC's HCP website (http://dnrc.mt.gov/HCP/).

4.9.2 REGULATORY FRAMEWORK

Management of trust lands in the planning area is accomplished in compliance with various wildlife-related federal and state regulations (Table 4.9-1). While some of these regulations (e.g., ESA) may provide protections specific to individual species, others provide more general direction on the protection of wildlife habitat. In addition, numerous other regulations govern other

types of environmental factors that can directly and indirectly affect wildlife and wildlife habitat, such as road building, water quality, riparian areas, and wetlands. Those regulations are described in more detail in Sections 4.4 (Transportation), 4.5 (Geology and Soils), 4.6 (Water Resources), and 4.7.3 (Wetlands), and 4.10 (Recreation) of this EIS.

TABLE 4.9-1. SUMMARY OF APPLICABLE FEDERAL AND STATE WILDLIFE-RELATED REGULATIONS

Regulation	Overseeing Agency	Purpose
Federal		
Endangered Species Act (16 USC 1531 et seq.)	USFWS	Protect and recover threatened and endangered plant and animal species.
Fish and Wildlife Coordination Act (16 USC 661 through 667)	USFWS and MFWP	To provide assistance to and cooperate with federal and state agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.
Migratory Bird Treaty Act and Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds)	U.S. Department of Interior and All federal agencies	Prohibits illegal hunting, capture, possession, or sale of migratory birds, for the protection of migratory birds or any part, nest, or egg of any such bird.
Bald Eagle and Golden Eagle Protection Act	USFWS	Prohibits take of bald or golden eagles.
State		
ARMs 36.11.401 through 450	DNRC	Provide regulatory guidance in timber sale planning for threatened and endangered species, DNRC sensitive species, game species, wildlife habitat.
MEPA (MCA 75-1-101 through 324) DNRC implementing regulations (ARMs 36.2.521 through 543)	DNRC	To provide a public process that assures 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.
Montana Nongame and Endangered Species Conservation Act (MCA 87-5-101)	MFWP	To provide adequate remedies for the protection of the environmental life support system from degradation and provide adequate remedies to prevent unreasonable depletion and degradation of natural resources.

The most applicable regulations governing wildlife and wildlife habitat on forested trust lands are the Forest Management ARMs. These rules were adopted to conserve wildlife and wildlife habitat and other resources of concern. Several ARMs apply to specific wildlife groups or state land management practices. These include rules governing threatened and endangered species, game species, biodiversity, old-growth forest, and road management (Table E4-8 in Appendix E, EIS Tables). The primary function of these rules is to provide land managers with tools to conserve species and habitat in a manner consistent with trust obligations. The forest management ARMs for threatened and endangered species are DNRC's interpretation of and commitment to complying

with ESA to avoid take as defined by that legislation. For most projects proposed on forested trust lands, DNRC wildlife biologists conduct site visits and identify mitigation measures to be implemented to avoid or minimize impacts on wildlife and wildlife habitat, based on the policies contained in the ARMs (Table E4-8 in Appendix E, EIS Tables).

In addition to the wildlife-specific ARMs, those that address the management of streams, wetlands, and other waterbodies also influence wildlife and wildlife habitat. The Montana SMZ Law (MCA 77-5-301 through 307) and rules (ARM 36.11.301 through 313) regulate commercial timber harvest conducted immediately adjacent to all streams, specific lakes, and other bodies of water in Montana. While this law's primary goal is to restrict the scope and range of activities that may pose a threat to aquatic habitat and species, these restrictions also affect the availability and quality of wildlife habitat in these areas. Refer to Section 1.5.2 for further details on these regulations and DNRC's commitments under them.

In addition to abiding by the Forest Management ARMs, DNRC participates in regional agreements and committees aimed at protecting wildlife and wildlife habitat. These include the Swan Agreement and the NCDE Subcommittee of the Interagency Grizzly Bear Committee. DNRC also recognizes the management direction provided in other state plans, such as the *Montana Gray Wolf Conservation and Management Plan* (MFWP 2003a) and the *Grizzly Bear Management Plan for Western Montana* (MFWP 2006).

4.9.3 GRIZZLY BEARS

This section describes the status, distribution, life history, habitat requirements, and risk factors for grizzly bears. In addition, this section includes an analysis of the effects of the HCP Transition Lands Strategy and the changed circumstances process on all HCP species (including fish), as well as other fish and wildlife species.

4.9.3.1 Affected Environment

Status

In 1975, the USFWS listed the grizzly bear as a threatened species in the contiguous United States (40 FR 31734-31736, July 28, 1975). Subsequent to listing, the USFWS developed a grizzly bear recovery plan in 1982 (revised in 1993), with the objective of sufficiently restoring populations so that the grizzly bear could be delisted (i.e., no longer classified by the USFWS as threatened or endangered) (USFWS 1993). The recovery plan established six grizzly bear recovery zones, defined as areas within which the population and habitat criteria for achievement of recovery will be measured (USFWS 1993). Recovery zones, named for the ecosystems in which they occur, are areas large enough and of sufficient habitat quality to support a recovered bear population. Four of these recovery zones, the Greater Yellowstone Ecosystem (GYE), the NCDE, the CYE, and the BE, occur wholly or partially in Montana. Portions of these four recovery zones occur in the planning area, but no HCP project area lands occur in the GYE (Table 4.9-2; Figure D-16 in Appendix D, EIS Figures). With the exception of the BE, grizzlies occur both within the formally designated recovery zones and in associated non-recovery occupied habitat (NROH), which was documented by Wittinger (2002).

TABLE 4.9-2 ACREAGES OF GRIZZLY BEAR RECOVERY ZONES AND ASSOCIATED NON-RECOVERY OCCUPIED HABITAT WITHIN THE PLANNING AREA AND HCP PROJECT AREA

Recovery Zone	Recovery Zones All Ownerships	Non-recovery Occupied Habitat in Montana[1]	Recovery Zone Lands in Planning Area[2] (% of Recovery Zone)		Non-recovery Occupied Habitat in Planning Area[1,2] (% of Non-recovery Occupied Habitat)		Recovery Zone on DNRC Lands in Planning Area[2] (% of Recovery Zone)		Non-recovery Occupied Habitat on DNRC Lands in Planning Area[1,2] (% of Non-recovery Occupied Habitat)		HCP Project Area in Recovery Zone (% of Recovery Zone)		HCP Project Area in Non-recovery Occupied Habitat[1,3] (% of Non-recovery Occupied Habitat)	
NCDE	5,711,299	2,459,088	5,711,299	(100.0)	2,459,088	(100.0)	204,139	(3.6)	160,640	(6.5)	147,845	(2.6)	72,875	(3.0)
BE[4]	3,021,200[5]	0	405,272	(13.4)	0	(0.0)	341	(< 0.1)	0	(0.0)	182	(< 0.1)	0	(0.0)
CYE	1,655,886[5]	873,230	1,338,763	(80.8)	873,230	(100.0)	6,855	(0.5)	12,246	(1.4)	6,174	(0.5)	12,122	(1.4)
GYE	5,899,789[5]	2,406,568	1,110,365	(18.8)	1,896,458	(78.8)	40	(< 0.1)	81,588	(4.3)	0	(0.0)	27,714	(1.5)
Total	**16,288,174[e]**	**5,738,886**	**8,565,699**	**(52.6)**	**5,228,776**	**(91.1)**	**211,374**	**(2.5)**	**254,475**	**(4.9)**	**154,201**	**(1.8)**	**112,711**	**(2.2)**

Note: Totals may not add up due to rounding.
1 NROH designation from Wittinger (2002).
2 Planning area includes all of the NWLO, SWLO, and CLO. Total acreage of lands in the planning area (all ownerships) = 39,412,232.
3 HCP project area includes all DNRC HCP-covered lands within the planning area.
4 The BE is currently not considered occupied by grizzly bears.
5 Includes some acreage outside of Montana and the planning area: 88 percent of the BE recovery zone occurs within Idaho; 19 percent of the CYE recovery zone occurs within Idaho; 71 percent of the GYE recovery zone occurs within Wyoming; and 7 percent of the GYE recovery zone occurs within Idaho.
Source: DNRC (2008a).

Distribution

The current distribution of grizzly bears in Montana is restricted to the western portion of the state in and around Glacier National Park, Yellowstone National Park, the Bob Marshall Wilderness, the Mission Mountains, Swan Valley, the Swan Mountains, and the Cabinet Mountains (Foresman 2001). On March 29, 2007, the USFWS published the final rule for the designation and delisting of the DPS of the Yellowstone population of grizzly bears (72 FR 14865-14938, March 29, 2007); in 2005 it was estimated that 546 bears occupied that ecosystem (72 FR 14865-14938, March 29, 2007, p. 14881).

In response to apparent increases in the NCDE population, an interagency project was undertaken recently to obtain a population estimate of grizzly bears in that ecosystem. This study, led by the U.S. Geological Survey (USGS), is called the Northern Divide Grizzly Bear Project. Preliminary analysis of deoxyribonucleic acid (DNA) obtained from hair samples in 2007 identified 545 individual grizzly bears in the NCDE. A final population estimate of 765 grizzly bears for that ecosystem was presented by USGS biologists on September 16, 2008 (Kendall et. al 2009). The study also found that the occupied range of the grizzly bears now extends 2.6 million acres beyond the 1993 NCDE recovery zone boundary set by the U.S. Fish and Wildlife Service in the Grizzly Bear Recovery Plan. The Recovery Plan recognized that grizzly bears would move and permanently reside in areas outside recovery zones (USFWS 1993).

The CYE, with an apparently stable or decreasing population of 30 to 40 bears, is below the recovery goal of 70 bears (MFWP 2002a; Wakkinen and Kasworm 2004; U.S. District Court, District of Montana, Missoula Division Order No. CV 01-152-M-DWM; Kasworm et al. 2005; 70 FR 69853-69884, November 17, 2005; 72 FR 14865-14938, March 29, 2007). Some recent grizzly bear mortality in the CYE is higher than the population can sustain and is largely the result of human-caused mortality (U.S. District Court, District of Montana, Missoula Division Order No. CV 01-152-M-DWM).

The BE recovery zone is not currently occupied by bears (72 FR 14865-14938, March 29, 2007 p.14869).

Relationship of DNRC Trust Lands to Grizzly Bear Distribution

The relationship of DNRC trust lands to grizzly bear recovery zones and NROH is provided in Table 4.9-2. Trust lands make up no more than 3.6 percent of any recovery zone in Montana and no more than 6.5 percent of the NROH associated with any ecosystem. Of 154,201 acres of HCP project area lands that fall within recovery zones, 96 percent are in the NCDE recovery zone, and only 182 acres of HCP project area lands occur within the BE recovery zone. HCP project area lands make up 2.6 percent of the NCDE recovery zone and 0.5 percent of the CYE recovery zone. Lands within the Stillwater Block and Swan River State Forest make up most (130,372 acres) of the recovery zone lands within the HCP project area. For NROH, the planning area includes approximately 5.2 million acres (91 percent of the NROH in Montana), 254,475 acres of which are located on trust lands, and 112,711 acres of which are located in the HCP project area.

Risk Factors

Two major factors affecting grizzly bear recovery include (1) habitat loss and degradation and (2) bear-human conflicts, especially those resulting in grizzly bear mortality. Human presence in, and use of, grizzly bear habitat occurs in many forms.

In the Rocky Mountains, the overwhelming majority of adult grizzly bear deaths are caused by humans (Mace and Waller 1998; McLellan et al. 1999; Benn and Herrero 2002; Wakkinen and Kasworm 2004). Human-caused mortality can be classified into six major categories: (1) direct bear-human confrontations, (2) attraction of grizzly bears to improperly stored food and garbage, (3) careless livestock husbandry practices including failure to dispose of dead carcasses properly, (4) direct killing for the purpose of protecting livestock, (5) erosion of grizzly bear habitat, and (6) hunting (both lawful and illegal) (USFWS 1993).

Of 172 human-caused grizzly bear mortalities documented for the NCDE from 1999 to 2008, 34 percent were associated with management actions primarily related to human foods and livestock, 26 percent resulted from illegal killing (i.e., poaching/vandal killing) or mistaken identification by black bear hunters, 26 percent resulted from train or automobile collisions, 9 percent were from self defense, 3 percent were due to management trapping, and 2 percent were associated with a human mortality (USFWS 2009).

Forest management practices are not a detectible source of grizzly bear mortality but have consequences to habitat effectiveness. Furthermore, roads used for forest management are also used by the public and sometimes indirectly contribute to grizzly bear mortality.

Relationship of Covered Activities to Grizzly Bear Risk Factors

The analysis for this EIS focuses on risk factors that DNRC has the opportunity to affect and that are addressed directly or indirectly in the HCP as part of conservation commitments. These include (1) forest roads and associated human activity, (2) physical alteration of habitat through timber harvest and other means, (3) livestock grazing, and (4) possibility of direct encounter by humans working in bear habitat.

Roads

The most pervasive and chronic effects on grizzly bears related to covered activities arise from the presence of roads and human activity associated with roads. Bears generally respond to roads and human presence in three ways: (1) they may be disturbed by human presence, suggesting a relatively short term – short distance response; (2) they may be displaced from roaded areas, suggesting an avoidance response and movement to another area; or (3) they may become habituated to human activities and roads but then expose themselves to a greater probability of encounter with humans.

Throughout most of their range in Canada and the contiguous United States, grizzly bears have been found to use areas near open roads significantly less than expected (Jonkel 1982; Hamer and Herrero 1983; McLellan and Shackleton 1988, 1989; Nagy et al. 1989; Heinrich et al. 1995). The federal *Grizzly Bear Recovery Plan* (USFWS 1993) devotes considerable attention to the harmful effects of roads on grizzly bears, concluding that increased human access on open roads and continued human use of closed roads have overall detrimental effects on grizzly bear populations.

In the *Biological Opinion on the Swan Valley Grizzly Bear Conservation Agreement,* the USFWS (1995), stated that roads and excessive road densities have been among the most serious adverse impacts of timber harvest on grizzly bears. The USFS (1982) indicated that a viable road and access management plan is "the most important factor influencing the long-term impacts on grizzly bears in habitat influenced by timber harvesting."

Many researchers have documented avoidance of roads and roaded areas by grizzly bears, as well as other negative impacts to grizzly bears caused by roads in Montana. Aune and Kasworm (1989), for example, found 63 percent of all known human-caused grizzly bear mortalities occurred within 0.6 mile of a road, including 10 to 11 known female mortalities. While the roads did not directly cause the mortality, they increased the probability and frequency of bear-human encounters, which sometimes resulted in the death of grizzly bears. Mattson (1993) documented that grizzly bears consistently under-used habitat within 300 to 1,600 feet of roads in the Yellowstone area, regardless of the road class (paved versus unpaved) and even at low levels of traffic (0.5 to 1.9 vehicles per hour). In the Swan Mountains, Mace et al. (1996 and 1999) found grizzly habitat use decreased as total road density increased. In this study, it was difficult to attribute direct effects on survival to roads; only 1 of 12 documented deaths of grizzly bears occurred in multiple-use areas (public land used for forestry, recreation, etc.), and annual mortality rate (accounting for variable exposure time) for bears using private lands in addition to multiple use lands was almost 20 times higher than for bears using only multiple-use lands (Mace and Waller 1998). Kasworm and Manley (1998) and Mace et al. (1999) also documented significant grizzly bear avoidance of habitats in proximity to roads in the Cabinet Mountains and NCDE, respectively. When bears avoid roads, they forgo the resources near the roads, or may be displaced into competition with other bears, or conflicts with humans.

Vegetation Changes

Forest management physically changes vegetation through timber harvest or prescribed burning. The response of grizzly bears to the physical changes of logging (including salvage harvest and pre-commercial thinning) is mixed and complex (Zager et al. 1983; Waller and Mace 1997a,b; McLellan and Hovey 2001) because treatments, post-treatments, cover types, and habitat types vary, and because logging is inevitably associated with roads and increased human activity, which tends to disturb or displace grizzly bears. A review by Moss and Lefranc (1987) found that, while many studies documented reduced grizzly bear use of logged areas (e.g., Mace and Jonkel 1980; Zager et al. 1983; McLellan 1990), others reported no evidence that vegetation changes resulting from timber harvest significantly impacts grizzly bears (e.g., Meehan 1974; Zager 1980). Alterations in timber cover can affect the quality of grizzly food and cover (Blanchard 1983; USFS 1985), causing bears to change their use of an area. East of the Continental Divide in the GYE, Anderson (1994) found that production of two species of huckleberries was lower in clearcuts than in similar uncut stands.

The manner in which logging slash is controlled or disposed may physically hinder bear use in an area or may limit the establishment of bear forage (Bratkovich 1986). Zager et al. (1983) found that 15- to 35-year-old clearcuts with slash piled by a bulldozer had lower canopy coverage of preferred summer grizzly bear plant foods than those with no slash or those that had been burned. Broadcast burns can encourage the growth of fruiting shrubs that are preferred forage for grizzly bears in the fall (Martin 1983; Zager et al. 1983; Bratkovich 1986; Moss and Lefranc 1987; Hamilton 2000).

Results from Martin (1983) suggested that light-intensity, post-harvest burning could stimulate production of blue huckleberry (*Vaccinium globulare)*, an important summertime fruit producer for grizzly bears on certain sites.

Livestock Grazing

The impacts to grizzly bears from agriculture and livestock were summarized by Harting (1987) into five classes:

- **Direct loss.** Mortality or loss of grizzly bears through control actions, relocations, or illegal kills associated with livestock allotments, ranching, or farming operations
- **Indirect loss.** Habituation of grizzly bears to human activity following attraction to livestock, livestock carrion, crops, etc., pre-disposing them to nuisance behavior elsewhere
- **Habitat loss.** Loss or modification due to grazing or other agricultural activity
- **Displacement.** Temporal or spatial displacement away from agricultural activity
- **Direct competition.** Competition with livestock for preferred forage species.

Grizzly bears are known to kill domestic sheep easily (Knight and Judd 1983), and specific individual bears learn to kill cattle calves as well (Anderson et al. 2002). Bears that kill livestock have a high rate of mortality caused by people.

DNRC has very few grazing licenses on very limited ownership in grizzly bear recovery zones (Table 4.9-3).

Humans Working in Bear Habitat

Generally, DNRC activities such as timber sale cruising and layout, site preparation, road maintenance include timber sale cruising and layout, site preparation, and road maintenance would not adversely impact grizzly bears. The effects of these non-motorized activities would most likely be similar to those from dispersed recreational activity (e.g., Mace and Waller [1996]), and from motorized activities summarized by Mace et al. (1996); namely short term disturbance or displacement due to creation of new roads or use of existing roads and adjacent management areas.

There has not been a case of a DNRC employee or its contractor, having a direct conflict with a grizzly bear.

Life History

Generally solitary, grizzly bears avoid one another, except during the mating season when male and female bears tolerate one another. Grizzly bears do not defend territories, but instead have home ranges they share with other grizzly bears, although social systems influence movements and interactions among resident bears. Home range sizes for adult female grizzlies vary from 50 to 150 square miles; an adult male can have a home range size as large as 600 square miles (Schwartz et al. 2003).

TABLE 4.9-3 ACREAGE OF GRAZING LICENSES AND LEASES ON TRUST LANDS WITHIN GRIZZLY BEAR RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT IN THE PLANNING AREA AND HCP PROJECT AREA, BY LAND OFFICE AND ADMINISTRATIVE UNIT FOR BLOCKED LANDS AND SCATTERED PARCELS

Land Offices and Unit Offices by Recovery Zone[2] (Scattered or Blocked Status)	Licenses on Trust Lands in the Planning Area[1]		Licenses in the HCP Project Area[1]		Leases on Trust Lands in the Planning Area[1]		Leases in the HCP Project Area[1]	
	Recovery Zone	Non-recovery Occupied Habitat[3]	Recovery Zone	Non-recovery Occupied Habitat[3]	Recovery Zone	Non-recovery Occupied Habitat[3]	Recovery Zone	Non-recovery Occupied Habitat[3]
NWLO	**4,928**	**9,395**	**4,198**	**7,879**	**0**	**613**	**0**	**273**
Kalispell Unit NCDE (Scattered)	2,454	632	2,137	584	0	117	0	117
Libby Unit CYE (Scattered)	0	3,346	0	3,346	0	0	0	0
Plains Unit CYE (Scattered)	1	651	1	651	0	0	0	0
Plains Unit NCDE (Scattered)[6]	N/A	786	N/A	786	N/A	210	N/A	156
Stillwater Unit NCDE (Blocked)[4]	2,139	N/A	2,061	N/A	0	N/A	0	N/A
Stillwater Unit NCDE (Scattered)	335	3,972	0	2,509	0	0	0	0
Swan Unit NCDE (Blocked)[6]	0	N/A	0	N/A	0	N/A	0	N/A
Swan Unit NCDE (Scattered)[6]	0	N/A	N/A	N/A	0	N/A	N/A	N/A
SWLO	**5,663**	**29,598**	**4,142**	**25,033**	**0**	**5,250**	**0**	**1,718**
Anaconda Unit NCDE (Scattered)[6]	N/A	4,070	N/A	4,070	N/A	638	N/A	0
Clearwater Unit NCDE (Scattered)	5,663	25,528	4,142	20,963	0	4,613	0	1,718
Hamilton Unit BE (Scattered)[5,6]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Missoula Unit BE (Scattered)[5,6]	0	N/A	0	N/A	0	N/A	0	N/A
Missoula Unit NCDE (Scattered)	0	0	0	0	0	0	0	0
CLO	**639**	**7,102**	**639**	**5,605**	**49,642**	**136,804**	**0**	**21,729**
Bozeman Unit GYE (Scattered)[6]	0	3,465	N/A	3,166	0	14,320	N/A	2,781
Conrad Unit NCDE (Scattered)[6]	0	0	N/A	N/A	30,539	45,293	N/A	N/A
Dillon Unit GYE (Scattered)[6]	N/A	1,838	N/A	640	N/A	57,559	N/A	18,868
Helena Unit NCDE (Scattered)	639	1,799	639	1,799	19,104	19,631	0	80
Total	**11,231**	**46,094**	**8,979**	**38,517**	**49,642**	**142,667**	**0**	**23,721**

1 Actual acres may be less than depicted. Acreage amounts were calculated based on parcel area. When licenses or leases where granted for a subset of the actual parcel acreage that license or lease acreage is an overestimate of the true license or ease area.
2 NCDE = Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
3 Non-recovery occupied habitat designation from Wittinger (2002).
4 Includes the Coal Creek State Forest and majority of the Stillwater State Forest.
5 The BE recovery zone is currently not considered occupied by grizzly bears.
6 N/A = not applicable. Where N/A is listed in the table, there is no such land area in the given unit.
Source: DNRC (2008a).

Grizzly bears in the contiguous United States spend 4 to 6 months in dens, typically beginning in October or November (Craighead and Craighead 1972; Nagy and Gunson 1990; Hellgren 1998). The bears hibernate for as long as 7 months. During this period, they do not eat, drink, urinate, or defecate. Over the course of the denning season, a bear may lose 30 percent of its body weight. All of this weight is stored as fat, which is acquired during the 2 to 4 months prior to entering dens. During the pre-denning period, bears increase their food intake dramatically and may gain as much as 3.64 pounds per day (Schwartz et al. 2003).

Mating occurs from May through July, and cubs are born inside the den in late January or early February. Cubs remain with their mother for 2 to 3 years (Foresman 2001). The age at which females produce their first litter varies from 3 to 8 years, with litter size varying from one to four cubs. Grizzly bears have one of the lowest reproductive rates among terrestrial mammals. Grizzly bear females cease breeding successfully some time in their mid to late 20s (Schwartz et al. 2003).

Grizzly bears are opportunistic omnivores and will eat fish, berries, grasses, leaves, insects, roots, carrion, small mammals, fungi, nuts, and ungulates. The bears are selective in their seasonal use of various kinds of forage and, therefore, move across the landscape as they follow the growth and abundance of preferred forage items (Blanchard 1983; Mace et al. 1996; Waller and Mace 1997a; McLellan and Hovey 2001).

Habitat Requirements

Grizzly bears are habitat generalists. Key habitat requirements include the availability of food, security (from humans and other bears), and den sites (Archibald et al. 1987; Harting 1987; Heinrich et al. 1995; Mace et al. 1996, 1999; Linnell et al. 2000) (Table 4.9-4). While biologists agree that preferred habitats of grizzly bears are early seral, fire-successional types, the proximity of security cover is also an important variable that has been shown to influence the use of foraging habitat. Given equal foraging opportunities, under cover and in the open, McLellan (1992) suggested that bears would prefer to feed under cover.

TABLE 4.9-4. GRIZZLY BEAR KEY HABITAT REQUIREMENTS

Habitat requirement	Key Habitats
Spring foraging[1]	Low-elevation mesic vegetation
Summer, autumn foraging[1]	Moderate- to high-elevation mesic vegetation
Security cover and isolation from humans[2,3]	Cover provided by vegetation and topographic breaks; absence or low density of roads and trails
Denning habitat[4]	Remote, high-elevation areas with slopes greater than 30 degrees; friable, deep soils; and snow accumulations

Sources:
[1] Mace et al. (1996); Mace et al. (1999); McLellan and Hovey (2001); Nielson et al. (2002); Waller and Mace (1997a).
[2] Archibald et al. (1987); Kasworm and Manley (1990); Mace et al. (1996); Mace et al. (1999); Mattson et al. (1987); McLellan and Shackleton (1988,1989); Wielgus et al. (2002).
[3] Mace and Waller (1997); White et al. (1999); Graves (2002).
[4] Pearson (1975); Servheen (1981); Zager and Jonkel (1983); Podruzny et al. (2002).

With the exception of a few forest vegetation types, such as horsetail associations, the majority of vegetative food items preferred by grizzly bears occur in early seral communities where forest cover is absent or relatively sparse (Hamer and Herrero 1983). Foraging areas that are consistently

described in the literature as favored by bears include avalanche chutes (Zager et al. 1980; Mace et al. 1996; Waller and Mace 1997a; Ramcharita and McLellan 2000; McLellan and Hovey 2001), fire-mediated shrub fields (Almack 1985, 1986; Hamer and Herrero 1987a,b; McLellan and Hovey 2001), and riparian areas (Servheen 1983; McLellan and Hovey 2001). Avalanche chutes may be used at any time of year, but seem to attract bears particularly in the spring. These areas are usually quite wet (due to deep snows that melt later than in other areas), and they contain both valuable forage species and a tangle of vegetation that provides visual screening. Fire-mediated shrub fields often contain soft-mast (e.g., berry) producing shrub species, an important food source for foraging bears in mid-summer and early fall. Riparian areas are primarily used in spring and early summer when habitats at higher elevations are still covered with snow or plant growth is otherwise delayed. Grizzly bear foraging habitat associated with riparian areas and shrub fields is scattered throughout the planning area and the HCP project area.

When bears emerge from their dens in the spring, their fat stores have been severely depleted; therefore, foraging to rebuild energy reserves is their primary focus. It is important that bears have adequate spring foraging opportunities close to their dens, especially when cubs have been born, to build up fat stores quickly. In their study of radio-collared female grizzly bears, Mace et al. (1999) found that the upper elevation limit observed for habitat use in spring was 4,900 feet. For this analysis, therefore, spring habitat is defined as all areas below 4,900 feet elevation, except in the Swan River State Forest. In that area, spring habitat is defined as all areas below 5,200 feet elevation.

Waller and Mace (1997) defined the spring period as the period from den exit to July 15 based on apparent changes in food habitats and behavior. For the proposed grizzly bear conservation strategy, the spring period is defined for the Stillwater Block as April 1 through June 15 for non-spring habitat and April 1 through June 30 for areas within spring habitat. For lands within the Swan River State Forest and DNRC scattered parcels, the spring period is defined as April 1 through June 15. These dates were selected to balance DNRC operational needs with the security needs of bears. The June 15 date is consistent with current management associated with the Swan Agreement, and it provides protective restrictions for the period immediately following the emergence of bears from dens, when they are nutritionally stressed following hibernation. In *Response to Peer Review of the A19 and Proposed Approach to Managing Access in Grizzly Bear Habitat*, prepared by the NCDE Technical Group (USFWS 2001:11), the authors acknowledge that the June 30 date used in that approach was an attempt to accommodate social concerns, but they felt justified in modifying the date to June 15 for two reasons. First, the most urgent concerns related to displacement from good habitat due to snow, mortality risk during black bear season, and vulnerability during the grizzly bear breeding season were all reduced or gone by the end of June. Second, the team acknowledged that there is no dramatic shift in elevation by bears after mid-June.

Spring habitat is available on blocked lands and scattered parcels throughout the planning area and the HCP project area. Spring habitat on HCP project area lands accounts for approximately 3 percent of the spring habitat in the recovery zones and NROH in the planning area. More than 80 percent of the spring habitat in the HCP project area occurs in the NWLO (Table 4.9-5).

In addition to foraging habitat, security cover and isolation from humans and human-associated activities are necessary habitat components for grizzly bears (Archibald et al. 1987; Mattson et al. 1987; McLellan and Shackleton 1988, 1989; Kasworm and Manley 1990; Mace et al. 1996, 1999).

TABLE 4.9-5. ACREAGE OF GRIZZLY BEAR SPRING HABITAT IN THE PLANNING AREA AND HCP PROJECT AREA, FOR RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT, BY LAND OFFICE AND ADMINISTRATIVE UNIT FOR BLOCKED LANDS AND SCATTERED PARCELS

Land Offices and Unit Offices by Recovery Zone[2] (Scattered or Blocked Status)	Spring Habitat in the Planning Area (all ownerships)[1]		Spring Habitat on Trust Lands in the Planning Area[1]		Spring Habitat in the HCP Project Area	
	Recovery Zone	Non-Recovery Occupied Habitat[3]	Recovery Zone	Non-Recovery Occupied Habitat[3]	Recovery Zone	Non-Recovery Occupied Habitat[3]
NWLO	**1,978,549**	**1,271,156**	**97,478**	**46,953**	**95,198**	**35,225**
Kalispell Unit NCDE (Scattered)	107,640	207,760	7,106	6,375	6,580	4,512
Libby Unit CYE (Scattered)	566,262	449,752	2,832	9,904	2,832	9,779
Plains Unit CYE (Scattered)	250,149	249,584	3,193	2,311	3,011	2,257
Plains Unit NCDE (Scattered)[4]	N/A	25,191	N/A	1,807	N/A	N/A
Stillwater Unit NCDE (Blocked)[4,5]	48,649	53	48,649	53	48,571	48
Stillwater Unit NCDE (Scattered)	467,628	338,817	3,493	26,502	2,467	16,822
Swan Unit NCDE (Blocked)[4]	31,871	N/A	31,871	N/A	31,738	N/A
Swan Unit NCDE (Scattered)[4]	506,351	N/A	335	N/A	N/A	N/A
SWLO	**67,945**	**372,734**	**2,756**	**37,796**	**2,094**	**28,455**
Anaconda Unit NCDE (Scattered)[4]	N/A	8,126	0	0	0	0
Clearwater Unit NCDE (Scattered)	32,205	363,038	2,324	36,088	1,821	28,306
Hamilton Unit BE (Scattered)[4,6]	5,344	N/A	N/A	N/A	N/A	N/A
Missoula Unit BE (Scattered)[4,6]	25,833	N/A	340	N/A	181	N/A
Missoula Unit NCDE (Scattered)	4,564	1,569	92	1,708	92	149
CLO	**381,517**	**786,427**	**30,604**	**66,556**	**4**	**91**
Bozeman Unit GYE (Scattered)	N/A	29,857	0	0	N/A	0
Conrad Unit NCDE (Scattered)[4]	310,793	596,481	20,164	46,841	N/A	N/A
Dillon Unit GYE (Scattered)[4]	N/A	0	N/A	0	N/A	0
Helena Unit NCDE (Scattered)	70,723	160,089	10,439	19,715	4	91
Total	**2,428,010**	**2,430,316**	**130,838**	**151,305**	**97,296**	**63,772**

Note: Totals may not add up due to rounding.
[1] For columns where acreages portrayed are for "all ownerships," the designation of scattered versus blocked lands is not applicable and the row identifier as scattered vs. blocked should be ignored. "Spring habitat" is defined as all areas below 5,200 feet elevation for the Swan Unit and all areas below 4,900 feet elevation for other lands.
[2] NCDE = Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
[3] NROH designation from Wittinger (2002).
[4] N/A = not applicable. Where N/A is listed in the table, there is no such land area in the given unit.
[5] Includes the Coal Creek State Forest and majority of the Stillwater State Forest.
[6] The BE recovery zone is currently not considered occupied by grizzly bears.
Source: DNRC (2008a).

Human activities can result in direct mortality of bears, as well as indirect negative effects by displacing bears to less suitable habitats (Mace and Waller 1998; McLellan et al. 1999; Benn and Herrero 2002; Wakkinen and Kasworm 2004; Schwartz et al. 2006). The most effective way to minimize the risk of adverse interactions between humans and bears is to provide spatial separation between areas of human activity and areas of bear activity. In areas where such separation is not possible, providing large areas of secure habitat that include seasonal habitats may reduce the potential for contact and minimize risk of disturbance and illegal mortality (Mace and Waller 1998).

While security cover is necessary primarily to allow grizzly bears to avoid contact with humans, the cover is sometimes necessary for bears to avoid contact with other bears. Specifically, females with cubs require spatial separation from aggressive males. This is particularly true in spring, when cubs-of-the-year are most prone to attack. Sows with cubs often select rugged and isolated habitats for this reason (Russell et al. 1979; Reynolds and Hechtel 1980; Banci 1991). Shrub and tree cover, as well as topographic landscape features, are commonly used as security from humans or other bears (McLellan and Hovey 2001; Wielgus et al. 2002).

There are no broadly accepted USFWS or IGBC standards related to grizzly bear cover. Cover is a habitat consideration addressed through a variety of standards and guidelines based on land management objectives of the landowner and location of their lands on the landscape. For this analysis, security cover adequate to reduce visual detection by humans has been defined as vegetation or topography that hides 90 percent of a grizzly bear from view at the distance of 200 feet (DNRC 2008i).

Table 4.9-6 shows existing forested hiding cover on DNRC lands in the planning area and the HCP project area for recovery zones and NROH. Cover amounts provided by geographic features were not included in this analysis. Most of the forested cover on DNRC lands in the planning area occurs within the HCP project area, specifically the NWLO. Within the NWLO, most of the cover is located on blocked lands within the Stillwater Block and Swan River State Forest.

Another key habitat requirement for grizzly bears is the presence of suitable denning habitat. Den site characteristics are variable, but several researchers have described dens located at high elevations in remote areas with slopes greater than 30 degrees, soils that are deep, and aspects where snow accumulates (Pearson 1975; Servheen 1981; Zager and Jonkel 1983; Podruzny et al. 2002). Sloped sites are often selected because they facilitate easier digging and are generally stabilized by trees, boulders, or root systems of herbaceous vegetation. In addition to excavating dens, grizzly bears den in natural caves and hollows under the roots of trees. While individual den sites are rarely reported to be used for more than one winter, numerous researchers have observed that dens rarely occur singly, but are concentrated in areas that apparently possess appropriate environmental conditions (Craighead and Craighead 1972; Hamer et al. 1977).

The literature on disturbance and impacts to grizzly bears during denning (or immediately before or after denning) suggests that the greatest risk involves females with young cubs that have recently emerged from den sites (Mace and Waller 1997; Reinhart and Tyers 1999; Graves and Reams 2001). Cubs are still vulnerable at this age, and it has often been noted that these family groups will remain near dens for some time before heading for lower-elevation areas with better forage. Bears generally appear to tolerate motorized activities occurring more than 1 kilometer (0.6 mile) from the den (Linnell et al. 2000). There is some indication that close encounters with dens can cause

TABLE 4.9-6. ACREAGE OF FORESTED GRIZZLY BEAR HIDING COVER AND ACREAGE OF NON-HIDING COVER ON TRUST LANDS WITHIN THE PLANNING AREA

Land Offices and Unit Offices by Recovery Zone[2] (Scattered or Blocked Status)[a]	Trust Lands in the Planning Area				HCP Project Area			
	Recovery Zone		Non-recovery Occupied Habitat[3]		Recovery Zone		Non-recovery Occupied Habitat[3]	
	Acres of Hiding Cover	% of Total Recovery Zone in Hiding Cover	Acres of Hiding Cover	% of Total Recovery Zone in Hiding Cover	Acres of Hiding Cover	% of Total Recovery Zone in Hiding Cover	Acres of Hiding Cover	% of Total Recovery Zone in Hiding Cover
NWLO	**104,688**	**(70.3)**	**31,727**	**(64.1)**	**103,248**	**(70.7)**	**24,966**	**(66.1)**
Kalispell Unit NCDE (Scattered)	6,230	(82.0)	6,131	(78.3)	5,989	(84.6)	4,467	(74.9)
Libby Unit CYE (Scattered)	1,763	(61.6)	5,905	(59.1)	1,763	(61.6)	5,831	(59.1)
Plains Unit CYE (Scattered)	3,248	(81.3)	1,342	(59.5)	2,629	(79.3)	1,342	(59.5)
Plains Unit NCDE (Scattered)[4]	N/A	N/A	2,313	(80.9)	N/A	N/A	2,313	(82.4)
Stillwater Unit NCDE (Blocked)[4]	60,020	(66.1)	N/A	N/A	59,956	(66.1)	N/A	N/A
Stillwater Unit NCDE (Scattered)	2,047	(58.2)	16,036	(60.4)	1,789	(71.7)	11,013	(65.3)
Swan Unit NCDE (Blocked)[4]	31,150	(78.2)	N/A	(0.0)	31,121	(78.4)	N/A	(0.0)
Swan Unit NCDE (Scattered)[4]	230	(68.9)	N/A	(0.0)	N/A	N/A	N/A	(0.0)
SWLO	**4,876**	**(53.0)**	**23,739**	**(46.7)**	**4,000**	**(53.8)**	**20,527**	**(49.6)**
Anaconda Unit NCDE (Scattered)[4]	N/A	N/A	3,376	(63.1)	N/A	N/A	3,114	(66.1)
Clearwater Unit NCDE (Scattered)	3,179	(49.8)	20,342	(45.4)	2,397	(50.1)	17,393	(48.3)
Hamilton Unit BE (Scattered)[4,5]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Missoula Unit BE (Scattered)[4,5]	145	(42.6)	N/A	N/A	52	(28.5)	N/A	N/A
Missoula Unit NCDE (Scattered)	1,552	(62.6)	20	(03.2)	1,552	(62.6)	20	(03.2)
CLO	**5,311**	**(10.0)**	**12,614**	**(8.2)**	**231**	**(36.1)**	**10,320**	**(30.7)**
Bozeman Unit GYE (Scattered)[4]	0	(0.0)	5,242	(24.5)	N/A	N/A	4,711	(57.9)
Conrad Unit NCDE (Scattered)[4,6]	4,480	(13.4)	0	(0.0)	N/A	N/A	N/A	N/A
Dillon Unit GYE (Scattered)	N/A	N/A	3,932	(06.5)	N/A	N/A	2,214	(11.3)
Helena Unit NCDE (Scattered)	831	(04.2)	3,440	(13.3)	231	(36.1)	3,394	(57.2)

1 See DNRC (2008i) for methods used to calculate grizzly bear hiding cover.
2 NCDE= Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
3 NROH designation from Wittinger (2002).
4 N/A = not applicable. Where N/A is listed in the table, there is no such land area in the given unit.
5 The BE recovery zone is currently not considered occupied by grizzly bears.
6 All lands on this unit occur outside of the HCP project area.
Source: DNRC (2008a).

physiological stress (Reynolds et al. 1986) or, in some cases, den abandonment (Swenson et al. 1997). Den abandonment, in turn, increases the likelihood of cub mortality.

For this analysis, post-denning habitat is defined as all areas that occur on sites with slopes greater than 45 percent at elevations greater than 6,300 feet (Mace and Waller 1997:41). Methods for this analysis are described in DNRC (2008i). Of 1.8 million acres of post-denning habitat in recovery zones and NROH in the planning area, less than 11,000 acres (0.6 percent) occur on trust lands (Table 4.9-7). The HCP project area contains 5,863 acres of post-denning habitat within recovery zones (mostly on blocked lands in the NWLO) and 2,989 acres in NROH (mostly within the CLO).

Habitat Linkage

An important habitat component for wildlife is the presence of habitat linkage. Servheen et al. (2001) define habitat linkages as "the area between larger blocks of habitat where animals can live at certain seasons where they can find the security they need to successfully move between these larger blocks of habitat." The importance of maintaining habitat linkage is an issue recognized by federal, state, and county governments; conservation organizations; and many others (Servheen et al. 2001). It is an issue encompassing not only wildlife conservation but also human safety and economics, since vehicle-wildlife collisions on highways result in many human fatalities and injuries each year and cost millions of dollars in property damage (Servheen et al. 2001). The main factors generally considered to affect the quality of linkage zones are major highways, railroads, road density, human site development, availability of hiding cover, and the presence of riparian areas (USFS 2005).

Habitat linkage and connectivity are important components of grizzly bear habitat (Servheen et al. 2001, 2003; USFWS 1993). Maintaining linkage and connectivity between small, isolated grizzly bear populations can benefit grizzly bears in several ways, including (1) allowing immigrant grizzlies to bolster a resident population in an area that has been affected by catastrophic events or negative environmental conditions, and (2) preserving genetic diversity by reducing negative effects from inbreeding. Task 37 in the federal *Grizzly Bear Recovery Plan* (USFWS 1993) called for the evaluation of linkage potential between grizzly bear recovery zones.

For this analysis, linkage in the planning area is qualitatively and quantitatively evaluated by considering three identified subsets of defined linkage zones or linkage areas: (1) those described by Servheen et al. (2001, 2003), (2) those identified in the Swan Agreement for the Swan River State Forest, and (3) additional potential zones within the planning area that were identified using methods developed by DNRC (2008i) that are similar to those used by Servheen et al. (2001) (Table 4.9-8; Figures D-15A, B, and C in Appendix D, EIS Figures). The DNRC methods incorporate measures of road density, secure areas, developed sites, and grizzly bear hiding cover to identify and map areas with the greatest potential linkage value. To compare the alternatives, the combination of the three methods identified above was deemed satisfactory for descriptive purposes.

The mapped zones in Figures D-15A, B, and C (Appendix D, EIS Figures) provide two important features: (1) they disclose the relationship of the HCP project area lands and non-project area lands in the planning area to areas estimated to have importance for linkage, and within those areas where the efforts of others have identified areas of importance for linkage; and (2) they provide a basis for understanding how impacts may or may not vary between the alternative management policy

TABLE 4.9-7. ACREAGE OF GRIZZLY BEAR POST-DENNING HABITAT ON DNRC BLOCKED LANDS AND SCATTERED PARCELS WITHIN THE PLANNING AREA AND HCP PROJECT AREA, FOR RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT, BY LAND OFFICE

Land Office and Unit Office by Recovery Zone[2] (Scattered or Blocked Status)	Post-denning Habitat in the Planning Area (all ownerships)[1]		Post-denning Habitat on Trust Lands in the Planning Area		Post-denning Habitat in the HCP Project Area	
	Recovery Zone	Non-recovery Occupied Habitat[3]	Recovery Zone	Non-recovery Occupied Habitat[3]	Recovery Zone	Non-recovery Occupied Habitat[3]
NWLO	**536,696**	**2,895**	**5,764**	**52**	**5,764**	**52**
Stillwater Unit NCDE (Blocked)[4,5]	4,498	N/A	4,498	N/A	4,498	N/A
Swan Unit NCDE (Blocked)[4]	1,266	N/A	1,266	N/A	1,266	N/A
Scattered parcels (NCDE and CYE)	530,932	2,895	0	52	0	52
SWLO (NCDE and BE)[6,7]	**260,346**	**22,979**	**99**	**421**	**99**	**333**
CLO (NCDE and GYE)[7]	**589,744**	**435,856**	**623**	**3,945**	**0**	**2,604**
Total	**1,386,786**	**461,730**	**6,487**	**4,418**	**5,863**	**2,989**

Note: Totals may not add up due to rounding.
1 For columns where acreages portrayed are for "all ownerships," the designation of scattered versus blocked lands is not applicable and the row identifier as scattered vs. blocked should be ignored.
2 NCDE= Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
3 NROH designation from Wittinger (2002).
4 N/A = not applicable. Where N/A is listed in the table, there is no such land area in the given unit.
5 Includes the Coal Creek State Forest and the blocked portion of the Stillwater State Forest that occurs within the NCDE.
6 The BE recovery zone is currently not considered occupied by grizzly bears.
7 Only scattered parcels, no blocked lands, are included in this land office.
Source: DNRC (2008a).

TABLE 4.9-8. ACREAGE OF POTENTIAL HABITAT LINKAGE ON TRUST LANDS WITHIN THE PLANNING AREA AND HCP PROJECT AREA, BY LAND OFFICE AND ADMINISTRATIVE UNIT

Land Office and Administrative Unit Office	Acreage of Habitat Linkage Identified by Servheen et al. (2003)		Acreage of Habitat Linkage Identified in the Swan Agreement		Acreage of Habitat Linkage using DNRC Methodology in Remainder of the Planning Area		Total Acreage of Habitat Linkage on Trust Lands in the Planning Area (and HCP Project Area)	
	Servheen et al. portion of Trust Lands in Planning Area	(Servheen et al. portion of HCP Project Area)	Swan Agreement portion of Trust Lands in Planning Area	(Swan Agreement portion of HCP Project Area)	Remainder of Trust Lands in Planning Area	(Remainder of HCP Project Area)	Trust Lands in Planning Area	(HCP Project Area)
NWLO	**32,655**	**(31,862)**	**19,821**	**(19,817)**	**24,876**	**(19,970)**	**77,352**	**(71,650)**
Kalispell Unit	0	(0)	0	(0)	7,665	(5,387)	7,665	(5,387)
Libby Unit	0	(0)	0	(0)	0	(0)	0	(0)
Plains Unit	643	(643)	0	(0)	2,243	(557)	2,886	(1,200)
Stillwater Unit	32,012	(31,219)	0	(0)	9,841	(8,899)	41,853	(40,118)
Swan Unit	0	(0)	19,821	(19,817)	5,127	(5,127)	24,948	(24,944)
SWLO	**6,778**	**(4,882)**	**0**	**(0)**	**54,901**	**(38,977)**	**61,679**	**(43,859)**
Anaconda Unit	0	(0)	0	(0)	21,453	(10,651)	21,453	(10,651)
Clearwater	0	(0)	0	(0)	19,517	(15,480)	19,517	(15,480)
Hamilton Unit	0	(0)	0	(0)	8,337	(7,697)	8,337	(7,697)
Missoula Unit	6,778	(4,882)	0	(0)	5,595	(5,149)	12,373	(10,031)
CLO	**0**	**(0)**	**0**	**(0)**	**179,110**	**(8,004)**	**179,110**	**(8,004)**
Bozeman Unit	0	(0)	0	(0)	36,615	(4,043)	36,615	(4,043)
Conrad Unit[1]	0	N/A	0	N/A	39,207	N/A	39,207	N/A
Dillon Unit	0	(0)	0	(0)	41,114	(952)	41,114	(952)
Helena Unit	0	(0)	0	(0)	62,174	(3,010)	62,174	(3,010)
Total	**39,433**	**(36,744)**	**19,821**	**(19,817)**	**258,887**	**(66,951)**	**318,141**	**(123,513)**

1 All lands in this unit occur outside to the HCP Project Area.
Source: DNRC (2008a). See DNRC (2008i) for methodology.

approaches being considered. No particular commitment to this map is being contemplated as part of this project or analysis.

More than 6 million acres of potential linkage are estimated to occur in the planning area (Table 4.9-9). Approximately 318,141 acres (5 percent) are on trust lands, of which 123,513 acres (2 percent) lie within the HCP project area (Table 4.9-9). Within the HCP project area, the majority of the potential linkage habitat occurs in the NWLO (Tables 4.9-8 and 4.9-9).

TABLE 4.9-9. ACREAGE OF POTENTIAL HABITAT LINKAGE (DNRC MODEL) WITHIN THE PLANNING AREA, BY LAND OWNERSHIP

Ownership[1]	Habitat Linkage within the Planning Area	
	Acres	Percent of Total[2,3]
USFS	1,746,661	27.7
BLM	153,578	2.4
NPS	153,224	2.4
Other Federal	34,997	0.6
DNRC (non-HCP)	318,141	5.0
HCP Project Area	123,513	2.0
NWLO	71,650[4]	1.1
SWLO	43,859[4]	0.7
CLO	8,004[4]	0.1
Other State (Non-DNRC)	151,388	2.4
Private Industrial Forest	136,540	2.2
Other Private	3,158,783	50.2
Other Land Ownership	436,320	6.9
Total	**6,289,632**	**100**

[1] USFS = U.S. Forest Service, BLM = Bureau of Land Management, NPS = National Park Service.
[2] Numbers may not sum to total due to rounding.
[3] These values were adjusted to take into account results based on outputs from the Servheen et al. (2003) effort and the Swan Agreement (USFWS et al. 1995).
[4] These values add up to the total in "HCP Project Area" row. These three land offices total all HCP project area lands in planning area with potential linkage.
Source: DNRC (2008a). See DNRC (2008i) for methodology.

4.9.3.2 Environmental Consequences

As described above, bears can be affected in a number of ways by the forest management activities considered for coverage under the HCP. Broadly, these effects fall into the categories of (1) effects caused by roads, (2) risk of bear-human conflicts, and (3) habitat modification. The following subsections discuss these potential effects and describe the following for each: (1) the criteria by which the effects of the alternatives are evaluated, (2) the rationale for those criteria, and (3) the relative effects of the alternatives. Each subsection is introduced by a bullet statement summarizing a potential effect and cause. Some bullet statements describe potential effects that span categories; for example, reduced visual screening is a habitat modification that results in an increased risk of bear-human conflicts.

The aquatic conservation strategies and the lynx conservation strategy are discussed in these sections as appropriate when commitments overlap those of the grizzly bear.

Road-related Effects

A key indicator of security and isolation from humans is the presence and use of roads. Roads, along with the activities associated with road construction, gravel pits, off-road vehicle access, snowmobile access, and other motorized and non-motorized recreation, can affect grizzly bears both directly and indirectly in terms of disturbance, displacement, habituation, and increased risk of mortality as described above. Road amounts on DNRC ownership have largely resulted from past projects and activities necessary to generate revenue for trust beneficiaries. Also, some existing roads on trust lands today were acquired through purchase or exchange with other landowners. Actions resulting in access development have included (but are not limited to) timber harvesting, cabin or home site access, utility easements, easements to access private property, and agriculture and grazing management. Roads developed to access timberlands decades ago were occasionally built in very high densities. Current Forest Management ARMs provide guidelines to minimize road construction and road access (Table E4-8 in Appendix E, EIS Tables).

Increasing numbers of people are using trust lands for non-motorized and motorized recreation, such as snowmobiling, hiking, camping, and swimming in creeks, rivers, and lakes, as well as hunting and fishing. All uses of forestlands, including DNRC staff use of roads closed to public access, can reduce the amount of area available to grizzly bears (as well as other species sensitive to human disturbance), depending on location of these activities, season of use, and other factors. Animals disturbed by human presence may flee from areas that provide vital habitat (e.g., den sites, key foraging areas during critical times of the year), interfering with activities essential to survival and possibly putting themselves or their young at an increased risk of predation (Claar et al. 2003; Ruediger et al. 2000).

Road density is a measure commonly used to assess the effects of roads on grizzly bears. Accounting for road density allows managers to monitor changes in the amount of roads in critical bear habitat, such as spring foraging habitat. However, the effects of roads on bears vary by location and management activities (MFWP 2002a).

For this analysis, two distinct methods for calculating road density were used to evaluate the impacts of the alternatives on grizzly bears. In areas of blocked lands, where DNRC manages large, contiguous blocks of land and can control the types of activities that occur on those lands (Stillwater Block and Swan River State Forest), a "moving windows" analysis was used to calculate road density (USFS 1995a). Elsewhere, where trust lands occur as scattered parcels, road density was calculated as miles of road per square mile of land area (i.e., the simple linear road density calculation, mi/mi^2). Of 154,201 acres of HCP project area lands in the recovery zones, about 85 percent occur on blocked lands (Table 4.9-10).

The preferred method of road density calculation, recommended by the IGBC where applicable, is a GIS-based moving windows analysis (USFS 1995a). This method considers the spatial location of roads in relation to one another, and is commonly used to assess impacts associated with road density on species such as grizzly bears. For wide-ranging species, this method is preferred for assessing impacts at large scales (USFS 1995a), and for grizzly bears, the scale of assessment is approximately 50 square miles, the minimum size of a female grizzly bear home range. This methodology also provides land managers with the ability to create density contour maps for visually assessing effects and understanding where the greatest road density occurs. In this way,

TABLE 4.9-10. ACREAGES OF LANDS IN GRIZZLY BEAR RECOVERY ZONES AND ASSOCIATED NON-RECOVERY OCCUPIED HABITAT IN THE PLANNING AREA AND HCP PROJECT AREA BY LAND OFFICE AND ADMINISTRATIVE UNIT FOR BLOCKED LANDS AND SCATTERED PARCELS, BY RECOVERY ZONE

Land Office and Recovery Zone[1] (Scattered or Blocked Status)	Recovery Zone in the Planning Area (All Ownerships)[2]	Non-recovery Occupied Habitat in the Planning Area (All Ownerships)[2,3,4]	Recovery Zone on Trust Lands in the Planning Area[2]	Non-recovery Occupied Habitat on Trust Lands in the Planning Area[4]	Recovery Zone in the HCP Project Area	Non-recovery Occupied Habitat in the HCP Project Area[4]
NWLO Subtotal	**4,626,501**	**1,615,487**	**148,895**	**49,436**	**146,120**	**37,718**
Kalispell Unit NCDE (Scattered)	216,467	300,781	7,603	7,828	7,079	5,965
Libby Unit CYE (Scattered)	914,265	587,602	2,861	9,989	2,861	9,865
Plains Unit CYE (Scattered)	424,498	285,628	3,994	2,257	3,313	2,257
Plains Unit NCDE (Scattered)	0	45,992	0	2,860	0	2,806
Stillwater Unit NCDE (Blocked)[7]	1,193,803	0	90,751	0	90,673	0
Stillwater Unit NCDE (Scattered)		395,449	3,519	26,502	2,494	16,826
Swan Unit NCDE (Blocked)	1,877,468	0	39,833	0	39,699	0
Swan Unit NCDE (Scattered)		34	334	0	0	0
SWLO Subtotal	**961,438**	**821,552**	**9,199**	**50,816**	**7,442**	**41,348**
Anaconda Unit NCDE (Scattered)	0	141,430	0	5,347	0	4,709
Clearwater Unit NCDE (Scattered)	475,615	655,416	6,379	44,821	4,781	35,990
Hamilton Unit BE (Scattered)[5]	299,700	0	0	0	0	0
Missoula Unit BE (Scattered)[5]	105,572	0	341	0	182	0
Missoula Unit NCDE (Scattered)	80,551	24,707	2,478	648	2,478	648
CLO Subtotal	**2,977,759**	**2,791,737**	**53,281**	**154,222**	**639**	**33,645**
Bozeman Unit GYE (Scattered)	1,110,366	1,116,446	40	21,365	0	8,132
Conrad Unit NCDE (Scattered)[6]	1,316,679	636,838	33,417	46,837	0	0
Dillon Unit GYE (Scattered)	0	780,013	0	60,224	0	19,582
Helena Unit NCDE (Scattered)	550,714	258,440	19,824	25,797	639	5,931
Total	**8,565,699**	**5,228,776**	**211,374**	**254,475**	**154,201**	**112,711**

Note: Totals may not add up due to rounding.
1 NCDE = Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
2 For columns where acreages portrayed are for "all ownerships," the designation of scattered parcels vs. blocked lands is not applicable and the row identifier as scattered vs. blocked should be ignored.
3 The scattered vs. blocked status is not relevant to the acres portrayed "all ownerships."
4 Non-recovery occupied habitat designation from Wittinger (2002).
5 The BE recovery zone is currently not considered occupied by grizzly bears.
6 Lands on this unit occur outside of the HCP project area.
7 Includes the Coal Creek State Forest and majority of the Stillwater State Forest.
Source: DNRC (2008a).

moving windows analysis provides more than just a simple density estimate over a given area (USFS 1995a). Results are summarized as the proportion of an analysis area in variously defined density classes (e.g., less than 1 mi/mi^2, between 1 and 2 mi/mi^2, more than 2 mi/mi^2). Moving windows analysis requires input of an adequate road layer, an adequate trail layer, and a defined analysis area.

In the Stillwater and Swan Units, road density is analyzed at the level of bear management unit (BMU) subunits, which is the analysis unit preferred by the USFWS. A BMU is an area in which the yearlong habitat needs of both male and female grizzly bears can be met. BMUs in the NCDE (which encompasses the Stillwater and Swan Units) are about 400 square miles in size. A BMU subunit represents the approximate size of an average annual female home range (about 50 square miles), generally delineated from ridge top to valley bottom and encompassing all seasonal habitats (USFS 1995c).

An alternative method of assessing road density is simple linear calculation, which is used for scattered parcels for this analysis because road data for trust lands and adjacent lands is limited. Many scattered parcels are less than or equal to one square mile in size (640 acres) surrounded by a matrix of other ownerships, often national forest lands. Using this method, the total miles of road in the analysis area is divided by the total size of an analysis area (in square miles). This method does not allow a spatial assessment of the amount and distribution of different density classes in an analysis area, but it does provide suitable surrogate estimates of density useful for comparison. Results calculated through this method are not directly comparable to those calculated through moving windows analysis. Anticipated changes in linear road density under the alternatives, however, can serve as an indicator of potential road-related effects on grizzly bears in scattered parcels. These estimates can be used to evaluate the likely broad-scale effects of the various conservation strategy approaches. An important consideration using the linear method is the size of the analysis area. As the size of a particular analysis area grows smaller, the road density for that area may be skewed toward larger values. For example, a 1-mile length of road crossing a 1-square-mile parcel (1 mile on each side) produces a road density of 1 mi/mi^2. If each side of that parcel is reduced to 0.5 mile, the parcel area becomes 0.25 square mile (0.5 mile times 0.5 mile); a straight road crossing that parcel would be 0.5 mile long, producing a road density of 2 mi/mi^2 (0.5 mile divided by 0.25 mile).

For this analysis, DNRC developed estimates for the future miles of road in different road management classes (open, restricted, and total) based on several sources. These included historical data on miles of roads constructed and project area acreages from personal communications with project leaders, foresters, or unit managers, as well as environmental documents and contracts that were available for timber sale contracts sold between fiscal years 1998 and 2006. Information from the Stillwater and Swan Transportation Plans developed for the proposed HCP (Appendix A, HCP, Tables 2-2 and 2-3, respectively) was used to determine road mile values in those areas under Alternatives 2, 3, and 4. Increases in Alternative 1 (No Action) were developed using the calculated constants for restricted roads in the Stillwater Block. The "Swan Agreement Future" column in Appendix A, HCP, Table 2-3 was used to determine road increases for the Swan River State Forest under Alternative 1. Note that the transportation plan for the Swan River State Forest would be implemented only if the Swan Agreement is terminated. If this happens, the actual amount of additional road open to motorized public access at any time in the future would depend on the status of access agreements between DNRC and adjacent landowners, as well as the timing of individual

landowners' decisions to pursue access across parcels of trust lands. Under the Swan Agreement in its current form, no changes are anticipated in the miles of road open to motorized public access in the Swan River State Forest.

The effects of roads on grizzly bears are described in terms of total road density and open road density. For this analysis, open roads include those classified as open, private, or seasonally open, and exclude restricted, highway, and county roads. Total roads include those classified as restricted, along with open, private, or seasonally open roads. The following two subsections address these topics in greater detail and compare the effects of the alternatives.

Total Road Density

Potential Effects

- The presence of road prisms on the landscape may cause bears to avoid areas they might otherwise use for feeding, breeding, and sheltering.

Indicators and Rationale

As described above, in a number of North American studies, the presence of roads has been shown to reduce habitat effectiveness or increase the risk of grizzly bear mortality. It is widely accepted that grizzly bears shift their behavior in response to human activities on those roads, not in response to the physical presence of the roads themselves. Open roads appear to elicit a more pronounced response than closed roads (Mace et al. 1996; IGBC 1998). However, even closed roads elicit a response, probably because closed roads still receive certain levels of human use. Road densities are an index of the extent and types of human access.

For this analysis, total road density is used as an indicator of the relative amounts of road prisms on the landscape predicted under the various alternatives to assess risk of grizzly bear displacement from habitat important for feeding, breeding, and sheltering. In Montana, the USFWS generally evaluates the effects of road presence on grizzly bears expressed as a percent of a given BMU subunit with a total road density greater than 2 mi/mi^2. Generally, a female in the NCDE can effectively use the home range to successfully raise cubs if about 20 percent or less of the BMU subunit exhibits a total road density greater than 2 mi/mi^2 (as well as other habitat measures) (IGBC 1998). Above these levels, a female with cubs may begin to experience significant loss of resources and increased risk of mortality.

In no case does DNRC ownership encompass an entire BMU subunit (a surrogate female home range) (Table 4.9-11). DNRC blocked lands occur in 13 grizzly bear subunits and account for 0.7 to 84 percent of any one subunit. DNRC controls 20 percent or more of the lands within seven BMU subunits.

The following subsection discusses the rules and commitments that would influence total road density under the alternatives. Resulting differences in total road density under the alternatives are illustrated using modeled estimates of future road densities. Moving windows analysis was used for the blocked lands in the Stillwater Block and Swan River State Forest, while linear road densities were calculated for scattered parcels elsewhere in the recovery zones and NROH.

TABLE 4.9-11. MOVING WINDOWS ESTIMATES OF THE PERCENTAGE OF TRUST LANDS WITH TOTAL ROAD DENSITIES EXCEEDING 2 MI/MI^2 UNDER EACH ALTERNATIVE, BY BMU AND BMU SUBUNIT FOR BLOCKED LANDS WITHIN THE HCP PROJECT AREA, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

Administrative Unit, BMU, and BMU Subunit	Percent of BMU Subunit within the HCP Project Area	Percent of HCP Lands within Subunit Exceeding 2 mi/mi^2				
			Alternative			
		Existing Conditions	1 No Action	2	3	4
Stillwater Block		**53.2**	**56.5**	**57.2**	**56.5**	**57.2**
Lower North Fork Flathead BMU		**5.0**	**5.0**	**5.0**	**5.0**	**5.0**
Werner Creek	1.3	5.0	5.0	5.0	5.0	5.0
Murphy Lake BMU		**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Krinklehorn	0.7	0.1	0.1	0.1	0.1	0.1
Stillwater River BMU		**55.5**	**58.4**	**58.4**	**58.4**	**58.4**
Lazy Creek	41.6	79.7	79.7	79.6	79.7	79.6
Stryker	80.6	37.9	42.1	42.1	42.1	42.1
Upper Whitefish	84.0	64.1	67.0	67.0	67.0	67.0
Upper North Fork Flathead BMU		**44.8**	**50.1**	**54.1**	**50.1**	**54.1**
Coal and South Coal	1.6	0.1	0.1	0.1	0.1	0.1
Hay Creek	5.4	55.0	55.6	57.0	55.6	57.0
State Coal Cyclone	42.8	44.5	50.8	55.2	50.8	55.2
Swan River State Forest		**76.8**	**90.2**	**90.2**	**90.2**	**90.2**
Bunker Creek BMU		**71.6**	**86.6**	**86.5**	**86.6**	**86.5**
Goat Creek	21.4	92.0	97.6	97.6	97.6	97.6
Lion Creek	10.6	97.8	100.0	100.0	100.0	100.0
South Fork Lost Soup	61.3	60.4	80.6	80.6	80.6	80.6
Mission Range BMU		**88.2**	**98.3**	**98.3**	**98.3**	**98.3**
Piper Creek	0.6	23.4	66.5	66.5	66.5	66.5
Porcupine Woodward	32.5	89.2	98.7	98.7	98.7	98.7

Source: DNRC (2008a).

Comparison of Alternatives

The primary factor driving any differences in total road density under the alternatives is the anticipated amount of new road construction. The alternatives do not differ in the amount of roads that would be abandoned or reclaimed (see Table 4.4-6 in Section 4.4, Transportation), so any differences in the miles of open, restricted seasonally, or restricted year-round roads would derive from differences in new road construction or changes in road classes. In addition to those constructed for forest management activities on trust lands, roads may be built as a result of easement requests from adjacent landowners. The following analysis, therefore, also addresses variations in provisions for granting easements under the alternatives.

Under Alternative 1, new road construction commitments would continue to consider the needs of public access, wildlife habitat, and adjacent landowners. The only areas where road construction would be specifically limited would be SMZs. New road construction in avalanche chutes would not specifically be constrained under this alternative and could reduce grizzly bear use of these important foraging areas. There would be no policy setting precise limits on permanent or temporary road construction, thereby potentially allowing more roads to be constructed under general constraints. ARM 36.11.421 requires that forest managers plan transportation systems for the minimum number of road miles needed; however, the degree to which transportation planning would be scrutinized would be less under Alternative 1 than any of the action alternatives. Under Alternative 1, the environmental impacts (including those on grizzly bears) from easements must be considered through DNRC's Access Road Easement Policy. Under Alternatives 2, 3, and 4**,** commitment GB-PR4 would require more specifically that new construction of open roads be minimized in riparian areas and avalanche chutes throughout the HCP project area. In addition, the development of transportation plans in the Stillwater Block and Swan River State Forest that specifically control how much and where new roads can be constructed over the 50-year Permit term would reduce the risk of direct and indirect effects on grizzly bears associated with displacement from important habitat.

The transportation plan for the Stillwater Block under Alternatives 2 and 4 would prohibit the construction of new permanent roads on Class A lands, and would designate where new road construction would be allowed on Class B lands. The prohibition of new permanent roads on Class A lands would minimize long-term displacement and mortality risk to bears using these areas. A total of 19.3 miles of new road construction would be allowed in the Stillwater Block (Appendix A, HCP, Table 2-2). Transportation commitments for the Swan River State Forest would be very similar to those for the Class B lands in the Stillwater Block, except that the Swan River State Forest lands would be subject to rest requirements. In the event that the Swan Agreement is terminated, new road construction would be limited to approximately 70.3 miles identified in the Swan River State Forest Transportation Plan map (Appendix A, HCP, Table 2-3). The Stillwater transportation plan under Alternative 3 would not identify Class A or Class B lands, but would maintain the existing prohibition on road density increases in the Stillwater Core. Given past access needs on the forest, it was predicted that an additional 17.6 miles of new road (restricted year-round) would be added over the course of the 50-year Permit term under Alternative 1. However, the specific locations of those roads were not predicted due to a high degree of uncertainty regarding long-term access needs under this alternative. For scattered parcels in recovery zones, Alternatives 2 and 4 include no conservation commitments that specifically limit total road density. In contrast, under Alternative 3, commitment GB-SC1 would prohibit any net increases in baseline total road densities for forest management projects at the DNRC administrative unit level.

Regarding easements, the implementation of commitment GB-NR2 under Alternatives 2, 3, and 4 would discourage granting access easements that relinquish DNRC control of roads. Within the recovery zones, this commitment would be complemented by GB-RZ6, under which individual easements would be evaluated and conditioned with mitigation measures for grizzly bears. In contrast to Alternative 1, all three action alternatives would provide increased protection and specific consideration for grizzly bears when access easements are considered. This increased consideration and subsequent protections may reduce the amount of roads and other human activities and access in bear habitat, thereby reducing impacts of displacement to grizzly bears.

Because DNRC is legally obligated to consider all reasonable easement requests, the additional commitments under the action alternatives would likely not substantially reduce the amount of new road construction across trust lands.

Under all four alternatives, in the Stillwater Block and Swan River State Forest, in all BMU subunits where HCP project area lands make up at least 5 percent of the total area, the proportion of trust lands where total road densities exceed 2 mi/mi^2 would increase (Table 4.9-11). As a result, grizzly bears might proportionally avoid suitable feeding, breeding, or sheltering habitat in these subunits. Under all alternatives, the greatest increases would occur in the Piper Creek and South Fork Lost Soup subunits in the Swan River State Forest. Throughout the Swan River State Forest, increases in total road density would be identical (or nearly so) under all alternatives, including Alternative 1. In the Stillwater Block, anticipated increases in total road density under Alternatives 2 and 4 would exceed those for Alternatives 1 and 3 in the Hay Creek and State Coal Cyclone subunits. The differences, however (1.4 percentage points in Hay Creek and 4.4 percentage points in State Coal Cyclone), do not represent substantial increases over current values, and would not be expected to result in any discernible differences in effects on grizzly bears in these areas.

Based on the linear density calculation method, total road densities on scattered parcels in all land offices would increase under all alternatives by year 50 (Table 4.9-12). Under current conditions and all alternatives at year 50, road densities in NROH are higher than in the recovery zones. The exception to the pattern of increasing road densities is Alternative 3, under which road densities on scattered parcels in the recovery zones would remain at existing levels. This reflects the additional provision under commitment GB-SC1, which would not allow increases in baseline total road densities. Thus, on scattered parcels under Alternative 3, displacement risk to grizzly bears due to the density of roads on the landscape would likely not increase appreciably from existing levels.

TABLE 4.9-12. TOTAL ROAD DENSITY USING LINEAR CALCULATION OF MI/MI^2 ON SCATTERED PARCELS FOR RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT IN THE HCP PROJECT AREA, BY ALTERNATIVE, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

	Existing Conditions		Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Land Office	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH
NWLO	2.8	3.8	3.4	4.5	3.4	4.5	2.8	4.5	3.4	4.5
SWLO	2.3	2.9	3.5	4.2	3.5	4.2	2.3	4.2	3.5	4.2
CLO	0.2	1.5	0.6	1.9	0.6	1.9	0.2	1.9	0.6	1.9

Source: DNRC (2008a).

The implications of these road density predictions to grizzly bear conservation vary. In some cases, where DNRC ownership represents a small percentage of a BMU subunit embedded in a matrix of national forest lands (e.g., Hay Creek subunit of the Upper North Fork Flathead BMU, where DNRC owns 5.4 percent of the lands) and the increase in total road density is minor (no more than 2 percent), a female with cubs can effectively use the subunit, including such DNRC lands during portions of the year and over her lifespan. In other cases (such as the Upper Whitefish BMU subunit of the Stillwater River BMU), DNRC controls more than 80 percent of the lands in a female grizzly bear's potential home range. High road densities could cause reduced habitat effectiveness

on significant amounts of habitat, resulting in either displacement of bears from important habitats or increased risk of bear-human encounters for bears that select these habitats anyway. Some, more tolerant bears, may habituate to roads and human activity and continue to use the affected lands, but they would be at greater risk due to greater potential for contact with humans. The potential for increased contact with humans would be minimized through the implementation of the HCP conservation commitments, including seasonal restrictions, the establishment of quiet areas, project-by-project consideration of important habitat features, and retention of cover. The effects of implementing these commitments are analyzed below under the respective issue statements.

Open Road Density

Potential Effects

- Use of roads in bear habitat by DNRC to conduct forest management and use of roads by the public may result in avoidance and/or displacement of bears from habitat they would otherwise use for feeding, breeding, and shelter. Bears avoiding roads may forego resources otherwise available near roads; they may experience increased energy expenditure to search more broadly for adequate resources; they may simply establish home ranges elsewhere to meet their needs; or they could be forced into competition with other bears.

Indicators and Rationale

Compared to total road density, open road density is a more direct indicator of the risks posed by roads to grizzly bears. Roads that are open to motorized use by the public receive more use and allow more humans to travel into areas that provide potentially suitable habitat for bears, substantially increasing the risk of their displacement from desirable areas in important seasons, such as spring. Thus, open road density is used as an indicator of relative human use on the landscape predicted under the various alternatives to assess risk of grizzly bear displacement from habitat important for feeding, breeding, and sheltering. To analyze effects on grizzly bears, all roads open to motorized public access during any part of the year were considered open for density calculations (excluding non-DNRC county roads, highways, and private roads) (DNRC 2008i).

In areas where grizzly bear conservation is a priority, road management emphasizes minimizing the amount of road open to motorized public access, either year-round or during key times of year in key areas (e.g., spring foraging areas, denning areas, etc.). In Montana, the USFWS generally evaluates the effects of road use on grizzly bears expressed as a percent of a given BMU subunit with an open road density of greater than 1 mi/mi^2. Generally, a female with cubs in the NCDE can effectively use her home range to successfully raise her cubs if about 20 percent or less of the BMU subunit exhibits an open road density greater than 1 mi/mi^2 (as well as other habitat measures) (IGBC 1998). Above these levels, a female with cubs may begin to experience significant loss of resources and increased risk of mortality.

In no case does DNRC ownership encompass an entire BMU subunit (surrogate female home range) (Table 4.9-11). DNRC blocked lands occur in 13 grizzly bear subunits and account for 0.7 to 84 percent of any one; with less than 20 percent ownership in seven BMU subunits.

It is important to note that the effects of open road density on grizzly bears are difficult to predict for several reasons. The utility of open road density as an indicator of the potential effects on grizzly bears is limited by uncertainty about (1) the amount of use that actually occurs on restricted road

systems, (2) differences in the effects of seasonally restricted roads compared to those with year-round use restrictions (and also how varying amounts of one class may offset or exacerbate impacts of another), (3) locations where bears may occur at any given time, and (4) variations in how individual bears may respond to roads and their use by humans.

The following subsection discusses the ARMs and commitments under the action alternatives that would influence open road density. Among these are provisions that would restrict increases in open road density, as well as requirements for inspecting and maintaining road closure structures (e.g., gates, berms) used to discourage motorized public use of restricted roads. Similar to the preceding analysis, resulting differences in open road density under the alternatives are illustrated using predicted estimates of future road densities. Moving windows analysis (USFS 1995a) was used for the blocked lands in the Stillwater Block and Swan River State Forest, while linear road densities were calculated for scattered parcels elsewhere in the recovery zones and NROH.

Comparison of Alternatives

None of the alternatives include program-wide commitments that would explicitly limit open road densities to a prescribed level. Under all alternatives, restrictions are applied within certain portions of the HCP project area, such as NROH or the blocked lands of the Stillwater Block and Swan River State Forest. In addition, commitments for monitoring and repairing road closures would influence the amount of road that is designated as closed to motorized public access but is accessible to motor vehicles.

As described earlier, the implications to grizzly bear conservation of the various road density indices vary. In some cases, where DNRC ownership represents a small percentage of a BMU subunit, a female with cubs can continue to effectively use the subunit, including such DNRC lands during portions of the year and throughout her lifespan. In other cases, DNRC controls a significant percent of a potential female grizzly bear home range. High road densities in this scenario could reduce habitat effectiveness on large acreages of habitat. Therefore, the HCP includes conservation commitments to avoid or minimize the potential adverse effects of disturbance and/or displacement, including seasonal restrictions, the establishment of quiet areas, project-by-project consideration of important habitat features, and retention of cover. The effects of these commitments are analyzed below.

Stillwater Block

Under Alternative 1, existing ARMs would not allow increases from the 1996 baseline in the proportion of BMUs that exceed an open road density of 1 mi/mi^2. Under special circumstances, minor increases could occur with approval from the FMB Chief. Road management decisions would be made on a project-by-project basis, and would be constrained by requirements to avoid take under Section 9 of the ESA. In most situations, any increase in miles of road open for motorized public access would be offset by closing an equal or greater amount of open road elsewhere in the Stillwater Block. Although the overall open road density would not increase, there would be no requirement to consider the location or timing of road closures or allowance of low-intensity forest management activities in spring relative to the needs of grizzly bears.

Under Alternatives 2 and 4, a 50-year transportation plan would be adopted for the Stillwater Block. The plan would identify the locations and miles of road that would be constructed and identify how the roads would be used (i.e., restricted year-round, restricted seasonally, open to low-intensity

forest management activities only, etc.). Use restrictions would emphasize the protection of key habitat areas (e.g., spring habitat) during key periods. Unlike Alternatives 1 and 3, some roads in the Stillwater Core would be open seasonally to motorized public access under Alternatives 2 and 4. As a result, functional open road densities in the Stillwater Block would be expected to increase for these two alternatives.

Under the Stillwater transportation plan, the amount of existing roads open year-round for all motorized public access would decrease by 18.3 miles (15 percent) from current amounts (Appendix A, HCP, Table 2-2). In contrast, the amount of existing roads available for motorized public access with seasonal restrictions would increase nearly tenfold, from 6.4 miles to 54 miles. Most of this increase would occur in the Stillwater Core, where roads currently closed year-round to motorized public access would be open with seasonal restrictions. Of the seasonally restricted roads in the Stillwater Block, 29.8 miles would be closed in spring (April 1 to June 30), and 24.2 miles would be closed in spring and fall (April 1 to June 30 and September 16 to November 30). Although these use restrictions were developed through consideration of grizzly bear seasonal habitat use and availability, it is possible that bears could be present in areas where roads are seasonally open. Compared to Alternative 1, implementation of the Stillwater transportation plan under Alternatives 2 and 4 would be expected to reduce, but not eliminate, the risk that bears may be displaced from habitat they would otherwise use for feeding, breeding, or shelter. In areas currently managed as part of the Stillwater Core, the risk attributable to functionally open roads would increase.

Under Alternative 3, road management in the Stillwater Block would be the same as under Alternative 1, with additional provisions for grizzly bears. None of the closed roads in the Stillwater Core would be opened to public access. Also, any changes in use restrictions that would cause the amount of designated security core in a BMU subunit to decrease would require the approval of the USFWS. DNRC would adopt the existing road network with the use restrictions currently in place, adding 17.6 miles of road with year-round restrictions during the 50-year Permit term. Overall, under Alternative 3, similar to Alternative 1, there would be 18.3 more miles of road open year-round to motorized public access in the Stillwater Block at Year 50, compared to Alternatives 2 and 4. However, the miles of road open with seasonal restrictions would be 47.6 miles less than under the other action alternatives. In areas outside the Stillwater Core, Alternative 3 would be expected to result in a slightly greater risk that bears may be displaced from habitat they would otherwise use for feeding, breeding, or sheltering, compared to Alternatives 2 and 4. Within the areas currently managed as security core, the risk would be the same as under Alternative 1, and lower than under Alternatives 2 and 4. Note that transportation plan provisions for areas of minimal human activity (i.e., security core areas and rest periods) in the Stillwater Block are addressed under Risk of Bear-Human Conflicts, below.

Swan River State Forest

Under all alternatives, the road system in the Swan River State Forest would continue to be managed in accordance with the terms of the Swan Agreement, unless the agreement is terminated by another cooperator. Similar to the Stillwater Block, any increases in open road miles above minimum thresholds required by the agreement would have to be offset by decreases elsewhere on the forest to remain in compliance. If the Swan Agreement is terminated, transportation management decisions would be made on a case-by-case basis, and would be constrained by requirements to avoid take under Section 9 of the ESA. DNRC would likely undergo revision of

existing ARMs to identify ways of ensuring ESA compliance. It is likely that the mileage of open roads in the Swan River State Forest on trust lands would not change substantially if the Swan Agreement is terminated under Alternative 1.

The transportation plan for the Swan River State Forest would be implemented only if the Swan Agreement is terminated. Under the Swan Agreement in its current form, no changes are anticipated in the miles of road open to motorized public access. If the agreement is terminated and replaced by the HCP Swan River State Forest Transportation Plan, the amount of open or seasonally restricted road could increase from the current 43.4 miles to as much as 66.5 miles under Alternatives 2, 3, and 4 (Table 4.4-6). The estimated total of 66.3 miles of open road under the proposed HCP strategy reflects the worst-case scenario. Included in this total are roads currently restricted that could be opened to motorized public access due to circumstances beyond the control of DNRC. On these roads, DNRC has established all lawful purpose reciprocal access agreements with adjacent landowners. Under current ownership, these roads would remain restricted through time under the Swan Agreement. If the Swan Agreement is terminated or neighboring lands change ownership within the 50-year Permit term, subsequent grantees of reciprocal access agreements could petition DNRC to change the status of these roads from restricted to open. Although cooperation from these grantees is not guaranteed under the proposed HCP, DNRC would work with appropriate parties in an effort to maintain these roads as restricted and to avoid or mitigate impacts to grizzly bears that would result from a status change on these roads. As a result of potential termination of the Swan Agreement and a worst-case open road assessment, the risk of displacement from otherwise suitable habitat would also likely increase proportionally. No new restrictions would be placed on any roads that are currently open to public motorized access.

Ultimately, the actual amount of additional road that would be open to motorized public access at any time in the future would depend on the management objectives of neighboring landowners and their willingness to be cooperators in the Swan Agreement. Regardless of the status of the Swan Agreement, commitment GB-SW1, which describes the transportation plan, would apply under all action alternatives and limit DNRC administrative and commercial use of roads closed to the public.

In summary, all four alternatives would be similar in their effect to grizzly bear displacement while the Swan Agreement is in place. Whereas, under Alternative 1, if the Swan Agreement were to be terminated, a backup strategy would have to be developed and adopted by DNRC. Under Alternatives 2, 3, and 4 the Swan River State Forest Transportation Plan would immediately be implemented by DNRC if the Swan Agreement is terminated. This plan would require that very similar commitments be met on trust lands as those required under the current Swan Agreement. Impacts to grizzly bears would likely be similar under any alternative, with more certainty and up-front planning provided in Alternatives 2, 3, and 4.

Scattered Parcels

On scattered parcels in the recovery zones (including the CYE), Alternative 1 would allow no permanent increases in open road density for parcels exceeding 1 mi/mi^2. However, temporary increases would be allowed on scattered parcels. Alternative 1 contains no specific provisions for minimizing the construction of new open roads in NROH. Throughout the project area, Alternative 1 offers no specific measures requiring consideration of the location of open roads in relation to important berry fields, wetlands, unique congregation areas, riparian zones, and avalanche chutes, or limitations on their construction during important times of the year, such as the spring period.

Rather, Alternative 1 provides a set of more general measures that would be applied on a case-by-case basis at the project level by DNRC biologists and foresters to minimize risk to grizzly bears.

Alternatives 2, 3, and 4 would take a more rigorous approach to limiting open road density on scattered parcels in the recovery zones, prohibiting any increases in baseline open road amounts at the administrative unit level for conducting forest management activities. Any decisions not to restrict access to open roads would need to be documented and a rationale provided. This would likely have the effect of minimizing increases in open road densities on scattered parcels, and could encourage decisions to restrict access in areas of potentially suitable grizzly bear habitat. Alternative 3 would go further, prohibiting any net increases in baseline total road densities for forest management projects at the DNRC administrative unit level as well. This would likely place even greater limits on the potential for increases in open road density on scattered parcels in the recovery zones.

In contrast to Alternative 1, the action alternatives would require DNRC to minimize construction of new open roads in NROH. In addition, within the CYE, DNRC would expedite the process of addressing open road densities, rather than addressing them on a project-by-project basis, to more promptly identify and minimize any existing potential risk to grizzly bears in that ecosystem. Collectively, these commitments would reduce the likelihood of open roads being located in key grizzly bear habitat during key times of the year.

Road Closures

Under Alternative 1, DNRC would continue its commitment to inspect all road closures within the Stillwater Block and Swan River State Forest annually (ARMs 36.11.431 and 432), and elsewhere inside recovery zones, as well as outside, at least every 5 years (ARM 36.11.421(14)). Repairs to ineffective road closures would be assigned a high priority when allocating time and budget. If any roads that are managed as closed to motorized public access have ineffective closure structures, they could in fact be accessible for up to 5 years, or possibly longer, depending on how long it takes to identify the problem, allocate funding, and complete the repairs. Based on this consideration, it is possible that in some areas, the density of actual (*de facto*) open roads could be higher than the calculated values for those areas. This could result in unanticipated adverse effects on grizzly bears, particularly in portions of recovery zones and NROH where closure devices are not currently checked annually. In addition, it is possible that new open road construction could occur in areas where calculated open road densities are less than 1 mi/mi^2 but *de facto* open road densities exceed that limit, increasing the risk of adverse effects in areas of high open road density.

Under Alternative 2, all primary road closures on trust lands within recovery zones would be inspected annually, and repairs would be completed within 1 year of identifying the problem. Compared to Alternative 1, this would be expected to lead to a decline in the miles of road on which unauthorized motorized public use could occur. The risk of unanticipated adverse effects on grizzly bears due to elevated densities of *de facto* open roads would be lower than under Alternative 1. Outside recovery zones, DNRC would continue its commitment to inspect all road closures at least every 5 years.

Under Alternative 3, DNRC would commit to repairing all ineffective closures in recovery zones during the same operating season in which they are identified to the extent that time, workforce, and contracting funds are available. Any repairs not completed during the same season would be

completed within 1 year of being identified. Compared to Alternative 1, these measures would also be expected to lead to a decline in the miles of road where unauthorized motorized public use could occur. Also, fewer miles would be open for *de facto* motorized public access than under Alternative 2, because fewer road miles would be constructed and closures would be inspected and repaired more frequently. The risk, therefore, of unanticipated adverse effects on grizzly bears due to elevated densities of functionally open roads would be lower than under Alternatives 1, 2, or 4.

Under Alternative 4, DNRC would commit to inspecting road closures on scattered parcels in recovery zones every 2 years and repairing ineffective closures within 1 year of identifying the problem. Compared to Alternative 1, this would be expected to lead to a decline in the miles of road where unauthorized motorized public use could occur, even though the management goal of those roads includes use restrictions. The mileage of *de facto* open roads that functionally would allow unauthorized motorized public access, and their associated risk to bears, would be greater than under Alternative 2, however, because inspections and repairs would occur less often.

Future Open Road Densities

Moving windows analysis of the anticipated changes in road densities in the Stillwater Block and Swan River State Forest indicates that open road densities would increase throughout both areas under all four alternatives (Table 4.9-13). In the Stillwater Block, the greatest increases would occur under Alternatives 2 and 4, with the adoption of the transportation plan resulting in currently closed roads in the Stillwater Core being opened to motorized public access on a seasonal basis. In the Swan River State Forest, modeled increases in open road density for the action alternatives reflect the worst-case scenario under which the Swan Agreement is terminated and all functionally open roads are added due to easement agreements held by adjacent landowners, and for which DNRC would not control access to these roads. Increases in the amount of trust lands with open road densities exceeding 1 mi/mi^2 represent an increased risk of mortality to grizzly bears due to encounters with humans, along with an increase in the amount of otherwise suitable feeding, breeding, or sheltering habitat that grizzly bears might avoid.

It should be noted that modeled changes in open road density do not account for additional roads that may be open to motorized public access due to damaged or ineffective closure structures. However, under the current ARMs, closure devices are checked annually on blocked lands. The percentage of effective closure devices on trust lands in the Swan River State Forest reported for years 2000 to 2007 averaged 93 percent and ranged from 88 percent to 99 percent. Thus, the density estimates in Table 4.9-13 may represent slight underestimates of *de facto* open road densities on trust lands.

TABLE 4.9-13. MOVING WINDOWS ESTIMATES OF THE PERCENTAGE OF TRUST LANDS WITH OPEN ROAD DENSITIES EXCEEDING 1 MI/MI^2 UNDER EACH ALTERNATIVE, BY BMU AND BMU SUBUNIT FOR BLOCKED LANDS WITHIN THE HCP PROJECT AREA, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

Administrative Unit, BMU, and BMU Subunit	Percent of BMU Subunit within HCP Project Area	Percent of HCP Lands with Open Road Densities Exceeding 1 mi/mi^2				
			Alternative			
		Existing Conditions	1 No Action	2	3	4
Stillwater Block		**41.5**	**41.5**	**50.4**	**41.5**	**50.4**
Lower North Fork Flathead BMU		**6.1**	**6.1**	**11.0**	**6.1**	**11.0**
Werner Creek	1.3	6.1	6.1	11.0	6.1	11.0
Murphy Lake BMU		**3.6**	**3.6**	**3.6**	**3.6**	**3.6**
Krinklehorn	0.7	3.6	3.6	3.6	3.6	3.6
Stillwater River BMU		**43.4**	**43.4**	**52.4**	**43.4**	**52.4**
Lazy Creek	41.6	72.3	72.3	72.2	72.3	72.2
Stryker	80.6	37.5	37.5	43.6	37.5	43.6
Upper Whitefish	84.0	35.1	35.1	52.7	35.1	52.7
Upper North Fork Flathead BMU		**34.3**	**34.3**	**43.0**	**34.3**	**43.0**
Coal and South Coal	1.6	0.0	0.0	0.0	0.0	0.0
Hay Creek	5.4	3.2	3.2	12.1	3.2	12.1
State Coal Cyclone	42.8	40.3	40.3	49.1	40.3	49.1
Swan River State Forest[1]		**36.1**	**36.2**	**60.6**	**60.6**	**60.6**
Bunker Creek BMU		**36.0**	**36.2**	**50.8**	**50.8**	**50.8**
Goat Creek	21.4	46.3	46.1	87.8	87.8	87.8
Lion Creek	10.6	46.0	45.8	85.9	85.9	85.9
South Fork Lost Soup	61.3	30.8	31.3	32.6	32.6	32.6
Mission Range BMU		**36.5**	**36.4**	**82.1**	**82.1**	**82.1**
Piper Creek	0.6	2.0	2.0	35.0	35.0	35.0
Porcupine Woodward	32.5	37.0	36.9	82.8	82.8	82.8

[1] Increases in future open road densities depicted under Alternatives 2, 3, and 4 are a result of the assumption in the analysis that the Swan Agreement in its current form would no longer constrain management, creating more functionally open roads on trust lands due to existing easements. Proposed HCP conservation commitments would not cause these estimated increases.

Source: DNRC (2008a).

The no-action alternative and the three action alternatives all include restrictions on increasing open road densities on scattered parcels in recovery zones. As modeled for this analysis, these differences would not be expected to result in marked differences in open road densities on these lands (Table 4.9-14). In both recovery zones and NROH in all three land offices, modeled increases under all four alternatives would range from 0 to 0.1 mi/mi^2. Slight variations in management policies between the no-action alternative and action alternatives would not likely result in noticeable differences in effects on grizzly bears at the landscape scale within the HCP project area.

TABLE 4.9-14. OPEN ROAD DENSITY USING LINEAR CALCULATION OF MI/MI^2 ON SCATTERED PARCELS FOR RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT IN THE HCP PROJECT AREA, BY ALTERNATIVE, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

	Existing Conditions		Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Land Office	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH	Recovery Zones	NROH
NWLO	1.4	2.1	1.5	2.1	1.4	2.1	1.4	2.1	1.4	2.1
SWLO	1.8	0.8	1.9	0.9	1.8	0.9	1.8	0.9	1.8	0.9
CLO	0.2	1.4	0.2	1.4	0.2	1.4	0.2	1.4	0.2	1.4

Source: DNRC (2008a).

Risk of Bear-human Conflicts

Secure Habitat and Quiet Areas

Potential Effects

- Reductions in the amount of area where grizzly bears are relatively safe from disturbance and encounters with humans may result in disturbance, displacement, habituation, and an elevated risk of human-caused mortality.

Indicators and Rationale

An increase in the amount of roads and human use of roads in grizzly bear habitat could reduce the amount of area where grizzly bears are relatively safe from disturbance and encounters with humans, leading to harassment and displacement of bears from areas they would otherwise use for feeding, breeding, and shelter. Increasing roads and use, which can reduce safe, quiet areas, could also cause bears to be more vulnerable to human-caused mortality.

Therefore, measures that restrict activities either over a period of time (several years) or during important seasons (within a year) can avoid or minimize effects on bears. Two terms, secure habitat and quiet areas, are used in this analysis to describe approaches to managing HCP project area lands to reduce or minimize risk of displacement of bears and bear-human conflicts. Secure habitat for grizzly bears (or security core area) is specifically defined by the IGBC (1998) as areas that are at least 0.3 mile from any open road or motorized trail and that receive no motorized use of roads or trails during the period they are considered secure habitat (typically at least 10 years). Such lands should also encompass areas of seasonal importance for bears throughout the year. Quiet areas are defined as areas periodically free from commercial activities, including subzones or scattered parcels in rest where commercial activities are restricted following periods of active management, or areas where management activities are restricted in certain key habitats during important seasons of the year. The Swan Agreement, under which DNRC and neighboring landowners cooperatively limit management activities following periods of active management in BMU subunits, provides an example of managing for quiet areas.

The following subsection analyzes the effects on bears under these two management approaches.

Comparison of Alternatives

Currently, the only area DNRC has designated as secure habitat under the ARMs is in the Stillwater and Coal Creek State Forests (Stillwater Core), where trust lands occur in large blocks within the NCDE grizzly bear recovery zone. Under Alternative 1**,** DNRC would commit to keeping the Stillwater Core (approximately 36,800 acres) in the Stillwater Block intact for at least 10 years, as practicable. Any net decreases from the 1996 baseline in the proportion of trust lands in a BMU subunit designated as security core areas would require approval from the FMB Chief. The potential for disturbance would be further minimized by the requirement that any management activities be conducted only during the denning period (November 16 to March 31) in security core areas. Under Alternative 1, the Swan River State Forest would continue to be managed using quiet areas (i.e., rotating BMU subunits), where 3 years of active management would be followed by 6 years of rest. Seasonal restrictions would be given consideration on a project-level basis for management activities on scattered parcels.

Under Alternatives 2 and 4, DNRC would no longer manage for secure habitat in the Stillwater Block using the traditional "security core area" approach. Instead, the transportation plan for that unit would identify large blocks of trust lands adjacent to National Forest System lands (Class A lands, totaling approximately 19,400 acres) to be managed as quiet areas, called subzones, on a schedule of 4 years of management and 8 years of rest. Low-intensity forest management activities and allowances for salvage harvest would not be prohibited within rested areas, except as restricted during the spring period. Construction of additional permanent roads on Class A lands would be prohibited for the 50-year Permit term.

The fixed transportation system, along with seasonal restrictions and management of large blocks of quiet areas, would represent a departure from the existing ARMs (Alternative 1). Under Alternatives 2 and 4, the concept of establishing areas managed to reduce the risk of bear-human conflicts in the Stillwater Block would shift from secure habitat to quiet areas. Instead of making long-term commitments (i.e., approximately 10 years) to keeping fixed areas free from motorized administrative, commercial, and public access during the non-denning period, DNRC would focus on minimizing the potential for disturbance in key habitats during key periods and limiting the frequency with which large-scale disturbance (e.g., commercial forestry) may occur. The rotation of commercial activities in combination with restrictions on commercial activities in spring habitat in the spring period and no net increases in open road densities on rested subzones would reduce the risk of displacement and bear-human conflicts such that potential adverse effects on bears would be sufficiently minimized to allow bears to successfully meet their habitat requirements.

On the Stillwater Block, resting subzones could receive up to 30 days per year for small projects, including salvage. The potential effects of these short disturbances during critical time periods for bears would be avoided by the requirement that these days occur either in non-spring habitat or outside the spring period when conducted in spring habitat. Should management needs specifically for salvage exceed 30 days, usable days allowed for small projects in other subzones would have to be forfeited. If these allowable annual days in total are exceeded, an allowance would be triggered for additional operating days up to the length of one full non-denning season (i.e., 150 days). Any time this occurs, DNRC would mitigate potential adverse effects by initiating a new 8-year rest period. A full uninterrupted 8-year period of rest would have to be achieved in the disturbed subzone before allowing any future salvage interruptions. This commitment is designed to provide compensatory rest in other non-target subzones and a required additional interruption-free 8-year

rest period to mitigate disturbance-related impacts to grizzly bears. Nonetheless, commitments that allow human access beyond that which currently is allowed in larger security core areas could increase the risk above present levels of disturbance or displacement of bears from areas they would otherwise use for feeding, breeding, and sheltering.

In the Stillwater Block under Alternative 3**,** DNRC would maintain its commitment to keeping the security core area intact for at least 10 years, similar to Alternative 1. In addition, approval from the USFWS would be required for any net decreases in secure habitat. To conduct salvage in the Stillwater Core under Alternatives 1 and 3, activities would have to be conducted in winter or an equal or greater amount of core area would have to be created through additional access restriction. Under Alternative 3, activities also could not occur in winter above 6,300 feet elevation.

As long as the Swan Agreement remains in effect, management of the Swan River State Forest under all action alternatives would also be the same as under Alternative 1. If the Swan Agreement is terminated, the forest would be managed under Alternatives 2, 3, and 4 as five independent subzones, with each subzone scheduled for 4 years of active management and 8 years of rest and allowances for salvage harvest as described above for the Stillwater Block. Similar to the Stillwater Block, low-intensity forest management activities would be allowed within rested areas, except as restricted during the spring period. Additionally, one salvage project exceeding 30 days would be allowed as described for the Stillwater Block. Within the Swan River State Forest, one gravel operation greater than 0.25 mile from an open road would also be allowed. When this occurs, DNRC would mitigate the potential effects on bears by (1) minimizing the distance of the pit from the open road, and (2) to the extent possible, ceasing activities on all allowable remaining pits while the pit in the rested subzone is active. The localized nature of the impact of gravel pits in combination with the proposed mitigations would avoid adverse effects on bears.

A similar rest-rotation schedule (4 years of activity followed by 8 years of rest) would be implemented on all scattered parcels in recovery zones and NROH associated with the CYE under Alternatives 2, 3, and 4; this would also represent a departure from the existing ARMs (Alternative 1). The rest commitment for scattered parcels would increase rest and provide quiet areas on approximately 35,770 acres of scattered parcels not currently provided for under Alternative 1. This commitment would serve to reduce the risk of disturbance to grizzly bears and lower potential for their displacement on this subset of scattered parcels. Small projects, including salvage, could also be conducted on scattered parcels on a limited number of days specific to each individual administrative unit (ranging from 45 to 90 days). Should management needs specifically for salvage exceed these limits, an allowance would be triggered, similar to that described above for blocked lands, for additional operating days up to the length of one full non-denning season (i.e., 150 days). In such situations, rest periods would not have to be restarted on scattered parcels; however, only one interruption of this type would be allowed per 8-year rest period per parcel for this purpose. Under Alternative 3 within the CYE recovery zone, DNRC would impose additional restrictions on the number of vehicle trips per parcel during the non-denning period, further restricting use of roads for administrative purposes and lessening disturbance potential for grizzly bears.

Compared to Alternative 1, the total amount of land area managed to reduce the risk of bear-human conflicts would increase under all of the action alternatives, from approximately 76,300 acres under

Alternative 1, to almost 95,000 acres under Alternatives 2 and 4, and to more than 112,000 acres under Alternative 3.

The degree to which activities are restricted in these areas would differ under the alternatives, however. Specifically, for the Stillwater Block, under Alternatives 1 and 3, approximately 39,600 acres in the Stillwater Unit would be managed as secure habitat for at least 10 years (Stillwater Core). In contrast, about 19,400 acres (most of which is a subset of the Stillwater Core) would be managed as quiet areas under Alternatives 2 and 4, with a maximum entry period of 4 years of activity followed by 8 years of rest from commercial logging activities. Management to reduce the risk of bear-human conflicts in the Swan River State Forest under all action alternatives would remain the same as under Alternative 1, although the management-rest schedule would be extended from 3 and 6 years to 4 and 8 years. Lastly, under all action alternatives, an additional 35,770 acres would be managed to reduce the risk of bear-human conflicts through a schedule of 4 years management followed by 8 years rest.

Analysis of the anticipated changes in secure habitat over 50 years in the Stillwater Block and Swan River State Forest indicates that the availability of secure habitat would decrease in both areas under all four alternatives (Table 4.9-15). In the Stillwater Block, the greatest decreases would occur in the Upper North Fork Flathead BMU under Alternatives 2 and 4, with the adoption of the transportation plan resulting in currently closed roads in the Stillwater Core being opened to motorized public access on a seasonal basis. Decreases in secure habitat in the Swan River State Forest, would be almost identical under all alternatives. Decreases in the availability of secure habitat on trust lands represent an increased risk of mortality to grizzly bears due to encounters with humans, along with an increase in the amount of otherwise suitable feeding, breeding, or sheltering habitat that grizzly bears might avoid. It should be noted, however, that the modeled decreases in secure habitat do not account for areas that would be managed as quiet areas in the Stillwater Block and scattered parcels, which would likely offset much of this risk, but to an uncertain degree.

Spring Habitat

Potential Effects

- Forest management activities conducted in spring habitat during the spring season could result in bears being disturbed or displaced from preferred habitats during this important period of nutritional stress.

Indicators and Rationale

Upon emerging from their dens in spring, grizzly bears are nutritionally stressed, having undergone inactivity during the winter months. As a result, their habitat use patterns during the spring are driven by the need to maximize energy intake. Activities that displace bears from spring foraging habitat may adversely affect their ability to consume adequate amounts of food in a short amount of time. Restricting DNRC activities in these areas during critical seasons would minimize and potentially avoid adverse effects on bears. Activity restrictions, duration of restrictions, and the amount of area over which these activities would be restricted are compared.

Comparison of Alternatives

In most of the project area under Alternative 1, no commitments would be in place to limit forest management activities (including road use) in spring habitat. Wildlife biologists would have

TABLE 4.9-15. ESTIMATES OF THE PERCENTAGE OF HCP LANDS IN SECURE HABITAT UNDER EACH ALTERNATIVE, BY BMU AND BMU SUBUNIT FOR BLOCKED LANDS, AT 50 YEARS FOLLOWING PERMIT ISSUANCE

Administrative Unit, BMU, and BMU Subunit	Percent of BMU Subunit within HCP Project Area	Percent of HCP Lands in Secure Habitat[1]				
			Alternative			
		Existing Conditions	1 No Action	2	3	4
Stillwater Block		**42.8**	**37.4**	**30.6**	**37.4**	**30.6**
Lower North Fork Flathead BMU		**79.6**	**79.6**	**79.6**	**79.6**	**79.6**
Werner Creek	1.3	79.6	79.6	79.6	79.6	79.6
Murphy Lake BMU		**92.5**	**92.5**	**92.5**	**92.5**	**92.5**
Krinklehorn	0.7	92.5	92.5	92.5	92.5	92.5
Stillwater River BMU		**42.3**	**39.0**	**30.7**	**39.0**	**30.7**
Lazy Creek	41.6	15.7	15.7	16.3	15.7	16.3
Stryker	80.6	49.1	46.0	39.7	46.0	39.7
Upper Whitefish	84.0	48.1	42.8	27.5	42.8	27.5
Upper North Fork Flathead BMU		**43.0**	**27.8**	**27.5**	**27.8**	**27.5**
Coal and South Coal	1.6	99.1	99.1	99.1	99.1	99.1
Hay Creek	5.4	29.3	29.3	29.9	29.3	29.9
State Coal Cyclone	42.8	43.4	25.5	24.9	25.5	24.9
Swan River State Forest[2]		**20.7**	**10.3**	**9.7**	**9.7**	**9.7**
Bunker Creek BMU		**22.8**	**12.8**	**12.5**	**12.5**	**12.5**
Goat Creek	21.4	9.9	4.7	2.6	2.6	2.6
Lion Creek	10.6	4.5	2.8	2.8	2.8	2.8
South Fork Lost Soup	61.3	30.2	17.2	17.4	17.4	17.4
Mission Range BMU		**16.1**	**4.7**	**3.4**	**3.4**	**3.4**
Piper Creek	0.6	65.5	0.0	0.0	0.0	0.0
Porcupine Woodward	32.5	15.3	4.8	3.5	3.5	3.5

[1] Secure habitat is defined as the area 0.3 mile from an open or restricted road.
[2] Decreases in secure habitat in the Swan River State Forest depicted under Alternatives 2, 3, and 4 are a result of the assumption in the analysis that the Swan Agreement in its current form would no longer constrain management, creating more functionally open roads on trust lands due to existing easements. Proposed HCP conservation commitments would not cause these estimated increases.
Source: DNRC (2008a).

opportunities to provide input during project planning and implementation, but there would be no explicit direction for which activities would be limited or how. On the Swan River State Forest, seasonal restrictions identified in the Swan Agreement would continue to limit most activities in spring habitat within linkage zones. Under this alternative, therefore, the risk of disturbing or displacing bears from spring foraging habitat would continue at current levels.

In contrast, under Alternatives 2, 3, and 4, specific restrictions would be implemented during the spring period in spring habitat in recovery zones and NROH. These restrictions would prohibit commercial forest management activities, pre-commercial thinning, and heavy equipment slash treatment. Other low-intensity activities would be allowed, and commercial forest management activities would be allowed within 100 feet of open roads. Allowing low-intensity activities presents limited risk to bears because of the low likelihood that bear use and DNRC activities would overlap in a given location at any give time. Additionally, the effect on bears is likely to be similar to a bear encountering a hiker on a trail (brief and limited) versus a bear encountering commercial

activities, which may cause a bear to forgo use of an area for an extended period. Activities near roads would not create additional adverse effects on bears beyond those attributed to the open road. Alternative 3 would implement additional restrictions eliminating all motorized activities in spring habitat, except for seasonally necessary and potentially beneficial activities, such as tree planting, spring burning, weed control, and emergency road maintenance. Alternative 4 is similar to Alternative 2 but would provide more management flexibility by eliminating limitations on site preparation, road maintenance, and bridge replacement.

Additional spring restrictions would be implemented under all three action alternatives in the Stillwater Block by restricting DNRC administrative activities on a group of roads in spring habitat during the spring period. In the Swan River State Forest, spring habitat restrictions would be applied in all project area lands below 5,200 feet elevation, not just within linkage zones as currently required by the Swan Agreement. In the CYE recovery zone and associated NROH, additional limits would be placed on the amount and location of motorized low-intensity activities under all three action alternatives, with slightly more stringent restrictions under Alternative 3 (see Appendix E, EIS Tables, Table E3-1).

Spring habitat restrictions would be implemented on 161,068 acres of trust lands, of which approximately 48,600 acres would be in the Stillwater Block, 31,700 acres would be in the Swan River State Forest, and 17,900 acres would be in the CYE (Table 4.9-5). The greatest reduction of risk would occur under Alternative 3, which includes the most stringent restrictions, with slightly smaller risk reductions under Alternative 2, followed by Alternative 4. By limiting the types of allowable activities during the spring period in areas where bears are more likely to be present, all three action alternatives would reduce the risk (compared to Alternative 1) of displacement from crucial habitat during this important season for bears. Minimizing this risk would be accomplished by allowing only those activities that are typically of short duration that must occur during narrow spring windows, or that provide indirect benefits to bears.

Denning and Post-denning Habitat

Potential Effects

- Mechanized forest management activities and/or the presence of humans near denning habitat, den sites, and post-denning habitat may result in physiological stress or den abandonment.

Indicators and Rationale

As described under Habitat Requirements, above, human activity near grizzly bear dens can cause physiological stress or, in some cases, den abandonment. Post-denning habitat, defined as areas with slopes greater than 45 percent at elevations greater than 6,300 feet, identifies areas with the greatest risk of disturbance to females with young cubs who have recently emerged from den sites. The risk of disturbance to bears in dens during the winter period is avoided by measures that restrict activities in denning habitat, defined as areas at elevations greater than 6,300 feet. The following subsection identifies and compares the rules, policies, and commitments that address forest management activities near denning habitat, den sites, and post-denning habitat under the alternatives. The amount of area over which activities would be restricted is also compared.

Comparison of Alternatives

Under Alternative 1**,** DNRC would provide den site protection on a case-by-case basis program-wide. In the Stillwater Core, the requirement to conduct management activities during the denning period (November 16 to March 31) would reduce the potential for disturbance to bears as they prepare to enter dens and after they emerge. On the Swan River State Forest, salvaging is not allowed in linkage zones during the spring period, and salvage harvest is only allowed in inactive subunits for 30 days each between June 15 and September 1 each year, which would have a similar result. The rest-rotation schedule identified under the Swan Agreement would indirectly reduce the potential for disturbance, but not specifically in areas of denning or post-denning habitat.

Under Alternatives 2, 3, and 4**,** commitment GB-PR5 would prohibit mechanized operations within 0.6 mile of known active, occupied den sites. Where specific information is available, (e.g., for bears that are subjects of radio-tracking studies, etc.), this measure would avoid the risk of physiological stress to denning bears. Because no consistent, formal survey efforts would be dedicated to locating den sites, it is possible that forest management activities may be allowed to take place near undetected, occupied dens. However, the likelihood that this would occur is extremely low. This is because it is not feasible to conduct forest management activities in denning habitat (slopes greater than 45 percent at elevations greater than 6,300 feet) during the denning season when snow depths are still high. Under all action alternatives, components of commitments GB-ST2, GB-SW3, and GB-SC2 would also restrict motorized activities above 6,300 feet, further reducing potential for physiological stress to any denning bears on or nearby trust lands.

Under all action alternatives in recovery zones, commitment GB-RZ5 would implement additional restrictions in post-denning habitat. No motorized forest management activities would be allowed in areas of mapped post-denning habitat (slopes greater than 45 percent at elevations greater than 6,300 feet) from April 1 through May 31. Compared to Alternative 1, this would reduce the risk of disturbance to grizzly bears emerging from dens, particularly females with young cubs. Alternative 3 would extend the area in which this restriction would be implemented, prohibiting motorized activities within 0.6 mile of mapped post-denning habitat within both recovery zones and NROH, greatly expanding the area that would be protected. Implementation of the rest-rotation schedule in the Stillwater Block, Swan River State Forest, and scattered parcels in recovery zones under all three action alternatives may provide for additional reduction of the risk of disturbance, but not specifically in areas of post-denning habitat. By prohibiting commercial forest management activities above 6,300 feet between November 16 and March 31, the rest-rotation commitments would provide additional protection of denning habitat under the action alternatives.

For the 8,852 acres of mapped post-denning habitat in recovery zones and NROH within the HCP project area (Table 4.9-7), Alternative 1 would not provide any site-specific restrictions (Table 4.9-16). Alternatives 2 and 4 would restrict forest management activities in 5,863 of these acres (all in recovery zones). Alternative 3 would restrict activities on all 8,852 acres, plus a 0.6-mile buffer, for a total of 66,376 acres in which activities would be restricted to reduce the risk of disturbance to bears emerging from dens (Table 4.9-16).

TABLE 4.9-16. ACREAGE BY ALTERNATIVE OF GRIZZLY BEAR POST-DENNING HABITAT IN THE HCP PROJECT AREA WHERE CONSERVATION COMMITMENTS WOULD APPLY WITHIN RECOVERY ZONES AND NON-RECOVERY OCCUPIED HABITAT, BY LAND OFFICE AND ADMINISTRATIVE UNIT FOR BLOCKED LANDS AND SCATTERED PARCELS

	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Land Offices and Unit Offices by Recovery Zone[1] (Scattered or Blocked Status)	**Recovery Zone**	**Non-Recovery Occupied Habitat[2]**	**Recovery Zone**	**Non-Recovery Occupied Habitat[2]**	**Recovery Zone**	**Non-Recovery Occupied Habitat[2]**	**Recovery Zone**	**Non-Recovery Occupied Habitat[2]**
NWLO	0	0	**5,764**	**0**	**41,062**	**534**	**5,764**	**0**
Kalispell Unit NCDE (Scattered)	0	0	0	0	43	0	0	0
Libby Unit CYE (Scattered)	0	0	0	0	0	0	0	0
Plains Unit CYE (Scattered)	0	0	0	0	0	0	0	0
Plains Unit NCDE (Scattered)[3]	N/A	0	N/A	0	N/A	534	N/A	0
Stillwater Unit NCDE (Blocked)[3,4]	0	N/A	4,498	N/A	33,708	N/A	4,498	N/A
Stillwater Unit NCDE (Scattered)	0	0	0	0	0	0	0	0
Swan Unit NCDE (Blocked)[3]	0	N/A	1,266	N/A	7,311	N/A	1,266	N/A
Swan Unit NCDE (Scattered)[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SWLO	0	0	**99**	**0**	**1,729**	**2,675**	**99**	**0**
Anaconda Unit NCDE (Scattered)[3]	N/A	0	N/A	0	N/A	1,968	N/A	0
Clearwater Unit NCDE (Scattered)	0	0	28	0	496	59	28	0
Hamilton Unit BE (Scattered)[3,5]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Missoula Unit BE (Scattered)[3,5]	0	N/A	0	N/A	0	N/A	0	N/A
Missoula Unit NCDE (Scattered)	0	0	71	0	1,233	648	71	0
CLO	0	0	**0**	**0**	**0**	**20,376**	**0**	**0**
Bozeman Unit GYE (Scattered)[3]	N/A	0	N/A	0	N/A	6,990	N/A	0
Conrad Unit NCDE (Scattered)[3]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dillon Unit GYE (Scattered)[3]	N/A	0	N/A	0	N/A	12,462	N/A	0
Helena Unit NCDE (Scattered)	0	0	0	0	0	924	0	0
Total	**0**	**0**	**5,863**	**0**	**42,792**	**23,584**	**5,863**	**0**

[1] NCDE = Northern Continental Divide Ecosystem, CYE = Cabinet-Yaak Ecosystem, BE = Bitterroot Ecosystem, GYE = Greater Yellowstone Ecosystem.
[2] Non-recovery occupied habitat designation from Wittinger (2002).
[3] N/A = not applicable. Where N/A is listed in the table, there is no such land area in the given unit.
[4] Includes the Coal Creek State Forest and majority of the Stillwater State Forest.
[5] The BE recovery zone is currently not considered occupied by grizzly bears.
Source: DNRC (2008a).

Risk of Direct Conflict

Potential Effects

- The presence of DNRC staff and contractors working in grizzly bear habitat, as well as public access and presence, may lead to bear-human encounters that could result in bear mortality.

Indicators and Rationale

Human contact is among the greatest risk factor for grizzly bears. Habituation to human presence and human foods can lead to increases in bear-human interactions, resulting in an elevated risk of injury or death to both (Mace and Waller 1998). Public use of trust lands for recreation or DNRC staff presence in the project area increase the risk of encounters. The risk of direct conflict can be managed by informing the public and DNRC staff of ways to avoid encounters with bears. Stringent requirements for food storage and sanitation can minimize the risk of habituation of bears to human foods and waste. No known incidents related to encounters or improper food storage and sanitation by DNRC staff and contractors leading to the death of a bear have occurred to date. Limitations on firearm possession may reduce the likelihood that a grizzly bear would be shot because of misidentification or malice by anyone conducting forest management activities on trust lands.

Livestock grazing (including the use of domestic sheep and goats for integrated noxious weed management) can also increase the risk of bear-human conflicts. Bears may be attracted to sheep grazing operations and facilities and to the carcasses of dead livestock. Grizzly bear predation of sheep can result in risks to human life, property damage, death of individual bears, or indirect mortality through habituation. Bears can benefit from feeding on livestock carcasses in remote locations away from people. However, when dead livestock occur near human dwellings or other areas with high levels of human activity, the potential for bear-human encounters may be high, which can eventually lead to the death of the bear through management actions.

Public use of recreation facilities, including leased cabin sites and developed recreation sites, can also lead to increased risk of bear-human interactions. Management of recreation facilities would not be a covered activity under the HCP, and trends in the use of such sites would not be expected to change from current trends under any of the alternatives. Therefore, public use of recreation facilities is not addressed further in this analysis.

The following subsection identifies and compares the rules, policies, and commitments under the alternatives that address risk management through public education, food storage and sanitation, limitations on firearms possession, and restrictions on livestock grazing.

Comparison of Alternatives

Information and Education. Alternative 1 provides for informal training as needed. In contrast, under all three action alternatives, DNRC would provide grizzly bear awareness information to all contractors and their employees, as well as training to DNRC employees in the same manner. Under the action alternatives, the long-term information and education program would help ensure that the risk of bear-human conflicts from DNRC activities remains low.

Food Storage. Under Alternative 1, food storage and sanitation requirements would continue to be included in contracts, and DNRC staff would be informally briefed. Alternatives 2 and 4, via commitment GB-PR3, would provide new rules requiring bear-resistant storage of all food and sanitation for all DNRC employees and in all forest management contracts for DNRC contractors and their employees, which would increase protection for people and bears. Alternative 3 would go further, requiring a DNRC agency-wide food storage and sanitation order for all activities, not just forest management activities. This order would be based on IGBC task force recommendations, and would be required to be implemented within 2 years of Permit issuance. All action alternatives would increase awareness of agency personnel and contractors, and would reduce the potential for food and sanitation-related risks to grizzly bears when compared with Alternative 1. Alternative 3 would provide a greater number of measures and considerably expand the scope of application, potentially even to where bears are not present. DNRC considers risks to grizzly bears attributable to food storage and sanitation concerns to be low across the forest management program because camping by staff and contractors is relatively uncommon and few livestock, food storage facilities, campgrounds, or other food or sanitation/storage facilities occur on, or are managed in association with, HCP project area lands. While all of the action alternatives provide additional measures intended to reduce risk to grizzly bears beyond Alternative 1, the actual degree that such measures would differentially reduce risk to bears in relation to DNRC's forest management program is uncertain.

Firearms. Under Alternative 1, firearms would continue to be prohibited for contractors and employees, except in the case of employees who are specifically authorized to carry a firearm under special circumstances. All three action alternatives would continue this prohibition, and would additionally require authorized employees to maintain a current written authorization on file. Although this additional requirement would not explicitly limit the availability of firearms to DNRC staff, it may reduce the risk of unauthorized firearm possession. Thus, there are no appreciable differences among the no-action or action alternatives regarding risk to grizzly bears.

Livestock Grazing. Under Alternative 1, DNRC would determine restrictions on a case-by-case basis regarding grazing concerns on lands in recovery zones or NROH. In situations where there is a high risk of contact between wildlife and livestock, DNRC would continue to work with MFWP on a case-by-case basis to develop grazing plans and to lessen the risk to predators, such as wolves and grizzly bears.

Under Alternatives 2, 3, and 4 in NROH**,** commitment GB-NR5 would require mitigation plans for use of sheep and goats for noxious weed control. Mitigation plans would minimize risk of depredation of livestock by bears (e.g., through the use of human shepherds, fencing/bedding areas, guard dogs). Additionally, prompt removal of all livestock carcasses identified as creating the potential for bear-human encounters would also minimize risk of bear-livestock conflicts. None of the action alternatives would differ in how livestock grazing concerns would be addressed. Within recovery zones, commitment GB-RZ4 would prohibit the authorization of any new small livestock grazing licenses, including those for the purposes of weed control. In addition, DNRC would not initiate the establishment of new grazing licenses, although proposals initiated by the public for larger, less vulnerable classes of livestock (such as cattle and horses) may be considered and allowed by DNRC. Compared to Alternative 1, like measures contained in the action alternatives would help reduce the risk of bear-human conflicts associated with livestock on trust lands.

Gravel Operations

Potential Effects

- Increased levels of human activity associated with gravel operations may displace bears from otherwise suitable habitat.

Indicators and Rationale

Limitations on the number, location, and size of active gravel pits is the primary means for avoiding or minimizing their potential effect on bears. Effects associated with gravel developments less than 0.25 mile from open roads are considered as disturbance associated with open roads, which is addressed in the analysis of open road density above. Therefore, this analysis primarily addresses provisions for gravel pits that would occur greater than 0.25 mile from open roads.

Comparison of Alternatives

Gravel pits are restricted in number, location, and timing, and have specific definitions regarding size: borrow-size (up to 1 acre), medium (1 to 4.9 acres), and large (5 to 40 acres). In Alternative 1, gravel pits only have to be located as close to planned roads as possible and must adhere to the requirements of Opencut Mining Permits for large gravel pits in all areas. Therefore, gravel pits could displace bears from suitable habitat because relatively few restrictions are in place under this alternative regarding the allowable numbers, sizes, timing of operations, and specific locations of pits.

Under all action alternatives, five active pits would be allowed on the Stillwater Block in any calendar year, with no more than three of these considered large, while the Swan River State Forest could operate four, with only three considered large. On scattered parcels, three pits would be allowed per administrative unit, with only two of these considered large. Gravel pits are only counted in this total if they are more than 0.25 mile from an open road, but include federal and state highway pits. Effects on bears from gravel pits within 0.25 mile of restricted roads would be avoided because those pits could only be operated during the seasons the roads are not restricted as described in the transportation plans. Pits within 0.25 mile would not be subject to restrictions on season or duration of use because they are considered close enough to open roads to be part of the disturbance associated with those roads. Thus, DNRC managers would be encouraged through these commitments to place pits adjacent to open roads to minimize disturbance risk in more remote locations.

The effects of gravel pits operated greater than 0.25 mile from an open road are minimized through the following measures:

- For pits operated in the spring period, the days of operation would count against the 10 days allowed for low-intensity activities as described in commitment GB-NR3 (see Appendix E, EIS Tables, Table E3-1).

- No gravel pits would be allowed in SMZs for all HCP project acre lands, and only one medium pit would be allowed in RMZs (but outside SMZs) within the Stillwater Block and Swan River State Forest.

During the 4-year window for forest management within active subzones on blocked lands or on scattered parcels, gravel pits more than 0.25 mile from an open road may be operated outside the spring rest period without restriction on amount and duration of use while commercial activities are also taking place. Specific commitments in the Stillwater Block (Class A and B lands), Swan River State Forest, and scattered parcels restricting the number and size of gravel pits in operation farther than 0.25 mile from an open road would be in place as well.

Gravel pits do remove suitable habitat from potential use by bears; however, for the period the pits are operating, bears are likely to avoid these areas due to the high disturbance and noise associated with this activity. However, assuming that all units would develop all allowable pits to the largest size possible, a maximum of 1,105 acres could be converted to a non-vegetated condition, and most of this acreage would lie close to existing open roads. This represents 0.4 percent of the 266,900 acres of HCP project area lands within all recovery zones and NROH. Some additional acreage could be affected that would be associated with state and federal highway construction projects; however, actual acreages are uncertain, and effects on federally protected species from those actions would be addressed under project-specific permitting processes with federal oversight outside the scope of this analysis.

With these gravel pit commitments in place under all action alternatives, risk of adverse effects to grizzly bears is low, and the commitments under all action alternatives would provide considerable additional protections for grizzly bears as compared to Alternative 1.

Habitat Modification

Visual Screening

Potential Effects

- Forest management activities that reduce vegetation density may reduce cover for bear movement, resting, feeding, and security, possibly rendering bears more vulnerable to human-caused mortality.

Indicators and Rationale

Activities that reduce the potential for vegetation to conceal a grizzly bear can lower effective bear use of habitat and render bears more vulnerable to human-caused mortality (Servheen et al. 1999). Visual screening along roads and in areas that provide foraging habitat for bears (e.g., riparian areas, wet meadows, shrub fields, avalanche chutes, etc.) can reduce the potential for human disturbance, as well as the risk of direct bear mortality due to mistaken identity or malicious actions.

For this analysis, modeled cover projections are used for comparison of the differences in how hiding cover would be affected under each of the alternatives. The model used to derive the DNRC sustainable yield estimate (DNRC 2004b) was also used to estimate forest cover at structural densities that would screen from view large mammals such as grizzly bears. The model was constrained differentially based on the varying characteristics and requirements of each of the alternatives. Outputs were projected for years 0 and 50 after Permit issuance (Table 4.9-17). Due to model limitations, hiding cover estimates for NROH lands could not be specifically obtained. Rather, the model estimated cover for HCP project area lands in recovery zones and all other HCP project area lands outside recovery zone boundaries. Another limitation that should be noted is that

no size limit or spatial distribution values could be placed on patches classified as cover, which could influence cover effectiveness, particularly at local scales. Even with these limitations, however, modeled outputs were considered reasonable and useful for assessing general trends and comparing the alternatives at a landscape scale. The following subsection also identifies and compares the rules, policies, and commitments under the alternatives that address the provision of visual screening in RMZs and WMZs in timber harvest units and along open roads.

TABLE 4.9-17. PROJECTED ACRES OF GRIZZLY BEAR HIDING COVER FOR EACH ALTERNATIVE ON THE HCP PROJECT AREA BY LAND OFFICE, AND STILLWATER BLOCK AND SWAN RIVER STATE FOREST THAT ARE SITUATED WITHIN GRIZZLY BEAR RECOVERY ZONES AND ALL OTHER PROJECT AREA LANDS OUTSIDE OF RECOVERY ZONES AT YEARS 0 AND 50

DNRC Land Office and Status in or out of Recovery Zones	Acres of Grizzly Bear Hiding Cover in the HCP Project Area				
	Year 0	50 years			
	All Alternatives	No Action	Alternative 2	Alternative 3	Alternative 4
CLO Total	30,409	35,320	35,320	35,219	35,320
CLO in Recovery Zones	231	252	252	252	252
CLO outside Recovery Zones	30,178	35,068	35,068	34,967	35,068
NWLO Total	186,464	186,519	185,553	186,197	185,640
NWLO Total in Recovery Zones	103,247	105,583	104,043	105,993	104,363
NWLO Total outside Recovery Zones	83,217	80,937	81,510	80,203	81,277
Stillwater Block in Recovery Zones (includes blocked and scattered parcels)	61,745	63,656	61,605	63,685	61,642
Stillwater Block outside Recovery Zones (includes scattered parcels)	11,015	11,183	11,065	10,963	11,140
Swan River State Forest in Recovery Zones (blocked lands)	31,121	31,644	32,371	31,944	32,311
Other NWLO Units in Recovery Zones (KU, LIB, PLNS)	10,381	10,282	10,067	10,365	10,409
Other NWLO Units outside Recovery Zones (KU, LIB, PLNS)	72,202	69,754	70,445	69,240	70,137
SWLO Total	61,695	60,656	60,677	60,641	60,677
SWLO in Recovery Zones	4,000	3,873	3,917	3,873	3,917
SWLO outside Recovery Zones	57,695	56,783	56,760	56,768	56,761
TOTAL in Recovery Zones (% of recovery zone acres)	107,478 (69.7)	109,708 (71.2)	108,211 (70.2)	110,119 (71.4)	108,531 (70.4)
TOTAL outside Recovery Zones	171,090	172,788	173,338	171,938	173,106
GRAND TOTAL	**278,568**	**282,496**	**281,549**	**282,057**	**281,637**
Total Percent Cover Estimates for 446,095 acres of Forested Trust Lands in the Project Area[1]	62.4	63.3	63.1	63.2	63.1

[1] Cover estimates in this table represent acreages of coniferous stands that are likely to provide screening characteristics that will hide grizzly bears. However, due to model limitations, no patch size, patch shape, or other spatial aspects can be presumed from these values.

Source: DNRC (2008a).

Comparison of Alternatives

Under Alternative 1, DNRC would be required to maintain hiding cover in certain areas, where practicable. In the Stillwater Block and the Swan River State Forest and on scattered parcels in grizzly bear recovery zones, visual screening would be provided, where available, along all riparian zones. DNRC would also be required to provide visual screening adjacent to open roads to the extent practicable. Within the Swan River State Forest and the Stillwater Block, DNRC would be required to retain no less than 40 percent of the trust lands in any BMU subunit in hiding cover.

Alternatives 2, 3, and 4 include GB-PR6, a program-wide commitment that would require DNRC to provide visual screening in riparian areas and in wetlands. In recovery zones and NROH, GB-NR4 would require that distance to visual screening in new harvest units be no more than 600 feet from any point in the unit. Additional visual screening provisions would be implemented in recovery zones, where GB-RZ2 would require DNRC to leave up to 100 feet of vegetation between open roads and clearcut or seed tree harvest units, with some allowances. This commitment to provide visual screening along open roads would be implemented under Alternatives 2 and 3, but not Alternative 4. Alternative 4 would only incorporate these measures as in Alternative 1 for the Stillwater Block and Swan River State Forest. The requirement to retain target amounts of hiding cover in BMU subunits in the Stillwater Block would cease under Alternatives 2, 3, and 4. Under all three action alternatives, the similar requirement for the Swan River State Forest would cease if the Swan Agreement is terminated. Collectively, the three measures described above (GB-PR6, GB-NR4, and GB-RZ2) would provide visual screening in important foraging areas, near harvest openings, and along open roads, reducing the risk of direct bear mortality and potentially increasing habitat effectiveness, compared to Alternative 1. However, Alternative 4 would require less screening along open roads than Alternatives 2 and 3, thus resulting in a slightly elevated risk to grizzly bears than those two alternatives.

Modeled cover projections at year 50 varied little between alternatives (Table 4.9-17). Estimates by alternative at year 50 were very similar for each individual land office and the two blocked units, indicating no severe differential harvesting on one land office versus another over the Permit term. Compared to the current condition, total estimates of forest vegetation that would provide visual screening in recovery zones increased slightly under all alternatives at year 50, and the estimate for Alternative 3 was greatest at 110,119 acres. The percentage of cover in recovery zones of all of the HCP project area lands ranged from 70.2 (Alternative 2) to 71.4 (Alternative 3), well above the 40 percent threshold requirements required by the ARMs and Swan Agreement under Alternative 1. Similarly for all forested HCP project area lands, the percentages of acres possessing cover under all action alternatives varied from 63.1 to 63.3 percent (Table 4.9-17). In recovery zones, Alternative 2 showed the greatest decrease at year 50 from Alternative 1 with about 1.4 percent fewer acres in cover. Localized risks to grizzly bears associated with management of forest cover could occur at smaller scales; however, this analysis indicates that anticipated levels would be relatively high across HCP project area lands over the 50-year Permit term. Thus, the greatest differences among the alternatives in how they address cover-associated risks to grizzly bears is likely through differences in how they address distance to cover and visual screening along open roads, as described above.

Habitat Elements

Potential Effects

- The way specific forest management projects are designed may impact important habitat elements for grizzly bears, such as berry fields and avalanche chutes.

Indicators and Rationale

Habitat features consistently described in the literature as favored by bears include avalanche chutes, fire-mediated shrub fields, whitebark pine stands, wetlands, riparian areas, and unique congregation or feeding areas. Management activities that reduce the effectiveness of such areas to provide forage, or reduce use of these important places during important seasons, could adversely impact the nutritional condition of bears. The following discussion identifies and compares the rules, policies, and commitments that address impacts to these habitat elements under the alternatives.

Comparison of Alternatives

Under Alternative 1, impacts to habitat elements would be addressed as identified for individual projects through the MEPA interdisciplinary process. No rules are currently in place to identify or mitigate the impacts of timber management activities on specific habitat elements. In contrast, Alternatives 2, 3, and 4 contain specific provisions for assessing impacts to specific grizzly bear habitat elements for projects in recovery zones. DNRC would develop mitigations that minimize impacts to these specific habitat elements. Mitigations would typically involve scheduling activities to occur while bears are not likely to be using an area or locating roads or skid trails to conserve important vegetative features, such as berry patches or dense stands or thickets that provide visual screening for likely feeding areas. As a result, the risk of adverse effects on foraging opportunities in key sites would be reduced compared to Alternative 1, which would provide no specific direction or assurances. As described earlier in this analysis, riparian areas and avalanche chutes would be similarly protected through the program-wide commitment that restricts road construction in these important areas.

Habitat Linkage

Potential Effects

- Forest management activities may result in increases in human access and reductions in forest cover in areas situated within or between existing large blocks of relatively secure habitat, resulting in adverse effects on habitat linkage for grizzly bears.

Indicators and Rationale

The effects of the alternatives are evaluated in two ways: (1) a comparison of standards for maintaining cover and other vegetative conditions and road densities conducive to promoting bear security and habitat linkage, and (2) an assessment of the likelihood that portions of linkage areas in the HCP project area would be converted to residential or other development.

Comparison of Alternatives

No boundary changes or land additions to any formally identified linkage zones would occur under any of the alternatives. With the exceptions of the Stillwater Block and Swan River State Forest,

DNRC's ability to influence linkage areas is relatively limited by the amount of land in the project area (approximately 2 percent) and distribution of lands in western Montana (Tables 4.9-8 and 4.9-9, and Figures D-15A, B, and C in Appendix D, EIS Figures). The Stillwater Block and the Swan River State Forest are important land areas with high value for linkage, and linkage zones have been formally identified within these areas (USFWS et al. 1995; Servheen et al. 2001). With the exception of spring restriction commitments for specific linkage zones in the Swan River State Forest that apply under the Swan Agreement, the commitments under all alternatives incorporate measures that are generally supportive of maintaining linkage for a diversity of species but are not tied to specific linkage zones defined by DNRC or others. For example, Servheen et al. (2001) identified a large, important linkage zone along Highway 93 that is adjacent to the southwest boundary of the Stillwater Block. There are no specific commitments applicable to that identified linkage zone; however, projects on all the bordering trust lands would be required to meet cover, security, and road density commitments established in the Forest Management ARMs, or similar commitments associated with all action alternatives for supporting effective linkage in that area. All of the alternatives are similar and vary slightly in how they contribute to, or may impact, habitat linkage for grizzly bears and other species on project area lands in western Montana.

Under Alternative 1 for all DNRC forest management projects, forest patch size, shape, connectivity, and habitat fragmentation would be considered at the project level under ARM 36.11.415. In the Stillwater Block, commitments to security core would remain in place, the 40 percent hiding cover in BMU subunits measure would remain, gates would be checked and repaired annually, and open road densities would be managed under the approach of no net increase from the 1996 baseline. Visual screening would continue to be required along open roads in the Stillwater Block. Similarly, on the Swan River State Forest, activities would be avoided in the spring period in defined linkage zones below 5,200 feet elevation, harvest unit design would require the 600-feet-to-cover measure, and a minimum of 40 percent hiding cover would be maintained per BMU subunit, as long as the Swan Agreement is in place. Open road density limits would also remain in place in the Swan River State Forest, gates would be checked and repaired annually, and visual screening would continue to be required along open roads and riparian areas. On scattered parcels in grizzly bear recovery zones, open roads would be restricted to no net increase on lands with greater than 1 mi/mi^2. Retention of cover associated with riparian zones and visual screening along open roads would continue to be required. These measures would continue to contribute to linkage in areas that are important for grizzly bears.

Under Alternatives 2, 3, and 4, forest patch size, shape, connectivity, and habitat fragmentation would continue to be considered in a similar manner at the project level under ARM 36.11.415. Under all action alternatives, access management would be addressed on blocked lands through the incorporation of relatively static transportation plans. The approaches under all action alternatives incorporate seasonal restrictions on roads; limits on amounts of open and restricted roads; and maintenance of large, relatively secure areas that would facilitate their use by grizzly bears during important seasons. Under all action alternatives, a program-wide commitment for all HCP project area lands would ensure that visual screening associated with RMZs and WMZs is retained, and that limited road construction would occur within riparian areas and avalanche chutes. Also, authorization of access easements with other parties would be subject to greater scrutiny and oversight by the FMB within both recovery zones and NROH, placing additional controls on access within areas potentially important for linkage. Similarly, in NROH and recovery zone lands (on both blocked lands and scattered parcels), additional restrictions on allowable activities in spring

habitat would reduce risk for bears during this important season, including areas with high linkage value. In particular, these improved spring commitments expand restrictions from those contained in Alternative 1 to include a much greater area associated with scattered parcels, the Swan River State Forest (if the Swan Agreement is terminated), and lands within the CYE. Checking and repairing gates and road closure devices would also be expanded under all action alternatives to include all scattered parcels in recovery zones. Repair time for ineffective closures could not extend beyond 2 years under any action alternative. Under all action alternatives, there would be no specific requirement to maintain a specific hiding cover percentage; however, the application of a requirement to restrict harvest unit size to ensure cover is available within 600 feet from any point within a clearing would be expanded to include all of the Stillwater Block and all scattered parcels within recovery zones and NROH. Under Alternative 1, this measure is only applicable on the Swan River State Forest. Given the results contained in Table 4.9-17 and DNRC's commitment by statute to a sustainable harvest volume (MCA 77-5-222), hiding cover amounts are not expected to vary appreciably under Alternative 1 or any of the action alternatives.

Under Alternative 3, maintenance of security core areas on the Stillwater Block at the DNRC 1996 baseline levels would continue. Under Alternatives 1 and 3, approximately 39,600 acres in the Stillwater Unit would be managed as secure habitat for at least 10 years (Stillwater Core). In contrast, about 19,400 acres (53 percent of the 36,800 acres) would be managed as quiet areas under Alternatives 2 and 4**,** with a maximum entry period of 4 years of activity followed by 8 years of rest from commercial logging activities. On the Stillwater Block, Alternative 3 would likely provide the greatest degree of habitat quality associated with the formally identified linkage zone along Highway 93 because it requires that the largest amount of blocked secure acreage that possesses the least allowable disturbance be maintained. In NROH and recovery zones, Alternative 3 would provide greater levels of restriction on low-intensity motorized activities in seasonally important areas, such as spring habitat, and greater motorized activity restrictions in recovery zones in post-denning habitat found at high elevations. Where such areas occur within lands important for linkage, bears may be better able to live and move through such places undisturbed. In contrast to Alternatives 1, 2, and 4, Alternative 3 provides a cap on the level of restricted roads on scattered parcels in recovery zones, allows less motorized use for low-intensity activities in the CYE in spring habitat, and provides for greater oversight and approval by the USFWS for activities associated with salvage harvest and interrupting parcels or subzones in rest.

In summary, given the amount and distribution of trust lands in western Montana, habitat connectivity between linkage zones is likely to be most influenced by land use and management on other ownerships, rather than DNRC forest management. However, all action alternatives provide for restrictions on access, quiet areas, cover maintenance, and control of development in similar ways. Alternatives 2, 3, and 4 would increase the amount and quality of linkage zones when compared to current conditions, especially within the Stillwater Block and Swan River State Forest, due to the variety of mitigation measures incorporated within these areas. There is likely little measurable difference between Alternatives 2 and 4 in how habitat linkage would be influenced for grizzly bears. However, Alternative 3 provides tighter controls on public and administrative motorized access, greater acreage of secure/quiet areas, and more rigid oversight and approval by the USFWS for activities associated with salvage harvest and interrupting parcels or subzones in rest. Collectively, these additional measures may result in somewhat greater potential to maintain important linkage areas of higher quality than Alternatives 1, 2, or 4. All three action alternatives

provide greater certainty of maintaining linkage in important areas over the 50-year Permit term than Alternative 1.

Summary

Compared to Alternative 1, all three action alternatives would impose greater restrictions on the location of new road construction and the granting of access easements, potentially reducing the risk of effects on bears due to the presence of roads in key habitat areas. Alternative 3 would include additional commitments, prohibiting any net increase in total road densities at the administrative unit level.

Within the Stillwater Block, implementation of the transportation plan under Alternatives 2 and 4 would be expected to reduce, but not eliminate, the risk that bears may be displaced from habitat they would otherwise use for feeding, breeding, or shelter, compared to Alternative 1. In areas that are currently managed as security core (Stillwater Core), however, the risk would increase because some roads that are currently closed year-round to motorized public access would be open with seasonal restrictions. This risk would be offset in part by the implementation of more rigorous requirements for monitoring and maintaining road closures. Under Alternative 3, DNRC would maintain existing road closures in the Stillwater Core, with additional provisions for grizzly bears.

Open road densities in the Swan River State Forest would be expected to remain at or near existing levels under Alternative 1. Under the action alternatives, if the Swan Agreement is terminated, open road densities could increase dramatically, depending on the status of access agreements with neighboring landowners. On scattered parcels in recovery zones and NROH, transportation commitments under the action alternatives would reduce the likelihood (compared to Alternative 1) of open roads being located in key grizzly bear habitat during key times of the year.

Compared to Alternative 1, the total amount of land area managed to reduce the risk of bear-human conflicts would increase under all of the action alternatives, from approximately 76,300 acres under Alternative 1 to almost 95,000 acres under Alternatives 2 and 4**,** and more than 112,000 acres under Alternative 3**.** The management emphasis in these areas would differ under the alternatives, however. Under Alternatives 2 and 4, areas in the Stillwater Core would instead be managed as quiet areas, with reduced restrictions on where and when management activities may occur. These changes could increase the risk of such activities occurring at locations that would displace bears. However, these increased risks would be offset by restrictions on commercial activities in spring habitat in the spring period and no net increases in open road densities in rested subzones. In contrast, under Alternative 3, DNRC would maintain its commitment to keeping the Stillwater Core area intact for periods of at least 10 years, which is similar to Alternative 1.

All three action alternatives would impose greater restrictions on activities in spring habitat, post-denning habitat, and near den sites, compared to Alternative 1. These restrictions would reduce the risk of displacement from important habitat during these crucial periods. The greatest reduction of risk would occur under Alternative 3, which would implement the most stringent restrictions, with slightly smaller risk reductions under Alternative 2, followed by Alternative 4. Additional provisions for public education, food storage and sanitation, limitations on firearms possession, restrictions on livestock grazing, and the location of gravel operations under the action alternatives would further reduce the risk of habituation to human presence and foods, as well as bear-human encounters.

Compared to Alternative 1, commitments under the action alternatives to provide additional visual screening in important foraging areas, near harvest openings, and along open roads, would reduce the risk the of direct bear mortality and potentially increase habitat effectiveness and maintenance of effective linkage. In addition, the action alternatives would include commitments to identify and mitigate the impacts of timber management activities on habitat features that provide key foraging opportunities, thereby reducing the risk of displacement from these sites.

4.9.4 CANADA LYNX

4.9.4.1 Affected Environment

Status and Distribution

The DPS of Canada lynx in the contiguous United States was listed as threatened by the USFWS on March 24, 2000 (65 FR 16051 -16086). A status review by the USFWS in 2003 concluded that listing the lynx as endangered was not warranted and that the contiguous United States DPS was correctly classified as threatened (68 FR 40076-40101, July 3, 2003).

Canada lynx are found in boreal forest habitat throughout northern Canada and Alaska; they extend south into the contiguous United States in the Northeast (northern Maine and New Hampshire), Great Lakes region, and Northern Rocky Mountains and Cascade Mountains (Nordstrom 2005). Lynx population densities are highest in the northern parts of their range (northern Canada and Alaska), and densities of the contiguous United States populations are lower and likely dependent on immigration from the northern populations (Ruediger et al. 2000; Nordstrom 2005). The Northern Rocky Mountains in the United States (i.e., within Idaho, Montana, Wyoming, and Utah represents one of the southern limits of their North American distribution (USFS and BLM 2004). In Montana, lynx are currently found in the Rocky Mountains from the Canadian border south to the Yellowstone area (Butts 1992; McKelvey et al. 1999; Ruediger et al. 2000) and east to the Big Belt, Little Belt, and Crazy Mountains (Butts 1992; Ruediger et al. 2000). Trapping records indicate historical presence in the Big Snowy, Little Snowy, and Highwood Mountains. Lynx distribution in Montana is shown on Figure D-17 (Appendix D, EIS Figures).

The current status of the lynx population in isolated Montana mountain ranges, including the Big Snowy and Judith Mountains, has not been determined (Ruediger et al. 2000). The current lynx population in Montana is unknown, although limited population data indicate that Montana likely has more lynx than any other western state (Foresman 2001). Foresman (2001) reported estimates for the Montana population at between 800 and 1,000 lynx, and MFWP (2005a) considered the Montana lynx population to be well-distributed and stable. However, more recent observations, particularly in light of observed climatic warming trends, have raised questions about numbers and stability of local populations (Squires 2007, personal communication; McKelvey et al. 2008). Lynx are capable of traveling long distances, and there are occasional records for Montana of lynx sightings in habitat unsuited to sustaining a lynx population (Foresman 2001).

In the planning area, lynx distribution encompasses the administrative boundaries of the CLO, NWLO, and SWLO (Figure D-17 in Appendix D, EIS Figures). DNRC does not monitor lynx populations, but does report sightings of lynx and other special status species to the MNHP (DNRC 2005b). Between 2001 and July 2005, DNRC biologists reported two lynx sightings to MNHP (DNRC 2005b).

As a result of the federal listing of lynx, DNRC developed ARMs for forest management activities to address lynx habitat issues and ESA requirements. The proposed lynx conservation strategy incorporates many of the existing Forest Management ARMs and contains additional commitments based on recent information and studies. The action alternatives minimize impacts of forest management activities on lynx, while allowing varying degrees of management flexibility for DNRC to meet its fiduciary and stewardship trust responsibilities. See Appendix A, HCP, for further details concerning the proposed HCP lynx conservation strategy (Alternative 2).

In 2000, the LCAS was developed by the USFS, BLM, and USFWS to provide a consistent and effective approach to conserve lynx on federal lands in the contiguous United States (Ruediger et al. 2000). The guiding principles of this document are: (1) to use the best scientific information available about lynx; (2) retain future options until more conclusive information concerning lynx management is developed; (3) integrate a consideration of natural ecological processes and landscape patterns, and explicitly consider multiple spatial scales; (4) consider the habitat requirements of other wildlife species, including other forest carnivores; and (5) develop a useful, proactive plan to conserve lynx on federal lands. The principles of the LCAS were used to guide development of the lynx conservation strategy for the proposed HCP.

The LCAS identified 17 risk factors affecting lynx productivity, mortality, and dispersal. These 17 risk factors can be grouped into four broad categories: (1) sources of direct mortality (e.g., from predation, trapping, shooting, and vehicle collisions); (2) habitat loss (e.g., from forest management and non-native plant species); (3) habitat fragmentation (e.g., from highways and human development); and (4) disturbance, particularly near den sites (e.g., from forest management and recreation). This EIS (and the proposed HCP) addresses the last three categories of risk factors, because these are most likely to be affected by DNRC forest management activities. In earlier conservation efforts, it was assumed that packed snowmobile routes provide unnatural trails into areas with deep snow, providing a competitive advantage to species such as coyotes. However, a recent study designed to examine this concern found little evidence for that hypothesis (Kolbe et al. 2007).

Life History

The lynx is a wide-ranging carnivore with relatively large home ranges (up to 50 square miles [Nordstrom 2005]) that requires various habitat features for foraging and denning. The distribution of lynx is closely associated with boreal forest and distribution of their principal prey, snowshoe hares (Koehler and Aubry 1994; Hodges 1999; Ruediger et al. 2000). Throughout their range, lynx rely on hares for anywhere from 35 to 97 percent of their diet; therefore, it is generally accepted that lynx select habitats with abundant snowshoe hare populations (Brand and Keith 1979; Koehler and Aubrey 1994; Murray et al. 1994). From 1998 to 2002, a study in northwestern Montana found that snowshoe hares made up 96 percent of the prey biomass found in winter diets of lynx (Squires and Ruggiero 2007). Lynx have large feet and long legs and are well-adapted to moving in moderately deep to deep soft snow, which may provide an advantage over competing predators (coyote and bobcat) when hunting in these conditions (Ruediger et al. 2000). In the western United States, most lynx habitat is found in coniferous forests of the Rocky Mountains (Kuchler 1964 as referenced in McKelvey et al. 1999) at elevations from 4,900 to 6,500 feet (McKelvey et al. 1999). Lynx are solitary animals, except for young of the year that remain with their mothers. Mating occurs in March and April, and dens are used by lynx for birthing and rearing kittens until the kittens are approximately 10 weeks of age (WDNR 1996; MFWP 2005a). While rearing kittens, lynx may be

highly sensitive to disturbance and, if disturbed, have been known to abandon den sites (Claar et al. 1999; Ruediger et al. 2000).

Analysis Units

The LCAS required establishment and delineation of lynx habitat within lynx analysis units (LAUs) through the lynx's range on federal lands. An LAU is a delineated area approximating the size of a lynx home range (16,000 to 25,000 acres), with at least 6,400 acres of primary vegetation present capable of supporting lynx. Table 4.9-18 summarizes the number and acreage of LAUs in Montana, and acreage of federal lands and trust lands within LAUs. Further details regarding lynx analysis and methodology can be found in Appendix B, HCP Documents (Document B-3 – DNRC Canada Lynx Habitat Mapping Protocols for Implementation of the HCP). Within the planning area, there are 830 LAUs containing about 8.4 million acres of lynx habitat on federal lands and 86,000 acres of habitat on trust lands. Thus, habitat on trust lands makes up about 1 percent of that identified on federal lands. In comparison to the amount of suitable habitat in LAUs found on federal lands in western Montana, DNRC's contribution is considerably smaller.

TABLE 4.9-18. LYNX HABITAT WITHIN FEDERALLY DEFINED (I.E., USFS AND BLM) LYNX ANALYSIS UNITS WITHIN THE PLANNING AREA

Subject Description	Amounts	
Number of LAUs Containing Federal Land with Federally Identified Lynx Habitat	830	
Acreage of LAUs Containing Federal Land with Some Amount of Federally Identified Lynx Habitat	19,388,255	
Acreage of Federally Identified Lynx Habitat within LAUs	8,409,506	
Acreage of Trust Land that Occurs within Federal LAUs	612,755	
Acreage (and Percent)[1] of DNRC Total Potential Lynx Habitat that Occurs within LAUs Containing Federally Identified Lynx Habitat	86,038	(1.0)

[1] The percentage of DNRC total potential lynx habitat acres of the federal lynx habitat acres occurring in LAUs.
Source: DNRC (2008a).

For this analysis and for implementation of the proposed HCP, DNRC delineated LMAs in areas believed to be of elevated importance for lynx conservation. LMAs represent DNRC's effort to develop management areas that reflect the complexity of DNRC ownership patterns and identify lynx habitat on trust lands in a manner similar to that used for delineating federal lands within LAUs in western Montana. DNRC developed LMAs based on available literature, correspondence with John Squires (USFS research biologist), the LCAS (Ruediger et al. 2000), and habitat definitions for several national forests in Montana. Six LMAs were delineated in the HCP project area, and these encompass approximately 151,000 acres of trust lands in the NWLO and SWLO. These are the Stillwater East, Stillwater West, Coal Creek, and Swan LMAs in the NWLO and the Garnet and Seeley Lake LMAs in the SWLO (Figure B-17 in Appendix B, HCP Figures).

Habitat Requirements

Forest cover types preferred by lynx in the western United States include lodgepole pine, subalpine fir, Engelmann spruce, and the cedar-hemlock cover type in northwestern Montana (Aubry et al. 1999). Lynx will also use cool, moist Douglas-fir, grand fir, western larch, and aspen cover types where they occur in or near subalpine forests (Ruediger et al. 2000).

Lynx use a variety of forest structural stages to meet their foraging, denning, and cover habitat needs. Foraging habitat includes areas where snowshoe hare densities are likely to be greatest. Snowshoe hares inhabit various successional stages and vegetation communities; however, they appear to prefer stands (young or older) that possess dense conifer or conifer and shrub understory vegetation (Hodges 1999). Optimal foraging habitat includes forested stands in the seedling or sapling age class with high stem densities and a dense overhead canopy or shrub layer between 3 and 10 feet in height. Lynx also use late-seral forests for foraging, as snowshoe hares also use these forest types (Griffin 2004). Denning habitat generally consists of late-seral forests with high horizontal cover, although younger forests with adequate woody debris are also used (Mowat et al. 1999; Squires 2008). The important component for all lynx den sites appears to be the amount of woody debris present, not the age of the forest (Mowat et al. 1999).

For this analysis, potential lynx habitat was defined and modeled throughout the EIS planning area. Potential lynx habitat includes both suitable habitat and temporary non-suitable habitat, and represents any stands with the potential to support vegetation types preferred by lynx, regardless of a stand's current structural condition. For units west of the Continental Divide, preferred habitat types were used as the primary indicators of potential lynx habitat regardless of elevation or average snow depths. For units east of the Continental Divide, elevation and other attributes from photo interpretation data were integrated into habitat identification due to SLI data limitations. For more details regarding mapping and modeling protocol, refer to Document B-3 – DNRC Canada Lynx Habitat Mapping Protocols for Implementation of the HCP (Appendix B, HCP Documents).

Suitable habitat consists of forest stands within habitat types considered to be preferred by lynx, where crown closure is at least 40 percent. Suitable lynx habitat also includes stands that contain at least 180 stems per acre that are greater than or equal to 6 feet tall. Suitable habitat is subdivided into winter foraging habitat, young foraging habitat, and other foraging habitat classes. Winter foraging habitat includes sawtimber stands that possess multi-layering of moderate- or well-stocked coniferous vegetation and horizontal cover. Young foraging habitat includes conifer seedling and sapling stands with an average height greater than or equal to 6 feet and a density greater than 2,000 stems per acre. Other suitable habitat is a subset of suitable lynx habitat that does not contain the necessary attributes to classify as winter foraging habitat or young foraging habitat. Winter foraging habitat is most likely to be influenced by commercial timber harvesting activities, while young foraging habitat is primarily influenced by pre-commercial thinning.

Temporary non-suitable habitat includes recently harvested or naturally disturbed (e.g., burned) areas that have fewer than 180 saplings per acre that are at least 6 feet tall, or less than 40 percent total stand canopy cover, but have the potential to be forested suitable lynx habitat over time. Non-habitat areas include permanent non-forested areas, such as dry forest types, rock, lakes, and meadows.

It should be noted that the definitions of suitable and temporary non-suitable habitat used for the proposed HCP and for this analysis differ slightly from those currently found in the Forest Management ARMs (ARM 36.11.403). Under both definitions, the amount of total potential lynx habitat on trust lands in the planning area is 218,727 acres. Of this, approximately 182,500 acres (using the HCP definition) or 186,600 acres (using the ARM definition) are considered suitable habitat. These values compare to approximately 8.5 million acres of suitable lynx habitat on federal lands in the planning area (Table 4.9-19). Additional information on lynx habitat by land office and unit is provided in the tables contained in the *Supporting Documentation for the HCP Wildlife*

Analysis (DNRC 2008i). Further details regarding lynx analysis and methodology can be found in Document B-3 – DNRC Canada Lynx Habitat Mapping Protocols for Implementation of the HCP (Appendix B, HCP Documents).

Approximately 93,000 acres of suitable lynx habitat currently occur on trust lands within DNRC LMAs, which is 83 percent of the total potential habitat in those areas (Table 4.9-20). On scattered parcels, suitable habitat makes up approximately 75,000 acres (85 percent) out of 88,000 acres of total potential lynx habitat (Table 4.9-21). Together, these values add up to approximately 168,000 of suitable habitat out of 199,000 acres of total potential habitat (84 percent). Note, however, that the total acreage value may include a small amount of double counting of scattered parcels within LMAs.

The Forest Management ARMs also include a definition of lynx denning habitat. For this analysis, denning habitat is defined as moderate- or well-stocked sawtimber stands with moderate to high levels of CWD. In some areas, CWD data were not available. In these areas, denning habitat is defined as sawtimber stands with crown cover of 40 percent or greater and a poor to very poor vigor index rating. Currently, approximately 73,400 acres of denning habitat occur on HCP project area lands, approximately 67 percent of which is in the NWLO (Table 4.9-22).

Den site requirements include log piles, consisting of downed wood and large logs, in mature forest stands (1 to 5 acres) free from human disturbance, and generally in proximity to foraging habitat (Koehler and Brittell 1990; Mowat et al. 1999; Squires and Laurion 1999; Ruediger et al. 2000). Lynx also occasionally use rock piles as den sites (Koehler and Brittell 1990; Mowat et al. 1999; Squires and Laurion 1999). Because of the diverse habitat requirements for lynx, natural disturbances (e.g., wildfire, insect infestations) have historically played a dominant role in maintaining the mosaic of forest successional stages necessary to support lynx populations (Ruediger et al. 2000).

Critical Habitat

On February 25, 2009, the USFWS announced a final rule designating 39,000 square miles of critical habitat for lynx in the lower 48 states (74 FR 8616-8662, February 25, 2009). Five critical habitat units were established, with two of those units encompassing parts of Montana. Most of the land area in Montana falls within Unit 3, which encompasses western Montana. Unit 5 is the Greater Yellowstone Area in southwest Montana. In total, approximately 182,700 acres of state trust lands were designated as critical habitat. The acres of critical habitat in the planning area, on all DNRC lands, and in the HCP project area are presented in Table 4.9-23.

TABLE 4.9-19. COMPARISON OF ACREAGES OF LYNX HABITAT ON FEDERAL VS. TRUST LANDS IN THE PLANNING AREA

Habitat Type	Lynx Habitat on Federal Lands in the Planning Area	Lynx Habitat[1] on Trust Lands in the Planning Area	
		HCP	Forest Management ARMs
Suitable Lynx Habitat[2]	8,456,017	182,456	186,610
Temporary Non-suitable Habitat[3]	—	36,271	32,117
Total Potential Lynx Habitat	8,456,017	218,727	218,727

1 Subtle differences in vegetative parameters exist between the action alternatives and Alternative 1 (Forest Management ARMs definitions). See Glossary for these definitions.
2 Suitable lynx habitat on federal lands includes suitable habitat as mapped by the USFS. Estimates for suitable habitat on trust lands are derived using DNRC's lynx habitat mapping protocol (see Appendix B, HCP Documents, Document B-3 – DNRC Canada Lynx Habitat Mapping Protocols for Implementation of the HCP.
3 Applies only to trust lands. Complete temporary non-suitable habitat maps were not available for federal lands.
Source: DNRC (2008a).

TABLE 4.9-20. COMPOSITION OF CURRENT LYNX HABITAT, USING THE HCP LYNX HABITAT DEFINITION, ON TRUST LANDS WITHIN LMAS PROPOSED UNDER THE HCP

Habitat Class	Proposed LMAs (Land Office)[1]												Total
	Stillwater West (NWLO)		Stillwater East (NWLO)		Coal Creek (NWLO)		Swan (NWLO)		Seely Lake (SWLO)		Garnet (SWLO)		
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
Winter Foraging Habitat[2]	19,224	(62.7)	25,323	(75.4)	4,514	(36.7)	16,706	(65.9)	3,482	(60.3)	1,009	(28.2)	70,259
Young Foraging Habitat[2]	507	(1.7)	288	(0.9)	767	(6.2)	56	(0.2)	26	(0.4)	0	(0.0)	1,644
Other Suitable Habitat[2]	7,430	(24.2)	2,757	(8.2)	2,488	(20.2)	4,301	(17.0)	1,802	(31.2)	2,116	(59.0)	20,894
Suitable Habitat Subtotal[2,3]	27,162	(88.5)	28,367	(84.5)	7,769	(63.2)	21,063	(83.1)	5,310	(92.0)	3,125	(87.2)	92,796
Temporary Non-suitable Habitat[2]	3,521	(11.5)	5,199	(15.5)	4,529	(36.8)	4,292	(16.9)	463	(8.0)	458	(12.8)	18,462
Total Potential Lynx Habitat[4,5]	30,682	(78.9)	33,566	(91.4)	12,298	(80.7)	25,355	(63.7)	5,773	(44.2)	3,583	(47.7)	111,258
Non-habitat[5]	8,183	(21.1)	3,143	(8.6)	2,937	(19.3)	14,479	(36.3)	7,286	(55.8)	3,926	(52.3)	39,955
DNRC Total Acres[6]	**38,865**	**(100.0)**	**36,709**	**(100.0)**	**15,236**	**(100.0)**	**39,834**	**(100.0)**	**13,059**	**(100.0)**	**7,510**	**(100.0)**	**151,213**

1 No LMAs are proposed within the CLO.
2 Percentages for these habitat classes describe habitat amounts proportional to total potential lynx habitat.
3 The Suitable Habitat Subtotal is the sum of Winter Foraging Habitat, Young Foraging Habitat, and Other Suitable Habitat, which are all presumed to currently provide habitat.
4 Total Potential Lynx Habitat is the sum of Suitable Habitat and Temporary Non-suitable Habitat acres. This category represents all lands potentially supporting lynx preferred climax vegetation types over time regardless of their current structural condition.
5 Percentages for these classes describe amounts proportional to DNRC Total Acres.
6 DNRC Total Acres is the sum of Total Potential Lynx Habitat and Non Habitat.
Source: DNRC (2008a).

TABLE 4.9-21. ACRES OF LYNX HABITAT BY DNRC LAND OFFICE ON SCATTERED PARCELS IN THE HCP PROJECT AREA UNDER CURRENT CONDITIONS AND MINIMUM ACRES REQUIRED AS A PERCENTAGE OF TOTAL POTENTIAL LYNX HABITAT AS REQUIRED UNDER THE PROPOSED ALTERNATIVES

Habitat Category	Current Condition (Acres)[1]	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Required Habitat	Acres	Required Habitat	Acres	Required Habitat	Acres	Required Habitat	Acres
NWLO									
Foraging Habitat[2]	8,642	10% of TPH	3,979	NA	NA	NA	NA	NA	NA
Denning Habitat	12,244	5 acres / parcel	775	NA[6]	NA	10% of TPH	3,979	NA[6]	NA
Other Suitable Habitat[3]	15,734	NA	NA	NA	NA	NA	NA	NA	NA
Suitable Habitat[4]	36,636	NA	NA	65% of TPH	25,864	70% of TPH	27,854	60% of TPH	23,875
Total Potential Lynx Habitat[5]	**39,791**	**NA**	**39,791**	**NA**	**39,791**	**NA**	**39,791**	**NA**	**39,791**
SWLO									
Foraging Habitat[2]	1,866	10% of TPH	1,634	NA	NA	NA	NA	NA	NA
Denning Habitat	2,781	5 acres / parcel	700	NA[6]	NA	10% of TPH	1,634	NA[6]	NA
Other Suitable Habitat[3]	9,591	NA	NA	NA	NA	NA	NA	NA	NA
Suitable Habitat[4]	14,238	NA	NA	65% of TPH	10,620	70% of TPH	11,437	60% of TPH	9,803
Total Potential Lynx Habitat[5]	**16,339**	**NA**	**16,339**	**NA**	**16,339**		**16,339**	**NA**	**16,339**
CLO									
Foraging Habitat[2]	4,122	10% of TPH	3,222	NA	NA	NA	NA	NA	NA
Denning Habitat	16,927	5 acres / parcel	790	NA[6]	NA	10% of TPH	3,222	NA[6]	NA
Other Suitable Habitat[3]	3,542	NA	NA	NA	NA	NA	NA	NA	NA
Suitable Habitat[4]	24,592	NA	NA	65% of TPH	20,943	70% of TPH	22,554	60% of TPH	19,332
Total Potential Lynx Habitat[5]	**32,220**	**NA**	**32,220**	**NA**	**32,220**		**32,220**	**NA**	**32,220**

NA = not applicable. For this table, "NA" means the current regulations or proposed alternative do not require a specific amount of the subject habitat category.
[1] The current condition presents the actual acres in the habitat category at the present time, whereas Alternative 1 depicts the required amount of habitat for future years.
[2] Foraging habitat is composed of winter foraging and young foraging habitat.
[3] Other suitable habitat is a subset of suitable lynx habitat that does not contain the necessary attributes to classify as foraging or denning habitat.
[4] Suitable habitat is all habitat with structural characteristics capable of providing lynx habitat.
[5] Total potential lynx habitat represents all lands potentially supporting lynx-preferred climax vegetation types over time regardless of their current structural condition.
[6] For Alternatives 2 and 4, the requirement for denning habitat is to retain at least two den sites per square mile rather than a requirement to retain a certain acreage of habitat.
Source: DNRC (2008a).

TABLE 4.9-22. ACREAGES OF EXISTING CANADA LYNX HABITAT (AS DEFINED IN THE DNRC FOREST MANAGEMENT ARMS) ON TRUST LANDS IN THE PLANNING AREA AND HCP PROJECT AREA BY LAND OFFICE

Habitat Class	Trust Lands in Planning Area (%)						Total	HCP Project Area (%)						Total
	NWLO		SWLO		CLO			NWLO		SWLO		CLO		
Denning[1]	33,205	(22.6)	2,209	(7.7)	17,463	(40.6)	52,877	31,790	(22.5)	1,828	(7.1)	13,172	(40.9)	46,791
Denning/Mature Foraging[1]	17,673	(12.0)	2,637	(9.2)	9,191	(21.4)	29,501	17,228	(12.2)	1,866	(7.3)	7,511	(23.3)	26,606
Denning/Young Foraging[1]	16	(0.0)	0	(0.0)	0	(0.0)	16	16	(0.0)	0	(0.0)	0	(0.0)	16
Mature Foraging[1]	20,338	(13.8)	5,911	(20.5)	496	(1.2)	26,745	19,426	(13.8)	5,456	(21.2)	366	(1.1)	25,247
Other Habitat[1]	55,981	(38.1)	14,879	(51.7)	5,547	(12.9)	76,407	53,343	(37.8)	13,509	(52.6)	3,542	(11.0)	70,394
Young Foraging[1]	987	(0.7)	78	(0.3)	0	(0.0)	1,065	929	(0.7)	14	(0.1)	0	(0.0)	943
Suitable Habitat Subtotal[1,2]	128,199	(87.3)	25,714	(89.4)	32,697	(76.0)	186,610	122,732	(86.9)	22,673	(88.2)	24,592	(76.3)	169,997
Temporary Non-suitable Habitat[1]	18,705	(12.7)	3,064	(10.6)	10,348	(24.0)	32,117	18,507	(13.1)	3,030	(11.8)	7,629	(23.7)	29,166
Total Potential Lynx Habitat[3,4]	146,904	(46.5)	28,778	(12.3)	43,045	(3.4)	218,727	141,239	(51.7)	25,704	(15.9)	32,220	(28.5)	199,163
Non-habitat[4]	169,352	(53.5)	205,966	(87.7)	1,219,485	(96.6)	1,594,803	132,161	(48.3)	136,224	(84.1)	80,961	(71.5)	349,347
Total Acres[5]	**316,256**	**(100.0)**	**234,744**	**(100.0)**	**1,262,530**	**(100.0)**	**1,813,530**	**273,401**	**(100.0)**	**161,927**	**(100.0)**	**113,182**	**(100.0)**	**548,510**

1 Percentages for these habitat classes describe habitat amounts proportional to total potential lynx habitat.
2 The suitable habitat subtotal is the sum of denning habitat, mature foraging habitat, young foraging habitat and other suitable habitat, which are all presumed to currently provide habitat.
3 Total potential lynx habitat is the sum of suitable habitat and temporary non-suitable habitat acres. This category represents all lands potentially supporting lynx preferred climax vegetation types over time regardless of their current structural condition.
4 Percentages for these classes describe amounts proportional to total acres.
5 Total acres is the sum of total potential lynx habitat and non-habitat.
Source: DNRC (2008a).

TABLE 4.9-23. ACRES OF LYNX CRITICAL HABITAT IN THE PLANNING AREA AND HCP PROJECT AREA

DNRC Land Office and Administrative Unit	Critical Habitat in the Planning Area (All Ownerships)	Critical Habitat on DNRC Lands in the Planning Area	Critical Habitat in the HCP Project Area
Northwest Land Office	**4,016,029**	**140,377**	**134,887**
Kalispell Unit	322,297	8,989	8,038
Libby Unit	766,119	1,350	1,350
Stillwater Unit	1,221,201	98,553	94,349
Swan Unit	1,706,412	31,485	31,150
Southwest Land Office	**1,260,728**	**41,544**	**39,427**
Anaconda Unit	160,074	5,182	3,793
Clearwater Unit	828,577	18,430	18,095
Missoula Unit	272,077	17,932	17,539
Central Land Office	**2,352,125**	**855**	**812**
Helena Unit	446,753	30	28
Bozeman Unit	1,196,876	826	785
Dillon Unit	0	0	0
Conrad Unit	708,497	0	0
Grand Total	**7,628,883**	**182,777**	**175,127**

Source: DNRC (2008a).

Canada Lynx Habitat Linkage

Habitat linkage and connectivity are important components of lynx habitat (McKelvey et al. 1999; Schwartz et al. 2002; Ruggiero et al. 2000; USFS and BLM 2004). Maintaining connectivity with lynx populations in Canada and between mountain ranges is an important consideration for lynx in western Montana and for populations farther south in the Rocky Mountains (Ruediger et al. 2000). Schwartz et al. (2002) also suggested that management actions in the contiguous United States should focus on maintaining connectivity with the core of the lynx's geographic range, thought to be in northern Canada (McKelvey et al. 1999). Lynx use a variety of habitats for dispersal as they move between home ranges, and are known to travel great distances to utilize suitable habitat patches (Ruggiero et al. 2000). When dispersing, lynx have been documented to cross large, early-successional stage stands or very large openings, which would otherwise be considered unsuitable if located within breeding territories (Ruggiero et al. 2000). Areas that provide opportunities for linkage are essential for allowing genetic dispersion between subpopulations of lynx, especially for ameliorating losses associated with catastrophic events. Impediments to lynx dispersal include highways and areas of human settlement, as well as a reduction in vegetative cover (Apps et al. 1999; Nordstrom 2005; Ruediger et al. 2000). Forest management activities may alter cover in uplands and riparian zones, which may reduce the effectiveness of linkage zones.

Lynx are highly mobile and have relatively large average home ranges, and they are capable of moving long distances to find abundant prey (68 FR 40076-40101, July 3, 2003, p.40083). Lynx are thought to frequently travel along linear features such as ridges, saddles, and riparian zones (Ruediger et al. 2000:1-4). Recent studies are providing strong evidence that lynx prefer to travel, hunt, and den where there is an abundance of forested cover (Koehler et al. 2008; Squires et al. 2008; Squires 2008). However, the literature does also contain many examples of lynx crossing large, unforested openings (Roe et al. 2000 as referenced in 68 FR 40076-40101, July 3, 2003, p.

40079). Connectivity of appropriate habitat types and cover types provides habitat connectivity and may increase the likelihood of survival and successful dispersal of lynx (Ruediger et al. 2000; 68 FR 40076-40101, July 3, 2003, p. 40097). There is little evidence to suggest that forest roads pose an appreciable threat to lynx (68 FR 40076-40101, July 3, 2003, p. 40083).

4.9.4.2 Environmental Consequences

Introduction

This analysis identifies the ways forest management activities proposed for coverage under the alternatives could affect lynx by modifying habitat availability and suitability, influencing habitat connectivity, or disturbing lynx at active dens. The elements of the lynx conservation strategy address these risks and provide organizational structure for this analysis. The following subsections identify the criteria by which the effects of the alternatives are evaluated, the rationale for those criteria, and the relative effects of the alternatives. Each subsection is introduced by a bullet statement summarizing a potential effect and likely cause for the effect. Consequences to lynx from the alternatives are based on how well each alternative addresses the risk factors to lynx. Evaluation criteria are used, such as predicted acreages of specific habitat amounts, to assess how well the alternatives provide for lynx conservation. Six elements of the lynx conservation strategy address the potential for forest management activities to affect habitat for lynx. These elements address (1) habitat suitability, (2) den site attributes, (3) CWD and snag retention, (4) foraging habitat attributes, (5) habitat connectivity, and (6) reduction of risk to female lynx with dens.

Habitat Suitability

Potential Effects

- Lynx require a mosaic of early, mature, and late-successional staged forests, some with high levels of horizontal cover and structure. Forest management activities may convert stands that serve as suitable lynx habitat to stands that do not serve as suitable habitat.

Indicators and Rationale

Management of lynx habitat typically focuses on maintaining forested areas in conditions that provide suitable habitat and stand conditions that help lynx fulfill important life requisites. These conditions can be created through natural or manmade disturbance processes. The LCAS standard for managing federal lands for lynx is maintenance of 70 percent suitable habitat and 30 percent temporary non-suitable habitat within LAUs, typically the size of a female lynx home range. Under historical conditions (pre-forestry) in western Montana within cover types that were likely to support lynx, approximately 38 percent of the landscape was in non-stocked and seedling/sapling stands at any given time (i.e., temporary non-suitable habitat). This estimate is a weighted average derived from Losensky (1997). Therefore, maintaining a range of 60 to 70 percent of potential lynx habitat within occupied lynx habitat as suitable habitat is expected to provide adequate suitable habitat for lynx. Further, capping the amount of habitat that can be converted per decade ensures a continuum of young forest growing into suitable foraging habitat over time.

Comparison of Alternatives

Under Alternative 1, within the Stillwater Block and the Swan River State Forest, DNRC would continue to abide by the ARMs that specify the proportion of total potential habitat to be retained as denning habitat (5 percent) and as some combination of mature or young foraging habitat (10 percent). For scattered parcels containing appreciable amounts of lynx habitat, DNRC would maintain at least 5 acres of denning habitat and 10 percent of the lynx habitat acreage in mature or young foraging habitat, where feasible. There would be no constraints on the amount of habitat that could be converted to temporary non-suitable habitat on blocked lands or scattered parcels.

Under all action alternatives, DNRC would be required to maintain target amounts of HCP project area lands in suitable lynx habitat, both within LMAs and on scattered parcels (commitments LY-HB7 and LY-LM1). Target ratios for suitable habitat would be 65 percent of total potential habitat under Alternative 2, 70 percent under Alternative 3, and 60 percent under Alternative 4. Providing target amounts of suitable habitat would contribute toward ensuring long-term habitat availability for lynx. A greater amount of suitable habitat available at any given time would provide greater potential to meet long-term lynx habitat objectives. Thus, Alternative 3 would provide the greatest assurance of lynx suitable habitat in the HCP project area, followed by Alternatives 2 and 4.

Under all action alternatives, commitment LY-LM2 would place additional constraints on the amount of lynx habitat that could be converted to non-suitable habitat per decade within LMAs. Under Alternatives 2 and 3, no more than 15 percent of total suitable habitat could be converted to temporary non-suitable per decade in any LMA; the limit under Alternative 4 would be 20 percent per decade.

To support development of the proposed HCP and this EIS analysis, the forest model used to calculate the annual sustainable yield for trust lands, as described in Section 4.2 (Forest Vegetation), was constrained by the commitments for lynx habitat required under Alternatives 2, 3, and 4 (see Table E3-2 in Appendix E, EIS Tables). The results of this exercise demonstrated that DNRC could apply the proposed habitat retention requirements for lynx and still generate a desirable sustainable yield while also maintaining a healthy and diverse forest.

As shown in Table 4.9-21, DNRC is currently meeting and exceeding its habitat commitments on scattered parcels as specified in the ARMs. This is demonstrated in Table 4.9-21 with acreages under current conditions, which are the actual amounts of habitat calculated to be on the ground today, higher than those under Alternative 1, which are the amounts of habitat required under the ARMs. Table 4.9-21 shows the minimum amount of lynx habitat that would be required under each alternative for scattered parcels within the NWLO, SWLO, and CLO. Alternative 1 does not require a target for total suitable habitat, but the requirements for denning and foraging habitat would result in the maintenance of approximately 11,000 acres of these two habitat categories. The action alternatives would require retention of substantially more habitat (between 53,010 and 70,680 acres, depending on the alternative) than Alternative 1 (approximately 11,100 acres). Alternative 3 would set the highest target for suitable habitat (70,680 acres), followed by Alternatives 2 and 4 (57,427 acres and 53,010 acres, respectively).

Table E4-9 (Appendix E, EIS Tables) shows acres of lynx habitat required for retention by habitat category under the existing ARMs (Alternative 1) and the minimum amount of lynx habitat required for each LMA under the proposed alternatives. Under the existing ARMs for the Stillwater and

Swan River State Forests, grizzly bear BMU subunits are used to analyze and apply rule commitments as surrogates for federal LAUs. Thus, there are no requirements for habitat retention within LMAs *per se* under Alternative 1. BMU subunits, LAUs, and LMAs are similarly sized analysis areas, with LAUs tending to be slightly smaller because they are based on estimated average lynx home range size for western Montana, which tends to be smaller than that of grizzly bears. LMAs were designed to have improved fit with trust lands and provide biologically relevant areas to analyze and apply proposed conservation commitments. Under Alternatives 2, 3, and 4, there would be three LMAs on the Stillwater Block, one in the Swan River State Forest, and two composed of scattered parcels of HCP project area lands on the Clearwater and Missoula Units (i.e., the Seeley and Garnet LMAs).

Under Alternative 1, approximately 190,251 acres of total potential lynx habitat would be managed for lynx (derived by adding the total potential habitat under current conditions in Table 4.9-21, and the total potential habitat in the Stillwater and Swan as shown in Table 4.9-20). Of these acres, 15 percent (28,538 acres) would be required to be in foraging or denning habitat for lynx. Under all of the action alternatives, approximately 10,000 additional acres would be managed for lynx habitat, for approximately 190,251 acres of total potential lynx habitat (derived by adding the total potential habitat under current conditions in Table 4.9-21 and the total potential habitat in the LMAs in Table E4-9 (Appendix E, EIS Tables). Under the action alternatives, DNRC would maintain 123,663 acres of suitable habitat under Alternative 2, 133,174 acres under Alternative 3, and 114,151 acres under Alternative 4.

Under all action alternatives, providing a target percentage of suitable habitat and limiting the habitat that can be converted per decade within LMAs would conserve lynx by promoting a balance of stands in various structural stages, which would ensure sustainability of lynx habitat and populations on HCP project area lands for the term of the Permit.

The requirement for retention of suitable habitat on scattered parcels within an administrative unit is expected to have limited benefit for lynx. This is because lynx occur at low densities and occupy large home ranges, making it difficult to achieve conservation objectives on small parcels of land (USFWS 2007:47). However, benefits could be realized for lynx roaming outside their normal home range in search of food, dispersing lynx, and when scattered parcels occur within lynx home ranges centered on adjacent federal lands providing habitat for lynx.

Den Site Attributes and CWD

Potential Effects

- Managing stands of lynx denning habitat may change the stand attributes (dense mature stands and abundant CWD) such that the stands would no longer be classified as denning habitat and subsequently would not provide adequate denning habitat on the landscape at scales important for lynx.

Indicators and Rationale

Denning habitat is found in a variety of forest conditions, and suitable den site attributes occur in small pockets scattered across the landscape at relatively high densities; lynx denning sites are not believed to be a limiting factor for lynx (USFS and BLM 2004:ROD [2007]:17). Forest

management activities, including salvage, can alter structural attributes of denning habitat by removing large downed wood. In addition, young trees in recently harvested areas may be too small to provide ample forest cover desirable for lynx (Squires 2008). The common component of denning habitat appears to be large amounts of CWD. This structure is most valuable when distributed throughout the home range on or near foraging habitat (USFWS 2007:48). Potential den sites for this analysis are defined as natural or man-made piles of slash and downed logs that are at least 8 feet in diameter and at least 3 feet tall at their highest point.

Comparison of Alternatives

Under Alternative 1, DNRC would continue to maintain 5 percent of total potential habitat on the Stillwater Block and the Swan River State Forest as denning habitat as defined in the ARMs. (Denning habitat is defined in *DNRC Canada Lynx Habitat Mapping Protocol for Implementation of the HCP* in Appendix B, Document B-3). On scattered parcels, DNRC would maintain at least 5 acres of denning habitat per parcel, where available and feasible. Salvage would not be allowed in patches of denning habitat identified as necessary to meet these acreage commitments. Additionally, the ARMs include provisions for snags and snag recruits (36.11.411) and CWD (36.11.414) on all DNRC projects, which would aid long-term CWD recruitment important for the creation of natural den sites for lynx.

Under Alternatives 2 and 4, DNRC would not retain specified amounts of denning habitat. Rather, commitment LY-HB2 would require DNRC to retain two potential den sites per square mile in lynx habitat at the project level, except for blowdown salvage units, where 1 percent would be left un-salvaged (this latter requirement would not apply under Alternative 4). Additionally, during project layout, den sites would be positioned adjacent to suitable habitat where possible. Under all three action alternatives, the specific den sites that are retained would be mapped annually and reported to the USFWS at 5-year intervals. Alternative 3 would retain at least 10 percent denning habitat of the total potential lynx habitat within LMAs and at the parcel level for each scattered parcel and require at least two den sites of more than 5 acres of denning habitat per square mile. No salvage would be allowed within units less than 5 acres in size, except around campgrounds or developments, unless field inventories verify more than 10 percent denning habitat and two den sites per square mile are present.

All alternatives would require CWD recruitment at the project level, following the guidelines specified in Graham et al. (1994) or other agreed-to reference, for a range of 4 tons per acre up to 25 tons per acre, depending on the vegetation type. Commercial green tree logging and salvage logging operations under all alternatives would be required to provide for minimum snag and CWD recruitment levels. Monitoring under all action alternatives would require documentation of compliance with retention measures and reporting of results in the 5-year monitoring report. Under all four alternatives, DNRC would ensure retention of legacy woody material important for escape cover for lynx, structure important for snowshoe hares, and future den sites.

Alternative 3 also requires that 10 percent of the suitable habitat provide denning opportunities for lynx, whereas Alternatives 2 and 4 require retention of two den sites per square mile within total potential lynx habitat. This commitment would be implemented on each timber sale in lynx habitat, and over time would result in a broad distribution of sites with woody material concentrations. Alternative 3 would maintain more suitable lynx habitat and provide for more denning opportunities than Alternatives 2 and 4. However, given that denning habitat is found in a variety of forest

conditions and suitable den site attributes occur in small pockets scattered across the landscape at relatively high densities, lynx denning sites are not believed to be a limiting factor for lynx (USFS and BLM 2004:ROD [2007]:17). Under all action alternatives, providing concentrations of woody material and provisions for retaining attributes important for denning lynx would help ensure that den sites will not become limiting for them in the future. Under all alternatives, lynx would have adequate den sites for successfully raising young.

Foraging Habitat

Potential Effects

- Forest management activities may convert stands that serve as foraging habitat to stands that do not serve as foraging habitat, thus lowering prey abundance for lynx and increasing their risk of starvation.

Indicators and Rationale

The intent of conserving lynx foraging habitat is to provide assurances that habitat likely to provide high densities of snowshoe hares will be maintained through time. Habitat conditions and food availability, particularly in winter, are likely primary limiting factors for lynx in western Montana (Squires 2005, personal communication). For this reason, identifying and maintaining habitat in areas occupied by lynx, which provides high levels of horizontal cover preferred by snowshoe hares and lynx in winter, is considered important. Such habitat consists of pole stands and mature moist forest, typically at elevations above 4,000 feet, that possess multiple forest canopies and cover provided by conifer limbs near the snow surface. In the winter, lynx appear to prefer using and foraging within stands that exhibit these characteristics (Squires 2005, personal communication). Dense, young sapling stands (more than 2,000 trees per acre) can also provide habitat for concentrations of hares in western Montana (Griffin 2004).

The acres of various successional forest stages required to support lynx foraging habitat are poorly understood, but are likely a function of site productivity and suitability for snowshoe hares. *Lynx Habitat Management Plan for DNR-Managed Lands* (WADNR 2005) describes foraging habitat similarly to the proposed HCP and requires acreage retention of 20 percent at scales comparable to federal LAUs in Montana (or in this case LMAs). In the absence of clear standards, the DNRC HCP relied on this study to establish the commitment for maintaining 20 percent foraging habitat within LMAs.

For this analysis, pre-commercially thinned stands are assumed to have potential to continue providing connectivity and are therefore considered suitable habitat, but are not immediately counted in the acres of foraging habitat. Refer to *DNRC Canada Lynx Habitat Mapping Protocols for Implementation of the HCP* (Document B-3 in Appendix B, HCP Documents) for more details regarding how foraging habitat was modeled and defined.

Comparison of Alternatives

Currently, Alternative 1 addresses foraging habitat by delaying thinning in young foraging stands with stem density greater than 4,000 stems per acre until the average tree height is greater than 15 feet. In addition, approximately 10 percent of the lynx habitat acreage in mature or young foraging habitat (foraging habitat) would be retained at appropriate sites.

All action alternatives would allow DNRC to continue pre-commercial thinning; however, these acres would not be counted in the requirement for the minimum retention of 20 percent foraging habitat within an LMA. The amount of pre-commercial thinning on trust lands is minimal. The statewide annual average acres of pre-commercial thinning from 1998 to 2004 was approximately 1,780 acres (see HCP Section 1.4.4, Covered Activities). Additionally, DNRC would conduct thinning activities in a manner to maintain some level of snowshoe hare use and to help expedite the development of future foraging habitat. Specifically, under all action alternatives, commitment LY-HB5 would require DNRC to retain small shade-tolerant trees in pre-commercial thinning units within lynx habitat that do not pose substantial competition risks to desired crop trees. This is expected to ensure that, over time, these trees will grow to form a potentially dense understory below the faster-growing crop trees. While these trees do compete with the desired crop trees for limited site resources, retaining some of these smaller shade-tolerant trees would provide potential habitat structure for snowshoe hares by increasing the levels of horizontal cover and accelerating the development of multi-storied stands. This commitment ensures that some of the tree species that provide horizontal cover of tree boughs near the snow surface would be retained in stands receiving pre-commercial thinning treatments. The duration that forest stands would provide these habitat characteristics would be variable. Given the slower growth rates expected from understory species, it is likely that such two-storied or multi-storied stands will provide decades of foraging habitat for hares and lynx. Additionally, commitment LY-HB5 would also require that patches of advanced regeneration of shade-tolerant tree species be retained where operationally feasible as a component of commercial harvest prescriptions in winter foraging habitat to help expedite the development of future foraging habitat.

Under Alternative 2, 20 percent of the total potential habitat within LMAs would be maintained as young or winter foraging habitat. Alternative 3 would require this commitment, as well as one requiring unthinned retention patches within pre-commercial thinning units totaling at least 20 percent of the stand acres. Retention patches could not be thinned until lower branches grow to above snow level (about 6 feet) (commitment LY-LM3). For stands to be classified as winter foraging habitat, they must have at least 10 percent crown closure in mature trees and dense sapling undergrowth. Alternative 4 is the same as Alternative 2 with regard to commitment LY-LM3, except that 10 percent of the available thinning acres would be retained until lower branches grow to above snow level in LMAs, more similar to Alternative 3. While the commitments state that any combination of young and mature foraging may make up the required 20 percent, it is likely that a higher percentage of the foraging habitat in LMAs would be composed of mature foraging habitat, which is considered to be potentially limiting for lynx in Montana (Squires 2005, personal communication). This is because of the dynamic condition of young forests and the short time period in which they grow out of foraging habitat and the associated difficulty in accurately tracking and updating these acreages (i.e., to ensure it is meeting this commitment, DNRC anticipates that the majority of foraging habitat retained will be in the mature foraging habitat condition).

All action alternatives would require retention of more suitable foraging habitat that would provide better habitat for snowshoe hares, the primary prey species of lynx. This is attributed to requirements for 20 percent foraging habitat within LMAs (versus 10 percent on blocked lands under Alternative 1), modifications to pre-commercial thinning activities, and the juxtaposition of foraging habitat and suitable habitat within LMAs. In addition, Alternative 3 would provide requirements that allow for young foraging habitat to remain suitable longer than in the other action alternatives. All action alternatives would provide for monitoring of thinning projects, unlike

Alternative 1, which has no specific monitoring requirements for lynx. However, under Alternative 1 lynx habitat amounts and potential for effects would continue to be analyzed and disclosed on individual projects in MEPA documents.

In summary, all three action alternatives would require higher minimum amounts of foraging habitat compared to Alternative 1. Under Alternative 2, commitment LY-LM3 would require DNRC to maintain at least 20 percent of the total potential lynx habitat in LMAs as foraging habitat. Alternative 3 would provide additional thinning restrictions to this requirement, while Alternative 4 would set a target value of 10 percent, but with the same thinning restrictions as Alternative 3. These requirements compare to the 10 percent target on blocked lands (and scattered parcels where practicable) under Alternative 1. However, based on existing acres of foraging habitat in the HCP project area (Table 4.9-20), the action alternatives could result in a substantial reduction in foraging habitat within the LMAs. Because there is no agreement among lynx biologists on the minimum amount of lynx foraging habitat required within a female lynx's home range for her to successfully reproduce and rear her young, it is anticipated that, despite the proposed conservation measures, adverse effects may occur if foraging habitat is reduced to 20 percent of an LMA.

Under the action alternatives, DNRC would continue to pre-commercially thin limited acres in lynx suitable habitat. However, thinned areas would retain limited viability (for reasons described above). These measures would minimize the potential effects of pre-commercial thinning on lynx foraging habitat.

Habitat Connectivity and Linkage

Potential Effects

- Forest management activities may result in increases in human access and reductions in forest cover in areas situated within or between existing large blocks of relatively unfragmented habitat, resulting in adverse effects on habitat connectivity and linkage for lynx.

Indicators and Rationale

For the purposes of this analysis, the term linkage is used to refer to movements across highways or between populations or geographic areas, and defined linkage areas (USFS 2007a; USFWS et al. 1995; Servheen et al. 2001). Connectivity refers to lynx movements within and between home ranges and is considered adequate where cover is abundant and forest openings are limited. Cover is also an important component of maintaining the integrity of defined linkage areas. No high-traffic road systems or highways are being considered as a component of any alternative; thus, the effects of highways on habitat linkage and habitat connectivity for lynx will not be addressed further.

This analysis examines the effects of the alternatives on cover, disturbance, and forest openings as a measure of connectivity within lynx habitat and within identified linkage areas (USFS 2007a; USFWS et al. 1995; Servheen et al. 2001).

Comparison of Alternatives

Under Alternative 1 on all DNRC forest management projects, forest patch size, shape, connectivity, and habitat fragmentation would be considered at the project level under ARM 36.11.415. Additionally, habitat connectivity would be addressed as a specific consideration for projects occurring in lynx habitat (ARM 36.11.435 (3)(a)(v)). Therefore, Alternative 1 minimizes effects on lynx and adequately conserves connectivity within lynx habitat.

Under Alternative 2, both within the HCP project area and on all trust lands, forest patch size, shape, connectivity, and habitat fragmentation would be considered in a similar manner at the project level under ARM 36.11.415. Additionally, for all action alternatives, the HCP commitments provide specific direction on lynx habitat connectivity, requiring that harvest units maintain a connected network of suitable lynx habitat along riparian areas, ridge tops, and saddles – high terrain areas where lynx seem to prefer to move (Koehler 1990; Staples 1995). Additionally, the HCP commitments provide: (1) threshold levels of suitable habitat that would be maintained in LMAs and scattered parcels outside LMAs and (2) restrictions on the percentage of habitat within LMAs that could be converted to a non-suitable condition each decade. The amounts vary between the alternatives as described in Table E3-2 (Appendix E, EIS Tables).

Habitat connectivity for lynx is further addressed within the HCP project area under Alternative 2 through implementation of the grizzly bear commitments:

- (GB-PR6) requiring visual screening in RMZs and WMZs across the HCP project area
- (GB-NR4) restricting harvest unit size to ensure cover is available within 600 feet from any point within a clearing within grizzly bear recovery zones and NROH (lynx habitat frequently overlaps with grizzly bear recovery zones).

Given the commitments for cover under the existing program and the commitments contained in Alternative 2, as shown in Table 4.9-17, grizzly bear hiding cover amounts at a programmatic scale are expected to provide sufficient hiding cover for bears to effectively move through habitats and forage in important habitats without human detection. Under Alternative 2, the grizzly bear commitments that maintain hiding cover for bears and retain vegetation in riparian areas and along roads, and limit forest openings, combined with the lynx commitments to maintain connectivity in areas expected to be favored by lynx would maintain sufficient habitat connectivity for lynx to successfully move within their home ranges and disperse.

Alternative 3 provides additional commitments for connectivity by limiting contiguous occurrences of temporary non-suitable habitat on scattered parcels outside LMAs to less than or equal to 200 acres, with harvest units broken up with 100-meter strips of suitable habitat where possible. This additional commitment would provide a small degree of improved habitat connectivity outside LMAs. The benefit of this commitment is likely to be small because scattered parcels are frequently islands of forested habitat in a sparse forest matrix of multiple ownerships. Thus, connectivity of mature or sub-mature forest cover can be difficult to provide at scales larger than one section (i.e., 640 acres). Improved habitat connectivity on scattered parcels outside LMAs has importance because lynx can roam outside their normal ranges in search of food during some years. To a limited degree, this commitment may facilitate foraging efficiency, travel, and dispersal of lynx.

The effects of Alternative 4 on lynx habitat connectivity would be the same as those described for Alternative 2.

As described earlier in the grizzly bear analysis, with the exception of the Stillwater Block and Swan River State Forest, DNRC's ability to influence linkage areas in western Montana is relatively limited by the amount of land in the project area (approximately 2 percent) and distribution of lands in western Montana (Tables 4.9-8 and 4.9-9 and Figures D-15A, B, and C in Appendix D, EIS Figures). The Stillwater Block and the Swan River State Forest are important land areas for linkage with high value for lynx (USFS 2007a), and formally identified linkage zones associated with grizzly bear conservation have been described for these DNRC blocks as well (USFWS et al. 1995; Servheen et al. 2001). Therefore, it is important to maintain cover and limit disturbance within these linkage areas to maintain their integrity.

Under Alternative 1, in the Stillwater Block, existing grizzly bear commitments maintain security core and 40 percent hiding cover in grizzly bear subunits. Similarly on the Swan River State Forest, grizzly bear commitments require harvest unit designs to maintain the 600-feet-to-cover measure, provide visual screening along riparian areas, and provide a minimum of 40 percent hiding cover per BMU subunit, as well as establish quiet areas following 3 years of commercial activity, as long as the Swan Agreement is in place. All these measures provide cover and limit disturbance and thereby support habitat connectivity and the integrity of these linkage areas for lynx as well as grizzly bears.

Under Alternative 2, the measures described above for connectivity would also protect the integrity of linkage areas in the Stillwater Block and Swan River State Forest. Further, restrictions on high-intensity activities in grizzly bear spring habitat in the spring period and management of quiet areas (4 years of activity followed by 8 years of rest from commercial logging activities) within blocked lands would limit disturbance in linkage areas to maintain their integrity. The effects of Alternative 4 on these linkage zones would be similar to those described for Alternative 2.

Under Alternative 3, maintenance of security core areas on the Stillwater Block at the DNRC 1996 baseline levels for BMU subunits would continue. Under Alternatives 1 and 3, approximately 36,800 acres in the Stillwater Unit would be managed as secure habitat for intervals of 10 years (Stillwater Core). In contrast, about 19,400 acres (53 percent of the 36,800 acres) would be managed as quiet areas under Alternatives 2 and 4, with a maximum entry period of 4 years of activity followed by 8 years of rest from commercial logging activities. On the Stillwater Block, Alternative 3 would likely provide the greatest degree of habitat quality associated with the formally identified linkage zone along Highway 93, because it requires that the largest amount of blocked secure acreage is maintained, thereby limiting disturbance.

In the Swan River state Forest, the action alternatives would implement a strategy similar to that applied under the existing ARMs. All these measures would maintain cover in linkage areas for lynx.

Collectively, the HCP commitments under the action alternatives help ensure that, within some of the most important areas for lynx in western Montana, habitat connectivity at the scale of a lynx home range would be maintained over time. They also help ensure that habitat linkage at the scale of several lynx home ranges would be maintained in association with these important areas.

Commitments contained in all action alternatives provide greater assurances that connectivity would be maintained for essential denning, foraging, and dispersal activities than Alternative 1. All action alternatives would require improved project-level tracking and documentation regarding how connectivity is addressed and maintained, and this would facilitate compliance. Alternative 3 would likely provide a slightly greater level of assurance that connectivity is maintained, followed by Alternatives 2 and then 4. All action alternatives provide for restrictions on access, quiet areas, and cover maintenance in similar ways. Alternatives 2, 3, and 4 would improve on the amount and quality of linkage zones when compared to current conditions, especially within the Stillwater Block and Swan River State Forest, due to the variety of complementary mitigation measures incorporated within those areas.

In summary, given the amount and distribution of trust lands in western Montana, habitat connectivity between linkage zones is likely to be most influenced by land use and management on other ownerships, rather than DNRC forest management. However, all action alternatives provide for restrictions on access, quiet areas, and cover maintenance in similar ways. Alternatives 2, 3, and 4 would improve on the amount and quality of linkage zones when compared to current conditions, especially within the Stillwater Block and Swan River State Forest, due to the variety of complementary mitigation measures incorporated within those areas.

Disturbance of Dens

Potential Effects

- Forest management activities near active lynx dens may disturb denning lynx and cause abandonment and mortality of young.

Indicators and Rationale

Timber harvest or motorized activities associated with project preparation during the spring denning season in lynx habitat may disturb females raising young in dens. Lynx with kittens may be especially vulnerable to disturbance while the kittens are young, and lynx have been known to abandon kittens as a result of disturbance (Claar et al. 1999; Ruediger et al. 2000). Lynx do not readily abandon kittens. Females also are able to move kittens, and typically move to several den sites over a denning period, even without the occurrence of human disturbance (USFWS 2000a:7-8).

Comparison of Alternatives

In general, forest management activities are not expected to result in adverse effects on denning lynx because of the low likelihood of overlap between a harvest unit and a lynx den site. Further, the denning period is likely to be over before conditions are suitable to initiate motorized forest management activities at the elevations typically occupied by lynx. Under all alternatives, den sites would be protected on a case-by-case basis as they are detected, which would typically occur through correspondence with local researchers that may have marked animals in the vicinity of a project. If an active den site is found, under Alternatives 2, 3, and 4, motorized forest management activities and prescribed burning within 0.25 mile of that site would be prohibited from May 1 through July 15, or earlier if fully vacated (LY-HB4).

Alternative 3 would add to those requirements by prohibiting motorized forest management activities and prescribed burning on LMAs with less than 10 percent denning habitat during the

same period and within the same distance to denning habitat, thereby providing additional protection to those LMAs lacking in denning habitat. Therefore, Alternative 3 would provide more protections for denning habitat and den sites than the other alternatives. The action alternatives provide a slight degree of additional protection for denning lynx and specific restriction dates to be applied in addition to how detected active lynx den sites would be treated under Alternative 1.

Snowmobile use associated with forest management activities is unlikely to affect den sites because den sites are likely to be located in heavily forested areas without disturbance and away from snowmobile trails. In addition, snowmobile use occurs primarily during the winter, when lynx are not denning. Thus, disturbance resulting from snowmobile use associated with forest management activities on denning lynx is expected to be minor.

Critical Habitat

When designating critical habitat, the known physical and biological features (primary constituent elements or PCEs) essential to the conservation of the species are identified. The primary constituent elements for lynx are the physical and biological features essential to the conservation of the species laid out in the appropriate quantity and spatial arrangement. For lynx, these features include boreal forest landscapes supporting a mosaic of differing successional forest stages and containing (1) a presence of snowshoe hares and their preferred habitat conditions, (2) winter snow conditions that are generally deep and fluffy for extended periods of time, (3) sites for denning that have abundant CWD, and (4) matrix habitat that occurs between patches of boreal forest in close juxtaposition such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

The analysis provided above considers the effects of the action alternatives on several key habitat features for lynx. These key habitat features can be linked to the PCEs for critical habitat. DNRC's commitments for suitable habitat retention within LMAs and on scattered parcels addresses the overall physical and biological feature essential to lynx – boreal forests landscapes supporting a mosaic of differing successional forest stages. While DNRC would conduct timber harvest within these areas, by retaining 65 percent as suitable habitat for Alternative 2, 70 percent for Alternative 3, and 60 percent for Alternative 4, it would maintain the function of these areas for lynx conservation. DNRC's commitment to retain 20 percent of total lynx habitat as foraging habitat addresses PCE 1. This commitment would require DNRC to retain more lynx foraging habitat compared to what is required under the existing ARMs.

However, data show that DNRC currently supports extensive foraging habitat such that retaining 20 percent per LMA could result in a net reduction in foraging habitat in the HCP project area. Additionally, lynx researchers have not determined how much foraging habitat lynx require within their home range. Therefore, reductions in foraging habitat would likely result in adverse effects on PCE 1. DNRC's activities would not affect PCE 2. DNRC's commitment for den site attributes and CWD would address PCE 3. Because no adverse effects on den site attributes or CWD would occur under the HCP, no adverse effects on PCE 3 are expected. As described in the analysis for linkage areas, DNRCs commitments are expected to provide adequate habitat connectivity. Therefore, no adverse effects on PCE 4 are expected.

Summary

All action alternatives provide a greater measure of lynx conservation on trust lands than Alternative 1 by providing greater commitments to maintain suitable habitat and foraging habitat in key areas of known importance for the species in western Montana for the next 50 years. Greater emphasis on monitoring and tracking important habitat conditions and features, such as den sites, would also be a common component of all action alternatives. Alternative 3 overall would provide the greatest measure of conservation benefit to lynx. This alternative does so by (1) maintaining the greatest amount of suitable habitat on blocked lands and scattered parcels, (2) requiring that both stands of denning habitat and potential den sites be maintained on blocked lands and scattered parcels, (3) requiring additional restrictions on pre-commercial thinning in young foraging habitat in LMAs, (4) requiring additional restrictions on allowable patch sizes of non-suitable habitat on scattered parcels to facilitate habitat connectivity, and (5) requiring additional restrictions on motorized activities in lynx habitat in spring in LMAs with less than 10 percent denning habitat to further reduce potential for disturbance to denning lynx. Alternative 2 ranks second in degree of conservation provided for lynx, followed by Alternative 4. Alternative 1 provides no firm numerical commitment to amounts of suitable lynx habitat that would be retained; however, under the existing management approach and sustainable yield, it is unlikely that suitable habitat amounts would fall below the 60 percent requirement contained in Alternative 4 on blocked lands or scattered parcels. One notable difference between Alternative 1 and all action alternatives is the designation of the Seeley and Garnet LMAs and commitments associated with them. The action alternatives would provide improved assurances for maintaining important habitat conditions in these key areas.

4.9.5 Effects of the Transition Lands Strategy (for Both Terrestrial and Fish Species)

4.9.5.1 Affected Environment

As described in EIS Chapter 2, Environmental and Procedural Setting, DNRC manages over 5.1 million surface acres of trust lands under five land use categories: agriculture, grazing, real estate, forest, and minerals. While most trust lands are classified under their predominant land use, DNRC retains flexibility to conduct other uses on those lands. For instance, there are classified forest lands in the HCP project area with secondary, non-forestry uses. DNRC may permit recreation, grazing, or other seasonal or temporary uses when they do not prohibit or limit the predominant forest management land use of that acreage.

DNRC is authorized to identify certain lands for other predominant land uses other than what they were originally classified. Under certain conditions, classified forest land may be identified for another predominant land use such as real estate.

DNRC's decision to reclassify forest lands to a real estate land use (commercial, industrial, residential, or conservation) is influenced by market conditions, financial analysis and expected financial rates of return, by direction contained in DNRC's Real Estate Management Programmatic Plan (DNRC 2004f) and DNRC's Real Estate Management Administrative Rules (ARM 36.25.901 through 918). Generally, lands selected for reclassification for non-forest uses are identified following considerable evaluation and analysis as outlined in the Real Estate Management Rules.

These rules provide a systematic approach to identify lands for potential development or conservation.

According to ARM 36.25.904, DNRC prioritizes real estate development projects on trust lands in urban areas over rural areas and generally excludes projects that may potentially affect federally listed threatened and endangered species. DNRC's Real Estate Management Administrative Rules limit the number of acres available for real estate uses to 30,000 acres statewide and to 1,500 acres in rural areas (ARM 36.25.911).

As stated above, DNRC recognizes that conservation can be a plausible use of trust land (ARM 36.25.910). DNRC has developed a systematic approach to allow outside entities to propose conservation use of lands identified for real estate projects. Following notice of real estate project proposals, DNRC allows entities 60 days in which to propose conservation use of those lands by issuing a letter of intent to DNRC. Any entity submitting a letter of intent during the 60-day period is granted an additional 45 days in which to apply to DNRC for a lease, license, easement, or other legal device to secure a conservation use. Those who complete and submit an application have 12 months to secure the conservation use. During that time, DNRC suspends all other actions not related to conservation use. If the applicant fails to submit a letter of intent or apply to the DNRC within the specified timeframes, DNRC may proceed with the original development project.

The Land Board maintains authority to sell or acquire certain trust lands as long as it is done so to secure long-term advantage to the trust beneficiaries and the people of the state of Montana. Montana statute outlines various restrictions associated with the sale of trust land (73-2-301 through 73-2-367, MCA).

DNRC's decision to sell, exchange, or acquire trust land is influenced by market conditions, financial analysis and expected financial rates of return, direction contained in DNRC Land Banking Rules (ARM 36.25.801 through 817), and the management discretion of the Land Board. Generally, lands selected for sale, exchange, or acquisition are screened through a rigorous process outlined in the Land Banking Rules. According to ARM 36.25.803, DNRC may sell a parcel of trust land that is determined significant to threatened or endangered species only if the Land Board provides or approves compelling reasons for the sale.

DNRC is required to conduct MEPA analysis for most real estate projects, except for those that are categorically excluded as outlined in ARM 36.25.918. All trust land sale, development, exchange, and conservation projects are required to comply with MEPA, while trust land acquisition is categorically excluded.

4.9.5.2 Environmental Consequences

Alternative 1 (No Action)

Under the No-action alternative, real estate projects would continue to comply with applicable policies, laws, and rules, including MEPA, DNRC's Real Estate Management Programmatic Plan, DNRC's Real Estate Management Administrative Rules, DNRC's Land Banking Rules, and other applicable state and county laws. The timing and amount of projects would continue to be influenced by market conditions, financial analysis and expected financial rates of return, direction contained in the laws and regulations listed above, and the management discretion of the Land Board.

DNRC would continue to sell, acquire, exchange, lease, and develop trust lands. Real estate projects would continue to be prioritized in urban areas and would abide by existing acreage thresholds identified in the Real Estate Management Rules and Section 4.9.5.1, Affected Environment, above. DNRC would likely continue to generally exclude projects that may potentially affect federally listed threatened and endangered species. Effects to wildlife would be analyzed under MEPA on a project-by-project basis. DNRC would continue to allow outside entities to propose conservation use instead of development as outlined in Section 4.9.5.1, Affected Environment.

Action Alternatives

To address the potential for changes in land ownership (into or out of state ownership) and/or land use (to or from management for timber production by DNRC), the HCP for each action alternative defines a process for adding lands to or removing lands from the HCP project area. Lands identified for addition to or removal from the HCP project area due to proposed ownership or land use changes are termed "transition lands."

Similar to Alternative 1, real estate projects occurring under the action alternatives would continue to comply with applicable policies, laws, and rules. Additionally, under all three action alternatives, DNRC would implement the transition lands strategy (HCP Chapter 3 in Appendix A, HCP), under which the habitat needs of HCP species would be assessed when parcels are considered for removal from or addition to the HCP project area. The analysis below describes the potential effects on HCP species from removing or adding lands to the HCP project area.

Effects of Removing Lands from the HCP Project Area

The transition lands strategy would limit the amount of land DNRC could remove from the HCP project area and provide the opportunity and framework for interested parties to extend conservation benefits on HCP project area lands through leases, licenses, or other legal instruments pursuant to existing state laws.

The greatest restriction on the amount of trust lands that may be removed from the HCP project area would be imposed in areas that provide key habitat for grizzly bear and bull trout. Under the transition lands strategy, no more than 5 percent (10,990 acres) of trust lands within bull trout core habitat areas, the NCDE and CYE grizzly bear recovery zones, or CYE NROH could be removed from the HCP project area. For all other HCP project area lands, DNRC would cap the removal of lands at 10 percent (32,870 acres) of the original HCP project area. Compared to Alternative 1, implementation of these caps would provide a firm commitment to limit the amount of land providing habitat for HCP species that could be removed from DNRC ownership and subsequently subject to development that would pose an elevated risk of adverse effects to HCP species.

For real estate projects, conservation measures would be considered at the project level and would be designed to address impacts to the habitat of grizzly bears, lynx, and/or other relevant wildlife species. Under the strategy, parcels identified as important for habitat linkage would receive special consideration for deed restrictions or other binding conservation measures prior to their disposal, which may increase certainty of minimizing risks to fish and wildlife from human development over the Permit term compared to Alternative 1.

Similar to the Alternative 1, the USFWS and other conservation groups would be notified before parcels are removed from the HCP project area, thereby giving them a chance to purchase or otherwise conserve these lands. DNRC would follow a similar notification process as outlined in Section 4.9.5.1, Affected Environment. However, under the action alternatives, entities would have 24 months to secure a conservation license, lease, or similar legal instrument rather than 12 months. If that entity has an existing Permit or agreement with the USFWS under which the leased, licensed, or disposed HCP project area lands will be managed in a manner providing similar or greater benefits to HCP species than the HCP, then those lands would not count against the caps described above.

The following sections analyze the effects of those uses that would effectively 'remove' lands from the HCP project area and count against the 5 and 10 percent caps.

Effects to Grizzly Bears

As described in Section 4.9.3.1 (Grizzly Bear – Affected Environment – Relationship of DNRC HCP Covered Activities to Grizzly Bear Risk Factors), the primary risk factors to grizzly bears in Montana are (1) habitat loss and degradation and (2) bear-human conflicts, especially those resulting in grizzly bear mortality. Conversion of lands managed for timber production to development can increase the presence of these risk factors. Development may also reduce the availability of suitable habitat and the effectiveness of linkage habitat, which reduces the ability of grizzly bears to travel between larger blocks of habitat.

Development would have the greatest effect on grizzly bears if it were to occur in DNRC's blocked lands (Stillwater Block and Swan River State Forest), which are in the NCDE grizzly bear recovery zone, because (1) the recovery zone is deemed the highest priority geographical area for recovery of the species, and (2) the blocked ownership configurations (rather than scattered) not only facilitate efficient management, but also increase opportunities for meaningful and effective landscape-scale conservation of wildlife habitat.

The likelihood that DNRC's blocked lands (which are in the NCDE grizzly bear recovery zone) would be adversely affected by the transition lands strategy is expected to be low. DNRC is less likely to develop, exchange, sell, or lease large amounts of land within the blocked forests because it facilitates management to keep lands blocked and to add lands to blocked areas. Additionally, the more restrictive cap on removing lands applies to the recovery zone (5 percent of the baseline HCP project area, meaning no more than 10,990 acres could be removed).

Effects to Lynx

Development can increase the risks to Canada lynx from sources of direct mortality, habitat loss, habitat fragmentation, and disturbance (see Section 4.9.4.1, Canada Lynx – Affected Environment – Status and Distribution).

Areas that provide linkage habitat are essential for allowing genetic dispersion between subpopulations of lynx, especially for ameliorating losses associated with catastrophic events. Development may lead to additional human disturbance; a reduction in the amount of suitable habitat, including foraging habitat; and/or a decrease in the effectiveness of linkage habitat, which reduces the ability of lynx to disperse and/or to move between home ranges to find prey.

Development would have the greatest effect on lynx if it were to occur in some of the scattered DNRC parcels in the Garnet Mountains and the Seeley Lake area or in DNRC's blocked lands, because (1) some of the scattered parcels in the Garnet Mountains and the Seeley Lake area are known to be high-use areas for lynx and (2) the blocked ownership configurations (rather than scattered) not only facilitate efficient management, but also increase opportunities for meaningful and effective landscape–scale conservation of wildlife habitat. These areas are encompassed in DNRC's LMAs established for lynx conservation purposes under the HCP.

The likelihood that LMAs would be adversely affected by the transition lands strategy is expected to be low because, coincidentally, four of the six LMAs occur within blocked lands and the NCDE grizzly bear recovery zone. As described above, the blocked lands are less likely to be adversely affected by the transition lands strategy. Additionally, the more restrictive cap on removing lands applies to the recovery zone (5 percent of the baseline HCP project area, meaning no more than 10,990 acres could be removed).

Some scattered parcels in the Garnet and Seeley LMAs are high-use areas for lynx. These parcels are part of a mosaic of Plum Creek, USFS, or BLM lands and limited private ownership. These LMAs are located outside the grizzly bear recovery zone, where removal of HCP project area lands is capped at 10 percent of the baseline HCP project area. Therefore, these LMAs are somewhat more susceptible to development and the associated effects to lynx.

Effects to HCP Fish Species

For aquatic species, such as bull trout, Columbia redband trout, and westslope cutthroat trout, increases in development threaten to alter stream and riparian habitats through streambank modification and destabilization, increased nutrient loads, and increased water temperatures (63 FR 31647-31674, June 10, 1998, p. 31662). Indirectly, urbanization within floodplains alters groundwater recharge by routing water into streams through drains rather than through more gradual subsurface flow (63 FR 31647-31674, June 10, 1998, p. 31662).

The more restrictive cap on removing lands applies to bull trout core habitat (5 percent of the baseline HCP project area, meaning no more than 10,990 acres could be removed). Coincidentally a large amount of the core habitat lies within blocked lands, which are less likely to be developed as already described. The transition lands strategy also includes opportunities for DNRC to add deed restrictions for the protection of core bull trout streams prior to land disposal. This would help reduce potential effects of development on streams.

Effects of Adding Lands to the HCP Project Area

When the state acquires forested trust lands with habitat for HCP species, DNRC would consider adding the parcels to the HCP project area. If added, DNRC would then conduct forest management projects on the newly acquired parcels under the HCP and the other applicable policies and rules that govern the forest management program. Habitat for grizzly bears, lynx, bull trout, Columbia redband trout, and westslope cutthroat trout would be managed under the full suite of applicable conservation strategies described in the HCP. For newly acquired parcels that would have been subjected to development if they had not become trust lands, adverse effects on habitat for HCP species would be limited to the effects associated with forest management.

DNRC anticipates that, with or without an HCP, the amount of forested lands added to trust lands ownership would greatly exceed the amount sold or developed, especially in the near term (5 to 10 years). Some land acquisitions would likely come with conservation easements that minimize or eliminate human development. With or without easements that restrict development, the lands would be managed under the ARMs and/or the HCP, such that the conservation of habitat for grizzly bear, lynx, Columbia redband trout, westslope cutthroat trout, and bull trout is a high priority and other wildlife species are considered appropriately. The current trend is that substantial amounts of forested parcels have either been acquired as trust lands recently or are potentially going to be acquired in the near term. For acquired parcels that possess conservation easements limiting future development, impacts to fish and wildlife habitat would be limited to impacts from forest management. As identified in HCP Chapter 3, Transition Lands Strategy (Appendix A, HCP), lands that may be considered for addition to the HCP project area include

- Scattered parcels in the Southwest Land Office (4,258 acres)
- Chamberlain Creek lands (if acquired by DNRC, approximately 14,581 acres)
- Lands in the Montana Working Forests Project (if acquired by DNRC, potentially more than 100,000 acres).

Effects to Grizzly Bears

Adding lands to the HCP project area is expected to benefit grizzly bears. Lands most likely to be acquired by DNRC are private timberlands. Potential benefits of acquiring these lands for bears include increased acres managed under spring restrictions, greater restrictions on motorized access on existing roads, fewer open roads in grizzly bear habitat, and increased connectivity and integrity of linkage areas.

Effects to Canada Lynx

Adding lands to the HCP project area is expected to benefit lynx. Potential benefits include increased acres managed as suitable habitat for lynx, particularly if these acres fall within mapped LMAs; increased acres managed as foraging habitat for lynx; increased den site protection; and increased connectivity and integrity of linkage areas. Even if the added lands are not potential lynx habitat, they could still facilitate habitat connectivity and linkage.

Effects to Aquatic Species

The addition of lands to the HCP project area and subsequent management under the long-term conservation assurances of the HCP would benefit HCP fish species. Lands most likely to be acquired would be private timberlands. The primary benefit of adding these lands to the HCP project area would be retention of these areas as working forests that are managed to improve stream connectivity and reduce sediment sources as opposed to development that may contribute to stream alterations as described above.

4.9.6 EFFECTS OF THE CHANGED CIRCUMSTANCES PROCESS (FOR BOTH TERRESTRIAL AND FISH SPECIES)

4.9.6.1 Introduction

Conditions that affect HCP species in the project area may change during the Permit term. The HCP for each action alternative identifies changed circumstances (as defined in 50 CFR 17.3) that can reasonably be anticipated and planned for by DNRC and the USFWS, and incorporates measures to be implemented if such circumstances occur. DNRC and the USFWS have identified fires, insect and disease outbreaks, wind events, slope failures, floods, and climate change as the natural events to be addressed as changed circumstances in the HCP (see HCP Chapter 6 in Appendix A, HCP). All of these natural disturbances can affect habitat conditions for the HCP and other fish and wildlife species. Natural disturbances can also be beneficial for fish and wildlife because they are part of the natural processes found in the ecosystem, as forest stands are naturally regenerated by disturbances.

Natural events that affect forest canopy cover include fires, severe outbreaks of disease or insect infestation, or high winds. Such events can affect grizzly bears, lynx, and other wildlife species by reducing the amount of available suitable habitat, reducing habitat connectivity, and reducing cover for secure movement. Events that reduce forest canopy cover in riparian areas can affect HCP and other aquatic species by reducing or eliminating riparian habitat and adversely affecting riparian functions, such as LWD recruitment, shade provision, nutrient loading, and sediment filtration. These changes can affect water temperature and turbidity and reduce the amount of available spawning, rearing, and migration habitat. Fires and outbreaks of insects or disease are natural processes that can be exacerbated by climatic warming, drought, and fire suppression.

Aerial detection flights across Montana indicate that the amount of acres infested by various insects is generally increasing (Meyer 2006). Population levels and associated insect damage decreased in 2005 and 2006 but increased again in 2007, when weather conditions where warmer and drier than usual (USFS and DNRC 2008). Overall, in many stands in Montana, beetle-related damage has declined because much of the susceptible hosts have been killed; however, beetle populations have increased markedly in a few areas just coming under attack. Diseases are more localized and less prevalent than insect infestations, with a few notable exceptions. Root-disease-caused mortality is more common west of the Continental Divide, causing more than 1 million acres of mortality. White pine blister rust continues to have a serious effect on western white pine populations, which currently comprise less than 5 percent of the original 5 million acres. Recent efforts that may improve conditions include the development of seedling stock with increased resistance and a new pruning technique that improves survival of affected trees.

Current fire trends toward increasingly severe fire seasons with more acres burned are expected to continue into the near term due to climate change and existing high wildfire fuel loads (Westerling et al. 2006). Among the many factors influencing fire risk, forest management activities are one factor that can directly reduce fire risk in a forest stand (Fiedler et al. 2004). DNRC uses silvicultural treatments to mimic the effects of naturally occurring disturbance regimes in a given forest type by using prescriptions that will create conditions similar to what a naturally occurring event, such as fire, would have historically created. The use of such practices would continue under all alternatives. Therefore, under all action alternatives, there would be no cumulative effects of the

proposed action alternatives on fire risk. In most areas, the potential contribution of DNRC-managed lands to the overall fire risk is low, because most forested trust lands are isolated, scattered parcels, relative to the large blocks of federal and private lands.

There is growing scientific consensus that global greenhouse gas levels are rising. It is widely accepted that increased use of fossil fuels, worldwide reduction of forests, and other human activities are contributing to atmospheric levels of greenhouse gases, especially CO_2, which far surpass historical norms. CO_2 is being produced at a rate faster than the rate at which the biosphere can sequester or fix it, therefore raising the concentration of CO_2 in the earth's atmosphere. Although the degree of temperature change and the extent to which climate will be affected are under debate, the consensus among scientists on the IPCC is that this rise in greenhouse gas levels will cause gradual warming and global climate change (IPCC 2007).

The rise in global temperature is already apparent; in the past century, mean global surface temperatures have risen between 0.5 and 1.0° F (EPA 2002). While this increase may seem minor, the effects of this warming trend could be significant, especially in light of widely accepted predictions regarding the rate at which warming will continue. In its 2007 assessment report, the IPCC modeled scenarios using various levels of CO_2 mitigation to predict the temperature rise associated with each one, and determined that mean global surface temperature will rise between 1.1 and 6.4° C (2 to 11.5 ° F) by the year 2099, with a mid-range prediction of 3° C (5.4° F) (IPCC 2007).

Impacts of global climate change will include altered precipitation patterns and an increase in frequency and severity of extreme weather events, such as storms, floods, and drought. Climate change will also likely impact natural ecosystems and associated biodiversity; socioeconomics, especially in areas that rely on resource extraction and agriculture; and human health and activities (RUS and MDEQ 2007).

Global climate change will affect various regions of the world differently. Montana will most likely be affected by changes in precipitation, as weather patterns shift and warmer temperatures influence the frequency and duration of storms. Biodiversity and natural ecosystems will likely display the evidence of subtle climatic differences. These impacts will vary depending on the sensitivities of different habitat types and different species. Montana will also potentially see a socioeconomic impact, as climate change will likely influence timber harvests, agriculture, and recreation.

Climatic conditions play a substantial role in determining the distribution of many species of fish and wildlife, particularly cold-water-adapted species such as bull trout (Rieman et al. 2007). A recent review of the effects of climate change on fish and wildlife (ISAB 2007) identified the following probable consequences of global warming in the Columbia River basin, which extends into western Montana: (1) warmer temperatures will result in more precipitation falling as rain rather than snow, (2) snowpack will diminish and streamflow timing will be altered, (3) peak river flows will likely increase, and (4) water temperatures will continue to rise. Based on modeled changes in the lower elevational limits of bull trout distributions in the interior Columbia River basin, Rieman et al. (2007) determined that a warming climate could result in losses of thermally suitable natal habitat area ranging from 18 to 92 percent. In a study that modeled the effects of geomorphology, climate, and fire on stream temperature across a sixth-order stream network in central Idaho, Isaak et al. (2007) found that most habitat loss in that area was attributable to recent

trends of increasing air temperature and decreasing flows. Brick et al. (2008) predicted that a warming climate will cause spring runoff to begin a month earlier, resulting in low water flows during the summer and fall months. This could affect the reproductive success of bull trout, which spawn during late summer low flows, as discussed in Section 4.8.3.1 (HCP Fish Species – Bull Trout).

Slope failures (also called mass movements or landslides) are a concern for aquatic species because sediments from landslides can enter watercourses and reduce aquatic habitat quality. Potential effects on aquatic species and habitats may include excess sedimentation, loss of connectivity and habitat complexity, and degradation to spawning, rearing, and migration habitats. If left unstabilized, mass movements can become a chronic source of sedimentation to adjacent streams. Although mass movement events typically occur within a relatively small area, they can have more extensive effects on aquatic habitat by affecting downstream conditions.

Flooding on HCP project area lands occurs most often when a large snowpack melts rapidly, after large rain-on-snow events, or when isolated storm events overwhelm the drainage capacity of a waterbody. The primary concerns in the event of a severe flood are sedimentation of streams, erosion of stream banks, and the incapacitation of stream crossing structures.

Potential effects on individual grizzly bears or lynx or their habitats resulting from mass movements or floods are expected to be minimal; DNRC and the USFWS determined that these events would not warrant additional mitigation measures beyond those identified in the conservation strategies for those two species. Therefore, no triggers or responses were developed for grizzly bears or lynx in the event of mass movement or floods.

DNRC regularly responds to natural disturbance events that affect forest health on trust lands by scheduling timber harvests to capture the salvage value of affected trees. Timber salvage is a covered activity that is specifically addressed through several of the HCP commitments. Because the quality of wood in dead trees deteriorates quickly, the associated environmental review processes are often conducted under compressed timelines. In addition, DNRC's salvage timber program (MCA 77-5-207) provides for the timely salvage logging of dead and dying timber that is threatened by insects, disease, fire, or windthrow. This mandate requires DNRC to move forward in a timely manner after an event occurs; therefore, salvage projects are often processed as emergency situations. Blowdown events and subsequent forest management activities are often small, localized projects that typically occur as small salvage sales through a timber permit.

DNRC's response to a mass movement may include small-scale salvage of damaged trees, depending on the stability and accessibility of the site. More typically, DNRC's response includes an attempt to stabilize the site to prevent further erosion and sedimentation to sensitive streams. Similarly, responses to flood events include stabilization of sites with a high risk of sediment delivery.

4.9.6.2 Effects of the Alternatives

Under Alternative 1, DNRC would continue to use interdisciplinary expertise in the design of salvage projects to avoid or minimize impacts to fish and wildlife species (including the HCP

species) in compliance with applicable ARMs. There would be no formal, systematic process for incorporating USFWS input into project design and implementation.

Under all three action alternatives**,** DNRC would still use interdisciplinary expertise to design salvage projects in compliance with applicable ARMs. In addition, however, DNRC would apply relevant HCP commitments specifically designed to minimize and mitigate the effects of forest management activities on HCP species. DNRC would also implement the changed circumstances process, which would involve notifying the USFWS of the change, assessing site conditions, and preparing a response plan. Through this process, DNRC would solicit input from the USFWS on mitigation measures to be included in salvage projects stemming from changed circumstances. By including USFWS input and participation in project planning and design, the changed circumstances process under the action alternatives would add assurances that the needs of fish and wildlife species and habitat are addressed in such projects.

In addition to incorporating USFWS participation in salvage project planning, the changed circumstances process would address strategies that would not be implemented under Alternative 1. These strategies are described in HCP Chapter 6 (Appendix A, HCP). Collectively, these commitments would result in greater consideration of the needs of HCP fish species, grizzly bears, and lynx in the design and implementation of salvage projects, compared to Alternative 1, and may include additional commitments to address new effects on the HCP species specific to the natural disturbance event.

Although the potential effects of climate change are beginning to be understood (including droughts, floods, glacial melting, changes in insect and disease infestations, shifts in species distribution, and changes in the timing of natural events), DNRC and the USFWS lack sufficient site-specific information to plan for and manage the effects of climate change at this time. No policy or change in management related to climate change has been proposed under the HCP. New research and guidance materials related to the future management of state forests in light of climate change and potential effects of climate change on the HCP species would be a topic of discussion as necessary between DNRC and the USFWS at scheduled annual meetings. Both parties would work together to develop appropriate responses to new research or guidance materials regarding the impacts of climate change on forest management and/or the HCP species.

4.9.7 OTHER WILDLIFE SPECIES

While there are no changes being proposed for management of other non-HCP species, this section addresses whether implementing one of the alternatives could affect non-HCP species.

The analyses of non-HCP species are addressed in two ways. First, all species potentially occurring in the planning area are addressed using wildlife habitat associations, where each species is associated with various habitats they use, then the effects, if any, to these habitats are described. Second, several species are analyzed further, due to their special status, or a potential for effects on their habitat from forest management under one or more of the action alternatives.

4.9.7.1 Wildlife Habitat Associations

In Table E4-7 in Appendix E, EIS Tables, each species that is known or expected to occur in the planning area is listed and associated with one or more of the various habitat categories. The

information contained in this table is necessarily general due to the large number of species addressed, but serves as a useful tool for understanding general forest structural associations of various species. Where there may be indications of changes associated with an action alternative, such as relative amounts of mature or old-growth forest, corresponding anticipated effects are also likely to be expected for species closely associated with these conditions as indicated in Table 4.9-24.

Upland Forest Successional Stages and Cover Types

Affected Environment

Forest management activities may alter the distribution of forest successional stages and cover types on the landscape. Different wildlife species have varying levels of association with the various successional stages; some species, for example, are primarily associated with young forests, and others are primarily associated with mature and old-growth forests (Table E4-7 in Appendix E, EIS Tables). Similarly, some species are associated with particular forest cover types, which are defined by the dominant tree species present in forest patches or stands. Landscape-scale changes in the availability of these habitat types may affect the distribution and composition of wildlife species communities on trust lands. The species being analyzed and their association with the various forest successional stages are identified in Table E4-7 in Appendix E, EIS Tables.

Current DNRC forest management practices and regulations are designed to provide a range of forest successional stages and cover types across the landscape. The philosophy is that a diverse array of native wildlife is best maintained and promoted by providing for diverse habitat conditions. The DNRC forest inventory program defines six forest successional stages: (1) grass/forb, (2) seedling/sapling, (3) poletimber, (4) young sawtimber, (5) mature sawtimber, and (6) old growth. The Forest Management ARMs do not specify requirements for the spatial or temporal distribution of these successional stages. Currently, more than 50 percent of the forested habitat in the planning area and the HCP project area is in the young sawtimber or mature sawtimber stage (Table 4.9-24). The most common forest cover types in the HCP project area are ponderosa pine, western larch/Douglas-fir, Douglas-fir, and mixed conifer (Table 4.2-7). The distribution of these cover types varies geographically. The CLO and SWLO have a higher proportion of the Douglas-fir and ponderosa pine cover types, which are typically found on the warmer, drier sites more common in the eastern and southern parts of the state. In contrast, the mixed conifer and western larch/Douglas-fir cover types are more prevalent on the cooler, moist sites found in the NWLO (Table 4.2-7). DNRC's forest management activities are designed to move stands toward DFCs, which identify target amounts of each cover type in each land office.

Among forest successional stages, wildlife species diversity is greatest in the mature sawtimber and old-growth stages. Within the planning area, there are 199 species associated with mature sawtimber and 174 species associated with old growth (Table 4.9-24). These two successional stages support diverse communities of flora and fauna and contain ecological features, such as large snags and down logs, often found in lower abundance in younger stands. Some species, while found in more than one successional stage, are associated most closely with the mature sawtimber and old-growth stages.

TABLE 4.9-24. ACREAGE OF FOREST SUCCESSIONAL STAGES AND ASSOCIATED WILDLIFE SPECIES ON TRUST LANDS IN THE PLANNING AREA AND HCP PROJECT AREA

Forest Successional Stage[1]	Planning Area				HCP Project Area				Number of Associated Wildlife Species[2]
	NWLO	SWLO	CLO	Subtotal	NWLO	SWLO	CLO	Subtotal	
Grass/forb (non-stocked forests)	6,088	10,121	6,676	22,885	5,830	9,657	1,742	17,230	255
Seedling/sapling (predominantly < 5-inch dbh)	32,382	7,923	2,164	42,469	30,271	7,033	1,056	38,360	179
Poletimber (predominantly 5- to 9-inch dbh)	18,659	7,123	33,784	59,566	17,969	6,115	13,278	37,362	163
Young Sawtimber (predominantly > 9-inch dbh and estimated to be < 100 years old)	42,032	36,407	44,504	122,943	37,688	30,707	24,335	92,730	198
Mature Sawtimber (predominantly > 9-inch dbh and estimated to be > 100 years old)	149,768	79,483	18,027	247,278	129,291	67,185	10,580	207,056	199
Old-growth (based on structural characteristics as defined in Green et al. 1992)[3]	39,173	13,467	11,684	64,324	36,851	10,839	5,666	53,356	174

[1] Successional stages approximating those defined in the SFLMP (DNRC 1996).
[2] From Table E4-7 in Appendix E, EIS Tables.
[3] Characteristic wildlife species for mature sawtimber and old-growth forests are similar.
Source: DNRC (2008a).

Risk Factor: Timber harvesting and associated activities may alter the representation of various forest successional stages and cover types, which could adversely affect the amount of habitat for wildlife species found in the planning area and project area.

Environmental Consequences

Similar to current management policies, none of the alternatives would require DNRC to maintain target amounts of specific successional stages. The availability and distribution of these stages in the HCP project area would be a product of varying amounts and intensity of forest management activity under the alternatives. Also, under all alternatives, DNRC would continue to manage stands toward a DFC. As described in Section 4.2 (Forest Vegetation), the various conservation commitments proposed under the action alternatives would not be expected to result in appreciable landscape-scale differences in proportions of different forest successional stages or cover types on HCP project area lands. Analysis in this section is based on material presented in Section 4.2 (Forest Vegetation), which describes the forest modeling process that was used to estimate the anticipated distribution of these successional stages and cover types under the alternatives.

Regarding cover types, the alternatives would not be expected to result in substantial differences in distribution of cover types in the HCP project area (see Section 4.2.2.3, Forest Vegetation – Cover Types and Desired Future Conditions). Under all alternatives, progress toward DFCs would continue, with seral forest types increasing and late-successional forest types decreasing compared to current levels. The effects on wildlife species associated with these cover types would be similar under all four alternatives, and would likely consist of displacement or temporary disturbance of animals in localized areas where cover type changes occur.

Across the project area, model results show the acreage in the seedling/sapling structural stage increasing compared to current conditions under all alternatives, and the poletimber and young sawtimber stages decreasing (Table 4.2-15). Increases in the amount of seedling/sapling forest would range from approximately 54,000 acres under Alternative 3 to approximately 72,000 acres under Alternatives 2 and 4. Wildlife species associated with forest in the seedling/sapling stage would have more success in areas where this habitat type becomes more abundant. Wildlife associated with poletimber and young sawtimber may be displaced from localized areas where timber harvest occurs, dependent upon availability of habitat in adjacent areas.

Throughout the project area, the availability of mature sawtimber would be expected to decrease by approximately 1 percent under Alternative 1 and 6 percent under Alternatives 2 and 4, but increase by approximately 1 percent under Alternative 3. These differences reflect varying levels of management restrictions in the Stillwater Core and riparian areas under the alternatives, with the least restrictions under Alternatives 2 and 4 and the greatest restrictions under Alternative 3. These slight variations in the availability of mature sawtimber under the alternatives would not be expected to result in discernable effects on wildlife species associated with this successional stage at the landscape scale. Some localized effects may occur such as displacement or disturbance of wildlife.

DNRC's policies and management approach for old-growth stands would not change under any of the alternatives. Under all four alternatives, the amount of old-growth forest would be expected to decrease throughout the project area from a current level of 11 percent to approximately 8 percent of HCP project area lands. Within the Stillwater Block, the amount of mature sawtimber and old-

growth forest within the Stillwater Unit would likely be less under Alternatives 2 and 4 because of increased management flexibility in the Stillwater Core, which would not occur under Alternatives 1 and 3. Potential effects on wildlife from loss of old-growth habitat would be addressed at the project level.

Summary

Acres of forest successional stages and cover types would vary over the permit term. However, all successional stages and cover types would continue to be represented across the landscape. Localized effects on wildlife attributed to the removal of a particular successional stage would be addressed at the project level.

Large Trees, Snags, and Coarse Woody Debris

Affected Environment

Structures such as large trees, snags, and CWD are important habitat components for a variety of wildlife species (Table E4-7 in Appendix E, EIS Tables). These habitat components are often available in mature and old-growth forest stands, but less available or absent from younger stands. Some younger forests, however, may provide remnant large trees, snags, and CWD, particularly in burned areas or where forest management emphasizes the retention of such structures. Current DNRC forest management rules require maintaining large snags and snag recruits (live trees that provide future sources of snags) and CWD for a variety of species dependent on this type of habitat (Table E4-8 in Appendix E, EIS Tables). Some bird species, such as the pileated woodpecker, prefer large trees or snags for nesting, while some mammals, such as lynx, often use debris piles or large fallen logs for den sites. CWD also provides habitat for species that serve as prey for lynx and grizzly bears.

Risk Factor: Forest management activities under the alternatives may result in the removal or destruction of structural elements, reducing the availability of these elements for wildlife. Over time, large, live trees, large snags, and CWD may become less common in intensively managed forests without intentional efforts to retain these elements on the landscape.

Environmental Consequences

Under all four alternatives, DNRC would continue to implement administrative rules that require CWD recruitment and retention of 4.5 to 24.5 tons of CWD per acre, depending on vegetation type (Graham et al. 1994). This amount is considered adequate to maintain desirable soil properties and site productivity. DNRC also addresses CWD retention for wildlife through these same requirements.

As previously discussed in Section 4.9.4, Canada Lynx, each of the alternatives, in various ways, increases the amount of CWD retained in lynx habitat for the specific purpose of providing denning habitat. Therefore, in managed lynx habitat, more CWD would be retained in the form of piled wood than outside lynx habitat, which would potentially benefit other species that use CWD within these habitats, such as hares, voles, mice, and shrews. The amount of additional CWD left for the purpose of lynx habitat is not quantified, but for the sake of other species associated with the use of CWD, it would be very similar between alternatives.

Under all four alternatives, continued implementation of ARMs specific to fishers, flammulated owls, black-backed woodpeckers, and pileated woodpeckers would also encourage the retention of additional snags on projects in habitats of these particular species. Under all alternatives, salvage operations would continue to retain minimum snag and CWD recruitment levels, so no differences regarding effects on species are expected for this activity under any of the alternatives.

Summary

Under all four alternatives, DNRC would continue to retain the minimum amounts of snags and snag recruitment trees currently specified in the ARMs. Because these ARMs are now part of the HCP, all action alternatives would provide greater certainty that these important habitat attributes would be present on HCP project area lands because these requirements would be in place under the 50-year Permit term.

Forested Riparian Habitats

Affected Environment

Forested riparian areas are among the most valuable habitats for wildlife (O'Neil et al. 2001). In the planning area, approximately 300 wildlife species utilize forested riparian areas (Table E4-7 in Appendix E, EIS Tables). These areas typically contain diverse and complex forest structural components (e.g., diversity of trees, shrubs, and forbs) that provide forage, cover, and nest sites for wildlife. In addition, forested riparian areas provide travel and dispersal corridors for a variety of species, such as marten, fisher, and mountain lion.

Current Forest Management ARMs define riparian, streamside, and wetland management zones and provide restrictions on timber harvest and associated activities in these areas (Table E4-8 in Appendix E). Note that the term "riparian" in this discussion includes those areas defined as "riparian," "wetland," and "streamside" in the ARMs.

Risk Factor: Forested riparian habitats may be altered over time across the landscape such that habitat for dependent species is adversely affected.

Environmental Consequences

The aquatic conservation strategy is the only strategy responsible for differences between the alternatives regarding conservation measures for riparian, streamside, and wetland habitat associated with prescriptive removal of timber; therefore, this strategy is the only one discussed in this section.

The measures for riparian harvest differ between alternatives solely for the stands adjacent to Tier 1 streams (those that support HCP fish species). Definitions and management strategies for the RMZ and CMZ differ between the alternatives. Management strategies adjacent to streams that do not support HCP fish species are the same for all alternatives.

Under Alternatives 2 and 4, DNRC anticipates conducting from 45 to 90 acres of Tier 1 riparian harvest annually within the 548,500-acre project area, compared to approximately 7,000 acres of total harvest annually within the project area. No harvest is allowed in the riparian area under

Alternative 3. Under the action alternatives, of the 1,578 miles of streams in the HCP project area, 451 miles (29 percent) would be classified as Tier 1 streams.

Alternative 1 (No Action)

Alternative 1 reflects the current management practices regarding conserving riparian habitat as defined by Tables E3-3 and E4-8 in Appendix E, EIS Tables. In Alternative 1, for Class 1 and 2 streams and lakes, the SMZ is defined as beginning from the OHWM to 50 or 100 feet, depending on the slope, and must be extended to include adjacent wetlands. Where fish exist in waterbodies, the RMZ extends from the OHWM to the SPTH. Adequate amounts of shade and CWD retention are determined at the project level. No clearcutting is allowed in the SMZ, and harvest must retain 50 percent of the trees greater than or equal to 8 inches dbh or 10 trees per 100-foot segment, whichever is greater, as well as shrubs and sub-merchantable trees. Some allowances for salvage harvest are permitted. In Class 3 streams and other bodies of water, the SMZ is defined as the OHWM to 50 feet. An RMZ is not established. Montana Forestry BMPs regulate borrow and gravel pits, which should be located as close to road activities as possible. Large gravel pits also follow requirements for Opencut Mining Permits. DNRC and grazing licensees are required to mitigate or rehabilitate riparian and stream channel damage when it is greater than the level specified in the ARMs, but no specific timeframes or structured commitments that verify when corrective measures would be implemented are provided in the ARMs. In this alternative, there is flexibility to manage stands in the RMZ outside the SMZ. In RMZ stands that are managed intensively, terrestrial species that prefer riparian edge habitat with more open canopies, such as red-tailed hawks and yellow pine chipmunks, would potentially benefit within the limited amount of stream miles treated.

Alternative 2 (Proposed HCP)

Under Alternative 2 class 1 streams and lakes with HCP fish species would have an RMZ of the OHWM to the 100-year site index tree height (typically 80 to 100 feet). This can be extended for CMZ with specific harvest prescriptions for Type 1 and Type 2 CMZ that include the entire flood-prone area. There would be a 25-foot no-harvest buffer in the RMZ. The remainder of the RMZ would retain 50 percent of trees greater than or equal to 8 inches dbh, as well as shrubs and sub-merchantable trees. No less than 15 percent of the total riparian area within each DNRC administrative unit would be in a non-stocked or seedling/sapling stage. The requirements for Class 1 streams and lakes with non-HCP fish species, and Class 2 and 3 streams and other bodies of water are the same as Alternative 1.

Similar to Alternative 1, this alternative has some flexibility to manage stands in the RMZ outside the SMZ. In RMZ stands that are managed intensively, species that prefer more open canopies, such as meadow voles and Wilson's warblers, would benefit. The conservation of riparian stands adjacent to Tier 1 streams is more prescriptive and certain than that specified in Alternative 1, and would provide somewhat more diverse and closed canopies than Alternative 1. Species that benefit from those stand conditions for nesting, foraging, and dispersal would have slightly more success in stands managed under this alternative. In managed stands adjacent to Tier 1 streams, the 25-foot no-harvest buffer would benefit species that rely primarily on minimal ground disturbance and closed stands in the area closest to the stream, such as the veery thrush and kingfishers. However, since only 29 percent of the streams in the project area are Tier 1 streams, the majority of the riparian buffers would be managed similarly to Alternative 1.

Alternative 3 (Increased Conservation HCP)

Alternative 3 is the same as Alternative 2, but the no-harvest buffer would be the entire RMZ and would be extended to include the CMZ. No harvest in the entire floodprone width of both Type 1 and Type 2 CMZs is part of this alternative. This alternative would offer the widest and most intact riparian corridor, adjacent to Tier 1 streams, to the benefit of species that utilize closed canopy riparian habitat, such as red-backed voles and fishers. However, because only 29 percent of the streams in the project area are Tier 1 streams, the majority of the riparian buffers would be managed similarly to Alternative 1.

Alternative 4 (Increased Management Flexibility HCP)

Alternative 4 is the same as Alternative 1, but the 25-foot no-harvest buffer would be in place, and from 25 to 50 feet all shrubs and sub-merchantable trees and at least 50 percent of trees greater than or equal to 8 inches dbh would be retained. CMZs would be managed as in Alternative 2. This alternative would offer more protection of riparian resources than Alternative 1, but not as much as Alternatives 2 or 3. Among the alternatives, Alternative 4 has the most flexibility to manage stands in the Tier 1 RMZ outside the SMZ. In RMZ stands that are managed intensively, species that prefer more open canopies, such as chipping sparrows and song sparrows, would have more opportunities to benefit under this alternative. As previously discussed under Alternative 2 above, in managed stands adjacent to Tier 1 streams, the 25-foot no-harvest buffer would benefit species that rely primarily on minimal ground disturbance and closed stands in the area closest to the stream. However, because 29 percent of the streams in the project area are Tier 1 streams, the majority of the riparian buffers would be managed similarly to Alternative 1.

Displacement Effects

Under all alternatives, species that utilize riparian corridors for nesting, foraging, and dispersal may be temporarily displaced, depending on the time of year nearby activities occur. Displacement would occur due to the physical presence of humans and logging equipment in and around the riparian zone during implementation of project activities. Under Alternative 3, the effect may be slightly less in stands adjacent to Tier 1 streams, due to the wider no-harvest buffer; however, some displacement would still be likely.

Gravel Pits

All action alternatives would prohibit construction of gravel pits within SMZs and RMZs associated with all Class 1 streams and lakes and Class 2 streams. This commitment would protect the majority of the riparian areas from habitat loss due to removal of vegetation, disturbance, and potentially detrimental effects on water quality. However, one medium non-reclaimed pit would be allowed within the portion of the RMZ extending beyond the SMZ in the Stillwater Block and Swan River State Forest. Under all alternatives, along class 3 streams, gravel pits would adhere to the Montana Forestry BMPs described for Alternative 1. All action alternatives would protect riparian habitat and riparian dependent species from gravel pits similarly, and slightly more than Alternative 1.

Summary

Alternatives 1, 2, and 4 allow for the most intensive management in the riparian area. Species that prefer canopies that are more open may have more success in stands managed under these

alternatives. Alternative 3 would provide the largest and most intact buffers of all alternatives for SMZs, RMZs, and CMZs. Alternative 2 would provide protection for the riparian zone, but also offers some management within that zone while protecting valuable nesting and dispersal habitat for species. Alternative 4 would offer more management flexibility than Alternative 2, but would provide more protection of riparian habitat than the current situation, Alternative 1. Alternatives 2, 3, and 4 each have a 25-foot no-harvest buffer. Species that rely primarily on the area closest to the stream, or that prefer closed, dark canopies, or that prefer undisturbed soil would benefit by having the no-harvest buffer. Under Alternative 1, those same species may experience more impacts due to the lack of the 25-foot no-harvest buffer. Alternative 4 allows the most flexibility for management outside the 25-foot no-harvest buffer and subsequently would provide the most benefits to species that prefer open stands, and the least benefits to species that prefer closed stands. Outside the 25-foot no-harvest buffer, the difference in effects of Alternatives 1 and 2 are minimal when considered at the landscape level.

Habitat Linkage for Non-HCP Species

Habitat linkage is important for a wide variety of species in addition to grizzly bears and lynx. Species with large home ranges require broad expanses of habitat of varying vegetation types and seral stages relative to their life history requirements. Examples of species with large home ranges are elk, mountain lions, and wolverines. Combinations of multiple human actions on the landscape that can fragment habitat and disrupt linkages include residential developments, highways, large clearcuts, transmission lines, and ski areas, to name a few. In addition, species with moderate- and small-sized home ranges can also be affected by the same or similar actions, but at smaller scales. Small mammals (such as northern bog lemmings), amphibians, and reptiles can have suitable habitat patches and riparian corridors bisected by roads, railways, transmission lines, and homes, which can serve to affect habitat quality and/or restrict movement and isolate local populations.

Affected Environment

The affected environment and analysis methodologies in the grizzly bear and lynx analyses (Sections 4.9.3, Grizzly Bear, and 4.9.4, Canada Lynx) were used to consider effects to linkage for non-HCP species.

There are more than 6 million estimated acres of potential linkage lands in the planning area, of which 123,513 acres (2 percent) lie within the HCP project area (Table 4.9-9).

Environmental Effects

The effects to linkage habitat for non-HCP species would closely resemble the effects to linkage habitat for grizzly bear and lynx. In terms of scale, given the amount and distribution of trust lands in western Montana, habitat connectivity between linkage zones is likely to be most influenced by land use and management on other ownerships, rather than by DNRC forest management.

Under Alternative 1**,** forest patch size, shape, connectivity, and habitat fragmentation would continue to be considered at the project level under ARM 36.11.415. Linkage habitat for non-HCP species would be conserved through the implementation of that rule and through rules pertaining to grizzly bears, lynx, and fishers.

All three action alternatives provide a greater certainty of maintaining linkage habitat than Alternative 1. The action alternatives would improve on the amount and quality of linkage zones when compared to Alternative 1, especially within the Stillwater Block and Swan River State Forest, due to the variety of complementary mitigation measures incorporated within those areas, such as limits on road densities, cover requirements, and requirements to provide quiet areas with limited commercial activity.

Alternative 3 provides tighter controls on public and administrative motorized access and retains the Stillwater Core, thereby providing the greatest degree of habitat quality associated with a formally identified linkage zone along Highway 93. Collectively, these additional measures would result in more conservation of linkage habitat than Alternatives 1, 2, or 4.

4.9.7.2 Further Analysis for Specific Non-HCP Species

In this section, several species are analyzed in more detail due to their particular status, or an increased potential for effects to their habitat from forest management under one or more of the action alternatives. To identify which species required more analysis, several important designations of species were reviewed: federally listed species, DNRC-listed species, state-listed species, big game, game birds, furbearers, and migratory birds.

Federally Listed Species

Gray wolf receives further analysis, because it is a federally listed wildlife species that occurs in the planning area and HCP project area.

DNRC-listed Species

DNRC-listed species are identified in Table E4-10 in Appendix E, EIS Tables. They are sensitive species that are closely associated with, or indirectly associated with, forested habitats in Montana. They are species DNRC routinely considers in project planning when the species has the potential to occur in the project area. DNRC generates and modifies the list relying principally on information and classification systems developed by the USFS and MNHP. The listing is based on the general geographic distribution and habitat affinities of the animal species and does not require site-specific evidence of their presence on state land.

All the DNRC-listed species are included in the analysis of wildlife habitat associations (Section 4.9.7.1). The DNRC-listed species identified below for further analysis are fisher, bald eagle, black-backed woodpecker, flammulated owl, pileated woodpecker, and peregrine falcon. The remainder of the DNRC-listed species will not be discussed further in this EIS, because they are rarely encountered in forest habitats, they do not occur in the HCP project area, and/or they are not affected or are likely to be minimally affected by forest management activities.

State-listed Species

State-listed species are identified in Table E4-10 in Appendix E, EIS Tables. For this analysis, state-listed species include the species that the MNHP ranks S1 or S2 in its species status rankings and are known to occur in the planning area. A ranking of S1 indicates a species that is "at high risk because of extremely limited and potentially declining numbers, extent, and/or habitat, making the

species vulnerable to extirpation in the state." A ranking of S2 indicates a species that is "at risk because of very limited and potentially declining numbers, extent, and/or habitat, making it vulnerable to extirpation in the state" (MFWP 2005b). Status determinations are made by MNHP and MFWP biologists in conjunction with representatives of the Montana Chapter of the Wildlife Society, the Montana Chapter of the American Fisheries Society, and other experts.

The full complement of state-listed species that occur within the planning area are included in the analysis of wildlife habitat associations (Section 4.9.7.1). The state-listed species included below for more detailed analysis are fisher, bald eagle, black-backed woodpecker, flammulated owl, and peregrine falcon. The remainder of the state listed species identified in Table E4-10 in Appendix E, EIS Tables, will not be discussed further in this EIS.

Big Game

Species listed as big game species are hunted at some time during the year and are a vital economic resource for both Montana residents and out-of-state hunters (MFWP 2003c). Big game species are identified in Table E4-11 in Appendix E, EIS Tables. Of these species, upland forests and/or forested riparian areas are important habitats for black bear, mountain lion, mule deer, white-tailed deer, elk, and moose (MFWP 2005a). These species are analyzed below. Preferred habitat of pronghorn, mountain goat, and bighorn sheep would not be affected appreciably by projects proposed in the HCP project area; therefore, there will be no further discussion of these species in this EIS.

Game Birds

Game birds are identified in Table E4-11 in Appendix E, EIS Tables. They are all included in the analysis of wildlife habitat associations (Section 4.9.5.1). No specific concerns regarding game birds were raised, therefore they are not analyzed further in this EIS.

Furbearers

Furbearers are identified in Table E4-11 in Appendix E, EIS Tables. They are all included in the analysis of wildlife habitat associations (Section 4.9.7.1). Wolverine and fisher receive further analysis below. They are both DNRC-listed and state-listed sensitive species. Wolverine has been petitioned for listing under ESA and precluded for reasons documented elsewhere, but continues to be litigated for protection under ESA.

Migratory Birds

Migratory birds refer to bird species whose breeding range occurs at latitudes higher than their wintering range and who engage in regular seasonal movement between those two ranges. Generally the breeding and wintering ranges for individual species do not overlap, although there are some exceptions. Migratory birds are given special protection and consideration through the Migratory Bird Treaty Act and Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds).

A 1988 amendment to the Fish and Wildlife Act of 1980 directs the USFWS to monitor and assess the status of migratory nongame birds, determine effects to those species, and identify appropriate

actions to be taken for species likely to be candidates for listing under the ESA. Under the authorization of this Act, the USFWS maintains a list of nongame migratory birds that, without additional conservation actions, are likely to become candidates for listing under ESA (USFWS 2002b). This list is referred to as "Birds of Conservation Concern" (BOCC) and is revised every 5 years.

Similarly, Montana Partners in Flight (MPIF), a partnership of government and non-governmental agencies, organizations, and individuals committed to the conservation of land birds and their habitats in Montana, has developed a prioritized list of migratory and non-migratory bird species and their habitats that are in need of conservation consideration. Priority I species refer to species of moderate or high global vulnerability, who have shown declining population trends from 1966-1996, and/or who have a relatively high proportion of their global population overlapping with Montana. (MPIF 2000). MPIF suggests conservation actions be prioritized for species on this list.

Migratory birds that are known or expected to occur in the planning area and are included in the USFWS BOCC and MPIF Priority I lists are found in Table 4.9-25. These species and their habitat associations are also listed in Table E4-7 in Appendix E, EIS Tables and are subsequently included in the analysis of effects on wildlife habitat associations (Section 4.9.7.1). Migratory species that are also DNRC-listed species that may be affected by forest management activities are analyzed in more detail in the following sections. Those species include black-backed woodpecker, peregrine falcon, and flammulated owl. Golden eagles are also analyzed in further detail below due to their coverage under the Bald and Golden Eagle Protection Act.

Non-HCP Individual Species Analyses

Gray Wolf

Affected Environment

The planning area includes portions of three designated recovery areas for gray wolves in the northern Rocky Mountains (Table 4.9-26). Wolves in the Northwestern Montana Recovery Area are currently listed under ESA as endangered, while those in the Greater Yellowstone Recovery Area and Central Idaho Recovery Area are considered experimental, non-essential populations. The planning area makes up 53 percent of the Northwest Montana Recovery Area, 12 percent of the Central Idaho Experimental Population Area, and 10 percent of the Greater Yellowstone Experimental Population Area (Table 4.9-26). Trust lands make up a small portion of these recovery areas at 0.9 percent (Table 4.9-26).

Status and Distribution

In April 2009, the USFWS announced their intent to remove the Northern Rocky Mountain Distinct Population (NRM) of gray wolves from the endangered species list (74 FR 15123-15188, April 2, 2009). The delisting would become effective on May 4, 2009.

When wolves are delisted, management authority would return to the state and tribal governments where wolves reside. The State of Montana adopted a wolf conservation and management plan prior to the USFWS' proposal to delist wolves, but the plan would not be implemented until the USFWS transfers legal authority. The purpose of the plan is to manage wolves consistent with

TABLE 4.9-25. USFWS LIST OF MIGRATORY BIRDS OF CONSERVATION CONCERN AND MONTANA PARTNERS IN FLIGHT PRIORITY MIGRATORY BIRD SPECIES IN THE PLANNING AREA

	USFWS, Region 6, List of Birds of Conservation Concern	Montana Partners in Flight Priority Level I Migratory Bird Species[1]
Swainson's Hawk	Yes	No
Ferruginous Hawk	Yes	No
Golden Eagle	Yes	No
Peregrine Falcon	Yes	No
Prairie Falcon	Yes	No
Yellow Rail	Yes	No
American Golden-Plover	Yes	No
Piping Plover	No	Yes
Mountain Plover	Yes	Yes
Solitary Sandpiper	Yes	No
Upland Sandpiper	Yes	No
Whimbrel	Yes	No
Long-billed Curlew	Yes	No
Marbled Godwit	Yes	No
Sanderling	Yes	No
Wilson's Phalarope	Yes	No
Yellow-billed Cuckoo	Yes	No
Flammulated Owl	Yes	Yes
Burrowing Owl	No	Yes
Williamson's Sapsucker	Yes	No
Red-naped Sapsucker	Yes	No
Lewis's Woodpecker	Yes	No
Black-backed Woodpecker	No	Yes
Loggerhead Shrike	Yes	No
Pygmy Nuthatch	Yes	No
Baird's Sparrow	No	Yes
Brewer's Sparrow	Yes	No
McCown's Longspur	Yes	No
Common Loon	No	Yes
Trumpeter Swan	No	Yes
Harlequin Duck	No	Yes
Least Tern	No	Yes
Olive-sided Flycatcher	No	Yes
Brown Creeper	No	Yes
Northern Harrier	Yes	No
Black-billed Cuckoo	Yes	No
Short-eared Owl	Yes	No
Red-headed Woodpecker	Yes	No
Le Conte's Sparrow	Yes	No
Bobolink	Yes	No
Grasshopper Sparrow	Yes	No
Chestnut-collared Longspur	Yes	No
Sprague's Pipit	No	Yes

[1] MPIF defines Priority Level I species as those species with declining population trends and/or high area importance.
Sources: USFWS (2002b); MPIF (2000).

Montana's own state laws, policies, rules, and regulations. MFWP intends to implement conservation and management strategies to make sure that all federal requirements are met, recovery is complete, and that wolves are integrated as a valuable part of Montana's wildlife heritage.

The *Northern Rocky Mountains Wolf Recovery Plan* (USFWS 1987) specifies a recovery criterion of 10 breeding pairs of wolves (defined in 1987 as two wolves of opposite sex and adequate age, capable of producing offspring) for 3 consecutive years in each of three distinct recovery areas: (1) northwestern Montana (Glacier National Park; the Great Bear, Bob Marshall, and Lincoln Scapegoat Wilderness Areas; and adjacent public and private lands); (2) central Idaho (Selway-Bitterroot, Gospel Hump, Frank Church River of No Return, and Sawtooth Wilderness Areas and adjacent, mostly federal, lands); and (3) the Yellowstone National Park area (including the Absaroka-Beartooth, North Absaroka, Washakie, and Teton Wilderness Areas and adjacent public and private lands). The plan also states that if two recovery areas maintain 15 breeding pairs for 3 successive years, gray wolves in the NRM could be reclassified to threatened status. And, if all three recovery areas maintain 15 breeding pairs for 3 successive years, the NRM wolf population could be considered fully recovered and could be considered for delisting.

In 2007, estimates indicated there are about 213 wolves in at least 23 breeding pairs in northwestern Montana (Sime et al. 2008). In 2006, the ranges of about 20 wolf packs overlapped DNRC lands within the HCP project area (Table E4-12 in Appendix E, EIS Tables). The Northwestern Montana Recovery Area has sustained fewer wolves than the other recovery areas. Wolf packs in this area may be near their local social and biological carrying capacity (72 FR 6105-6139, February 8, 2007, p. 6109). State management, pursuant to the Montana State wolf management plan, would ensure this population continues to persist (72 FR 6105-6139, February 8, 2007, p. 6109).

The wolf population in the Northern Rockies has been expanding in numbers and distribution, and it was determined that biological recovery levels have been met (USFWS et al. 2006). In the state of Montana at the end of 2005, there were 46 wolf packs (a pack is defined as two or more wolves traveling together) composed of 256 wolves distributed primarily in northwestern Montana and the Greater Yellowstone area (USFWS et al. 2006) (Table 4.9-27). In 2005, Montana's recovery goal was 19 breeding pairs of wolves. Territories used by these packs included over 2 million acres in the planning area, approximately 66,802 acres of which are trust lands. Of these acres, 45,804 are trust lands within the HCP project area (Table 4.9-28 and Figure D-19 in Appendix D, EIS Figures).

Life History

Wolves are highly social animals that establish themselves in packs with large annual home ranges, or territories, averaging 185 square miles in northwestern Montana and 344 square miles in the greater Yellowstone area (MFWP 2003a). Distribution of wolves is primarily based on the availability of ungulate prey (e.g., deer and elk), in conjunction with areas with no or minimal conflicts with human uses and interests and with suitable den and rendezvous sites (USFWS 1987; MFWP 2003a). In Montana, wolves establishing new packs have demonstrated a greater tolerance of human presence and disturbance than previously thought characteristic of this species (MFWP 2005a). In Montana, ungulate prey for wolves includes white-tailed deer, mule deer, elk, and moose.

In the Northern Rockies, the breeding season peaks in mid to late February (Boyd et al. 1993). Wolves localize their movements around a den site and give birth in late April, following a 63-day

TABLE 4.9-26. NORTHERN ROCKIES GRAY WOLF RECOVERY AREAS WITHIN THE PLANNING AREA AND HCP PROJECT AREA

Gray Wolf Recovery Area and Corresponding States	Recovery Area Acres (State Subtotals)	Acreage (% of Total Recovery Area or Population Area) of Wolf Recovery Area within Planning Area		Acreage (% of Total Recovery Area or Population Area) of Wolf Recovery Area on Trust Lands within the Planning Area		Acreage (% of Total Recovery Area or Population Area) of Wolf Recovery Area on HCP Project Area Lands	
Northwest Montana Recovery Area	40,838,296	21,602,504	(52.9)	976,600	(2.4)	416,703	(1.0)
Idaho	(3,014,756)	—	—	—	—	—	—
Montana	(37,823,540)	—	—	—	—	—	—
Greater Yellowstone Experimental Population Area	119,473,651	11,745,105	(9.8)	626,962	(0.5)	69,787	(0.1)
Idaho	(6,749,432)	—	—	—	—	—	—
Montana	(49,954,100)	—	—	—	—	—	—
Wyoming	(62,770,119)	—	—	—	—	—	—
Central Idaho Experimental Population Area	49,729,114	6,038,518	(12.1)	209,848	(0.4)	61,918	(0.1)
Idaho	(43,616,316)	—	—	—	—	—	—
Montana	(6,112,798)	—	—	—	—	—	—
Total	**210,041,061**	**39,386,127**	**(18.8)**	**1,813,410**	**(0.9)**	**548,408**	**(0.3)**

Source: DNRC (2008a).

TABLE 4.9-27. NORTHERN ROCKIES GRAY WOLF RECOVERY AREA PACK AND BREEDING PAIR SUMMARIES FOR YEAR 2005

Recovery Area	Number of Wolf Packs (Individuals)	Wolf Breeding Pairs (by State)
Northwest Montana Recovery Area Subtotal	**20 (130)**	**11**
Idaho	1 (4)	(1)
Montana	19 (126)	(10)
Greater Yellowstone Experimental Population Area Subtotal	**45 (325)**	**20**
Idaho	1(7)	(1)
Montana	16 (66)	(3)
Wyoming	28 (252)	(16)
Central Idaho Experimental Population Area Subtotal	**68 (565)**	**40**
Idaho	57(501)	(34)
Montana	11(64)	(6)
Total	**133 (1,020)**	**71**

Sources: USFWS et al. (2006); DNRC (2008a).

TABLE 4.9-28. ACREAGE ESTIMATES OF GRAY WOLF TERRITORY AREA FOR YEAR 2005 WITHIN THE PLANNING AREA AND HCP PROJECT AREA

Montana Wolf Packs by Recovery Area	Acreage of Wolf Pack Territory within the Planning Area[1]	Acreage of Wolf Pack Territory on Trust Lands within Planning Area (% of total in Planning Area)		Acreage of Wolf Pack Territory on Trust Lands within the HCP Project Area (% of total in Planning Area)	
Northwest Montana Recovery Area Subtotal	904,820	38,279	(4.2)	33,015	(3.6)
Greater Yellowstone Experimental Population Area Subtotal	433,766	8,772	(2.0)	4,829	(1.1)
Central Idaho Experimental Population Area Subtotal	827,116	19,752	(2.4)	7,960	(1.0)
Total	**2,165,702**	**66,802**	**(3.1)**	**45,804**	**(2.1)**

[1] Values presented in this column will not add up to the corresponding subtotals due to overlap of pack territories, which was removed for the analysis.

Sources: USFWS et al. (2006); DNRC (2008a).

gestation period. After the pups are 8 weeks old, they are moved to rendezvous sites, which are gathering sites for members of a wolf pack that are used primarily during the summer. Pup survival is highly variable and influenced by several factors, including disease, predation, and nutrition (Johnson et al. 1994). From late April until September, pack activity is centered at or near the den or rendezvous sites. Pups travel and hunt with the pack by September. The pack hunts throughout its territory until the following spring (MFWP 2003a).

Habitat Requirements

As habitat generalists, wolves utilize a wide variety of habitats, including forests, shrublands, and grasslands. In a study of 22 dens in Idaho, Montana, and Canada, Trapp (2004) found that wolves denned in areas that had greater canopy cover, hiding cover, herbaceous ground cover, and woody debris, and were closer to water, compared to random sites. Rendezvous sites are generally located in meadows or forest openings near the den, but sometimes are several miles away (MFWP 2002b). Suitable den sites for wolves generally consist of secluded areas with moderate slopes and adequate cover. In northwestern Montana, Matteson (1993) found that, relative to available habitat, wolves selected for den site locations that were on valley bottoms, flat to moderate slopes, and lower slopes; south and east aspects; close to trails, meadows, and other openings; and far from human presence. Distance to the nearest road did not appear to be a factor in wolf den site selection, but many of the roads identified by Matteson were closed for a portion of the year or lightly used.

MFWP (2002b) determined that wolves in Montana, Idaho, and Wyoming should be functionally connected through emigration and immigration events, resulting in the exchange of genetic material between sub-populations (MFWP 2002b). This functional relationship is consistent with the biological intent of the recovery plan and is an underlying prerequisite for successful wolf recovery in the northern Rockies. Designation of actual habitat linkage zones or migration corridors is impossible for a habitat generalist and highly mobile species like the gray wolf (MFWP 2002b). Isolation is unlikely as long as populations remain at or above recovery levels and regulatory mechanisms prevent chronically low wolf numbers or inhibit dispersal (Forbes and Boyd 1997). The extent to which linkage is a limiting factor for wolf recovery is currently being further

considered as a component of the ongoing delisting process. For further discussion on linkage areas and related impacts, see the relevant components contained in the grizzly bear analysis and lynx analysis, which are applicable also to large-ranging species such as wolves.

Between the mid 1980s and the late 1990s, about half of the packs recolonizing northwestern Montana did so outside of the anticipated recovery area and linkage corridors suggested in the recovery plan (Forbes and Boyd 1997; USFWS et al. 2000a). It appears that overall management for wolf survival across broad landscapes already used by wolves is more realistic than discrete corridors because of the dispersal rates and distance capabilities (Fritts and Carbyn 1995). Outside refuges, such as national parks, legal protection and public education across broad landscapes will facilitate those functional connections across the region (Forbes and Boyd 1997).

Risk Factors

The primary risk factor to gray wolves in northwestern Montana is human-wolf conflicts resulting from control actions to resolve conflicts due to livestock depredation (MFWP 2003a; USFWS 2006b). Other legal killing, illegal killing, and collisions with cars or trains are also substantial sources of mortality. Disease and parasites and inadequate abundance of ungulate prey are also risk factors (USFWS 2006b). However, according to the USFWS (2006b), decline in ungulate prey in the northern Rocky Mountains is not expected to occur at levels that would affect wolf recovery or long-term viability, and substantial effects to wolf populations from disease or parasites are not expected because wolf exposure to these diseases and parasites has been occurring for decades.

In Montana, the total number of livestock confirmed killed by wolves between 1987 and 2004 is 190 cattle and 409 sheep. The USFWS and the State of Montana work with livestock producers to reduce the risk of wolf-caused losses and resolve conflicts through a combination of non-lethal deterrents and lethal control. Between 1987 and 2003, a total of 166 wolves were killed in Montana to resolve conflicts (MFWP 2003a).

Like many wild animals, wolves are capable of posing a threat to human safety, but such occurrences are rare and unlikely. In the past 100 years, there have been several published accounts of human fatalities due to habituated wolves (MFWP 2008). It is unusual, however, for a wild wolf to associate or interact with people or linger near buildings, livestock, or domestic dogs for extended periods of time (MFWP 2003a).

Timber harvest may be a source of disturbance within 1 mile of wolf dens and rendezvous sites while pups are young (Claar et al. 1999; MFWP 2002b; Fontaine 2004, personal communication). During this period, aerial yarding may be less disturbing to wolves than a ground-based yarding system (Fontaine 2004, personal communication). Forest management activities involving motorized equipment may impact wolves by disrupting den sites or rendezvous sites, which could cause abandonment of dens and pups increasing their risk of mortality.

Wolves are not known to demonstrate behavioral aversion to roads. In fact, they readily travel on roads, frequently leaving visible tracks and scat (Claar et al. 1999). The underlying concern about road densities stems from the potential for increased human-caused mortalities and illegal killings (Mech et al. 1988; Mech 1989; Pletscher et al. 1997; Fontaine 2004, personal communication;

Meier 2004, personal communication). Thus, increases in the amount of roads on the landscape may indirectly influence human-caused mortality risk to wolves.

Wolves' sensitivity to timber harvest is closely tied to potential impacts of these activities on ungulates, their primary prey. Disturbance and removal of forest cover by timber harvest generally creates young growth that is a necessary element of moose, deer, and elk habitats (Thomas et al. 1988; Armleder et al. 1989; Meier 2004, personal communication). However, the condition of winter range is important in maintaining ungulate populations, particularly the availability of adequate amounts of dense, mature forest cover near forage areas (Thomas et al. 1988; Armleder et al. 1989; Baty et al. 1996). Reductions in forest cover on important wintering areas can have adverse impacts on elk and deer, which may subsequently influence prey availability for wolves. Timber harvest on winter range used by elk can also be a significant source of disturbance causing elk to be displaced from preferred areas (Thomas et al. 1988).

Grazing of forest lands may degrade ungulate winter range (Thomas et al. 1988) and may also bring domestic livestock in contact with wolves, thus facilitating wolf/livestock conflicts. Overall, wolves cause a small number of the total livestock losses in Montana compared to other sources of livestock mortality (MFWP 2002b, 2003a). However, wolf depredation may disproportionately impact one or a few livestock producers because of where a wolf pack territory is established relative to livestock distribution, livestock type, and/or grazing practices (MFWP 2002b). Thus, changes in livestock management practices on forest lands or increases in the abundance of livestock on forest lands could increase wolf vulnerability to human-caused mortality.

Environmental Consequences

Currently, DNRC's Forest Management ARMs provide protection for wolves and their habitat and require acknowledgement of the importance of habitat elements for elk, mule deer, and white-tailed deer. The ARMs also allow for coordination of management actions with a statewide management plan that would be put in place if wolves are delisted. Under all four alternatives, DNRC would continue to cooperate with state and federal wolf managers, and minimize disturbance risk near known den sites and rendezvous sites by suspending all mechanized activities, including use of roads, within 1 mile of den sites and 0.5 mile of rendezvous sites. Four subsections in this analysis identify the ways in which Forest Management ARMs and activities proposed for coverage under the HCP alternatives could affect gray wolves: (1) disturbing wolves at denning and rendezvous sites, (2) increasing risk of disturbance and human-caused mortality due to road increases, (3) affecting cover abundance and habitat suitability for ungulate prey species, and (4) changing livestock management on forest lands.

Disturbance of Den Sites and Rendezvous Sites

Under all alternatives, the ARMs and existing practices such as adding protective clauses to contracts would minimize risk to denning wolves by providing adequate disturbance buffers around dens. DNRC specialists and foresters would also continue to cooperate with state and federal managers and comply with measures provided by MFWP pertaining to wolf management and control actions in both the endangered population recovery area and experimental population zone. Cooperation would occur on a case-by-case basis at the project level to minimize risk of conflicts where wolves are known to occur.

The risk of disturbance to wolves at dens and rendezvous sites may also depend somewhat on the availability of areas that are managed for minimal human presence. Thus, for this analysis it is relevant to consider differences between the alternatives in the amount of areas specifically designated as grizzly bear security core or quiet areas as criteria for evaluating additional potential for den site disturbance.

Alternative 1: Under the no-action alternative**,** DNRC would commit to keeping the Stillwater Core (approximately 36,800 acres) intact for at least 10 years, as practicable. The potential for disturbance would be further minimized by the requirement that management activities be conducted only during the grizzly bear denning period (November 16 to March 31), which is outside the period of greatest activity at wolf dens and rendezvous sites (late April through September). The Swan River State Forest would be managed for quiet areas, where 3 years of active management would be followed by 6 years of rest. During rest periods, such areas may provide large blocks of undisturbed habitat available for denning habitat and rendezvous sites. No specific provisions for secure habitat or quiet areas would be required on scattered parcels; however, management of scattered parcels typically occurs on a sporadic basis, often leaving them minimally disturbed for many years at a time following individual projects.

Alternatives 2, 3, and 4: Compared to Alternative 1, the total amount of land area managed for minimal human disturbance would increase under all of the action alternatives, from approximately 66,300 acres under Alternative 1 to almost 95,000 acres under Alternatives 2 and 4 and more than 102,000 acres under Alternative 3. The management emphasis in these areas would differ under the alternatives, however. Under Alternatives 2 and 4, areas currently managed as security core in the Stillwater Block (Stillwater Core) would instead be managed as quiet areas, with reduced restrictions on where and when management activities may occur. These changes could increase the risk of such activities occurring at locations that would result in harassment or displacement of wolves at dens or rendezvous sites. In contrast, under Alternative 3, DNRC would maintain its commitment to keeping the Stillwater Core intact for at least 10 years, similar to Alternative 1. Within the Stillwater Block, implementation of the transportation plan under Alternatives 2 and 4 would be expected to reduce, but not eliminate, the risk of disturbance to wolves at undetected den or rendezvous sites, compared to Alternative 1.

Management for quiet areas in the Swan River State Forest would be the same as under Alternative 1 as long as the Swan Agreement remains in effect. If the Swan Agreement is terminated, the forest would be managed as five independent subzones, with each subzone managed on a schedule of 4 years of active management and 8 years of rest, with allowances for salvage harvest. Compared to Alternative 1, the longer rest periods may make potential denning and/or rendezvous habitat available with minimal disturbance for longer periods.

Disturbance and Human-caused Mortality Risk Associated with Road Density

In Montana, recovery measures have not stressed restrictions on road densities to protect wolves. However, this discussion does acknowledge there is some potential for additional impacts to wolves associated with roads by increasing the incidence of contact with humans. Anticipated changes in road density under the alternatives are described in detail in Section 4.9.3.2 (Grizzly Bear). Higher road densities, depending on their location relative to denning and rendezvous sites, can reduce the habitat effectiveness of an area and increase the risk of mortality due to illegal killing.

Alternative 1: In the Stillwater Core, open road densities would remain at current levels. Elsewhere, road management decisions would be made on a project-by-project basis, and would be constrained by requirements to avoid take under Section 9 of the ESA. As a result, any increase in the miles of road open for motorized public access would likely be offset by the imposition of access restrictions (either seasonal or year-round closures) of an equal amount of open road elsewhere on the Stillwater Block or the Swan River State Forest. In scattered parcels, Alternative 1 would allow no permanent increases in open road density for parcels exceeding 1 mi/mi^2; this requirement would be imposed only within the grizzly bear recovery zones, however. DNRC anticipates minimal increases in open road density on the HCP project area over the next 50 years (see Tables 4.9-13 and 4.9-14 in Section 4.9.3.2, Grizzly Bear); thus, future additional impacts to wolves associated with open roads are not anticipated. However, risk of vehicle collisions could occur on all open roads where wolves are present should traffic volumes increase appreciably. Additional risk over the next 50 years could be created due to projected increases in total road densities by providing additional access for non-motorized recreational users and conduits for illegal motorized use (Table 4.9-11). Such increases on scattered parcels range from 0.4 to 1.2 mi/mi^2 (Table 4.9-12).

Alternative 2, 3 and 4: Within the Stillwater Block, implementation of the transportation plan under Alternatives 2 and 4 would be expected to result in some localized increases in road densities, compared to Alternative 1. In the Stillwater Core, road densities would increase because some roads that are currently closed year round to motorized public access would be open with seasonal restrictions. This risk would be offset in part by the implementation of more rigorous requirements for monitoring and maintaining road closures. Under Alternative 3, DNRC would maintain existing road closures in the Stillwater Core. If the Swan Agreement is terminated, open road densities could increase dramatically, depending on the status of access agreements with neighboring landowners. Similar to Alternative 1, DNRC anticipates minimal increases in open road density in the HCP project area over the next 50 years (see Tables 4.9-13 and 4.9-14 in Section 4.9.3.2, Grizzly Bear); thus, future additional impacts to wolves associated with open roads are not anticipated under any action alternative. Also similar to Alternative 1, projected increases in total road miles in the HCP project area (Tables 4.9-11 and 4.9-12) would provide additional access for non-motorized recreational users and conduits for illegal motorized use, which could increase the human-caused mortality risk for wolves.

Compared to Alternative 1, all three action alternatives would impose greater restrictions on the location of new road construction and the granting of access easements, potentially lessening the risk of effects on wolves due to the presence of roads in key habitat areas. Alternative 3 would include additional commitments, prohibiting any net increase in total road densities at the administrative unit level in grizzly bear recovery zones.

Cover Abundance and Habitat Suitability for Ungulate Prey Species

Discussion of big game habitat is found in Section 4.9.7.2 (Further Analysis for Specific Non-HCP Species), and summary information from that analysis is presented here. As noted in that section, patches of dense forest cover are an important component of big game habitat, depending on their location. This analysis, therefore, focuses on cover abundance.

Alternative 1: Under this alternative, habitat management for big game species (including riparian areas, which provide important habitat for many species) would continue current management

practices as defined by Table E4-8 in Appendix E, EIS Tables. Current rules allow for consideration of hiding cover, fawning/calving habitat, and summer range and winter range, and encourage coordination with MFWP. No specific mitigations are required for retention of cover for big game species, such as elk and deer. If cover for big game is identified as an environmental issue on a particular project, it is addressed at the project level with input from a DNRC wildlife biologist. Some other required commitments do provide cover and provide some assurances for big game species in addition to project-level recommendations. ARMs pertaining to wolves, biodiversity, management of SMZs, grizzly bears, lynx, and fishers provide measures that address maintenance of cover that would also be usable by elk and deer. Due in large part to DNRC's sustainable yield requirement for planting and continued successional growth, forested vegetation at the landscape scale that would provide coniferous forest hiding cover is not expected to change appreciably on HCP project area lands due to logging activities over the next 50 years (Table 4.9-17 in Section 4.9.3, Grizzly Bear). Acreages of pole timber, young sawtimber, and mature sawtimber stands would continue to be well represented under Alternative 1, with a sizable increase expected in the seedling/sapling class at year 50 (Table 4.2-15 in Section 4.2, Forest Vegetation). Thus, some noticeable differences and elevated risk to big game, and subsequently wolves, could be realized at local scales due to removal of hiding cover or cover important to wintering deer and elk. Under current ARMs, such risks would be required to be considered by DNRC specialists and foresters at the project level.

Alternatives 2, 3 and 4: Under all three action alternatives, increased widths of areas managed as no-harvest buffers adjacent to Tier 1 waterbodies would likely increase the availability of hiding cover and undisturbed fawning/calving habitat, particularly for species that are closely associated with riparian areas. In addition, the requirement to provide visual screening in riparian areas and in wetlands would likely result in increased cover habitat for big game species. In upland areas in the grizzly bear recovery zones and NROH, additional visual screening requirements would likely provide cover habitat. Additional visual screening provisions between open roads and clearcut or seed tree harvest units would be implemented under Alternatives 2 and 3, but not Alternative 4. Collectively, these measures would increase the availability of cover habitat in riparian areas, near harvest openings, and along open roads, potentially increasing big game habitat effectiveness, compared to Alternative 1. Under all action alternatives, ARMs pertaining to wolves, biodiversity, and big game would continue to be implemented. As under Alternative 1, forested vegetation at the landscape scale that would provide coniferous forest hiding cover is not expected to change appreciably on HCP project area lands due to logging activities over the next 50 years (Tables 4.9-17 in Section 4.9.3.2, Grizzly Bear). Acreages of pole timber, young sawtimber, and mature sawtimber stands would continue to be well represented under these alternatives, with a sizable increase expected in the seedling/sapling class at year 50 (Table 4.2-15 in Section 4.2, Forest Vegetation). Thus, some noticeable differences and elevated risk to big game, and subsequently risk to wolves, could be realized at local scales due to removal of hiding cover or cover important to wintering deer and elk. Under current ARMs, such risks would continue to be required to be considered by DNRC specialists and foresters at the project level.

None of the alternatives would specifically limit the size of patches or how patch patterns would be represented through time on the landscape; thus, there would be no measurable differences between how any of the alternatives would affect these cover attributes for elk, deer, and moose over the 50-year Permit term.

Livestock Management on Forest Lands

Alternative 1: Under this alternative, DNRC specialists and managers would also continue to cooperate with state and federal wolf biologists and comply with measures provided by MFWP pertaining to wolf management and control actions in both the endangered population recovery area and experimental population zone. Cooperation would occur on a case-by-case basis at the project level to minimize risk of conflicts where wolves are known to occur. Additional grazing licenses could be established on lands suitable for grazing, which could elevate risks for wolves. However, DNRC specialists and managers would continue to cooperate with licensees and wolf biologists to maintain good husbandry practices on a situation-by-situation basis to minimize impacts to wolves associated with livestock grazing.

Alternatives 2, 3 and 4: None of the action alternatives would differ with regard to how livestock grazing concerns would be addressed. In addition to the ongoing measures that would occur as indicated above for Alternative 1, under Alternatives 2, 3, and 4, grizzly bear commitment GB-NR5 would require in NROH weed grazing mitigation plans for sheep and goats and prompt removal of all livestock carcasses identified as creating the potential for bear-human encounters, which would also lessen risk for wolves. Within recovery zones, GB-RZ4 would also prohibit the authorization of any new small livestock grazing licenses, including those for the purposes of weed control. In addition, DNRC would not initiate the establishment of new grazing licenses, although proposals initiated by the public for larger, less vulnerable classes of livestock (such as cattle and horses) may be considered and allowed by DNRC in recovery zones. Compared to Alternative 1, the grazing measures contained in all action alternatives would help reduce the risk of wolf-human conflicts associated with livestock on trust lands. None of the measures in any of the alternatives would be expected to compromise DNRC's ability to implement the management plan for wolves in Montana following their delisting.

Summary

Overall, Alternative 3 is designed to provide the lowest road densities; more seasonal restrictions on vehicles and harvest activities; longer rest periods in spring bear habitat, which may overlap with gray wolf denning and rendezvous habitat; and the best options for improved big game habitat. Alternative 2 also would provide lower road densities, seasonal restrictions, spring rest rotation periods, increased cover in critical areas such as riparian zones, and other factors required for wolf habitat, although to a lesser degree than Alternative 3, as more management flexibility is built into this alternative. Alternative 4 would provide greater management flexibility with improved protection over current conditions by incorporating the same rest periods and road closures as Alternative 2, but generally with more management options and less protection for wildlife needing these features. The combination of mitigations built into these alternatives for grizzly bear also play an important role in protecting gray wolf habitat and reducing disturbance to important areas, such as rendezvous sites and denning habitat. It is expected that all action alternatives would provide additional protections for gray wolves. Alternative 3 would provide the most protections and the least amount of harvesting, while keeping security habitat intact, which could benefit wolves; therefore, this alternative would provide the most complete package of beneficial measures. Alternative 2 would also provide a complete package of beneficial measures, with just slightly less protection for gray wolf habitat than Alternative 3, but more than Alternative 4.

Wolverine

Affected Environment

Wolverines are not DNRC-listed species. However, they were petitioned for federal listing and are thus given more detailed consideration in this analysis.

In July 2000, wolverines were petitioned for federal listing, and in October 2003, the USFWS presented a finding that there was insufficient information on wolverines to warrant listed status (68 FR 60112-60115, October 21, 2003). In June 2005, a complaint was filed against the USFWS for using inappropriate standards in its evaluation. Shortly after, the U.S. District Court of Montana ruled the USFWS petition finding in error and ordered it to undertake a status review of the species. The USFWS completed the review, and in March 2008 determined that the population of the North American wolverine in the contiguous United States was not discrete and did not meet the definition of a distinct population segment. The USFWS, therefore determined that the wolverine was not a listable entity within the contiguous United States (73 FR 12929-12941, March 11, 2008). In addition, the USFWS concluded that the contiguous United States population of the North American wolverine did not constitute a significant portion of the entire North American subspecies, meaning a listing of the wolverine as a subspecies was also not warranted. This determination has been formally challenged as environmental groups again filed suit to federally list the species on September 30, 2008.

Wolverines are rare, medium-sized carnivores that are generally described as opportunistic scavengers in the winter and opportunistic omnivores in summer, consuming prey that includes snowshoe hares, marmots, ground squirrels, red squirrels, salmon, porcupine, mice, voles, and berries (Banci 1994; Copeland and Whitman 2003). All studies have shown the importance of large mammal carrion, and the availability of large mammals influences the distribution, survival, and reproductive success of wolverines. Over most of their range, ungulates provide this carrion (Banci 1994). Wolverines are generally solitary and wide-ranging. They occur at relatively low densities (e.g., one per 65 square kilometers in northwestern Montana) (Hornocker and Hash 1981). Home ranges of males are larger than those of females, with home ranges of up to several hundred square kilometers. The mean annual home range of males was 422 square kilometers, and female home ranges were 388 square kilometers in Montana (Hornocker and Hash 1981).

Wolverines historically inhabited forested regions across the northern tier of North America. Their distribution in North America included much of Canada, southward into the United States from Maine to Washington State (van Zyll de Jong 1975; Copeland and Whitman 2003). In the southerly portion of their distribution, wolverines extended down the Cascade Mountains of Oregon and into the southern Sierras in California, and down the Rocky Mountains into Arizona and New Mexico (Banci 1994; Hash 1987). Wolverines have experienced dramatic reductions in their southern distributional extent (Banci 1994; Heinemeyer and Copeland 1999), although in Montana their distribution likely decreased to a minimum around 1920 and has since expanded (Newby and McDougal 1964). Increases in Wyoming (Hoak et al. 1982) and Idaho (Groves 1988) in the past have also been suggested. In the United States, their present distribution is restricted to the Rocky Mountains, and only Idaho, Montana, and Wyoming are known to support populations (Hoak et al. 1982; Copeland and Whitman 2003). Recent findings suggest that wolverine range in the contiguous United States contracted substantially by the mid-1900s (Aubry et al. 2007). There are

also several concerns about wolverines in the northern Rockies including low-population densities, population isolation, and long-term threats due to warming climate trends (Ruggiero et al. 2007). Wolverines have been documented within the NWLO, SWLO, and CLO.

Excessive mortality associated with trapping and human-associated developments are usually suspected to be the primary causes of wolverine reductions (Proulx 2000; Copeland and Whitman 2003). In Montana, MFWP authorizes limited harvest, which is primarily maintained to allow for the incidental take of wolverines in traps set for other target species (Banci 1994; Heinemeyer and Copeland 1999; Giddings 2003, personal communication). Since 1993-1994 (i.e., in the previous 10 years), the number of wolverines harvested in Montana annually ranged from 4 to 15, with an average of 11 (Giddings 2003, personal communication). Low wolverine densities, the fragmented nature of suitable habitat at the southern extent of their North American range, and high demographic sensitivity to adult mortality raise concerns that the harvesting of wolverines in southern boreal forests could have a detrimental effect on their metapopulation dynamics (Ruggiero et al. 2007).

At the landscape scale, particular plant associations do not appear to define wolverine habitat as much as the presence of abundant food supplies (i.e., ungulate carrion) and sparsely inhabited wilderness areas that contain persistent snow until late spring (Kelsall 1981; Banci 1994; Aubry et al. 2007). Copeland and Whitman (2003) suggested that vegetative characteristics appear less important to wolverine than physiographic structure of the habitat, and Copeland et al. (2007) found that topographic variables provided greater predictive power in their habitat models than vegetative parameters. Other studies have found that, within home ranges (and except for denning, see below), wolverines exhibit no strong affinity for specific habitats (Krott 1982; Banci and Harestad 1990; Landa et al. 2000; Raphael et al. 2001). Hornocker and Hash (1981) reported that wolverines were "reluctant to cross openings of any size such as clearcuts or burns" in Montana (Hornocker and Hash 1981). However, in that same study, Hornocker and Hash (1981) also found no differences in movements, habitat use, or behavior between wolverines occupying logged areas and those occupying unlogged areas, and that wolverines evidently were not inhibited from crossing clearcuts. In addition, wolverines in Idaho were documented to commonly cross natural openings and areas with sparse overstory (e.g., burns, meadows, and open mountaintops) (Copeland 1996). In Scandinavia, wolverines exist in a much more intensively developed environment and can cross highways at least occasionally (Landa et al. 2000). Consequently, avoidance of open areas by wolverines may have been over-stated by Hornocker and Hash (1981), even though wolverines in the Rocky Mountains do appear to prefer forested areas over open areas, particularly when they are active. Hornocker and Hash (1981) found 70 percent of wolverine use in medium to scattered timber, particularly for forests featuring subalpine fir. Research in Idaho showed similar results, with montane coniferous forest types accounting for 70.2 percent of wolverine use (Copeland 1996). Copeland et al. (2007) reported that wolverines used an elevation zone year round that ranged from about 7,218 to 8,530 feet, with only minor shifts to lower elevations in winter. In that study, wolverines primarily used vegetation communities dominated by whitebark pine in summer, and shifted use into Douglas-fir and lodgepole pine communities in winter, possibly to take advantage of a greater abundance of ungulate carrion (Copeland et al. 2007).

Although abundance of food and large tracts of undisturbed wilderness are important factors for wolverines at the landscape scale, denning habitat may be an important factor at the watershed level for wolverines in Montana and other portions of their Rocky Mountain range (Copeland 1996; Magoun and Copeland 1998). Where denning habitat is absent or made unavailable due to excessive human disturbance, wolverines will probably be absent (Copeland 1996; Copeland and Whitman 2003; Copeland 2004, personal communication).

Den sites in forested habitats below tree line have been found to include a variety of features, such as avalanche chutes, caves, uprooted trees, burrows, overhanging banks, snow tunnels, snow-covered tree roots, rocks and boulders, and logjams (Hash 1987). Snow cover that persists through the spring denning period appears vital to reproduction. Elevations and habitats associated with this attribute may be critical for successful natal (birthing) dens throughout the wolverine's range (Ruggiero et al. 2007). Female wolverines appear to prefer high-elevation, north-facing talus slopes for natal denning. Often located within cirque basins, the females occupy extensive snow tunnels that form a complex of dens (Magoun and Copeland 1998). Two marked females and one unmarked female in Copeland's (1996) study used subalpine talus habitat for denning sites, whereas coniferous riparian sites were used at lower elevations, characterized by dense shrub and regenerating understory and multiple layered downed timber.

There is a body of evidence that suggests females are prone to disturbance at natal den sites (Heinemeyer et al. 2001). Other studies also report den abandonment as a result of human disturbance (Pulliainen 1968; Myrberget 1968; Copeland 1996). The movement of kits to less suitable habitat because of interface with winter recreationists and other human activities may result in detrimental energy expenditures, stress, increased susceptibility to predation, exposure, or competition for limited den sites. Resource extraction (including timber harvesting), backcountry skiing and snowmobiling, roads, and other forms of human disturbance are concerns where wolverines are found (Ruggiero et al. 2007) and are risk factors that may be an issue in the HCP project area.

In general, DNRC does not maintain trails, winter recreation areas, or other facilities devoted to outdoor recreation that could disturb denning wolverines. However, DNRC does manage lands that support some of these facilities. In addition, DNRC licenses other parties to groom and maintain snowmobile and cross-country ski trails on trust lands. The Stillwater Block has existing land use licenses with three commercial snowmobile outfitters and with the Flathead Snowmobile Association for grooming trails. The Stillwater Unit has also issued land use licenses for a commercial dogsled outfitter and a commercial groomed Nordic ski track. In addition, there are several ski trail licenses on the Swan River State Forest, the Libby Unit, and the Kalispell Unit. However, the Libby and Kalispell Units do not possess habitat likely to be suitable for use by wolverines (Table 4.9-29).

TABLE 4.9-29 ACRES OF WOLVERINE HABITAT IN THE HCP PROJECT AREA BY ELEVATION RANGE FOR EACH LAND OFFICE AND ADMINISTRATIVE UNIT OFFICE

Land Office and Administrative Unit	Acres Within Elevation Range (Feet)							
	6,001 to 6,500	6,501 to 7,000	7,001 to 7,500	7,501 to 8,000	8,001 to 8,500	8,501 to 9,000	9,001 to 9,500	Total
NWLO								
Stillwater	9,050	3,964	230	0	0	0	0	13,243
Swan	1,727	1,049	104	0	0	0	0	2,880
Plains	14	27	0	0	0	0	0	41
Libby	0	0	0	0	0	0	0	0
Kalispell	0	0	0	0	0	0	0	0
Subtotal	**10,792**	**5,040**	**333**	**0**	**0**	**0**	**0**	**16,165**
SWLO								
Missoula	0	685	360	16	0	0	0	1,060
Clearwater	8	72	23	0	0	0	0	104
Anaconda	0	0	0	0	0	0	0	0
Hamilton	0	0	0	0	0	0	0	0
Subtotal	**8**	**757**	**383**	**16**	**0**	**0**	**0**	**1,164**
CLO								
Bozeman	0	638	173	36	0	0	0	847
Dillon	0	0	0	0	484	245	0	729
Helena	210	228	58	0	0	0	0	496
Subtotal	**210**	**866**	**231**	**36**	**484**	**245**	**0**	**2,071**
Total	**11,010**	**6,663**	**947**	**52**	**484**	**245**	**0**	**19,400**

Source: DNRC (2008a).

Wolverines are capable of very long dispersal movements (Vangen et al. 2001; Copeland and Whitman 2003) and appear capable of recolonizing appropriate habitats if travel routes are not entirely disrupted (Landa et al. 2000). However, genetic subdivision among populations have been documented, particularly in the southern extent of their North American distribution (Cegelski 2002; Kyle and Strobeck 2002; Schwartz et al. 2007); gene flow is primarily male-mediated (Wilson et al. 2000). Banci (1994) states that wolverine habitat needs must be met at more than one scale: (1) at the stand scale to meet requirements for food and dens, and (2) at the landscape scale to meet requirements for home range sizes, travel corridors, and dispersal corridors. Banci (1994) has stressed the importance of refugia in the form of large protected areas connected by adequate travel corridors. Such refugia are important for providing dispersers to surrounding habitats. Rivers, lakes, mountain ranges, or other topographical features do not seem to block movements of wolverines (Hornocker and Hash 1981; Banci 1987, 1994). However, because wolverines tend to avoid human developments, extensive human settlement and major access routes may function as barriers to dispersal. Thus, linkages are required to connect wolverine habitats among areas that generally lack broad-scale human influence. Habitat alteration, or fragmentation, may isolate subpopulations of wolverines, increasing their susceptibility to local extinction processes.

For this analysis potential wolverine habitat on HCP project area lands was identified by using a combination of three attributes: (1) persistent late spring snow cover for year 2008, (2) elevation,

and (3) consideration of the spatial extent of snow cover within 5 square miles of trust land parcels that possessed abundance of snow cover (DNRC 2008i). Because of influences of latitude, varying climatic patterns, and variability in the distribution and elevation of mountain ranges in western Montana, information in addition to the elevation range wolverines used in Idaho, as described by Copeland et al. (2007), was used to predict habitat acreages and locations. Satellite imagery for 2008 was used because snow pack was normal to slightly above normal for most of western Montana and provided a reasonable predictive snapshot for identifying areas with persistent snow late in spring. Areas exhibiting these attributes are expected to be those most likely to provide conditions suitable for denning females and where disturbance influences may be most limiting for wolverines on trust lands.

DNRC owns and manages relatively few acres of high-elevation habitat containing persistent snow late into spring. This is due to the relatively limited amount and distribution of trust lands in western Montana. As a general rule, trust land parcels tend to be situated more in valley bottoms and on mid-slopes, rather than on large, extensive high-elevation ridgelines and mountain peaks where late persistent snow typically occurs. In the planning area, there are 23,060 acres of wolverine habitat (Table 4.9-30). These acres comprise 1.3 percent of the total 1,813,300 acres of trust lands in the planning area. Approximately 91 percent of the DNRC wolverine habitat acres occur at elevations between 6,000 and 7,500 feet, and 70 percent exist on the NWLO. Of the wolverine habitat on trust lands in the planning area, 13,243 acres (57 percent) occur within the Stillwater Block. In the HCP project area, there are 19,400 acres of wolverine habitat, of which 16,123 acres (83 percent) occur on the Stillwater Block and Swan River State Forest (Table 4.9-29). The remaining 3,277 acres are scantily distributed across the Plains, Missoula, Clearwater, Bozeman, Dillon, and Helena Units (Table 4.9-29).

Environmental Consequences

The following analysis identifies and compares the rules, policies, and commitments that address the provision of suitable habitat under the alternatives in the HCP project area, as well as a quantitative comparison of anticipated habitat availability.

Den Site Disturbance: At high elevations, where potential habitat occurs in zones where snow persists into late spring, DNRC rarely conducts logging activities or administrative activities, such as sale planning and project preparation, until after June 15 each year. This is because plowing costs are prohibitive, conditions are more dangerous, and snow cover restricts the ability to conduct most activities. Thus, the potential for forest management activities to disturb female wolverines in dens on trust lands at elevations greater than 6,000 feet is minimal under all alternatives. Under a grizzly bear commitment contained in all action alternatives, DNRC would be prohibited from conducting motorized forest management activities at elevations greater than 6,300 feet from November 16 through May 31 each year, which would provide additional certainty of minimal disturbance risk to denning wolverines compared to Alternative 1.

TABLE 4.9-30 ACRES OF WOLVERINE HABITAT IN THE PLANNING AREA BY ELEVATION RANGE FOR EACH LAND OFFICE

	Acres within Elevation Range (feet)									
Land Office	5,501 to 6,000	6,001 to 6,500	6,501 to 7,000	7,001 to 7,500	7,501 to 8,000	8,001 to 8,500	8,501 to 9,000	9,001 to 9,500	9,501 to 10,000	Total
NWLO	0	10,813	5,050	334	0	0	0	0	0	**16,197**
SWLO	0	9	764	383	16	0	0	0	0	**1,171**
CLO	774	570	2,208	812	344	403	480	101	0	**5,692**
Total	**774**	**11,392**	**8,022**	**1,529**	**360**	**403**	**480**	**101**	**0**	**23,060**

Source: DNRC (2008a).

Habitat Alteration and Linkage: As described earlier in the grizzly bear and lynx subsections, with the exceptions of the Stillwater Block and Swan River State Forest, DNRC's ability to influence linkage areas in western Montana is relatively limited by the amount of HCP project area lands in the planning area (approximately 2 percent) and distribution of lands in western Montana (Tables 4.9-8 and 4.9-9 and Figures D-15A, B, and C in Appendix D, EIS Figures). The Stillwater Block and the Swan River State Forest are important land areas for linkage with high value for lynx, grizzly bears (USFS 2007a; USFWS et al. 1995; Servheen et al. 2001), and most likely, wolverines, given the amounts and locations of persistent snow zones in these areas (Table 4.9-29). All of the alternatives are similar in how they contribute to, or may impact, habitat linkage for wolverines, and all action alternatives provide greater certainty and protection for wolverines than Alternative 1.

Under Alternative 1 on all DNRC forest management projects, forest patch size, shape, connectivity, and habitat fragmentation would be considered at the project level under ARM 36.11.415. In the Stillwater Block, commitments to the Stillwater Core would remain in place and the 40 percent hiding cover in grizzly bear BMU subunits commitment would remain. Similarly, on the Swan River State Forest, harvest unit design would require the 600-feet-to-cover measure, visual screening would continue to be required along riparian areas, and a minimum of 40 percent hiding cover would be maintained per BMU subunit, as long as Swan Agreement is in place. These are all measures that would support maintaining cover, habitat connectivity, and linkage for wolverines.

Under Alternatives 2, 3, and 4, forest patch size, shape, connectivity, and habitat fragmentation would continue to be considered in a similar manner at the project level under ARM 36.11.415. Given that particular plant associations do not appear to explain wolverine habitat as much as topographic variables (Copeland et al. 2007), no appreciable impacts are anticipated to wolverines associated with human-influenced changes in forest cover type representation over the next 50 years under any of the alternatives considered. Also, given the results contained in Table 4.9-17 and DNRC's commitment by statute to a sustainable harvest volume (MCA 77-5-222), hiding cover amounts at a programmatic scale are not expected to vary appreciably under Alternative 1 or any of the action alternatives**.** Under all action alternatives, projects planned in lynx habitat would be designated harvest units to maintain a connected network of suitable lynx habitat along riparian areas, ridgetops, and saddles, which would also benefit wolverines. All action alternatives would also require that threshold levels of suitable habitat be maintained in LMAs at levels from 60 percent (Alternative 4) to 70 percent (Alternative 3), with additional restrictions on the rates habitat could be converted to a non-suitable condition each decade. Under all action alternatives, a grizzly bear program-wide commitment for all HCP lands would ensure that visual screening associated with riparian zones and wetland management zones is retained, and that limited road construction and restrictions on gravel pit development would occur within riparian areas. Under all action alternatives, a grizzly bear requirement to restrict harvest unit size to ensure cover is available within 600 feet from any point within a clearing would be expanded in application to include all of the Stillwater Block and all scattered parcels within grizzly bear recovery zones and NROH. This measure would also benefit wolverines where recovery zone lands and NROH overlap or occur in relatively close proximity to high-elevation habitats preferred by wolverines; overlap is most substantial on the Stillwater Block and Swan River State Forest. Under Alternative 1, the 600-feet-to-cover measure is only applicable on the Swan River State Forest. Collectively, these measures help ensure that, within some of the most likely areas of importance for wolverines in western Montana, habitat connectivity would be maintained over time. Commitments contained in all action alternatives would provide greater assurances that connectivity would be maintained for essential

denning, foraging, and dispersal activities than Alternative 1. All action alternatives would require improved project-level tracking and documentation regarding how connectivity is addressed and maintained, which would facilitate compliance. Alternative 3 would likely provide for the greatest level of protection (subtle difference), followed by Alternatives 2 and then 4.

Under Alternative 3, maintenance of security core areas on the Stillwater Block at the DNRC 1996 baseline levels by BMU subunit would continue. Under Alternatives 1 and 3, approximately 36,800 acres in the Stillwater Block would be managed as secure habitat for intervals of 10 years (Stillwater Core). Most of the high-elevation wolverine habitat occurs on these lands. In contrast, fewer acres (19,400 acres, or 53 percent of the 36,800 acres) would be managed as grizzly bear quiet areas under Alternatives 2 and 4, with a maximum entry period of 4 years of activity followed by 8 years of rest from commercial logging activities. On the Stillwater Block, Alternative 3 would likely provide the greatest degree of habitat quality associated with the formally identified linkage zone along Highway 93, because it requires that the largest amount of blocked secure acreage is maintained. Any beneficial effect of the scattered parcels grizzly bear or lynx commitments associated with cover retention are likely to be small because scattered parcels are frequently islands of forested habitat in a sparse forest matrix of multiple ownerships. Thus, connectivity of mature or sub-mature forest cover can be difficult to provide at scales larger than one section (i.e., 640 acres).

In summary, given the amount and distribution of trust lands in western Montana, habitat connectivity between linkage zones is likely to be most influenced by land use and management on other ownerships, rather than DNRC forest management. However, all action alternatives provide for restrictions on access, quiet areas, cover maintenance, and control of development in similar ways. Alternatives 2, 3, and 4 would improve on the amount and quality of linkage zones when compared to current conditions, especially within the Stillwater Block and Swan River State Forest, due to the variety of complementary mitigation measures incorporated within those areas.

Fisher

Affected Environment

The fisher is a state-listed and DNRC-listed sensitive species, and it is managed by MFWP as a furbearer. Fishers were extirpated from Montana by the 1930s (Foresman 2001), and no fishers were detected in harvest records from 1929 to 1959 (Vinkey 2003). Reintroduction efforts in 1959 and 1960 in Lincoln, Granite, and Missoula Counties resulted in the establishment of populations in those counties. More recent reintroductions were made in the Cabinet Mountains between 1988 and 1991 (Foresman 2001).

Fishers occur primarily in dense coniferous or mixed forests (Thomas et al. 1993). The general living requirements for fishers are met through the interspersion of habitats providing large areas of continuous overhead cover, food availability (which is often found in higher abundance in edges and ecotones), and den sites. These elements are interspersed primarily in mature, dense, conifer-dominated forests and riparian forests (Lieffers and Woodard 1997). Fishers may also occur in early successional forests with dense overhead cover (Thomas et al. 1993).

Fishers are snag-dependent secondary cavity users (Powell and Zielinski 1994). Fisher kits are born and raised in maternal dens, which are typically located high in hollow trees (Powell 1993; Olsen et al. 1996). Large snags (greater than 20 inches dbh) are important as maternal den sites (Thomas et

al. 1993). Diet consists primarily of mammals (small rodents, shrews, squirrels, hares, muskrat, beaver, porcupine, raccoon, deer carrion), although fishers also may consume birds and fruit. Snowshoe hares are an important dietary item for fishers in Montana, as is deer carrion (Foresman 2001).

Mature structural stages and climax successional stages provide the best combination of required overhead cover for foraging and security, as well as potential den sites for fisher. Avoidance of non-forested and early seral stage habitats with little overhead cover has been documented in several studies (Kelly 1977; Powell 1977; Arthur 1987; Weir and Harestad 1997). Because dense, mature, conifer-dominated canopies are the most critical feature required for suitable fisher habitat, the availability of dense overhead cover is considered the primary habitat-limiting factor for this species. Timber harvesting is the primary human-related cause of habitat loss (Douglas and Strickland 1987; Thompson 1986; Thompson 1991; Buck et al. 1994; Thompson and Harestad 1994). Timber harvest can also contribute to habitat fragmentation, which reduces the suitability of habitat for fisher (Powell 1993; Badry et al. 1997). The connection of habitat units with adjacent units provides landscapes that are effectively large enough to maintain healthy populations of fisher (Jones and Garton 1994).

Environmental Consequences

Under all four alternatives, DNRC would continue to analyze effects to fishers on a project-by-project basis and implement conservation measures for fisher habitat as they do under the current Forest Management ARMs (ARM 36.11.440). These measures emphasize the maintenance of dense forest, snags, and LWD in riparian areas. These rules also require DNRC to manage for at least one forested patch providing connectivity between adjacent third-order drainages, preferably in saddles, where landscape conditions allow. No additional rules specifically address the availability or connectivity of dense, mature, conifer-dominated forest in upland areas, although biodiversity rules require that these factors are considered in project planning.

Effects on fishers would be related primarily to the availability of mature and old-growth forest and snags. In addition, anticipated variations in the condition of forested riparian habitat in the HCP project area may indicate differences in the effects of the alternatives. None of the alternatives include any provisions to change the Forest Management ARMs that address the removal of standing snags or LWD. DNRC's policies and management approach for old-growth stands would not change under the HCP alternatives. DNRC would continue to have the same old-growth management options it currently has as outlined in ARM 36.11.418 (old-growth restoration maintenance, and removal).

Differences among the alternatives in the availability of mature and old-growth forest in the project area are discussed in Sections 4.2.2.4 (Size Class) and 4.2.2.5 (Age Class), and summarized below for the pileated woodpecker. As noted in those discussions, Alternatives 2 and 4 would yield slightly lower proportions of acres in the mature sawtimber size class and the old-growth age class, compared to Alternatives 1 and 3. The most prominent differences would be seen in the Stillwater Block. Comparatively higher proportions of mature sawtimber and old-growth forest would be expected under Alternative 3, attributable in part to the wider riparian zones associated with this alternative, along with other conservation strategies that would limit activities associated with timber management in certain areas, such as the Stillwater Core.

With regard to riparian habitat, timber management under the alternatives would differ only in stands adjacent to Tier 1 streams (streams that support HCP fish species). Of 1,578 miles of stream in the project area, 451 miles (29 percent) are Tier 1 streams. The alternatives would not differ, therefore, in the management of forested riparian habitat along most streams in the project area. Under all alternatives, existing ARMs would require that within cover types preferred by fishers, 75 percent of the acreage within 100 feet of Class 1 streams, and 50 feet of Class 2 streams, must be maintained in a moderate to dense mature forest condition. Under Alternatives 2 and 4, the 25-foot no-harvest buffer adjacent to Tier 1 streams would minimize reductions in riparian forest canopy cover, potentially increasing the likelihood that fishers may use riparian corridors for forage, travel, and security, compared to Alternative 1. Alternative 3 would offer the widest and most intact riparian corridors adjacent to Tier 1 streams, resulting in the greatest amount of closed-canopy riparian habitat among the alternatives. See the discussion of Forested Riparian Habitats in Section 4.9.5.1 (Wildlife Habitat Associations) for additional detail on this habitat type.

Bald Eagle

Affected Environment

The USFWS removed the bald eagle from the federal list of endangered and threatened species, effective August 8, 2007 (72 FR 37346-37372). The delisting of bald eagles under ESA was challenged, and while the Court re-initiated the listing in certain areas of the United States, the species remains delisted in Montana. Bald eagles remain protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. In 1994, the Montana Bald Eagle Working Group published the Montana Bald Eagle Management Plan, which identifies risks and directs management activities. As a signatory to this document, DNRC follows guidelines in this plan as appropriate and as stated in the ARMs. Monitoring of all bald eagle nests occurs as part of the statewide monitoring plan. In Montana, the number of known breeding bald eagles increased from 12 pairs in 1978 to 308 pairs in 2002, well above the minimum recovery plan target of 99 pairs (MBEWG 1994; K. Dubois 2003, personal communication; DNRC 2005b). The population still appears to be increasing, with about 10 to 15 new nests found each year (DNRC 2005b). Many of the nesting pairs in Montana are year-round residents. Montana also supports significant numbers of wintering bald eagles (up to 600 in Glacier National Park during the 1980s) and is an important bald eagle migratory corridor, particularly along the Rocky Mountains and Yellowstone River (MBEWG 1994). The state's wintering bald eagle population increased from 470 eagles in 1982 to 782 in 1997 (Buehler 2000). Within the planning area, there are 333 documented bald eagle nesting territories that have been active within the past 5 years, 242 of which include some trust lands and 113 of which are associated with trust lands within the HCP project area (Figure D-18 in Appendix D, EIS Figures).

Bald eagles prefer to nest and perch in large trees (usually conifers or cottonwoods), typically within 1 mile of a lake or reservoir greater than 80 acres in size, or a large river (MBEWG 1994). Typically, nests are re-used in subsequent years. Nest stands are usually greater than 20 acres in size and contain several large trees (MBEWG 1994; MPIF 2000). Roost sites are typically located in mature conifer or cottonwood stands less than 10 acres in size (MBEWG 1994).

Winter roosting habitat is characterized by large stands of coniferous old growth, usually located on north-facing slopes away from prevailing winds. In Montana, wintering eagles are associated with unfrozen portions of large lakes and free-flowing rivers, but are also scattered through upland areas

feeding on ungulate carrion, game birds, rabbits, and hares (Swenson et al. 1981). Although large communal roosts are often associated with bald eagle wintering areas, none have been discovered in Montana (MBEWG 1994). As a signatory to the Montana Bald Eagle Management Plan, DNRC mitigates for such areas as they become known and are managed on a project-by-project basis. Therefore, this issue will not be addressed in detail in this analysis.

As identified by the USFWS (59 FR 35584-35594, July 12,1994), the primary risk factors to bald eagles include habitat loss and degradation, especially the loss of shoreline nesting trees through human development in shoreline areas, human disturbance associated with recreational use of waterways and shores, and contamination. Disturbance can cause nest abandonment and can also negatively affect foraging and roosting bald eagles (MBEWG 1994).

Environmental Consequences

DNRC's Forest Management ARMs ensure that timber harvest is conducted pursuant to the *Montana Bald Eagle Management Plan* (MBEWG 1994) and the *Habitat Management Guide for Bald Eagles in Northwestern Montan*a (MBEWG 1991). Under all four alternatives, all identified nesting territories would be protected utilizing the guidelines in these two plans. Timber harvest, road and trail construction and use, and various other activities would be conducted in a manner that would minimize disturbance to eagles during the nesting season and prevent or minimize impacts to their habitat within their nesting territories. None of the alternatives would change the way bald eagle nesting territories would be managed. SMZs adjacent to large streams and lakes provide for the retention of large trees that may be used as nest sites in the future. The amount of potentially suitable nest sites protected within SMZs under each alternative would depend on SMZ width and activity restrictions within SMZs. Alternative 3 would be expected to result in the greatest number of potentially suitable nest sites, followed in descending order by Alternatives 2, 4, and 1.

Golden Eagle

Affected Environment

Like bald eagles, golden eagles receive protections under the Bald and Golden Eagle Act and the Migratory Bird Treaty Act. A 1978 amendment to BGEPA authorized the 'taking' of golden eagle nests that interfere with resource development. The USFWS is authorized to issue permits for the removal of inactive nests that interfere with resource operations (e.g., mining, timber extraction) as long as the taking is compatible with preservation of the area nesting population (50 CFR 22.3). Golden eagles are also considered a "potential species of concern" in Montana, because current or limited information suggests that the species may potentially be vulnerable within the state or that more information is needed before an accurate status assessment can be made (MNHP 2008c).

Golden eagles are found year-round throughout Montana (MFWP 2009). They frequently nest on rocky outcrops, cliff faces, and buttes and occasionally nest in large diameter trees (R. Domenech 2009, personal communication). Nesting territories typically occur near open grassland or shrub steppe habitats (Kochert et al. 2002). Nests are large – sometimes over six feet in diameter – and vary in density from 55 to 105 square miles per pair (MFWP 2009). Availability of food and preferable nesting sites ultimately determines nesting density. Golden eagles typically forage in open habitats such as grasslands or shrublands where jackrabbits, hares, ground squirrels, and carrion make up the majority of their diet. Occasionally, golden eagles prey on young deer or

antelope, waterfowl, grouse, weasels, and skunks. In the winter, golden eagles typically prefer open habitats and tend to avoid urban, agricultural, and forested areas (Kochert et al. 2002).

Population data for golden eagles in the state of Montana and the planning area are limited. Several observations of breeding, foraging, and overwintering individuals have been documented throughout the state (MNHP 2009). Good et al. (2004) estimated that approximately 11,500 golden eagles populate two Bird Conservation Regions (BCRs) that encompass Montana (BCR 10 and BCR 17); population estimates for the state of Montana were not determined in the study. Some researchers estimate that approximately 900 breeding pairs are interspersed throughout the state (R. Domenech 2009, personal communication).

Primary risk factors to golden eagles include: accidental trauma as a result of collisions with vehicles, power lines, or other structures; electrocution; gunshot; incidental poisoning from pesticides, other toxins, consumption of prey exposed to chemicals, or toxic baits intended to attract other animals; and habitat loss and degradation resulting from shrubland wildfires, urbanization, energy development, mining, agriculture, and other activities that occur in golden eagle habitat (Kochert et al. 2002).

Environmental Consequences

Although DNRC Forest Management ARMs do not contain specific management standards for golden eagles, DNRC must continue to comply with the Bald and Golden Eagle Act and the Migratory Bird Treaty Act. Therefore, when encountering active golden eagle nests during forest management activities, DNRC typically implements something similar to the following strategy. DNRC staff conduct species occurrence searches of MNHP records for sensitive species and site reviews for each project. If a nest is found, DNRC checks with other local biologists to assist in developing site-specific protective measures that minimize risk of nest failure, nest abandonment, or harm to fledglings. Such measures include setting up 'no disturbance zones' and 'activity restriction periods' around active golden eagle nests. DNRC also refers to suggested management guidelines set forth in publications such as the *Interagency Rocky Mountain Front Wildlife Monitoring/Evaluation Program Management Guidelines for Selected Species* (1987) and *Draft Guidelines for Raptor Protection from Human and Land Use Disturbances, Mountain-Prairie Region* (USFWS 2005c).

None of the alternatives would change the way golden eagle nesting territories would be managed. Under all four alternatives, all identified active golden eagle nests that may be affected by forest management activities would be protected utilizing the strategy described above. Timber harvest, road and trail construction and use, and various other activities would be conducted in a manner that would minimize disturbance to eagles during the nesting season.

Black-backed Woodpecker

Affected Environment

The black-backed woodpecker is a state-listed and DNRC-listed sensitive species. Black-backed woodpeckers are non-migratory residents west of the Rocky Mountain Front in Montana (MPIF 2000) and have been documented near the CLO, NWLO, and SWLO. This species inhabits dense boreal and montane coniferous forests between 2,500 and 5,500 feet elevation (Dixon and Saab 2000; MPIF 2000). Black-backed woodpeckers are strongly associated with standing, recently dead

trees, especially burned forests (Hutto 1995). Kreisel (1998) and Hutto (1995) found that black-backed woodpecker densities are greatest in stands up to 5 years following fires. They forage almost exclusively on standing dead trees, and rarely on logs or on the ground (Kreisel 1998). Black-backed woodpeckers are primary excavators and cavity nesters (Caton [1996] in Dixon and Saab 2000). They show a strong preference for nesting in clumps of snags, rather than isolated snags (Saab and Dudley 1998). For nesting, they strongly prefer burned, unlogged Douglas-fir stands with a pre-fire canopy closure greater than 70 percent (Saab et al. 2002), but will also use lodgepole pine and ponderosa pine (Hitchcox 1996).

The population and distribution of black-backed woodpecker are limited by the availability of recently burned stands and by post-fire salvage harvest (Hutto 1995; MPIF 2000). Hillis et al. (2002) concluded that fire suppression between 1940 and 1988 had significantly reduced the acreage of available recently burned forest below historical levels for black-backed woodpeckers, likely causing a decline in black-backed woodpecker population numbers. Between 1988 and 2000, they found the acreage of recent burns had increased above historical conditions, providing an opportunity for black-backed woodpecker population expansion. Black-backed woodpeckers are sensitive to post-fire salvage harvest (Hillis et al. 2002). In a study in northwestern Montana, Hitchcox (1996) reported that 10 of 10 black-backed woodpecker nests found were in unlogged burned stands of Douglas-fir, lodgepole, and ponderosa pine. No nests were found in salvage-logged burned stands.

Environmental Consequences

Under all four alternatives, DNRC would continue to analyze effects on a project-by-project basis and implement conservations measures for black-backed woodpecker habitat as they do under the current ARMs. These measures apply in areas that meet the definition of black-backed woodpecker habitat (fire-killed stands of trees greater than 40 acres, less than 5 years since disturbance, and with more than 40 trees per acre that are greater than or equal to 9 inches dbh). They include minimizing mechanized activity within 0.25 mile of black-backed woodpecker habitat from April 15 through July 1 and retaining approximately 10 percent of burned acreage in an unharvested condition. None of the alternatives includes any provisions to change the ARMs that address the harvest of standing snags.

Effects on black-backed woodpeckers would be related primarily to the anticipated availability of recently burned stands and to the conduct of salvage harvest in burned areas. As noted in Section 4.2.2.7 (Wildfire), the frequency of wildfire is likely to increase somewhat on forested trust lands through the 50-year Permit term under all four alternatives. This is not due to management activities or commitments in the alternatives, but instead to outside factors such as persistent drought, increasingly warmer and drier summers, and the influence of management on adjacent ownerships.

Salvage harvest and fuel wood collection in recently burned stands reduces the availability of snags black-backed woodpeckers need for foraging, nesting, and roosting. In addition, the removal of unburned, diseased trees, and snags eliminates potential cavity sites and a forage source (Goggans et al. 1989; MPIF 2000). Post-fire management that reduces the availability of these habitat features below critical levels may lead to local or widespread declines in black-backed woodpecker populations (Dixon and Saab 2000; USFS 2002).

Under all four alternatives, the design and implementation of salvage operations would take into consideration minimum recruitment levels for snags and CWD. These measures, along with those implemented in areas identified as black-backed woodpecker habitat, would be expected to ensure the maintenance of adequate amounts of habitat in the HCP project area. The effects of salvage harvest on black-backed woodpeckers and their habitat are not expected to differ appreciably among the alternatives. Under the action alternatives, large fires that have 90 percent stand mortality on 1,000 to 10,000 acres in the HCP project area within a sixth-order HUC containing a Tier 1 RMZ, and where 20 percent or more of the watershed area has been subject to 90 percent stand mortality, would trigger a changed circumstance. In such situations, post-fire salvage harvest would require development of a site-specific plan in cooperation with the USFWS to address watershed mitigation concerns. Although such plans would be required infrequently and would focus on the needs of aquatic HCP-covered species, some minimization and mitigation measures that might be implemented (e.g., retaining remnants of unburned timber) would be expected to benefit black-backed woodpeckers.

Flammulated Owl

Affected Environment

The flammulated owl is a state-listed and DNRC-listed sensitive species. Flammulated owls are typically present in the northern portion of their range between May and October (McCallum 1994a). Their distribution in Montana is principally west of the Continental Divide (MPIF 2000). Flammulated owls are strongly associated with mid-elevation, relatively open, dry old-growth conifer forests that include ponderosa pine and Douglas-fir (McCallum 1994b; MPIF 2000; Hillis et al. 2002). Flammulated owls require forest stands that are larger than 20 acres, are on south- or west-facing slopes, have abundant large trees or snags, and are situated less than 400 feet from areas that provide suitable foraging sites and cover for roosting (Linkhart et al. 1998; McCallum 1994b; MPIF 2000). Foraging habitat includes open-canopy forest and grassy openings; dense patches of xeric shrub or sapling/pole conifers provide cover for roosting and singing (Wright et al. 1997; McCallum 1994b). Flammulated owls require cavities for nesting, preferring large (greater than 20 inches dbh) Douglas-fir or ponderosa pine as nest trees, and therefore depend on healthy populations of medium- and large-sized woodpeckers, such as flickers and pileated woodpeckers (McCallum 1994b,c; Powers et al. 1996; Yasuda 2001).

Based on the loss of favored habitat, the population of flammulated owls has likely declined and may continue to decline (McCallum 1994c; MPIF 2000). In a landscape-level assessment of flammulated owl habitat conditions in USFS Region One (western and central Montana), Hillis et al. (2002) concluded that as much as 88 percent of suitable flammulated owl habitat has been lost since the implementation of fire suppression and logging. Flammulated owls are sensitive to a fire suppression management regime, which may allow shrub and conifer encroachment into grasslands, may lead to denser forest stands, and may increase the risk of catastrophic, stand-replacing fires (McCallum 1994a; Hillis et al. 2002). Large, old pines may become more susceptible to insects and disease if Douglas-fir is allowed to become more common in ponderosa pine stands (Hillis et al. 2002). Flammulated owls may tolerate or even benefit from selective harvest that maintains 35 to 65 percent canopy closure if large trees or snags are retained, but clearcutting renders stands unsuitable as flammulated owl habitat for decades (McCallum 1994a; Marshall et al. 1996; Wright et al. 1997).

Environmental Consequences

Under all four alternatives, DNRC would continue to analyze effects on a project-by-project basis and implement conservation measures for flammulated owl habitat as they do under the current ARMs. In areas identified as preferred habitat for flammulated owls, this includes commitments to favor seral ponderosa pine where appropriate (based on historical fire regimes); favor older-aged ponderosa pine for retention or recruitment on warm, dry slopes; manage for open stand conditions on warm, dry slopes; and promote non-uniform stands while retaining occasional dense patches of conifer regeneration and shrubs. None of the alternatives includes any provisions to change the ARMs that address the removal of standing snags. DNRC's policies and management approach for old-growth stands would not change under the action alternatives. DNRC would continue to have the same old-growth management options it currently has as outlined in ARM 36.11.418 (old-growth restoration, maintenance, and removal). The relative amounts of selective harvest versus clearcut harvest would not be expected to vary under the alternatives.

Effects on flammulated owls would be related primarily to anticipated changes in the availability of seral and older-aged ponderosa pine, as well as the frequency and severity of wildfire. Under all four alternatives, DNRC would continue to manage stands toward DFC cover types (see Section 4.2.1.2, Forest Vegetation Management). The emphasis on managing to increase the abundance of ponderosa pine (rather than Douglas-fir) on warm, dry sites would be expected to increase the availability of suitable habitat for flammulated owls. Under all alternatives in managed areas, seral cover types dominated by shade-intolerant species (e.g., ponderosa pine, western larch/Douglas-fir, and western white pine) would be expected to increase in the project area, while late-successional cover types dominated by shade-tolerant species would be expected to decrease. The inverse would be true in unmanaged stands. Attainment of DFCs is discussed further in Section 4.2.2.3 (Cover Types and Desired Future Conditions).

As noted in Section 4.2.2.7 (Wildfire), the frequency of wildfire is likely to increase somewhat on trust lands through the 50-year Permit term under all four alternatives. This is not due to management activities or commitments in the alternatives, but instead to outside factors, such as persistent drought, increasingly warmer and drier summers, and the influence of management on adjacent ownerships. Under all four alternatives, DNRC would continue to suppress human-caused and naturally ignited fires, possibly contributing to further erosion of the quality and quantity of suitable habitat for flammulated owls.

Pileated Woodpecker

Affected Environment

The pileated woodpecker is a state-listed and DNRC-listed sensitive species. Pileated woodpeckers are non-migratory, year-round residents limited to the northwest portion of the state, west of the forested eastern slopes of the Rocky Mountains (McClelland and McClelland 1999). Pileated woodpeckers are found at elevations up to 6,200 feet in western Montana and 7,400 feet east of the Continental Divide (Hillis et al. 2003), occasionally moving to lower elevations in the local area during winter (Bull and Jackson 1995; MPIF 2000). They inhabit dense coniferous and deciduous forests with large trees (greater than 20 inches dbh) that provide habitat for nesting and roosting (Bull and Jackson 1995; MPIF 2000). Pileated woodpeckers prefer large, contiguous blocks of mature and old-growth forest with a canopy closure between 50 and 75 percent (Schroeder 1983; Bonar 1999; McClelland and McClelland 1999; MPIF 2000). They may occur in younger stands if

trees or snags remain that are adequate for nesting (Aubry and Raley 2002). Pileated woodpeckers eat insects, which they locate primarily by excavating cavities in dead wood (snags, logs, stumps) and trees (Bull and Jackson 1995; Aubry and Raley 2002).

Pileated woodpeckers require large trees infected with heart rot, which allows excavation to the tree core. Older forests typically contain more diseased trees and, therefore, potential cavity sites (McClellan and McClellan 1999; Aubry and Raley 2002). The large excavations that pileated woodpeckers create for nesting, roosting, and foraging provide habitat for a variety of cavity-dependent wildlife, including several species of owls and ducks, American marten, and fisher (Aubry and Raley 2002). Pileated woodpeckers are very sensitive to stand-replacing timber harvest in mature and old-growth forests, and the associated removal of diseased trees, snags, and logs (Schroeder 1983; McClelland and McClelland 1999).

Environmental Consequences

Under all four alternatives, DNRC would continue to analyze effects on a project-by-project basis and implement conservations measures for pileated woodpecker habitat as they do under the current ARMs. This includes a commitment to retain pileated woodpecker habitat in patches that are as large as possible where it is feasible to do so. None of the alternatives includes any provisions to change the ARMs that address the removal of standing snags or LWD. DNRC's policies and management approach for old-growth stands would not change under the action alternatives. DNRC would continue to have the same old-growth management options it currently has as outlined in ARM 36.11.418 (old-growth restoration, maintenance, and removal).

Effects on pileated woodpeckers would be related primarily to the anticipated availability of mature and old-growth forest, where suitable large trees and snags are most likely to occur. As noted in Section 4.2.2.4 (Size Class), the proportion of HCP project area lands in the mature sawtimber size class (which includes old growth) at Year 50 would vary from 55 percent to 59 percent under the alternatives (Table 4.2-15). Alternatives 2 and 4 would yield slightly lower proportions of acres in the mature sawtimber size class, compared to Alternatives 1 and 3. This difference can be attributed to the increased acreage available for active management in the Stillwater State Forest under Alternatives 2 and 4. The reduced availability of potentially suitable habitat for pileated woodpeckers under Alternatives 2 and 4 may result in localized reductions in woodpecker numbers (particularly in the Stillwater Block), but the differences among the alternatives are small and are not likely to appreciably affect habitat availability for pileated woodpeckers in the project area. Alternative 3 would yield a slightly higher proportion of mature sawtimber than the other alternatives. This can be attributed in part to the wider riparian zones associated with this alternative, retention of the Stillwater Core, and additional provisions for lynx denning habitat.

Under all alternatives, the amount of old growth on HCP project area lands is expected to decrease because the proportion of lands in the oldest age classes is currently high and is likely to receive the most harvesting (Section 4.2.2.5, Age Class). The magnitude of the decrease is likely to vary among alternatives, particularly at the localized scale. Under Alternatives 2 and 4, the increased flexibility for management in the Stillwater Core would result in greater decreases in the amount of old growth in the Stillwater Core, compared to Alternatives 1 and 3. Under Alternative 3, the decrease in the amount of old growth is likely to be less than other alternatives, at least within riparian areas. The increased riparian area width outlined by the conservation strategies for this

alternative would promote the development of old growth in those areas because they would essentially be excluded from active management.

Peregrine Falcon

Affected Environment

The peregrine falcon is a state-listed and DNRC-listed sensitive species. Falcon populations declined throughout North America during the middle of the 20th century, but rebounded in response to a ban on the use of dichloro-diphenyl-trichloroethane (DDT) and other chlorinated hydrocarbons, combined with a successful captive breeding, rearing, and release program (USFWS 2003). The peregrine falcon was delisted on August 25, 1999 (64 FR 46542-46558). The number of active nest sites in Montana has increased steadily over the last decade, growing from 13 in 1994 to 68 in 2007 (Montana Peregrine Institute 2008).

Peregrine falcons usually nest on cliffs, typically 150 feet or more in height. Eggs are laid and young are reared in small caves or on ledges. The birds are sensitive to disturbance during all phases of the nesting season (Pacific Coast American Peregrine Falcon Recovery Team 1982; Towry 1987). Disturbance can cause desertion of eggs or young, and later in the breeding season can cause older nestlings to fledge prematurely (Hays and Milner 2004). Peregrine falcons arrive in northern breeding areas between late April and early May; departure begins in late August to early September. In the Bozeman area, observations in the 1950s and 1960s suggested migration periods around May 5 and September 15 (Skaar 1969).

Environmental Consequences

Under all four alternatives, DNRC would continue to analyze effects on a project-by-project basis and implement conservations measures for peregrine falcon habitat as they do under the current ARMs. These measures are designed to minimize the risk of disturbance to nesting falcons by limiting human activity and the use of mechanized equipment within 0.5 mile of known nest sites. No ARMs address the potential for disturbance at undetected nest sites (e.g., by limiting activity near cliffs that provide suitable nesting habitat); however, DNRC considers this species in fine-filter analyses on all projects and evaluates the presence of cliff features that may offer potential nest sites. If potential nest sites are detected, DNRC consults with other local biologists, experts, and databases (such as the MNHP database) to determine if nesting birds have been detected at the site. Because large cliff features are their primary limiting habitat element in western Montana, there are few potential influencing factors associated with any of the alternatives other than those and the associated mitigations described above. Thus, no appreciable effects or differing effects to peregrines or their habitat would be anticipated under any of the alternatives considered.

Big Game Species

Affected Environment

The planning area provides habitat for nine big game species with open or restricted hunting and trapping seasons (Table E4-11 in Appendix E, EIS Tables). Species listed as big game are hunted at some time during the year and are a vital economic resource for both Montana residents and out-of-state hunters (MFWP 2003c). Of these species, upland forests and/or forested riparian areas are important habitats for black bear, mountain lion, mule deer, white-tailed deer, elk, and moose (MFWP 2005a).

Preferred habitat by pronghorn, mountain goat, and bighorn sheep would not be affected appreciably by forest management projects proposed in the HCP project area; therefore, there will be no further discussion of these species in this EIS. The presence of mature forest is particularly important for deer, elk, and moose winter range. The planning area contains over 16 million acres of winter range for these species, approximately 1 million of which is on trust lands and approximately 383,098 acres of which is in the HCP project area (Table 4.9-31). Management of big game species on trust lands is addressed under ARM 36.11.443 (Table E4-8 in Appendix E, EIS Tables).

TABLE 4.9-31. BIG GAME WINTER RANGE IN THE PLANNING AREA AND HCP PROJECT AREA

Species	Acres in the Planning Area (All Ownerships)	Acres (Percent) on Trust Lands within the Planning Area		Acres (Percent) within the HCP Project Area	
White-tailed deer	2,164,509	142,521	(6.6)	100,793	(4.7)
Mule deer	8,885,160	578,107	(6.5)	123,280	(1.4)
Elk	8,660,960	568,840	(6.6)	236,344	(2.7)
Moose	5,151,573	262,059	(5.1)	182,996	(3.6)
Total[1]	**16,807,993**	**1,042,126**	**(6.2)**	**383,098**	**(2.3)**

[1] Given area may provide winter range for more than one ungulate species. Consequently, the total acreages are not the sum of the acreages for each species.
Source: DNRC (2008a).

Elk and deer herds inhabit the planning area. Both elk and deer utilize coniferous forests interspersed with natural or man-made openings (mountain meadows, grasslands, burns, and logged areas) (MFWP 2005a). They require some basic habitat components, such as security cover, shelter (may use to maintain thermal equilibrium), and adequate forage areas. High open road densities reduce habitat effectiveness. Good winter range is critical for their survival and should comprise adequate forage and cover combinations at lower elevations (MFWP 2005a). In addition, summer range, migration corridors, and calving or fawning areas with adequate forage and cover are important for survival of these species. Big game species, such as elk, deer, and moose are prey for species such as grizzly bears, mountain lions, and wolves, and are of importance in the ecological relationships of forested ecosystems for the large carnivores.

Hunting is a popular sport in Montana, and several hunting seasons are focused mostly during the fall and winter on trust lands within the planning area for big game species such as black bear, mountain lion, elk, deer, and moose, although a spring black bear hunt is offered as well (MFWP 2007c). Refer to Sections 4.10 (Recreation) and 4.13 (Socioeconomics) for further details on hunting.

Environmental Consequences

This analysis will focus on the six primary big game species: black bears, mountain lions, mule deer, white-tailed deer, elk, and moose. The four ungulate species are described in more detail, with greatest emphasis on elk, mule deer, and white-tailed deer.

Black bears are habitat generalists, utilizing a wide range of habitats. Because black bears are omnivores, foraging sites will be similar to grizzly bears; therefore, black bear habitat needs are

assumed to be met within the implementation of the grizzly bear conservation strategy on HCP project area lands in recovery zones and NROH. Refer to the discussion of environmental consequences in Sections 4.9.3.2 (Grizzly Bear) and 4.9.5 (Other Wildlife Species), as well as Table 4.9-24 and Table E4-7 in Appendix E (EIS Tables) for further information.

Mountain lions are also habitat generalists strongly influenced by deer and elk populations, because these species are their primary prey. Thus, many of the factors that affect the abundance of deer and elk can indirectly affect mountain lions for this reason. See the discussion of impacts to ungulates for these further details. It is not expected that mountain lions would be affected by any of the alternatives appreciably or differentially, other than as related to those parameters that may influence habitat suitability for elk, mule deer, and white-tailed deer as described below. Therefore, specific effects on mountain lions will not be addressed further, but should be inferred in the analysis of effects related to ungulates as described below.

Risk Factors

There are five habitat elements in the HCP project area that elk, mule deer, white-tailed deer, and moose require for maintaining adequate population levels – hiding and thermal cover, calving/fawning areas, winter range, summer range, and travel corridors.

Big game habitat would primarily be affected by the grizzly bear conservation strategy, as timing of harvests, location relative to spring bear habitat and security cover, as well as road closure options all would impact elk, deer, and moose to some degree. The aquatic conservation strategy would also affect use of riparian zones by moose, as well as deer and elk, because all these species utilize these highly productive zones for some, if not all, of their habitat requirements. The lynx conservation strategy contains habitat connectivity commitments that would assist in providing cover along riparian areas, saddles, and ridgetops that big game will utilize.

Primary factors from the conservation strategies discussed in the HCP that have the potential to affect the five habitat elements needed for big game species and that are used as evaluation criteria are:

- **Cover retention and location.** Size and spacing from cover stands, visual screening of units and roads, cover retention, and location of units with respect to wintering areas, calving/fawning areas and summer range
- **Road management.** Timing and location of road closures and road construction relative to the five habitat elements on the landscape
- **Spring management.** Spring management coinciding with calving/fawning areas
- **Security habitat.** Rest period commitments in relation to summer range and fall security needs.

Each of these primary factors that affect elk, white-tailed deer, mule deer, and moose will be discussed separately.

Cover Retention and Location

Location and size of units all potentially could affect how big game populations utilize their winter and summer range, as well as calving/fawning areas and migration corridors, depending on the

location of these units with respect to the critical elements of their range. Timing of harvesting next to a known calving area could have detrimental impacts to elk, for example.

Alternative 1: Current regulations that are part of Alternative 1 allow for consideration of all the factors mentioned above, and coordination with MFWP is encouraged; however, no specific mitigation is currently required when timber sales are planned to provide for specific cover retention needs.

Alternative 2, 3 and 4: Distance to visual screening (commitment GB-NR4) in NROH in all three action alternatives, and visual screening consisting of 100 feet of vegetation alongside open roads and clearcuts (commitment GB-RZ2) within the recovery zone for Alternatives 2 and 3 provide for escape cover adjacent to harvest units. This provides for better utilization of forage in clearcuts by elk and deer than that provided by Alternative 1. Analysis at the landscape scale does not allow for more detailed discussion of how harvest patterns associated with any of the alternatives would affect big game. That determination would have to be made at the project level. Refer to the discussion of Upland Forest Successional Stages and Cover Types in Section 4.9.7.1 (Wildlife Habitat Associations) and Table 4.2-15 in Section 4.2 (Forest Vegetation) for further information on effects of projected timber harvest upon successional stages by alternative.

In summary, Alternatives 2 or 3 provide the most complete mitigation package for the potential loss of cover during harvest activities. However, all alternatives would maintain an abundance of similar amounts of hiding cover (Table 4.9-17 in Section 4.9.3.2, Grizzly Bear) over the 50-year Permit term. Because more cover is retained within RMZs, SMZs, and WMZs in all action alternatives, where calving or fawning areas can be located throughout the HCP project area, this commitment in the grizzly bear conservation strategy would improve big game habitat in these areas.

None of the alternatives specifically limits the size of patches or how patch patterns would be represented through time on the landscape; thus, there would be no measurable differences between how any of the alternatives would affect these cover attributes for elk, deer, and moose over the Permit term.

Road Management

Alternative 1: Refer to Section 4.9.3.2 (Grizzly Bear) for a more detailed analysis of the differences between the alternatives regarding road amounts. In general, this alternative generally considers the needs of wildlife when considering construction of new roads on HCP project area lands. It also has provisions for repairing defective closures in the Stillwater Block and Swan River State Forest; however, there are no long-term commitments for a transportation plan in these areas, although a commitment to maintaining no more than 1 mi/mi^2 open road density is made in the Stillwater Block and within 33 percent of the BMUs subunits in the Swan River State Forest. Outside these areas, on scattered parcels in grizzly bear recovery zones, a commitment to not allow increases in open roads beyond 1 mi/mi^2, or increases on parcels that already exceed 1 mi/mi^2, is in place. Without the firm 50-year commitments provided in the proposed HCP, as specified in the transportation plans found in the action alternatives, it is likely that this alternative would result in more adverse effects on elk and deer using winter range, summer range, and critical fawning/calving habitat due to disturbance and displacement associated with greater road densities.

Alternative 2, 3, and 4: These alternatives provide improvements over the current situation. Conservation strategy commitments for grizzly bear regarding road closures, road density, and other aspects of a transportation plan in the Stillwater Block and Swan River State Forest would also benefit elk and deer. Lower road densities and closures in some areas for roads and gravel pits that would benefit grizzly bear would also promote habitat use of these same areas for big game. Therefore, alternatives that maintain the lowest road density and close the most roads and gravel pits are expected to benefit big game the most and have the least indirect effects from secondary use of roads, such as motorized and non-motorized use. This would be especially important within big game winter range and during fall hunting season. Refer to Section 4.9.3.2 (Grizzly Bear) for a more detailed description of the effects of roads across the landscape and their relation to wildlife species, as well as a comparison between alternatives.

In summary, of the three action alternatives, Alternative 3 offers more restrictive seasonal closures and vehicle use limitations; therefore, this alternative would have lower direct and indirect impacts from the transportation package of any of the alternatives. Alternative 2 also provides a reasonably protective transportation package that also would allow some management flexibility, while Alternative 4 retains most of the same features as Alternative 2, but also would offer the most management flexibility.

Spring Management

Alternative 1: There are no specific spring management restrictions incorporated in this alternative for elk and deer, with the exception of spring management restrictions associated with the Swan Agreement; therefore, no additional protections are in place during fawning/calving season for deer and elk compared with the action alternatives.

Alternatives 2, 3 and 4: Spring management periods for grizzly bear coincide with fawning and calving seasons to a degree, allowing for secure fawning/calving habitat during that important time of year. Spring management and rest period commitments would only improve use of summer range and calving or fawning areas. Alternatives 2 and 3 are very similar and provide the most restrictive spring management of all the alternatives, with Alternative 3 providing the most restrictions on timing of and activities allowed within spring bear habitat, and potentially important summer range for deer and elk. Refer to Section 4.9.3.2 (Grizzly Bear) for a complete description of details regarding spring management and rest periods between the alternatives. Alternative 4 is similar to Alternative 2, but allows more flexibility for site preparation, road maintenance, and bridge replacement. These spring management scenarios would keep human activities, both direct (such as harvesting) and indirect (such as motorized recreation), away from important calving/fawning habitat during the critical times of the year within recovery zones and NROH, and should adequately promote habitat use by big game in most years, particularly under Alternative 3, which provides more restrictive spring management in NROH.

Security Habitat

Alternative 1: In this alternative, the Stillwater Block has no Class A and Class B land designations (as proposed in the action alternatives), which provide for additional mitigation for forest management and transportation issues, but does maintain the Stillwater Core. Within the Swan River State Forest, there are rest periods (3 years active management followed by 6 years rest) implemented in cooperation with the USFS and Plum Creek to provide for large blocks of undisturbed habitat available for summer and fall use.

Alternatives 2, 3, and 4: Designation of Class A and B lands in the Stillwater Block offers commitments for grizzly bear that provide for a rest period schedule, limiting how often harvesting can occur, imposing seasonal restriction for roads, and retaining hiding cover. These commitments apply to all the action alternatives in the Stillwater Block. In addition, Alternative 3 maintains the same security core as Alternative 1, whereas Alternatives 2 and 4 do not. The Swan River State Forest and scattered parcels also have similar restrictions in place that provide quiet areas free from commercial management during 8-year rest periods. In Alternatives 2 and 4, the CYE would provide for more restrictive rest periods than other areas, with Alternative 3 providing even more restrictions than these two alternatives regarding road use and construction. All of these restrictions would only benefit big game use of the five habitat elements (cover, calving/fawning areas, winter range, summer range, and travel corridors). Alternative 3 provides the most security core, Class A and B land designations, and provisions for securing road closures; therefore, it is likely to provide the most cover and secure, undisturbed habitat for summering, calving, or fawning areas.

In summary, Alternatives 2 and 3 appear to provide improved cover and increased road closures throughout the grizzly bear NROH and recovery zones as they relate to big game habitat needs, with Alternative 3 committed to a few more restrictions than Alternative 2 as they apply to all but the first criterion (hiding and thermal cover). Alternative 4 is either the same as Alternative 2 or contains slightly fewer restrictions, providing more management flexibility. None of the alternatives specifically limits the size of patches or how patch patterns would be represented through time on the landscape; thus, there would be no measurable differences between how any of the alternatives would affect these cover attributes for elk, deer, and moose over the Permit term.

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4.10 RECREATION

This section addresses recreational opportunities (including access and recreational activities) on HCP project area lands, and evaluates how the alternatives may affect recreational access and the quality of the recreational experience. Analysis of recreational access considers both motorized access (i.e., open roads) and non-motorized access (primarily on roads with seasonal or year-round use restrictions). Analysis of the recreational experience considers visual resources and the availability of different types of recreational opportunities.

4.10.1 AFFECTED ENVIRONMENT

This section describes recreational access and recreational uses of forested trust lands.

4.10.1.1 Introduction

In 2005, Montana hosted more than 10 million non-resident visitors. Total spending impacts of these travelers exceeded $3.9 billion, which generated almost 46,000 jobs and $211 million in state and local tax revenues (ITRR 2006). The most frequently cited reasons for visiting Montana were the state's parks, mountains, and forests. Recreational activities (driving for pleasure, wildlife watching, day hiking, and picnicking) made up four of the five most popular activities for non-residents (ITRR 2006). During 2004, visitors to western Montana spent more than $1.17 billion in the pursuit of nature-based activities (Swanson 2004). Recreationists value public lands as places to relieve stress and connect with nature (Swanson 2004).

Montana residents and non-residents enjoy recreation opportunities on DNRC-managed trust lands, as well as lands managed by MFWP; federal agencies including NPS, USFS, BLM; and various local and private entities. The planning area wholly or partially encompasses two national parks (Glacier and Yellowstone), 10 national forests, 36 state parks, a national battlefield, a national historical site, along with numerous local parks and other outdoor recreation areas. The planning area also encompasses numerous surface water recreational resources, including reservoirs, Flathead Lake, and the Flathead Wild and Scenic River (Figures D-6A through D-6C in Appendix D, EIS Figures).

Western Montana is characterized by rugged, beautiful landscape and abundant year-round recreation opportunities. Springtime offers wildflowers and whitewater rafting. In summer there are numerous opportunities for fishing, hiking, horseback riding, boating, and berry picking. The most popular activity in autumn is hunting, and winter is a time for skiing, snowmobiling, sledding, and ice fishing. Other popular outdoor recreation activities in the planning area include mountain biking, bird watching, camping, climbing, off-road vehicle use, and photography.

4.10.1.2 Recreational Access

Trust lands are open to recreational use if they are legally accessible and have not been closed or restricted to such use by rule or by DNRC (ARMs 36.25.146 through 162). Legally accessible state lands are those that can be accessed by public roads, public rights-of-way, or public easements; by public waters that are recreationally navigable under the Stream Access Law; by adjacent federal, state, county, or municipal land if that land is open to public use; or by permission of an adjacent

landowner (ARM 36.25.145(15)). Of 5.2 million acres of trust lands statewide, about 3.6 to 3.7 million acres (70 percent) are legally accessible from public land (Frickel 2005, personal communication). No estimates are available for the proportion of trust lands in the planning area or HCP project area that are legally accessible.

Certain lands are categorically closed to recreational use, meaning recreational activities are prohibited. Such closures include agricultural lands (between planting and harvest) as well as lands leased for home sites or cabin sites, active military purposes, or commercial purposes. Some tracts are temporarily, seasonally, or permanently closed or restricted on a site-specific basis. Reasons for such site-specific closures or restrictions may include the protection of public safety, livestock activities, threatened and endangered or sensitive species, or a lessee's improvements. In addition, some tracts may be closed for short durations for management purposes (e.g., concentration of livestock, recent weed spraying, timber harvest). The amount of land closed for management purposes fluctuates in accordance with on-the-ground activities.

Most recreational users gain access to trust lands in the planning area by driving, and most access in the HCP project area is for hunting, fishing, or wildlife-associated recreation (see Section 4.10.1.3, Recreational Use, below). There are 5,426 miles of road on trust lands within the planning area. Of this total, 4,005 miles are classified as open to public access (including highways and county roads), 49 miles are restricted seasonally to motorized public access, and 1,199 miles are restricted year-round (Table 4.4-2). The remaining road miles are split between abandoned (115 miles) and reclaimed (58 miles). The Swan River State Forest has 105 miles (49 percent of all road miles) designated for spring closure (Table 2-3 in Appendix A, HCP). Of 363 miles of road in the Stillwater Block, 230 miles are closed year-round to motorized public access and 6 miles are closed seasonally. The West Fork Road in the Stillwater Block provides access (in combination with other roads) to Upper Whitefish Lake from U.S. Highway 93 at Stryker. The road is open to motorized public access year-round, but is typically closed by snow between November and the end of May, during which it receives moderately heavy snowmobile use.

Future management of public access on roads is guided by road management rules (ARM 36.11.421). These rules dictate that DNRC shall plan transportation systems that (1) result in the minimum number of road miles; (2) consider public access, adjacent landowners, and resource protection and management, including forestry practices, fire protection, and wildlife habitat; and (3) include implementation of BMPs. DNRC also considers the obliteration of roads that are not primary access routes during project-level analysis.

Illegal recreational use occurs on some trust lands and primarily includes motorized use of restricted roads, pioneering unauthorized roads or trails, and establishment of illegal campsites. Illegal use is greatest where urban developments are in proximity to trust lands, particularly where terrain and vegetation pose few obstacles to cross-country travel. Concerns associated with illegal recreational use include but are not limited to motorized use of restricted roads that threaten grizzly bear or other wildlife security needs, illegally pioneered roads or trails near bull trout streams, and the potential for human-caused wildfires. DNRC efforts to control such illegal uses are ongoing.

4.10.1.3 Recreational Use

Hunting, fishing, and wildlife-associated recreation are the most popular recreational activities on trust lands. Other recreational activities on trust lands include motorized recreation, bicycling, hiking, cabin leases, camping, and outfitting (leading big game hunting trips or guided rafting and fishing tours). Primary winter recreation activities include downhill skiing, snowboarding, cross-country skiing, snowmobiling, snowshoeing, and ice fishing (MFWP 2003b).

Recreation on trust lands has been increasing steadily in recent years. Although DNRC does not collect recreational use data, sales of recreational use licenses provide an indicator of general trends. All recreational activities (including hunting, fishing, hiking, camping, picnicking, etc.) on trust lands require a recreational use license from DNRC. The type of license required depends on the type of activity conducted. A general recreational use license is required for most types of non-commercial or non-concentrated activities. A special recreational use license is required for commercial use (such as outfitting) or concentrated use (e.g., large group activities). DNRC tracks the number of general use licenses sold annually, as well as the revenue generated by sales of special use licenses. Recreational use license sales showed an increasing trend between 1999 and 2006 (Table 4.10-1).

TABLE 4.10-1. STATEWIDE RECREATIONAL USE LICENSE SALES, LICENSE YEARS 1999 TO 2006[1]

License Type	1999	2000	2001	2002	2003	2004	2005	2006
General (number sold)	36,479	37,605	39,089	47,764	50,795	434,106[2]	464,432[3]	446,171
Special (revenues)	$86,170	$98,950	$104,200	$114,600	$91,200	$112,300	$109,378	$103,613

[1] The license year extends from March 1 through the last day of the following February.
[2] Includes 4,200 general licenses and 429,906 conservation licenses.
[3] Includes 6,029 general licenses and 458,403 conservation licenses.
Source: DNRC (2005c, 2005d, 2006a).

Note that the apparent sharp increase in general use license sales between 2003 and 2004 reflects the implementation of a new policy, under which the cost of a conservation license (required by MFWP as a prerequisite for purchasing a hunting, fishing, or trapping license) was increased to cover the fee for recreational use of trust lands. Note also that the values in Table 4.10-1 represent license sales statewide rather than within the planning area. Data on licenses sold or revenues from licenses sold specifically within the planning area are not available. In addition, the location of a license sale does not necessarily reflect the location of the recreation activity; a person purchasing a license in one area is not required to recreate on state land in the same area.

Hunting, Fishing, and Wildlife-associated Recreation

DNRC has estimated that 96 to 97 percent of the recreational use conducted on trust lands statewide is for hunting, fishing, or wildlife-associated recreation, with the remaining 3 to 4 percent coming from other types of uses.

In 2001, an estimated 871,000 state residents and non-residents 16 years old and older fished, hunted, or participated in wildlife-watching activities in Montana (USFWS and U.S. Census Bureau 2001) (Table 4.10-2). Approximately 40 percent of respondents fished, 26 percent hunted, and 79 percent participated in wildlife watching. The sum of these numbers exceeds 100 percent

because many people participated in more than one activity. The activity levels of younger participants (Montana residents ages 6 to 15) were also estimated for the year 2000. In the separate survey of the younger age group, an estimated 66,000 (50 percent of Montana residents between 6 and 15 years old) fished, 18,000 (13 percent) hunted, and 50,000 (42 percent) watched wildlife (USFWS and U.S. Census Bureau 2001).

TABLE 4.10-2. FISHING, HUNTING, AND WILDLIFE WATCHING IN MONTANA FOR YEARS 1991, 1996, AND 2001

Activity	1991	1996	2001
Total Participants			**871,000**
Fishing	342,000	336,000	349,000
Hunting	223,000	194,000	229,000
Wildlife Watching	558,000	394,000	687,000
Total Days Engaged in Activity			
Fishing	3,156,000	2,617,000	4,068,000
Hunting	2,591,000	1,807,000	2,442,000
Wildlife Watching	4,317,000	2,697,000	4,612,000

Source: USFWS and U.S. Census Bureau (2001).

In all survey years, wildlife watching accounted for the greatest number of person-days spent in wildlife-based recreation in Montana (Table 4.10-2). Montana is reported to be a leading state in birdwatching, with a participation rate of 44 percent, double the national average and highest of any state (Lomax 2005). In 2001, the number of person-days devoted to wildlife watching was nearly double the number of days devoted to hunting. Nearly 1.6 million (65 percent) of the hunting days in Montana took place solely or partially on public land (USFWS and U.S. Census Bureau 2001). Nearly 2.7 million visitors to Montana participated in wildlife watching, ranking behind only shopping as the most popular recreational activity (MFWP 2003b). Fishing was listed as an activity by 1.2 million visitors. Of the non-resident wildlife-watching participants, approximately 94 percent visited public areas (USFWS and U.S. Census Bureau 2001). National survey data do not differentiate between federal, state, and other public land. For the three western travel regions (Glacier, Gold West, and Yellowstone), the top attractions for non-resident visitors in 2004 were mountains, open space, rivers, wildlife, and the national parks (Swanson 2004).

The amount of hunting that occurs on trust lands can be indirectly estimated by assuming that trust lands are used at a rate that is roughly proportionate to their distribution on the landscape. In other words, if 10 percent of the area of a particular hunting district consists of trust lands, then approximately 10 percent of the hunting activity in that district may be assumed to occur on those lands. This is likely an underestimate, because many private landowners do not permit hunting on their property. Statewide, approximately 52 percent of hunting days occurred wholly or partially on private land (USFWS and U.S. Census Bureau 2001). This suggests that public land is used more heavily than private land, because private land accounts for approximately 65 percent of the total area of the state.

Different hunting district boundaries are established for different game species. The total number of districts that overlap the planning area varies from 23 for black bear to 121 for deer and elk (Table 4.10-3). In most districts, HCP project area lands make up a small proportion of the area

open to hunting; more than half of all hunting districts have less than 1 percent HCP project area lands. With only one exception, HCP project area lands make up no more than 20 percent of any hunting district for any species. The exception is deer and elk district 282 (the Blackfoot-Clearwater Wildlife Management Area), 26 percent of which consists of HCP project area lands.

TABLE 4.10-3. PROPORTION OF HCP PROJECT AREA LANDS IN MFWP HUNTING DISTRICTS IN THE PLANNING AREA

	Number of Hunting Districts, by Proportion of HCP Project Area Lands within District Boundaries						Maximum Percentage
Species	**0%**	**0 - 1%**	**1 - 5%**	**5 - 10%**	**10 - 20%**	**> 20%**	
Bighorn Sheep	14	8	10	2	1	0	15
Black Bear	4	8	8	2	1	0	14
Deer and Elk	54	28	31	4	3	1	26
Moose	34	23	21	4	1	0	17
Mountain Goat	26	12	9	0	1	0	10
Pronghorn	20	10	8	0	0	0	4

Source: MFWP (2005c).

Two watchable wildlife destinations are found in the HCP project area, and both were built by other organizations. These two sites are the Old Squeezer Loop and a nature trail at Point Pleasant campground. The *Montana Wildlife Viewing Guide* includes a description of the Old Squeezer Loop on the Swan River State Forest (Fischer and Fischer 1990). The site, noted for its birding opportunities, includes two loop trails and several benches for wildlife viewing. Labor for construction of the facility was provided by the Montana Department of Corrections. The site is not maintained by DNRC. The other site is an interpretive nature trail built by Friends of the Wild Swan at the Point Pleasant campground also in the Swan River State Forest. This 2-mile loop trail features an old logging site and old-growth forest, with a wide variety of labeled tree and plant species.

Other Recreation Uses

In general, DNRC does not maintain trails, winter recreation areas, or other facilities devoted to outdoor recreation. DNRC does, however, manage lands that support some of these facilities, and licenses other parties to groom and maintain snowmobile and cross-country ski trails on trust lands. Three commercial snowmobile outfitters and the Flathead Snowmobile Association have land use licenses for grooming trails in the Stillwater Unit The Stillwater has also issued land use licenses for a commercial dogsled outfitter and a commercial groomed Nordic ski track. In addition, there are several ski trail licenses on the Swan River State Forest, the Libby Unit, and the Kalispell Unit.

Recreational Trail Use

Trails on trust lands are used for non-motorized recreation (e.g., hiking, horseback riding, mountain biking) and for motorized recreation (e.g., off-road vehicle use, motocross, snowmobiling). Several trails occur in the planning area, but only a small proportion of the total trail length is on trust lands. In many cases, both the trailhead and the destination are on National Forest lands. Of 9,878 miles of trail in the planning area, only 170 miles (2 percent) are on trust lands; of these, approximately 85 percent are within the HCP project area (Table 4.10-4). Bicyclists ride on trails and on both open

and closed roads in the planning area. The Great Divide bike route from Canada to New Mexico passes through the Stillwater State Forest.

TABLE 4.10-4. MILES OF RECREATIONAL TRAILS IN THE PLANNING AREA BY LAND OFFICE

	NWLO	SWLO	CLO	Planning Area Total
DNRC – HCP Project Area Lands	84	56	5	144
DNRC – Non-HCP Lands	6	18	2	26
Other Ownerships	4,478	4,412	818	9,708
Total	**4,568**	**4,486**	**824**	**9,878**

Source: DNRC (2008a).

Some non-motorized recreation takes place on roads that are closed to motorized public access. Stryker basin and Herrig Lake on the Stillwater State Forest are popular destinations that recreational users approach on horseback, bicycle, or foot. Motorized public access was curtailed in the 1990s. Herrig Lake was stocked with fish in the past, but it is likely that this practice stopped when the road was closed.

Outfitting

Outfitting is another common recreational use of trust lands. Outfitters include guides leading big game hunting trips (e.g., for mountain lion and black bear) and guides who offer guided rafting and fishing tours. Popular put-in and take-out points for rafting outfitters in the HCP project area include Cedar Creek and Point Pleasant on the Swan River State Forest, and a tract on the Blackfoot River on the Clearwater Unit.

Campgrounds

There are five campgrounds on HCP project area lands, and all are located on the Stillwater and Swan River State Forests. These are the Spring Creek and Upper Whitefish Lake campgrounds on the Stillwater (18 sites total) and the Soup Creek, Point Pleasant, and Cedar Creek campgrounds on the Swan (24 sites total). Most camping occurs between Memorial Day and Labor Day; campgrounds also receive considerable use during the hunting season. In addition to the campgrounds identified above, Camp Westana Girl Scout Camp is located at Lower Stillwater Lake. Use of the site is managed through the special recreational use license program. In addition to scouting activities, the site is used by other gatherings (e.g., family reunions and weddings).

Dispersed Uses

Dispersed camping occurs on trust lands throughout the planning area, with rivers and lakes being common destinations. In addition to the activities described above, other popular activities in the planning area include berry picking, hiking, birding, and mushroom hunting. Mushroom picking has become an annual spring activity for both recreational and commercial pickers. Mushroom and berry picking on trust land requires a general recreational use license for private gathering or a special recreational use license for commercial collection.

Cabin Leases

Other recreation facilities on trust lands include cabin sites, which are leased to private parties for a 15-year term. DNRC administers more than 750 cabin and home sites statewide, of which 668 are in the planning area. The number of leased cabin sites on HCP project area lands cannot be readily determined from available data. Many cabin lease sites adjoin stream- or lake-front property. Approximately 1,200 acres (0.07 percent) of trust lands in the planning area are leased as cabin sites.

4.10.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences analysis for recreation addresses the potential effects of the alternatives on recreational opportunities in the analysis area. These include effects on recreational access and effects on the quality of the recreational experience on HCP project area lands. The analyses associated with the three action alternatives address covered forest management activities, which do not include the management of recreation areas, campgrounds, or other recreational facilities. Analyses in this section focus on potential direct and indirect effects on recreation that might arise from changes in management of transportation (Section 4.4) and forest vegetation (Section 4.2) within the HCP project area.

4.10.2.1 Introduction and Evaluation Criteria

Forestland management has the potential to affect recreation resources primarily through road management and timber harvest. The relationship between roads and the recreational experience is complex. Roads can provide access for certain popular recreation activities but can permanently reduce recreation opportunities in wild, backcountry areas. Roads that are open to public motorized use provide ready access to recreation destinations. This can be particularly valuable for persons engaged in hunting, fishing, or wildlife viewing, which are the most common recreational uses of HCP project area lands. Closed roads offer opportunities for hiking, mountain biking, berry picking, and other non-motorized activities. Economic value analyses have found that hiking is more highly valued in unroaded areas, while cross-country skiing is more highly valued in roaded areas (Walsh et al. 1984). Sediment from roads can reduce fish populations and catch rates, affecting the value of some sites as tribal or sport fisheries (e.g., Hueth et al. 1988; Rice 1989). Management that degrades scenic quality or reduces the abundance and catchability of fish has been found to diminish recreation benefits (Hueth et al. 1988).

The recreational experience can be affected by the amount and location of areas where timber harvest occurs. Timber harvest can either enhance or detract from the quality of recreational experiences, affecting different users in various ways. Recreational users who seek opportunities for hunting, berry picking, or scenic views may be attracted to areas that have recently been subject to even-aged timber harvest, where little forest canopy is present. Conversely, recreational users who seek experiences in old-growth forest or wild, backcountry areas may avoid such areas; in addition, the quality of the recreational experience for these users may be diminished in areas where managed stands are a prominent feature of the visual landscape.

The potential effects of the alternatives on recreational access and quality of experience are based on the following evaluation criteria:

Recreational Access

- Miles of road by classification
- Changes in forest management policies affecting access to roads.

Quality of Experience

- Amount and location of timber harvest.

For this analysis, the potential effects of the alternatives on recreational access are addressed qualitatively, based on the quantitative analyses in Sections 4.4 (Transportation) and 4.2 (Forest Vegetation). Discussions examine anticipated changes in the location and mileage of roads that would be open or closed to motorized public access, or that would be open with seasonal restrictions. Expected changes in the amounts and location of timber harvest are also discussed. In addition, potential changes in access to popular recreation destinations are addressed.

Public and administrative access to trust lands was identified as an issue during public scoping. Many commenters expressed concern about possible road closures. They were concerned that the HCP would result in more road closures and affect their recreational access to trust lands or affect DNRC's ability to manage trust lands.

Others asked how lands would be treated under the HCP for those areas that are primarily used for recreation. None of the alternatives addressed in this EIS address the management of recreation areas. As noted in Section 4.10.1.3 (Recreational Use), DNRC does not maintain trails, winter recreation areas, or other facilities devoted to outdoor recreation. Neither the no-action alternative nor any of the three action alternatives would be expected to result in changes to special recreational use and land use licenses.

4.10.2.2 Alternative 1 (No Action)

Recreational Access

As described in the discussion of environmental consequences for transportation under Alternative 1 (Section 4.4.2.2), DNRC would continue to direct transportation management under Alternative 1 according to the existing road management rules (ARM 36.11.421). These include minimizing the extent of roads on trust lands while also considering the needs for public access.

Based on the analysis of roads needed for the permit term, the total amount of roads in the HCP project area would increase by more than 1,400 miles by year 50 (Table 4.4-6). Nearly all of this increase would be in the form of roads that are closed to motorized public access. In all parts of the HCP project area, increases in the amount of roads open to non-motorized public access would result in expanded opportunities for hiking, mountain biking, berry picking, and other such activities. The amount of roads open to motorized public access in the project area would increase by approximately 41 miles by year 50, with all open road increases occurring in the scattered parcels of the SWLO, CLO, and NWLO. This change (4 percent above current conditions) does not

represent a substantial increase over current total open road miles, and is not expected to result in any discernible differences in recreational access in these areas. No additional miles of road open to motorized public access would be expected in the Stillwater Block or the Swan River State Forest.

Opportunities for wintertime recreation (e.g., snowmobiling, cross-country skiing, snowshoeing) would not be expected to change from current conditions. Wintertime motorized access to groomed trails and other licensed facilities would continue. It is not likely that any new areas would be opened to motorized access. It is worth noting that winter recreation maps indicate areas that are open or closed to motorized use, but not all users are aware of these closures. Snowmobiles are not confined to roads; even on roads, deep snow can render closure signs and structures invisible. It is likely that a considerable amount of snowmobile use currently occurs in areas that are closed to motorized access, and would continue to occur under this and the other alternatives.

In the Stillwater Block, there would be no long-term transportation commitments. Due to existing commitments, any increase in the mileage of road open for motorized public access would likely be offset by the imposition of access restrictions (either seasonal or year-round closures) of an equal amount of open road elsewhere in the Stillwater Block. The amount of roads with year-round restrictions would increase by 17 miles, which would provide additional opportunities for non-motorized recreation. Recreational access to destinations that currently lack motorized public access (e.g., Stryker basin, Herrig Lake) would likely continue to occur on horseback, foot, or bicycle.

The road system in the Swan River State Forest would continue to be managed in accordance with the terms of the Swan Agreement. Similar to the Stillwater Block, any increases in open road mileage would likely be offset by decreases elsewhere on the forest. The amount of roads with year-round restrictions is predicted to increase by 70 miles by year 50, resulting in increased opportunities for non-motorized recreation on closed roads. If the Swan Agreement is terminated, transportation management decisions would be made on a case-by-case basis, and would be constrained by requirements to avoid or mitigate for take under the ESA. DNRC would look to the rulemaking process to identify ways of ensuring both ESA compliance and continued public access, and would look for opportunities for collaboration with the USFS. It is likely that the miles of open road on the Swan River State Forest would not change substantially if the Swan Agreement is terminated under Alternative 1.

Current road management rules require DNRC to inspect all road closures (inside grizzly bear recovery zones as well as outside) at least every 5 years (ARM 36.11.421(14)), with repairs to ineffective road closures assigned a high priority when allocating time and budget, but no schedule for completion established. On the Stillwater Block and Swan River State Forest, DNRC is required to inspect all road closures annually, and make necessary repairs within one operating season. DNRC would continue to meet this requirement for roads on the Stillwater Block and Swan River State Forest. However, DNRC currently does not meet the 5-year inspection cycle for roads on scattered parcels, and if it cannot determine a way to meet this requirement in the future, it may modify the rules. If any roads that are managed as closed to motorized public access have ineffective closure structures, they could in fact be accessible for up to 5 years – or possibly longer – depending on how long it takes to identify the problem, allocate funding, and complete the repairs. Based on this consideration, the numbers of miles of road open for motorized public access in

Table 4.4-6 likely represent underestimates of the total miles of road on which motorized recreational access is possible.

Quality of Recreational Experience

Based on the output of the forest management model that was used to calculate sustainable yield (Section 4.2.2.2, Sustainable Yield), 53.2 million board feet of timber would be harvested annually from trust lands under Alternative 1 (Table 4.2-14). Opportunities for hunting, berry picking, and other activities in young, open-canopy forest would likely increase in areas where management would occur. For some users, the quality of the recreational experience may decrease due to the increased visibility of these managed stands. Timber management increases, along with increases in the amount of roads, would likely reduce the amount of wild, backcountry areas available for recreation.

4.10.2.3 Alternative 2 (Proposed HCP)

Recreational Access

As under Alternative 1, DNRC would continue to minimize the extent of roads on trust lands while also considering the needs for public access. Based on the transportation model, increases in total road miles in the HCP project area at year 50 would be approximately 21 miles lower overall than Alternative 1 (Table 4.4-6). Similar to that alternative, nearly all of the new road miles would be closed to motorized public access. The most notable differences from Alternative 1 would be in the Stillwater Block and the Swan River State Forest, where the amount of road open year-round or seasonally to motorized public access would increase by 29 and up to 23 miles, respectively. These differences would stem from the implementation of transportation plans for the blocked lands in those two areas, which are addressed in greater detail below.

Under the transportation plan for the Stillwater Block, the amount of existing roads open year-round for all motorized public access would decrease by 18.3 miles (15 percent) (Table 4.4-6). In contrast, the amount of existing roads available for motorized public access with seasonal restrictions would increase nearly ten-fold, from 6.4 miles to 54 miles, of which 29.8 miles would be closed in spring (April 1 to June 30) and 24.2 miles would be closed in spring and fall (April 1 to June 30 and September 16 to November 30) (Table 2-2 in Appendix A, HCP). Compared to current conditions, the amount of roads in the Stillwater Block that would be open during the summer and autumn months (i.e., that would have no restrictions or spring restrictions only) would increase by 15.3 miles (Table 2-2 in Appendix A, HCP). This would result in increased opportunities for motorized access for hunting, fishing, berry picking, hiking, picnicking, and numerous other activities.

Increases in the amount of roads in the Stillwater Block that are seasonally available to motorized public use would occur at several popular destination points, including Stryker Basin and Herrig Lake, which would be open from July 1 through September 15 (Figure D-4 in Appendix D, EIS Figures). Recreational use of Herrig Lake would likely increase, which could include an increase in fishing (depending on whether MFWP resumed stocking the lake). Additional roads would be opened seasonally along the southern extent of Stryker Ridge and near Woods Lake in the Stillwater State Forest, and along Coal Ridge in the Coal Creek State Forest. The West Fork Road, which

provides access to Upper Whitefish Lake from the north, would be closed to motorized public access from April 1 to June 30. Access to Upper Whitefish Lake during the month of June (when the road typically melts out) would be from the south only. Driving times would probably be about the same, but persons wishing to complete a scenic loop drive would have to wait until the West Fork Road opens on July 1.

The proposed HCP also includes a transportation plan for the Swan River State Forest. This plan would be implemented only if the Swan Agreement is terminated. Under the Swan Agreement in its current form, no changes are anticipated in the miles of road open to motorized public access. If the agreement is terminated and replaced by the HCP Swan River State Forest transportation plan, the amount of open or seasonally restricted road may increase from the current 43.4 miles to as much as 66.5 miles (Table 4.4-6). As a result, opportunities for motorized recreation would increase. Opportunities for non-motorized recreation on closed roads would also increase from current conditions, but not as much as under Alternative 1 (Table 4.4-6). The actual amount of additional road that would be open to motorized public access at any time in the future would depend on the status of access agreements with adjacent landowners, as well as the timing of individual landowners' decisions to pursue access across parcels of trust lands. Additional opportunities may become available for motorized recreation on the Swan River State Forest, but no specific destinations would be targeted for increased access. No new restrictions would be placed on any roads that are currently open to public motorized access under Alternative 2.

In most areas throughout the planning area, winter recreation opportunities would not be expected to differ from those anticipated under Alternative 1. Seasonal openings of additional areas to motorized use in the Stillwater Block and the Swan River State Forest (if the Swan Agreement is terminated) may create additional opportunities for snowmobile use. Several areas that are currently closed year-round would be open to motorized use between December 1 (or earlier, for roads with no autumn restrictions) and March 31. As noted in the discussion of effects under Alternative 1, a considerable amount of snowmobile use would likely continue to occur in areas that are closed to motorized access. Formally opening some areas to motorized use during winter may encourage some users to increase their activities in areas where use is authorized. The spring closure of the West Fork Road could reduce some late-season opportunities, but opportunities in that area are typically limited by patchy snow starting in April. Vehicular access to groomed trails and other licensed facilities would not be expected to differ from Alternative 1, because roads in the Stillwater Block (where the most changes would be likely to occur) are under snow through most of the winter season.

Under Alternative 2, all primary road closures in grizzly bear recovery zones would be inspected annually, and repairs would be completed within one year of identifying the problem. Compared to Alternative 1, this would be expected to lead to a decline in the mileage of roads where motorized public use occurs even though the management goal of the road includes use restrictions. For this reason, the numbers of miles of road open for motorized public access in Table 4.4-6 likely represent underestimates of the total miles of road on which motorized recreational access is possible, but to a lesser degree than under Alternative 1. Outside of the recovery zones, DNRC's inspection and repair of road closures would be expected to continue as under Alternative 1.

Quality of Recreational Experience

The annual sustainable yield under Alternative 2 would be 58 million board feet per year (Table 4.2-14), 9 percent more than under Alternative 1. The most noticeable difference between Alternatives 1 and 2 would be in the Stillwater Block, where increased access would allow more timber management in the Stillwater Core under Alternative 2. Under this alternative, approximately 15 million board feet would be harvested annually in the Stillwater Unit, up from approximately 10 million board feet under Alternative 1 (Table 4.2-14). Opportunities for hunting, berry picking, and other activities in young, open-canopy forest would likely increase in areas where management would occur, particularly in the Stillwater Core. For some users, the quality of the recreational experience may decrease due to the increased visibility of these managed stands. Timber management increases, along with increases in the amount of roads, would likely reduce the amount of wild, backcountry areas available for recreation, particularly in the Stillwater Core.

4.10.2.4 Alternative 3 (Increased Conservation HCP)

Recreational Access

For scattered parcels, the effects of Alternative 3 on recreational access would be lower than those described above for Alternatives 1 and 2. Effects in the Stillwater Block would be almost identical to those described under Alternative 1, while effects in the Swan River State Forest would be the same as those described under Alternative 2. Based on the transportation model, the total amount of road miles open for motorized public access under this alternative would be slightly higher than under Alternative 1 and lower than under Alternative 2. Increases in total road miles would be approximately 2 percent less than Alternative 1 at year 50, resulting in slightly fewer opportunities for road-based recreation, mostly in the scattered parcels (Table 4.4-6). Effects on recreational access in all seasons would be as described for Alternative 1.

The most prominent difference between Alternatives 3 and 2 would be in the Stillwater Block, where DNRC would implement the same transportation commitments as under Alternative 1, along with additional provisions within the Stillwater Core. Similar to Alternative 1, Alternative 3 would not be expected to result in any change in the amount of roads open for motorized public access.

Under this alternative, the HCP transportation plan (described under Alternative 2) for the Swan River State Forest would be implemented if the Swan Agreement is terminated during the Permit term. Under this plan, miles of open or seasonally restricted road could increase by as much as 23 miles, providing additional opportunities for motorized recreation.

Under Alternative 3, DNRC would commit to repairing all ineffective closures in grizzly bear recovery zones during the same operating season in which they are identified, to the extent that time, workforce, and contracting funds are available. Any repairs not completed during the same season would be completed within 1 year of being identified. Compared to Alternative 1, this would be expected to reduce the miles of road on which motorized public use occurs even though the management goal for those roads already includes use restrictions. Fewer miles would be open for *de facto* motorized public access than under Alternative 2, because repairs would occur more frequently, although inspection frequency would be the same.

Quality of Recreational Experience

The annual sustainable yield under Alternative 3 would be approximately 51 million board feet per year (Table 4.2-14), 5 percent less than under Alternative 1. In the HCP project area as a whole, increases in the amount of forest harvested would be smaller than those anticipated under Alternative 1. Similar to Alternative 1, access restrictions in the Stillwater Block would limit opportunities for active forest management there; the average annual harvest from the Stillwater Unit would be approximately 10 million board feet. Similar to Alternative 1, opportunities for hunting, berry picking, and other activities in young, open-canopy forest would likely increase. However, in the Stillwater Block, these increases would not be as great as under Alternative 2. For some users, the quality of the recreational experience may decrease due to the increased visibility of these managed stands. Timber management increases and increases in the amount of roads would likely reduce the amount of wild, backcountry areas available for recreation.

4.10.2.5 Alternative 4 (Increased Management Flexibility HCP)

Recreational Access

Alternative 4 would result in the same total length of new roads in the HCP project area and road management classification as Alternative 2 in all portions of the HCP project area.

The effects associated with Alternative 4 on recreational access would be almost identical to those described above for Alternative 2. The total amount of road miles (including roads open for motorized public access, as well as those with seasonal or year-round restrictions) would be the same as under Alternative 2, and the transportation plans for the Stillwater Block and the Swan River State Forest would be implemented as described. Under Alternative 4, DNRC would commit to inspecting road closures on scattered parcels in grizzly bear recovery zones every 2 years, and repairing ineffective closures within 1 year of identifying the problem. Compared to Alternative 1, this would be expected to reduce the miles of road on which motorized public use occurs even though the management goal for those roads already includes use restrictions. The miles of *de facto* open road under Alternative 4 would be greater than under Alternatives 2 and 3, however, because inspections and repairs would occur less often.

Quality of Recreational Experience

The amount and location of timber harvest under Alternative 4 would be very similar to what is described above for Alternative 2.

4.10.2.6 Summary

Under all four alternatives, increases in the amount of roads open to non-motorized public access would result in expanded opportunities for hiking, mountain biking, berry picking, and other such activities throughout the HCP project area. Under Alternatives 2 and 4, implementation of a transportation plan in the Stillwater Block would result in increased opportunities for motorized public access as compared to Alternatives 1 and 3 due to greater access to the Stillwater Core. In the Swan River State Forest, access would remain the same for all alternatives if the Swan Agreement remains in effect; otherwise, opportunities for motorized public access could increase under the action alternatives. As a result of timber harvest under all alternatives, opportunities for

hunting, berry picking, and other activities in young, open-canopy forest would likely increase. On the other hand, opportunities for recreation in unmanaged areas would be reduced, and the quality of the recreational experience for some users may decrease due to the increased visibility of managed stands. Under the action alternatives, increases in the amount of roads available for motorized public access would likely reduce the amount of wild, backcountry areas available for recreation, particularly in the Stillwater Block.

4.11 VISUAL RESOURCES

Visual resources are generally regarded as important because they enhance quality of life, influence the quality of recreational experiences, and, in some cases, affect the value of adjacent properties. Forestlands are considered to be an important visual or scenic resource by many Montana residents and visitors. For local residents, forest scenery contributes to casual and inexpensive recreation experiences near home, and to a general sense of well-being, security, and stability. In addition, the scenery in western Montana is a factor in attracting tourists and new residents to the area. For both residents and visitors, the scenic condition influences opinions concerning ecosystem health and forestland management. This section describes the affected environment and environmental consequences of the no-action and action alternatives on visual resources.

4.11.1 AFFECTED ENVIRONMENT

This section first identifies the regulations governing visual resources and how DNRC incorporates visual resource considerations in timber sale planning. This discussion is followed by a description of the landscape characteristics within the planning area and a summary of visual resource concerns related to forest management activities.

4.11.1.1 Regulatory Framework

The Forest Management ARMs contain no specific provisions for the consideration of potential visual impacts. Also, standard timber sale contract language provides no such guidance. Further, the ARMs do not stipulate re-planting requirements or a maximum size for clearcut harvest areas, which would reduce the visual impacts of timber harvest.

Some commitments for other resources, however, can lessen the visual impact of forest management activities. For example, on the Stillwater Block, Swan River State Forest, and scattered parcels in grizzly bear recovery zones, DNRC is required to provide visual screening adjacent to open roads to the extent practicable (ARMs 36.11.431 through 433). Visual screening is defined as vegetation or topography (or both) providing visual obstruction that makes it difficult to see into adjacent areas from the roadbed. The distance required to provide visual screening, typically 100 feet, is dependent on the type and density of cover available.

The ARMs also contain provisions for the maintenance of forest cover along streams. Where streams occur parallel to roads, such cover would also be expected to provide some visual screening for road users. Within the grizzly bear management areas identified under ARMs 36.11.431 through 433 (see above), DNRC is required to maintain hiding cover, where available, along all riparian zones. Hiding cover is defined as vegetation that provides visual screening capable of obstructing from view 90 percent of an adult grizzly bear at 200 feet. In addition, DNRC is required to consider providing hiding cover near riparian zones on scattered parcels in the CLO within the NCDE (ARM 36.11.434).

The SMZ Law contains provisions for management standards that require the retention of trees along all streams, specific lakes, and other bodies of water in Montana. Clearcutting is prohibited within SMZs, which extend at least 50 feet from streams. On slopes greater than 35 percent, the SMZ width on Class 1 and 2 streams and lakes is extended to 100 feet. For lakes and all streams,

the SMZ width must be extended to incorporate adjacent wetlands that intercept the SMZ boundary. Harvest within a Class 1 SMZ must retain at least 50 percent of trees greater than or equal to 8 inches dbh, or 10 trees greater than or equal to 8 inches dbh for every 100 feet, on both sides of a stream, whichever is greater. Harvest within a Class 2 SMZ must retain at least 50 percent of trees greater than or equal to 8 inches dbh, or 5 trees greater than or equal to 8 inches dbh for every 100 feet, on both sides of a stream, whichever is greater. Harvest within a Class 3 SMZ must retain sub-merchantable trees and shrubs. Tree densities provided by the minimum retention levels would not be expected to result in full visual screening along streams.

On fish-bearing streams, SMZs are supplemented by RMZs. The total RMZ width, including the SMZ, is equal to the average SPTH at age 100 years. Harvest conducted within the combined SMZ and RMZ must retain all bank edge trees and retain enough other trees to ensure adequate levels of shade and potential LWD recruitment to the stream. These requirements provide a greater level of visual screening for fish-bearing streams, compared to other waterbodies.

When visual resources are identified as an environmental issue for a project, DNRC may incorporate mitigations into the timber sale design to address effects on visual resources. Visual resources are more frequently addressed on scattered parcels rather than blocked lands. This is because scattered parcels often have more neighboring landowners who raise concerns about visual resources. Examples of measures that may be implemented to mitigate potential adverse effects on visual resources include the following:

- Uneven unit boundaries, to simulate a more natural appearance
- Feathering (the use of partial harvesting techniques between clearcuts and neighboring stands of trees to reduce the appearance of change between harvested and non-harvested sites)
- Retention of intermediate-sized trees in seed tree clumps
- Retention of additional canopy cover on the downslope side of roads in steep areas, to avoid eroding soils and vegetation loss
- Restrictions on skidding and site preparation.

4.11.1.2 Landscape Characteristics

The following descriptions of the landscape characteristics of the planning area are summarized from DNRC's Real Estate Management Programmatic Plan final EIS (DNRC 2004f) and supplemented by information from *Ecoregions of Montana* (Woods et al. 2002).

Northwest Land Office

Land administered by the NWLO lies within the mountainous and rugged Northern Rockies and Canadian Rockies ecoregions. Much of this region is classified as open mountains, a distinctive setting with high, detached mountain ranges separated by broad, smooth-floored valleys. The primary valley in this region is the Flathead Valley. Mountainous portions of the region are characterized by closely spaced ranges separated by narrow, restricted valleys. Elevations range from approximately 2,000 feet to more than 10,000 feet above sea level. The state's lowest elevation of 1,800 feet above sea level occurs within this region, where the Kootenai River flows

into Idaho. Manmade features are readily observable on many of the mountains surrounding the lowlands. These include roads and clearcuts resulting from logging operations on a variety of land ownerships, areas of historical mining activity, transmission lines and other utility corridors, scattered rural residences, and the effects of grazing.

Forestlands in western Montana encompass a variety of forest types. North-facing slopes and floodplain terraces along most rivers in the NWLO support mixed, relatively dense conifer forests. South-facing floodplain terraces, benches, and slopes in this land office are characterized by more open forests dominated by ponderosa pine and Douglas-fir forests.

The Stillwater State Forest, which includes approximately 39,600 acres of grizzly bear security core, is in the NWLO. The predominant forest cover types in the Stillwater Core are subalpine fir and mixed conifer. Although management activities are currently restricted, the area has been managed heavily in the past. Most of the Stillwater Core is not visible from any local towns, major highways, or main forest roads. The primary exception is the west slope of Stryker Ridge, on which some roads, skid trails, and old clearcuts are visible from U.S. Highway 93 north of Kalispell. In addition, forest roads on the east side of Stryker Ridge offer views into some areas of the Stillwater Core.

Southwest Land Office

Most of the area of the SWLO lies within the Middle Rockies ecoregion, although the scattered parcels associated with the Sula State Forest, near Hamilton, are in the Idaho Batholith ecoregion. The landscape of the Middle Rockies ecoregion is dominated by detached mountain ranges separated by numerous broad, grass- or shrub-covered valleys. The Idaho Batholith ecoregion is typically mountainous, deeply dissected, and partially glaciated. Elevations in the SWLO range from approximately 3,000 feet in the Bitterroot Valley to more than 10,000 feet in the Anaconda and Flint Creek ranges. As with the NWLO, man-made features are readily observable on many of the surrounding mountains.

Forestlands in the SWLO are similar to those described for the NWLO, with north-facing slopes and floodplain terraces along most rivers supporting mixed, relatively dense conifer forests. South-facing floodplain terraces, benches, and slopes are characterized by more open forests dominated by ponderosa pine and Douglas-fir forests.

Central Land Office

Land administered by the CLO encompasses diverse ecoregions, ranging from the Rocky Mountain Front in the northwest, to the Northwestern Glaciated Plains and the Northwestern Great Plains in the east, to the Middle Rockies in the south and southwest. HCP project area lands are all in the Middle Rockies ecoregion, with characteristics similar to those of the SWLO. Elevations range from approximately 4,500 feet to 10,000 feet. Forestlands in the CLO include coniferous forests providing the dominant colors, with shrubs, grasses, and deciduous trees providing seasonal variations.

4.11.1.3 Visual Resource Concerns Affected by Forest Management Activities

Assessing scenic values is generally a subjective exercise; scenic quality is typically determined by evaluating the overall character and diversity of landform, vegetation, color, water, and man-made

features in a landscape. Typically, more complex or diverse natural landscapes are considered to have higher scenic quality than landscapes with less complex features. Visual impacts of human activities are commonly assessed on the basis of contrast (e.g., form, line, color, and texture) to the surrounding landscape. Examples of forest management activities that may affect scenic values include road construction and intensive timber harvest, such as clearcutting or heavy thinning.

Viewers experience landscapes at different scales, depending on the distance from the observer. At close range (typically less than 1,000 feet), leaves, trunks, branches, and other features of individual trees are discernable. At distances up to 3 or 5 miles, individual trees are still visible but do not stand out distinctly from the landscape. At greater distances, the visual experience is defined by broad changes in foliage and topography. Changes that are visible from nearby (e.g., light thinning treatments) may not be readily apparent at greater distances. Conversely, an observer may find a clearcut to look unappealing when viewed from a distance, but appreciate the vistas available from within the clearcut.

Primary areas where forest-related visual concerns exist at the landscape scale include major highway corridors, cities and towns, and residential areas near managed forestlands. Areas where visual resources are experienced at a more immediate scale include trails and other recreation areas. Forested landscapes in these areas are often highly visible to the public and can be managed to reduce the visual impact of harvest and road-building activities.

Forest management practices may be particularly relevant near roadways that have been designated as scenic drives. Of 27 designated scenic byways and scenic drives in the state of Montana, 24 are wholly or partially within the planning area (Travel Montana 2005). This includes five congressionally recognized national scenic byways and two back country byways. Five scenic drives occur in the vicinity of HCP project area lands in the NWLO. These include the Lake Koocanusa and St. Regis Paradise scenic byways and the Bull River Valley, Clark Fork, and Seeley Swan scenic drives. In the SWLO, the Garnet Back Country Byway and the Bitterroot Valley scenic drive pass through areas with appreciable amounts of HCP project area lands. No designated scenic drives occur near HCP project area lands in the CLO.

4.11.2 ENVIRONMENTAL CONSEQUENCES

The environmental consequences analysis for visual resources addresses the potential effects of the alternatives on scenic quality in the planning area. This effects analysis considers changes that are visible both at the landscape scale (i.e., apparent to residents and users of scenic drives) and at the local scale (i.e., apparent to recreational and other users of HCP project area lands).

4.11.2.1 Introduction and Evaluation Criteria

Analyses in this section focus on potential direct and indirect effects on visual resources that might arise from changes in the amount and location of timber harvest (see Section 4.2.2, Environmental Consequences) and the amount and location of road building (see Section 4.4.2, Environmental Consequences) under the alternatives. The analysis of effects for each alternative also addresses any changes in Forest Management Rules that may reduce the visual impacts of timber harvest.

For this analysis, comparisons of the potential effects of the alternatives on the visual landscape are based on the following evaluation criteria:

- Expected changes in the amount and location of timber harvest
- The location and magnitude of expected changes in road miles.

As noted above in Section 4.11.1.3 (Visual Resource Concerns Affected by Forest Management Activities), assessing scenic values can be a subjective exercise. It is generally accepted, however, that timber harvest affects visual resources by changing the visible characteristics (e.g., crown cover, size class) of the forested landscape. The type of timber harvest employed also influences visual impacts. Even-aged harvest techniques (e.g., clearcut harvest or heavy thinning) typically result in more dramatic changes in the crown cover, size class, and age class of the residual stand, compared to uneven-aged management (selective removal of single trees or groups of trees within a harvest unit). Notably, at the HCP project area scale, no discernable differences would be expected among the four alternatives with regard to crown cover or size class (see Section 4.2, Forest Vegetation). The alternatives do differ, however, in terms of the modeled amount and location of timber harvest that would occur (Table 4.2-14). The basis of these differences is the amount of area available for forest management, particularly in the Stillwater Core. In any given area, the effects on visual resources would be greater under alternatives with a higher annual harvest rate, compared to those with a lower rate.

Analysis of the visual effects from roads is based on changes in the total miles of road on HCP project area lands, as presented in Table 4.4-6, and whether the amount of change between alternatives would be enough to detect a visual difference.

Under any of the four alternatives, the ARMs will continue to have no specific provisions for the consideration of visual impacts associated with forest management on trust lands. DNRC will continue to seek opportunities to mitigate for the visual impacts of timber harvest at the project level, when such impacts are identified as an issue. The amount of timber harvest is not expected to vary substantially from year to year. In addition, DNRC will endeavor to minimize new road construction.

4.11.2.2 Alternative 1 (No Action)

Under Alternative 1, DNRC would continue to retain visual screening where practicable along open roads within grizzly bear recovery zones. Residual tree densities provided by SMZ requirements would provide additional visual screening for roads that parallel fish-bearing streams. These measures would continue to reduce the visibility of even-aged harvest units from adjacent roads, although recently harvested areas would be visible in mid-range and distant views.

Approximately 53.2 million board feet of timber would be harvested annually from trust lands statewide under Alternative 1 (Table 4.2-14). Over the 50-year Permit term, the amount of forest harvested would likely result in a noticeable increase in the amount of visibly modified forestland. Access restrictions in the Stillwater State Forest would limit opportunities for active forest management there; as a result, a smaller proportion of the Stillwater Block would undergo visual impacts, compared to other areas.

Based on the t analysis of roads needed for the permit term, the total amount of roads in the HCP project area would increase by more than 1,400 miles by year 50 (Table 4.4-6). Abandoned or reclaimed roads would make up approximately 20 percent of the increased mileage; as time passes, vegetation may grow on and over these roads, reducing their visual impact compared to maintained roads. In the Stillwater Block and the Swan River State Forest, limitations on the allowable amount of open roads would not prevent the construction of new roads. Although motorized public access restrictions on new and existing roads would be implemented to ensure no net increase in open road density, new roads would be visible from adjacent areas.

4.11.2.3 Alternative 2 (Proposed HCP)

Under Alternative 2, visual screening requirements would be similar to those described for Alternative 1, except that vegetation would be retained (through commitment GB-RZ2) between open roads and clearcut or seed tree harvest units within grizzly bear recovery zones (with some allowances), and not just where practicable. Within NROH and recovery zones, commitment GB-NR4 would impose an additional requirement that all portions of new clearcut and seed tree harvest units must be no more than 600 feet from visual screening. This requirement would have the effect of constraining the maximum size of such harvest units (or, for larger units, ensuring a relatively long, narrow shape) within grizzly bear NROH and recovery zones, thereby reducing their visual impact. Requirements for no-harvest buffers along HCP fish-bearing streams (commitment AQ-RM1) would likely provide some additional visual screening for nearby roads. Tree retention requirements along all other streams would be the same as required under Alternative 1.

The statewide annual sustainable yield under Alternative 2 would be 58 million board feet per year (Table 4.2-14), 9 percent more than under Alternative 1. Compared to Alternative 1, this larger amount of forest harvested each year would likely result in a larger increase in the amount of visibly modified forestland in the HCP project area. The most noticeable difference would be in the Stillwater Block, where increased access would allow more timber management in the Stillwater Core. Approximately 15 million board feet would be harvested annually in the Stillwater Unit, up from approximately 10 million board feet under Alternative 1 (Table 4.2-14). Changes in the amount of timber harvest in other land offices and other administrative units of the NWLO would be comparable to those anticipated under Alternative 1.

Compared to other areas, timber harvest in the Stillwater Unit would be more likely to result in visual impacts when viewed either from a distance or from nearby. This is because a greater proportion of timber management would occur as even-aged harvest in that area than in other areas. This would be particularly true in the Stillwater Core, which is mostly in the higher-elevation areas of the Stillwater Unit where the forest types are not conducive to uneven-aged management. Other logistical and operational challenges, such as the anticipated difficulty in accessing these sites and the limited options for harvesting methods (i.e., helicopter yarding in many situations), would also render even-aged management the most feasible option in many parts of the Stillwater Block. For these same reasons, many stands in the Stillwater Unit (and especially in the Stillwater Core) would have a relatively low priority for treatment because forest management at those sites would not be as cost-effective as management elsewhere.

Predicted increases in road miles under Alternative 2 would be almost identical to those anticipated for Alternative 1 (Table 4.4-6). Increases would be slightly smaller in all but two areas. In the

Swan River State Forest, there would be no difference in total road miles by the end of the Permit term between Alternatives 1 and 2. Increases in the Stillwater Block would be slightly larger than those anticipated under Alternative 1.

4.11.2.4 Alternative 3 (Increased Conservation HCP)

The vegetation retention commitments described under Alternative 2 for recovery zones (GB-RZ2) and NROH and recovery zones (GB-NR4) would be the same for Alternative 3, resulting in the same effect of reducing visual impacts of clearcut and seed tree harvest units from adjacent roads in these areas. Under Alternative 3, vegetation retention within a wider buffer along HCP fish-bearing streams (commitment AQ-RM1) would result in more visual screening for nearby roads as compared to Alternative 2.

The statewide annual sustainable yield under Alternative 3 would be approximately 51 million board feet per year (Table 4.2-14), 5 percent less than under Alternative 1. In the HCP project area as a whole, increases in the amount of visibly modified forestland would likely be smaller than those expected under Alternatives 1 and 2. Access restrictions in the Stillwater Block would limit opportunities for active forest management there; the average annual harvest from the Stillwater Unit would be approximately 10 million board feet, similar to the amount anticipated under Alternative 1.

In most areas, predicted increases in road miles under Alternative 3 would be smaller than those predicted for Alternatives 1 and 2 (Table 4.4-6). The greatest difference in road increases is in the scattered parcels of the NWLO, where total road miles would increase from a current value of 826.7 to 1,412.7 under Alternative 3 (compared to 1,456.6 miles under Alternative 2 and 1,469.0 miles under Alternative 1). These represent increases of 71, 76, and 78 percent, respectively, which are not likely to translate into a discernible difference in the visual landscape.

4.11.2.5 Alternative 4 (Increased Management Flexibility HCP)

Within NROH and recovery zones (commitment GB-NR4) and along HCP fish-bearing streams (commitment AQ-RM1), visual screening requirements under Alternative 4 would be the same as under Alternative 2, resulting in the same effect of reducing visual impacts of clearcut and seed tree harvest units from adjacent roads in these areas. Within recovery zones, visual screening requirements along open roads would be the same as those described for Alternative 1, and would therefore reduce the visibility of even-aged harvest units from adjacent roads to a lesser extent than under Alternatives 2 or 3.

Similar to Alternative 2, the statewide annual sustainable yield under Alternative 4 would be approximately 58 million board feet per year (Table 4.2-14). Consequently, the increase in amount of visibly modified forest would likely be the same. Similar to Alternative 2, Alternative 4 would allow increased access for timber management in the Stillwater Block. The logistical and operational constraints, as well as the effects on visual resources, would be similar under both alternatives.

In all areas, predicted increases in road miles under Alternative 4 would be identical to those modeled for Alternative 2 (Table 4.4-6), and the visual impacts would be the same.

4.11.2.6 Summary

Under all four alternatives, increases in the amount of roaded areas and forest in the non-stocked and seedling/sapling size classes would result in decreases in the amount of natural-appearing forested landscape. Such changes would be visible from roads (including scenic drives), trails, recreation areas, and viewpoints in the planning area. Under Alternatives 2 and 4, increased access in the Stillwater Core would result in more timber management (largely even-aged harvest), resulting in greater visual impacts than under Alternatives 1 or 3. Under all three action alternatives, slightly smaller increases in total road length at year 50 were predicted for the permit term, compared to Alternative 1, with the smallest increases expected to occur under Alternative 3. In all parts of the HCP project area, the visual impacts of roads would not be expected to differ substantially among the alternatives.

4.12 ARCHEOLOGICAL, HISTORICAL, CULTURAL, AND TRIBAL TRUST RESOURCES

4.12.1 AFFECTED ENVIRONMENT

This section describes the regulatory framework under which cultural, paleontological, and tribal trust resources are considered. It also provides a description of the types of cultural, paleontological, and tribal trust resources in the planning area and their relative abundance or frequency of occurrence.

Cultural resources include archaeological sites, historic sites, architectural properties, traditional cultural properties (TCPs), districts, landscapes, structures, features, or objects resulting from human activity. Cultural resources are non-renewable resources that can be either prehistoric and thousands of years old, or historic dating from 1805 (for Montana). They are recognized as tangible materials or sites, at least 50 years old, resulting from human behavior. Some cultural resource sites are known for the planning area that extend back several thousand years. As one moves forward in time, the number and variety of sites increases, mainly as a result of the increase in Native populations and, after 1860, European, Euroamerican, and Asian immigration and population increase.

Paleontological resources are fossilized plant and animal remains that are rare and have scientific research value. Non-renewable paleontological and cultural resources provide invaluable information about the behavior of past plant, animal, and human populations and their environments.

Tribal trust resources include natural resources on and off Indian lands that are reserved for tribes through treaties, executive orders, statutes, or judicial decisions and protected as a trust obligation of the United States.

4.12.1.1 Regulatory Framework

Cultural and paleontological resources have been recognized as important and irreplaceable resources by both state and federal administrators and legislators, resulting in the passage of federal and state legislation and regulations (Table 4.12-1). Federal regulations relevant to cultural resources include the National Historic Preservation Act (NHPA), the Archeological Resources Protection Act (ARPA), NEPA, the American Indian Religious Freedom Act (AIRFA), the Native American Graves Protection and Repatriation Act (NAGPRA), Executive Orders, and a Department of the Interior Secretarial Order. State of Montana regulations consist of the Montana State Antiquities Act (MSAA), MEPA, and the Montana Human Remains and Burial Site Protection Act.

In order to carry out the policy set forth in NEPA, it is the continuing responsibility of the federal government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, functions, programs, and resources to the end that the nation may, in part (and as is relevant to this discussion), preserve important historic, cultural, and natural aspects of our national heritage. Although rules and guidelines specific to NEPA have not been drafted that direct federal agencies in the identification, evaluation, and preservation of "important historic, cultural, and natural aspects of our national heritage," it is generally accepted,

TABLE 4.12-1. FEDERAL AND MONTANA STATE LEGISLATION AND REGULATIONS GOVERNING PROTECTION OF CULTURAL AND PALEONTOLOGICAL RESOURCES

Law or Order	Purpose (Summarized)
Federal Laws, Executive Orders, and Policy	
National Historic Preservation Act (NHPA)	Specifies a process by which federal agencies identify, consider project effects, and make efforts to protect existing or eligible historic properties during project planning for any federal undertaking, or federally funded or permitted activity. Affords the Advisory Council of Historic Preservation a reasonable opportunity to comment on a federal agency's conclusions. Requires federal agencies to solicit consultation from potentially affected Native American tribes.
Executive Order 11593, Protection and Enhancement of the Cultural Environment	Requires federal agencies to inventory and record cultural resources, and in consultation with the Advisory Council, ensure that plans and programs contribute to the preservation and enhancement of non-federally owned archaeological and historic sites. Requirements now subsumed under NHPA amendments and regulations.
National Environmental Policy Act (NEPA) (42 USC 4321 et seq.)	Requires federal agencies to take into consideration, prior to their decision making process, the potential environmental impacts of their proposed actions and reasonable alternatives to those actions. Federal agencies must consider potential impacts to ecological, aesthetic, historic, cultural, economic, social, and health resources.
Archaeological Resources Protection Act (ARPA)	Provides for the protection and confidentiality of archaeological resources on federal and Indian lands. Establishes a method for federal land managers to issue permits to conduct archeological work generally directed at NHPA compliance. Applies to all lands fee-owned by the federal government and Indian lands held in trust by the United States.
American Indian Religious Freedom Act (AIRFA)	Requires consultation with Native American organizations if an agency action will affect a sacred site on federal lands.
Native American Graves Protection and Repatriation Act (NAGPRA)	Requires consultation with the appropriate Native American tribes prior to the intentional excavation of human remains and funerary objects on federal lands. It also establishes procedures for repatriation of human remains found on federal land, as well as funerary items and human skeletal remains in federally funded institutions such as museums.
Executive Order 13007, Indian Sacred Sites	Requires federal agencies to accommodate access to and ceremonial use of Indian sacred sites on federal lands by Indian religious practitioners, shall avoid adversely affecting the physical integrity of such sites, and shall maintain the confidentiality of such sites.
American Indian Tribes and the Endangered Species Act (AITESA), Secretarial Order No. 3206	Provides guidelines for coordinating ESA compliance and tribal trust responsibilities.
Montana State Laws	
Montana State Antiquities Act (MSAA) (MCA 22-3-401 et seq.) with administrative procedures in ARMs 36.2.801 through 813	Defines the duties and responsibilities of the State Historic Preservation Office (SHPO). Mandates that state agencies, in consultation with the SHPO, develop procedures to be followed for identification of NRHP-eligible cultural (heritage) properties and paleontological (fossilized plant and animal remains which are rare and critical to scientific research) resources when the agency intends to authorize an undertaking on state-owned land.
Montana Environmental Policy Act (MEPA) (MCA 75-1-103:2 et seq.)	Requires the state agency involved in the action to, in part, take into consideration the impacts that the proposed action will have on important historic, cultural, and natural resources and, whenever possible, make efforts to preserve those properties. MEPA is not restricted to state lands and requires consideration regardless of land ownership status.
Montana Human Remains and Burial Site Protection Act (MCA 22-3-801 et seq.)	Provides for the protection of human remains and all associated grave goods accidentally discovered from unmarked, or marked but unprotected burial sites.

although not well articulated, that federal agency compliance with NHPA constitutes compliance with the portion of NEPA that mandates consideration of those resources defined as "historic properties" under NHPA.

The NHPA requires federal agencies to follow a process to identify, and make efforts to protect, historic properties on federal lands, or within defined areas of potential effect for federally permitted or funded undertakings. The term "undertaking" refers to projects, activities, or programs partially or wholly funded, permitted, or otherwise authorized by a federal agency. The process of NHPA compliance commences with the federal agency examining the nature of the project to be authorized, permitted, or funded, and then determining if the manner of authorization meets the criteria of an undertaking.

The process to be followed under NHPA for identification of cultural resources, and their subsequent evaluation and consideration in the decision-making process, is outlined in regulations issued by the Advisory Council on Historic Preservation (Protection of Historic Properties [36 CFR Part 800]). It should be noted that NHPA also establishes the Advisory Council on Historic Preservation, State Historic Preservation Officers (SHPOs), and Tribal Historic Preservation Officers (THPOs). These entities serve as review parties that provide recommendations and assist federal agencies in preservation law compliance.

The principles of the American Indian Tribes and the Endangered Species Act (AITESA) require federal agencies to work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems; recognize that Indian lands are not subject to the same controls as federal public lands; assist tribes in promoting, developing, and expanding tribal programs for healthy ecosystems; be sensitive to Indian culture and provide tribes information related to tribal trust resources and Indian lands; and strive to protect sensitive tribal information from disclosure. Like most federal regulations, AITESA does not pertain to DNRC's operations, but the USFWS must demonstrate compliance with this Act if it issues a Permit to DNRC. This is achieved by the ongoing outreach the USFWS and DNRC have conducted with tribes in the form of early scoping notices, seeking input on TCPs, discussion of project effects, and seeking input from tribal representatives regarding how to lessen identified impacts.

The process by which DNRC implements the mandates of MSAA consists of a series of steps largely conducted in consultation with the SHPO and fully outlined by ARMs 36.2.801 through 813. This process closely mirrors the previously outlined NHPA process found at 36 CFR Part 800, with the exception that MSAA does not recognize the Advisory Council on Historic Preservation, and the NHPA sets a higher standard for tribal consultation and involvement. While MEPA and MSAA are distinct and separate laws, the Montana SHPO concurs that compliance with MSAA will fulfill the environmental effects assessment requirements of MEPA.

DNRC's process for complying with MSAA and MEPA while conducting forest management activities is described below. This process involves inventorying and evaluating cultural and paleontological resources, determining potential impacts to such resources, and applying measures intended to avoid or mitigate potential impacts during forest management activities. DNRC currently does not have resource guidelines for monitoring known historic properties (heritage properties), paleontological resources, and TCPs in the planning area.

During the initial scoping of proposed timber sales, DNRC contacts the tribal governments on the statewide timber sale scoping list and the DNRC archaeologist to inform them of the location of the proposed project area, the projected volume to be harvested, the number of road miles to be constructed or improved, the number of acres in the project area, as well as other activities associated with the project. Initially, the DNRC archaeologist will use existing information to determine if cultural and paleontological resources are present within a project's area of potential effect and decide if an inventory is warranted.

If an inventory takes place and cultural or paleontological resources are located, then cultural resources are evaluated in terms of the National Register of Historic Places (NRHP) criteria; paleontological resources are evaluated to determine if they are scientifically significant materials. If a cultural resource is evaluated in consultation with the SHPO and determined to be potentially eligible for listing in the NRHP, or if a paleontological resource of scientific value is identified, then DNRC and the SHPO determine if the qualities that make the resource a heritage property or paleontological resource will be diminished if a project is allowed to proceed. If a proposed project may adversely affect a heritage property or paleontological resource, DNRC then considers, in consultation with the SHPO, ways to avoid or mitigate adverse effects.

If an inventory does not take place, or if resources are not identified prior to the project, DNRC includes language in the MEPA document stating that if cultural and paleontological resources are found at any time during the project, the DNRC archaeologist will be contacted immediately. Additionally, DNRC includes the following language in all timber sale contracts: "If a cultural resource is discovered, the Purchaser shall immediately suspend all operations in the vicinity of the cultural resource and notify the Forest Officer. Operations may only resume if authorized by the Forest Officer. Cultural resources identified and protected elsewhere in this contract are exempted from this clause. Cultural resources, once discovered or identified, are not to be disturbed by the Purchaser, or their employees or sub-contractors."

The final relevant state law, the Montana Human Remains and Burial Site Protection Act (MCA 22-3-801), is typically invoked during an unanticipated discovery of human remains on state land. The law applies only to state and private lands within Montana because federal lands and interests are subject to the mandates of NAGPRA and AIRFA. In contrast to MSAA and MEPA, no methodical searches specific to human skeletal remains within a proposed project's area of potential effect prior to authorization of a project have been conducted to date.

Federal Tribal Trust Responsibility

The federal trust responsibility between Indian tribes and the federal government is not defined, in part, because of reluctance by tribes and Congress to place limits on the trust. This relationship has been consistently recognized by federal courts and has been described as special, unique, moral, and solemn. In addition, the rights reserved by the tribes in treaties and agreements, which were not expressly terminated by Congress, continue to this day. These tribal rights and authorities extend to natural resources, which may be reserved by treaties, executive orders, and federal statutes. The federal courts have developed the Canons of Construction, guiding premises, that treaties and other federal actions "should, when possible, be read as protecting Indian rights in a manner favorable to Indians" (Cohen 1982).

The courts' interpretation of tribal rights and treaty language continues to evolve and define federal legal responsibilities. The primary focus of the federal government trust responsibility is the protection of Indian-owned assets, natural resources on reservations, and the treaty rights and interests that tribes reserved on off-reservation lands. In carrying out its responsibilities, a federal agency must assess proposed actions to determine potential effects on treaty rights, treaty resources, or other tribal interests. Where potential effects exist, the agency must consult with affected tribes and explicitly address those effects in planning documents and final decisions. Consultation with the tribes is an essential step in carrying out this responsibility.

When used in the context of government-to-government relationships, the term consultation means an active, affirmative process that (1) identifies issues and seeks input from appropriate American Indian governments, and (2) considers their interests as a necessary and integral part of the USFWS decision-making process. The federal government has a legal obligation to consult with American Indian tribes. This legal obligation is based in laws, executive orders, and statutes. This legal responsibility is, through consultation, to consider Indian interests and account for those interests in the decision.

4.12.1.2 Paleontological and Archaeological Overviews

Paleontological Overview

A fossil is defined as the remains, trace, or imprint of a plant or animal that has been preserved in a geologic context. Generally, fossils occurring in Montana represent the course of geologic time from hundreds of millions of years ago until approximately 10,000 years ago. Typically, these materials reflect extinct forms of flora and fauna, or flora and fauna that are no longer present in a specific region. Paleontological resources (fossils of scientifically significant value) are rare in those portions of the HCP project area west of the Continental Divide, but fossil-rich outcrops of Cretaceous-age rocks are exposed in the northern half of the project area east of the Continental Divide. Although these exposures increase the potential presence of paleontological resources, overall, their likelihood in the planning area is considered very low. At this time there are only three known fossil localities in the HCP project area (Table 4.12-2).

Archaeological Overview

The planning area overlaps three culture areas, the Great Plains east of the Continental Divide, the Columbia Plateau to the west, and the Great Basin to the south. Throughout the twentieth century, anthropologists and archaeologists defined and refined the native culture areas of North America in which the tribes share many common cultural traits. Contemporary borders between states did not exist in aboriginal times and have little bearing on plant and animal distributions and indigenous land use patterns and resource exploitation.

Prehistoric resources are further subdivided into broad time periods. The earliest time period is generally labeled as the Early Prehistoric or Paleoindian period (believed to be the earliest ancestors of contemporary Native Americans) and is believed to begin at ca. 12,000 radiocarbon years before present (BP) and extend to ca. 8,000 BP. The earliest occupants of North America, in part, hunted now extinct forms of giant fauna including mammoth, mastodon, and long-horned bison. It is currently believed that a warming and drying trend depleted the large continental glaciers that

TABLE 4.12-2. ACRES OF INVENTORIED AND CULTURAL AND PALEONTOLOGICAL SITES DOCUMENTED IN THE HCP PROJECT AREA BY COUNTY

County	Total Trust Land Surface Acres	Trust Land Surface Acres within the HCP Project Area	Trust Land Surface Acres Inventoried within the HCP Project Area	Number of Prehistoric Archaeological Sites Known in the HCP Project Area	Number of Historic Sites Known in the HCP Project Area	Number of Traditional Cultural Properties Known in the HCP Project Area	Number of Paleontological Sites Known in the HCP Project Area
Beaverhead	334,478	61,788	1060	2	2	0	0
Deer Lodge	7,553	1,771	0	0	0	0	0
Flathead	129,904	109,717	3436	6	6	0	1
Gallatin	49,964	9,182	0	0	0	0	0
Granite	20,423	16,444	820	4	2	0	2
Jefferson	32,150	194	0	0	0	0	0
Lake	55,038	48,144	1328	0	10	0	0
Lewis and Clark	134,679	33,902	1920	16	22	1	0
Lincoln	65,362	61,991	2945	6	13	0	0
Madison	133,116	11,788	1920	2	2	0	0
Mineral	21,863	16,924	870	8	1	0	0
Missoula	69,262	56,354	1575	7	5	0	0
Park	33,400	4,314	0	0	0	0	0
Powell	61,324	37,152	2560	5	4	0	0
Ravalli	29,424	20,914	4280	3	3	0	0
Sanders	63,006	53,554	1205	6	15	0	0
Silver Bow	13,234	4,365	640	3	3	0	0
Total	**1,254,180**	**548,497**	**24,559**	**68**	**88**	**1**	**3**

covered much of the northern hemisphere at that time. This theorized extended period of drought, which may have commenced shortly before, or after, the arrival of the first peoples to the Americas, may have persisted until amelioration of climatic conditions around ca. 5,000 BP.

The following period from 8,000 to 1,000 BP, known as the Middle Prehistoric period or Archaic, was a time when human populations increased (especially toward the end of the Middle Prehistoric period) and exploited a broader range of animals and plant resources to survive than did their Paleoindian counterparts. In some culture areas, the Archaic lifeway persisted until European contact.

For the study area, the Late Prehistoric period begins ca. 1,000 to BP to ca. AD 1750 and marks the transition from the atlatl and dart to the bow and arrow as the dominant weaponry system. It also marks abrupt changes in social order, which, in part, can be seen in the large-scale communal bison kills common to that period.

The Proto-historic period is marked by the arrival of horses of Spanish stock brought into the region by the Shoshone, and also the presence of metal and glass trade items (including firearms) initially distributed across the Canadian Plains from French and British traders. For the study area, the Proto-historic period gives way to the Historic Period with the presence of the Corps of Discovery in the region and the first known written records.

Cultural (and paleontological) resource sites are non-renewable in nature and can be easily disturbed or destroyed. Loss of these resources equates to a loss of the only existing records of Prehistoric and Proto-historic site types. Prehistoric and Proto-historic site types in the HCP project area include open campsites, cave or rockshelter occupation sites, human burials, vision quest sites, cairns (rock piles) and cairn lines, tipi ring sites, medicine wheels, stone effigies, animal kill and/or processing sites, hunting blinds, lithic extraction and processing sites, plant processing sites, and pictograph and petroglyph sites. The frequency of some of these site types, however, changes dramatically from the east side to the west side of the Continental Divide.

Table 4.12-2 summarizes cultural and paleontological information for trust lands within the planning area. To date, less than 5 percent of the trust lands within the planning area have been inventoried for cultural or paleontological resources. This includes four counties where no trust lands in the planning area have been inventoried. Inventories have located a total of 68 prehistoric archaeological sites, with an average density of one site for every 361 acres surveyed, although Lake County lands produced no sites. This density is somewhat lower than Montana SHPO data, which indicate that surveys on all categories of land in the counties within the planning area have produced one site for every 267 acres. Trust lands in the planning area are currently inventoried at the rate of approximately 1,500 acres per year, with five or fewer prehistoric sites located.

It is impossible to determine the exact nature or number of resources that may have been previously disturbed on trust lands in Montana. A few small-scale cultural resource inventories were conducted beginning in 1979, followed by more frequent investigations in subsequent years as required by the environmental review process and the MSAA. The implementation of updated research and survey designs based on the results of previous work and current methods and techniques, combined with various mitigation measures, can lead to the preservation of significant resources and provide data that will guide future research and management activities

4.12.1.3 Cultural and Trust Resources of Native American Tribes

Native American Tribes in the Historic Period

Ethnographically, the planning area and HCP project area include both the southern and western territory of the Blackfeet and areas claimed by both the Flathead Salish and the Kootenai. Ethnographic sources indicate that several American Indian ethnic groups were present in the planning area before and during the time of earliest European contact. Groups known to have formally occupied, controlled, or used western Montana include the Flathead Salish, Upper Pend d'Oreille, Kootenai, Blackfeet, Crow, Northern Shoshone, Gros Ventre, and Plains Cree. The Flathead, Upper Pend d'Oreille, and Kootenai are widely accepted as the primary prehistoric occupants of Montana east and west of the Continental Divide, along with the Blackfeet to the east and Northern Shoshone in southwestern Montana. Other groups moved into the area from the north and east, with the Blackfeet controlling much of the region from the mid-1700s through the mid-1800s (Walker and Sprague 1998:138-140).

Two Indian reservations are located within the planning area, the Flathead Reservation (containing the Confederated Salish and Kootenai Tribes [Flathead, (Upper) Pend d'Oreille, and Kootenai]) west of the Continental Divide and the Blackfeet Reservation to the east containing the Blackfeet Tribe (see Figure D-3 in Appendix D, EIS Figures). The other federally recognized tribes listed in Table 4.12-3 traditionally used at least portions of the planning area, as did members of the tribes now located north of the International Boundary in Canada. The HCP project area is composed of trust lands, and a few scattered parcels are located within the Flathead Indian Reservation boundaries.

TABLE 4.12-3. FEDERALLY RECOGNIZED TRIBES OF MONTANA AND ADJACENT STATES WITH CULTURAL INTERESTS IN WESTERN MONTANA FORESTS

Country	Tribes
United States	
Montana, western	Flathead, Kootenai, (Upper) Pend d'Oreille
Montana, eastern	Blackfeet (South Piegan or Pikuni and Blood), Gros Ventre, Plains Cree, Assiniboine, Crow, Sioux
Idaho	Lower or Bonners Ferry Kootenai of Idaho, Coeur d'Alene, Nez Perce
Washington	Kalispel (Lower Pend d'Orielle)
Canada	Upper Kootenai of British Columbia; the North Piegan, Blackfeet, and Blood of Alberta

The establishment of reservations did not eliminate all Native American rights to their aboriginal territories. Treaties often included provisions for Indian people to continue to hunt and fish on open and unclaimed lands within their former territorial boundaries. Thus, although the majority of Indian people lived within the boundaries of their respective reservations, they continued to use their former territories for subsistence and ceremonial purposes. In some cases, reservation boundary revisions left individual Indian allotments outside the reservation boundary.

TCPs are sites eligible for inclusion in the NRHP because of their cultural importance to a "living community's" historically rooted beliefs, customs, and practices (Parker and King 1998:1-2). In Montana, these sites typically encompass both the historical and the continuing aspect of the traditional beliefs, customs, and practices of a federally recognized tribe or tribes. TCPs can be tangible or intangible and include individual sites or locations, such as vision quest sites or sweat lodges with their associated fire pits, or areas where plants or minerals are or were gathered. They also can be broader areas, such as river or stream valleys and/or all or portions of mountain ranges, that encompass multiple sites or locations and plants, animals, minerals, or pure water used in customary practices. However, not all cultural properties identified by an individual representing a specific living community as having cultural significance meet the definition and intent of TCP status. To be eligible for inclusion in the NRHP, TCPs must meet the NRHP criteria of significance and integrity (Parker and King 1998). In 1997, the Keeper of the NRHP drafted a letter intended to clarify some confusion that SHPOs were experiencing concerning TCPs. In this letter, the Keeper noted that

> *"It is critical that the [traditional] activities be documented... National Register guidance also requires information establishing that the property is of importance to the community... The documentation must specifically address the ways in which the property meets one or more of the criteria for eligibility and the information must also address the physical integrity of the property and its setting… A property or natural feature important to a traditional culture's religion and mythology is eligible if its importance has been ethnohistorically documented and if the site can be clearly defined... A significance ascribed to a property only in the last 50 years cannot be considered traditional ... The fact that a certain cultural tradition is over 50 years old ... is also not sufficient justification for determining a property eligible for listing, if the direct association between the particular tradition and the property being evaluated is less than 50 years old."*

TCPs are not a defined site type in the Montana SHPO Cultural Resource Inventory System; therefore, it is not possible to retrieve specific information about TCPs. Personnel at SHPO indicate that there may be 30 to 40 such sites in the counties contained in the planning area. DNRC is only aware of one TCP at least partially on HCP project area lands (Table 4.12-2).

The forests of Montana provided a significant portion of the subsistence base of the Native Americans who occupied the planning area prehistorically. Tribal members continue to hunt, fish, and gather animal, plant, and mineral resources from state and federal public lands for use in subsistence and traditional practices or to use as raw materials. Table 4.12-4 lists the various resources discussed or tabulated in the ethnographic literature on the various tribes. This list may not be exhaustive because most tribes and individual members are hesitant to openly discuss religious and spiritual practices and the materials used for such practices with those who are not enrolled tribal members. DNRC has not identified any tribal member who utilizes trust lands to hunt, fish, or gather any of the listed resources or generally exercises their subsistence rights. DNRC sent a letter and made telephone contact with the offices of the Confederated Salish and Kootenai THPO and the Blackfeet THPO regarding use of trust lands by tribal members for hunting, fishing, or gathering or for traditional practices. Neither tribal office identified TCPs they were concerned about for the purpose of this project.

TABLE 4.12-4. CULTURALLY IMPORTANT ANIMAL, PLANT, AND MINERAL RESOURCES FOR NATIVE AMERICAN TRIBES IN WESTERN MONTANA

Resource Type	Specific Resource
Animals	Bison[1], grizzly bear[1], black bear, moose, elk, caribou, mule deer, white-tail deer, pronghorn antelope, big-horn sheep, mountain goat, porcupine, marmot, beaver, hare, rabbit, squirrel, wolf[1], wolverine, mountain lion, bobcat, badger, skunk, muskrat
Birds	Swan, sand hill crane, goose, duck, pelican, prairie chicken, spruce grouse (fool hen), partridge, chicken hawk, eggs (especially waterfowl)
Fish	Salmon (outside area), trout, sturgeon, grayling, char, chub, sucker, whitefish, squawfish, shiners
	Fresh water clam/mussel
Plants	Roots/bulbs – bitterroot, camas, wild carrot (yampah), false onion (several species), lomatium (biscuitroot, wild celery, several species), wild onion (several species), balsamroot, mariposa, tiger and chocolate lily, Indian potato, prairie or wild turnip, artichoke, wild garlic, wild thistle (several species), yellow bell, bugleweed, false-agoseris, western sweet-cicely, silverweed, water-parsnip, cattail, edible valerian, mule's ear
	Fruit/berries – huckleberry, serviceberry, blueberry, chokecherry, elderberry, bullberry, raspberry, strawberry, blackberry, dewberry, soapberry, cranberry, gooseberry, wild plum, wild or Oregon grape, currant, haw (hawthorn) berry, thimbleberry, thornberry, red-osier dogwood (red willow), kinnikinnick, rosehip, salal, pin cherry, bitter cherry
	Nuts/seeds – hazel, white-bark pine, balsamroot
	Greens – cow parsnip, fireweed, balsamroot, barestem lomatium (Indian celery) and other lomatium, mule's ear, cactus, wild rhubarb
	Leaves/tea – chokecherry, hackberry, Labrador tea, mint, wild bergamot, wild rose stems and flowers, barestem lomatium seeds and leaves
	Cambium (inner bark) – lodgepole pine, ponderosa pine, other evergreens, black cottonwood
	Pitch/gum – black pine, pine, spruce, larch, milkweed
	Mushrooms – pine, cottonwood, oyster
	Fungus/lichen – black tree lichen
	Cooking pit linings – Douglas-fir boughs, ponderosa pine needles, wild strawberry, fireweed, wild rose, mountain alder, shrubby penstemon, sticky geranium
	Medicinal/ritual for humans (internal or external) – mullein, willow bark, juniper, sagebrush, yarrow, stinging nettle, buttercup (several species), Indian hellebore, tree fungus (conk), cascara, kinnikinnick, Oregon grape, lomatium, willows, water hemlock, death camas, baneberry, juniper, sagebrush, Oregon grape, wild rose, Douglas-fir boughs, larch, lodgepole pine, ponderosa pine, native tobacco, red-osier dogwood, kinnikinnick, sweetgrass, subalpine fir, snowbrush, horsetail, mint, devil's club, plantain (several species), smooth sumac, soapberry, waxberry, mountain valerian, false Solomon's seal
	Medicinal for horses – sticky geranium, yellow pond lily, lomatium
Minerals, Rocks, etc.	Clay, fossils (ammonites), steatite, minerals (iron oxide)
Raw Materials	Trees – lodgepole pine, white pine, Douglas-fir, grand fir, subalpine fir, Engelmann spruce, cedar, western yew, Rocky Mountain maple, cottonwood, juniper, willow (several species), alder, cherry, oceanspray, silverberry, serviceberry, mock orange, red-osier dogwood, snowbrush, sagebrush
	Plants – tule, cattail, reed, beargrass, stinging nettle, Oregon grape, dock, grass (several species), moss, milkweed, horsetail, native tobacco
	Hides – bison[1/], elk, deer, mountain goat, bear, wolf[1/], coyote, fox, wolverine, badger, mountain lion, lynx, bobcat, badger, skunk, marten, fisher, mink, weasel/ermine, otter, marmot, raccoon, porcupine, beaver, muskrat, hare, rabbit, squirrel, gopher, mice
	Horns/antlers/teeth/bones/hooves/sinew – bison[1], big-horn sheep, mountain goat, elk, deer, beaver
	Feathers and other material – bald and golden eagle, hawk, owl, woodpecker, red-shafted flicker; porcupine quills
	Fungus/lichen – conks, wolf lichen

[1] Species no longer present or no longer as abundant as early contact levels.

Sources: Brunton (1998:226); Darnell (2001:642-643); DeMallie and Miller (2001:577-578); Dempsey (2001:605-607, 609-610); Fowler and Flannery (2001:679-680); Hunn et al. (1998:525-545); Lahren (1998:284-288); Malouf (1998:297-301); Voget (2001:698-701).

4.12.1.4 Historical Overview

The planning area, both east and west of the Continental Divide, followed a similar historical progression as other areas in the West. United States government explorers and fur traders came first, followed by missionaries, miners, ranchers, farmers, and other diversified commercial interests.

Known historic site types in the planning area include exploration and overland migration sites such as trails (likely Native American in origin), river fords, wagon roads, encampments, or geologic/geographic landmarks; inscriptions including pictographs, petroglyphs, or tree carvings; transportation sites such as late nineteenth to early twentieth century roads, railroad engineered features (bridges, trestles, ballast, track and ties), and construction camps; isolated trappers' or miners' cabins; homesteading, ranching, and farming sites such as residences (including foundations), outlying buildings, and structures; cultural landscape elements (including fences, field/pasture patterns, stock ponds and dams, stock trails and river fords), irrigation structures, and artifact scatters; mining and mine-related sites such as prospect pits and trenches, placer or hydraulic mine equipment or deposits, lode mining adits, shafts, waste rock, interior tramways, mills (various types), smelters, tailing piles, tailing ponds, flumes, power plants, bunkhouses, mess halls, kitchens, livestock shelters, trash dumps, trails, two-track roads, truck trails, rail lines, and construction debris (borrow pits, tree stumps); logging-related sites such as logging camps, stumps, skid lines, sky-line cables, lumber mills, power plants, roads, donkey engines, big wheels, rail lines, cables, livestock facilities, log decks, and flumes; abandoned town sites including foundations and trash dumps; and fire towers or lookouts and related cabins.

Inventories have located a total of 88 historic cultural resource sites on trust lands in the planning area (Table 4.12-2). There is an average density of one site for every 279 acres surveyed, suggesting a slightly higher density than prehistoric sites. However, this density of sites of historic age is somewhat lower than Montana SHPO data that indicate surveys on all categories of land in the counties in the planning area have produced one site for every 180 acres. Trust lands in the planning area are currently inventoried at the rate of approximately 1,500 acres per year, with five or fewer historic sites located.

4.12.1.5 Stillwater Core

While subjected to various management practices in the past, recently there has been limited timber harvest activity in the Stillwater Core, which is managed for grizzly bear security. Since the mid-1980s, there have been a total of 11 cultural resource inventories of roughly 3,400 acres on the Stillwater and Coal Creek State Forests within the Stillwater Core. A total of six cultural resource sites have been recorded within those areas and consist of historic fire lookouts, historic buildings, historic roads or trails, and an historic camp. Portions of the Stillwater Core not yet inventoried for cultural resources are likely to contain similar historic site types, as well as prehistoric lithic scatters, campsites, and mining sites.

4.12.2 ENVIRONMENTAL CONSEQUENCES

Cultural and paleontological resources provide information about past lifeways, and TCPs provide information about ongoing cultural activities. As a result, identification and protection of these non-renewable resources is important. This section discusses possible changes in potential direct and

indirect effects on cultural and paleontological resources and TCPs from differences in forest management policies among the four alternatives. Cumulative effects on cultural and paleontological resources and TCPs are discussed in Chapter 5.

4.12.2.1 Introduction and Evaluation Criteria

Impacts from natural decay, landscape changes, and forest management activities potentially result in the loss of non-renewable cultural and paleontological resources and TCPs or cultural use areas on trust lands in Montana. Direct impacts to paleontological and cultural resources and TCPs or cultural use areas may result from activities such as road building, timber harvesting, construction or reconstruction of stream crossings, excavation of gravel pits, or prescribed burns that get out of control. Natural processes, such as wildfire or erosion and redeposition of soils, can also adversely affect historic properties (or heritage properties) and TCPs or cultural use areas. Such processes can be accelerated as a result of forest management activities. Indirect effects on cultural resources and TCPs or cultural use areas may include changes in stream flow or sediment loads, vandalism, and unwanted human disturbance.

This section addresses how and to what extent historic properties (heritage properties) or paleontological resources or TCPs would be affected by changes in DNRC forest management activities under the alternatives.

Several of DNRC's forest management activities have the potential to adversely affect historic properties (heritage properties) or paleontological resources or TCPs: timber harvesting, slash disposal, prescribed burning, site preparation, reforestation, road construction, and gravel quarrying for forest road surface materials. The following DNRC management activities have the potential to adversely affect TCPs and tribal trust resources, such as hunting, fishing, and plant gathering: weed control and fertilization, at least temporarily, and grazing and road construction or reconstruction across or near rivers or streams on a long-term basis. However, application of pesticides or fertilizers is not a covered activity under the HCP, and is not further analyzed in this section. Typically, DNRC applies fertilizer on road cuts or through direct application to individual planted trees. This level of application is not expected to affect TCPs or tribal ability to hunt, fish, or gather plants.

To describe and compare the likelihood of these effects among the no-action and action alternatives, the following evaluation criteria are used:

- Miles of road by classification
- Harvest levels and locations.

As previously inaccessible areas or areas with limited access to humans are made more accessible, there would be a greater possibility for unauthorized entry to cultural and paleontological resources and TCPs or cultural use areas likely to contain such resources. Those resources are currently protected from incompatible human activities by limiting access to backcountry areas. Increases in acres of land disturbed by timber harvest activities, including road construction, would increase the potential to adversely affect cultural and paleontological resources and TCPs.

For this analysis, total road miles, including those classified as abandoned or reclaimed, are used to compare the alternatives. While abandoned and reclaimed roads are no longer in use, construction and maintenance of those roads prior to abandonment or reclamation would have resulted in land surface disturbances that could have adversely affected cultural resources.

The only comment related to cultural resources that was received during public scoping recommended that "Executive Orders be addressed, specifically those that concern Indian tribal governments and Minority populations." Based on communications with both the Confederated Salish and Kootenai THPO and the Blackfeet THPO, there are currently no concerns regarding future access to TCPs or cultural use areas on trust lands. This would not be expected to change over the Permit term for any of the alternatives.

4.12.2.2 Alternative 1 (No Action)

Under Alternative 1, timber harvest and management activities on DNRC's forestlands would be no different than those of the past 12 years. Annual timber harvest under Alternative 1 would continue at the current level of more than 53 million board feet, based on annual sustainable yield (Table 4.2-14). By the end of the Permit term, roads on lands within the HCP project area would increase by 1,408 miles, for a total of 4,053 miles, including those abandoned or reclaimed during the Permit term. Of the total new road miles, 731 miles would be located on NWLO lands, 473 miles on SWLO lands, and 204 on CLO lands (Table 4.4-6). This increase over existing conditions would generally be evenly distributed across the planning area; however, most of the increased road miles over the Permit term would restrict year-round motorized public access. The largest increase in road miles would occur on scattered parcels in the NWLO, where nearly 400 miles of constructed roads would restrict year-round motorized public access. Miles of open or seasonally-restricted roads, which allow public access at least part of each year, would remain unchanged in the Stillwater Block and Swan River State Forest and increase by a total of 41 miles for all scattered parcels in the HCP project area.

DNRC would continue to operate under the existing SFLMP and Forest Management ARMs, which include the MSAA. Selected cultural and paleontological resource inventories would be conducted prior to timber harvests, gravel extraction, and road construction based on presence of known sites, high likelihood of a potential site, available personnel, and funding. Current DNRC management practices include harvest restrictions along streams within SMZs and RMZs (50- to 100-foot buffers) that may be protective of cultural and paleontological resources, although some timber harvest activities would continue to be allowed in these high-sensitivity zones. Such activities in these areas would increase the likelihood of indirect adverse effects, such as erosion of sediments from, or deposition of sediments on, cultural resources located in or near drainages. However, restricted harvest in these areas may also improve or encourage the growth of native plants important to tribal members who continue to gather those resources.

4.12.2.3 Alternative 2 (Proposed HCP)

While there would be a slight decrease in number of miles of roads under Alternative 2 as compared to Alternative 1, the increased harvest would likely increase the potential for adverse effects on cultural and paleontological resources and TCPs within the HCP project area. By the end of the Permit term, there would be 21 fewer miles of roads within the HCP project area as compared to

Alternative 1 (see Table 4.4-6). The estimated annual timber harvest under this alternative would be nearly 5 million board feet greater than Alternative 1, primarily due to increased flexibility to manage timber in the Stillwater Core (Table 4.2-14).

By opening up the Stillwater Core to active forest management under Alternative 2, additional timber harvest would occur in this area, and the miles of road accessible for motorized use by the public at least part of the year would increase as compared to Alternative 1. This additional activity and increased access would increase the likelihood of adverse effects on cultural and paleontological resources and TCPs or cultural use areas.

Because the Stillwater Core would be open to forest management activities under Alternative 2, the USFWS, DNRC, and SHPO have developed a process for inventorying, evaluating, and avoiding or mitigating impacts to cultural resources specific to this area. Tribal governments that may potentially have interest in this area are currently being contacted to review this process.

Under Alternative 2, DNRC would apply a 25-foot no-harvest buffer in RMZs for Class 1 streams and lakes with HCP fish species (commitment AQ-RM1). This would provide increased protection of cultural and paleontological resources and TCPs or cultural use areas located in those areas as compared to current practices that would be followed under Alternative 1. Harvest restrictions in RMZs for all other classes of streams and lakes would be the same as those under Alternative 1.

Under Alternative 2, DNRC would implement current cultural resource management procedures for HCP project area lands. DNRC would be required to comply with the mandates of MSAA and MEPA for future ground-disturbing undertakings. Issuance of the Permit would not change the potential for DNRC to affect historic properties. Similarly, tribal access to TCPs would not be changed.

4.12.2.4 Alternative 3 (Increased Conservation HCP)

Alternative 3 would result in a lower level of timber harvest and fewer miles of road at the end of the Permit term as compared to Alternatives 1 and 2. Consequently, this alternative would be expected to have a lower likelihood for adverse effects on cultural and paleontological resources and TCPs or cultural use areas. Under Alternative 3, timber harvest and management activities on DNRC's forestlands would be lower than Alternatives 1 and 2, as would miles of road present in the HCP project area at the end of the Permit term. The estimated annual timber harvest under Alternative 3 would be about 3 million board feet lower than Alternative 1 and 7 million board feet lower than Alternative 2 (Table 4.2-14). Alternative 3 would result in 86 fewer miles of roads within the HCP project area than under Alternative 1 and 65 fewer miles than Alternative 2 (see Table 4.4-6). While the majority of this decrease would be among the scattered parcels of the NWLO, there would also be fewer miles in the SWLO. Miles of road at the end of the Permit term and timber harvest levels within the Stillwater Block would be the same as those under Alternative 1 because the Stillwater Core would be retained. As for Alternatives 1 and 2, most of the new road miles under Alternative 3 would be restricted year-round to motorized public access, which would partially offset the potential for adverse effects on cultural resources from human activity and access.

Compared to Alternatives 1 and 2, an 80- to 100-foot no-harvest buffer for RMZs on Class 1 streams and lakes with HCP fish species would provide the greatest protection of cultural and paleontological resources and TCPs or cultural use areas located in those areas. As for Alternative 2, however, harvest restrictions in RMZs for all other classes of streams and lakes would be the same as those under Alternative 1.

Similar to Alternative 2, DNRC would implement current cultural resource management procedures for HCP project area lands. However, since the Stillwater Core would be retained, the process of inventorying, evaluating, and mitigating for cultural resources in this area would not apply.

4.12.2.5 Alternative 4 (Increased Management Flexibility HCP)

Under Alternative 4, estimated annual timber harvest and total road miles at the end of the Permit term would be equivalent to those under Alternative 2 (Tables 4.2-14 and 4.4-6). While timber harvest would vary somewhat between land offices, as compared to Alternative 2, the likelihood for adverse effects on cultural and paleontological resources and TCPs or cultural use areas would be similar. Like Alternative 2, the Stillwater Core would likely experience more timber harvest due to increased flexibility for management in this area. As for Alternative 2, a 25-foot no-harvest buffer for RMZs on Class 1 streams and lakes with HCP fish species would also provide increased protection of cultural and paleontological resources and TCPs or cultural use areas located in those areas.

Similar to Alternatives 2 and 3, DNRC would implement current cultural resource management procedures for HCP project area lands. The process for inventorying, evaluating, and mitigating impacts to cultural resources in the Stillwater Core would apply since this area would be open to management activities as it would under Alternative 2.

4.12.2.6 Summary

Within DNRC's existing forest management program, activities associated with timber harvest and road construction are the primary sources of potential adverse effects on non-renewable cultural and paleontological resources and TCPs or cultural use areas on trust lands. For the four alternatives, Table 4.2-14 indicates that annual timber harvest would range from just under 51 to 58 million board feet per year, and Table 4.4-6 indicates that there would be between 1,322 and 1,408 miles of new road constructed on HCP project area lands. The one indirect benefit to cultural and paleontological resources and TCPs under all the alternatives would be the large amounts of road with restricted motorized public access year-round.

Alternative 3 would result in the least amount of annual timber harvest, the lowest amount of new roads at the end of the Permit term, the widest buffers for stream systems supporting HCP fish species, and retention of the Stillwater Core. Thus, this alternative would be expected to have the lowest likelihood of adversely affecting cultural and paleontological resources and TCPs or cultural use areas.

Alternative 1 would be expected to have a lower likelihood of adverse effects resulting from timber harvest as compared to Alternatives 2 and 4. Conversely, Alternatives 2 and 4 would be expected to have a lower likelihood of adverse effects from road construction than Alternative 1 and lower likelihood of adverse effects from timber harvest along streams supporting HCP fish species due to the 25-foot no-harvest buffer that would be implemented for those alternatives. However, within

the Stillwater Block, Alternatives 2 and 4 would result in a higher likelihood of adverse effects to cultural and paleontological resources and TCPs or cultural use areas because there would be increased flexibility to manage in the Stillwater Core. Additional harvest activities, as well as increased public access to the Stillwater Core, would increase risks to existing resources in the area.

4.13 SOCIOECONOMICS

Quality of life incorporates a number of factors (Center for Rural Affairs 2007), including (1) availability of good-paying jobs; (2) access to critical services, such as education and health care; (3) strong communities; and (4) a healthy natural environment. Management of the HCP project area could affect the people and communities in the overall planning area, thus the affected environment and environmental consequences of the four alternatives on social and economic values that contribute to quality of life are described in this section. An evaluation of environmental justice is also provided at the end of this section.

4.13.1 AFFECTED ENVIRONMENT

While there is no specific regulatory framework under which DNRC addresses socioeconomic conditions, it does have a fiduciary responsibility to maximize revenues for its trust beneficiaries in the short and long term. Generation of revenues for the trusts affects socioeconomic conditions because these revenues support employment and operations for the trust beneficiaries.

This section describes the existing regional social and economic conditions within the planning area. FMB revenues are also summarized, as are revenues generated from recreational licenses and residential leases. Finally, this section closes with a discussion of natural amenities and non-use values because these contribute to quality of life within the planning area.

4.13.1.1 Regional Social and Economic Conditions

The State of Montana and U.S. Census Bureau primarily report socioeconomic data by county, which is the approach used for this section of the EIS. There are 25 counties in the planning area, shown in Figure D-22 (Appendix D, EIS Figures).

Flathead County has the greatest amount of HCP project area within its boundaries (109,688 acres) (Table 4.13-1). In comparison, although Broadwater, Cascade, Glacier, Liberty, Meagher, Teton, and Toole Counties are in the planning area, they have no HCP project area lands within county boundaries. Total acreage by county may fluctuate through the years based on trust land sales and acquisitions.

Population

The population of the planning area was estimated to be 644,231 people in 2006 (Table 4.13-2). Although the overall population of the counties comprising the planning area increased between 2005 and 2006 by 7,736 (1.2 percent), 10 of the 25 counties had small population declines (Table 4.13-2). Missoula County, which is located in the SWLO, had the largest population in the planning area due to the urban population in the city of Missoula.

By 2020, the planning area population is projected to increase to 762,630 people, which represents an 18.4 percent increase over the 2006 population. Over 60 percent of the population growth is projected to be concentrated in three counties: Flathead, Gallatin, and Missoula. Conversely, Cascade, Deer Lodge, Liberty, Pondera, Teton, and Toole Counties are projected to decrease in population by 2020.

TABLE 4.13-1. ACREAGE OF LAND BY COUNTY FOR THE PLANNING AREA AND HCP PROJECT AREA

County	Land Office[1]	County (Acres)	Planning Area (Acres)	Project Area (Acres)
Flathead	NWLO	3,361,229	131,252	109,688
Lake	NWLO	1,057,296	55,060	48,145
Lincoln	NWLO	2,350,959	65,852	62,020
Sanders	NWLO	1,783,681	64,105	53,558
Deer Lodge	SWLO	473,937	7,869	1,768
Granite	SWLO	1,107,788	20,639	16,426
Mineral	SWLO	782,064	22,460	16,924
Missoula	SWLO/NWLO	1,673,590	69,423	56,365
Powell	SWLO/NWLO	1,491,165	60,002	37,175
Ravalli	SWLO	1,534,902	29,486	20,915
Silver Bow	SWLO	459,500	13,486	4,369
Beaverhead	CLO	3,566,469	336,938	61,804
Broadwater	CLO	791,402	24,127	0
Cascade	CLO	1,733,226	78,408	0
Gallatin	CLO	1,620,256	49,676	9,191
Glacier	CLO	1,942,247	8,301	0
Jefferson	CLO	1,060,932	32,565	198
Lewis & Clark	CLO/SWLO	2,235,984	133,959	33,904
Liberty	CLO	925,691	86,573	0
Madison	CLO	2,305,465	134,108	11,774
Meagher	CLO	1,530,860	90,692	0
Park	CLO	1,704,924	35,429	4,305
Pondera	CLO	1,049,827	58,558	0
Teton	CLO	1,465,419	103,855	0
Toole	CLO	1,244,063	99,536	0
Yellowstone Park	CLO	159,355	0	0
Planning Area Total/Average		**39,412,231**	**1,812,358**	**548,530**

[1] Counties split by land office boundaries are listed with the land office in which they have the most area.
Source: DNRC (2008a).

Employment and Income

Income and employment data can help characterize the economy of the planning area. Historically, Montana's economy depended on natural resources (DNRC 2004f). The mountainous regions of western Montana yielded timber for wood products manufacturing and minerals for mining. However, the economy in recent years has relied less on natural resources and more on service-producing jobs, and tourism is becoming more important. Education, health, accommodations, arts, food, and other services; retail/wholesale; government; and construction/manufacturing were the industrial sectors that employed the most people in the planning area in 2005 (Table 4.13-3).

TABLE 4.13-2. 2005 AND 2006 POPULATION ESTIMATES AND DENSITIES AND 2020 POPULATION PROJECTION FOR COUNTIES IN THE PLANNING AREA

		2005		2006		
County	Land Office[1]	Population Estimate	Population Density (Persons per Square Mile)	Population Estimate	Population Density (Persons per Square Mile)	2020 Population Projection
Flathead	NWLO	83,172	15.8	85,314	16.2	108,910
Lake	NWLO	28,297	17.1	28,606	17.3	35,980
Lincoln	NWLO	19,193	5.2	19,226	5.2	20,920
Sanders	NWLO	11,057	4.0	11,138	4.0	13,170
Deer Lodge	SWLO	8,948	12.1	8,888	12.0	8,160
Granite	SWLO	2,965	1.7	2,909	1.7	3,360
Mineral	SWLO	4,014	3.3	4,057	3.3	4,700
Missoula	SWLO/NWLO	100,086	38.3	101,417	38.8	123,310
Powell	SWLO/NWLO	6,999	3.0	6,997	3.0	7,810
Ravalli	SWLO	39,940	16.7	40,582	16.9	55,500
Silver Bow	SWLO	32,982	45.9	32,801	45.7	33,010
Beaverhead	CLO	8,773	1.6	8,743	1.6	9,630
Broadwater	CLO	4,517	3.7	4,572	3.7	5,640
Cascade	CLO	79,569	29.4	79,385	29.3	75,940
Gallatin	CLO	78,210	30.9	80,921	32.0	107,100
Glacier	CLO	13,552	4.5	13,578	4.5	13,900
Jefferson	CLO	11,170	6.7	11,256	6.8	14,680
Lewis & Clark	CLO/SWLO	58,449	16.7	59,302	17.0	72,880
Liberty	CLO	2,003	1.4	1,863	1.3	1,830
Madison	CLO	7,274	2.0	7,404	2.1	8,760
Meagher	CLO	1,999	0.8	1,968	0.8	2,130
Park	CLO	15,968	6.0	16,084	6.0	18,900
Pondera	CLO	6,087	3.7	6,032	3.7	5,680
Teton	CLO	6,240	2.7	6,115	2.7	6,060
Toole	CLO	5,031	2.6	5,073	2.6	4,670
Planning Area Total/Average[2]		**636,495**	**10.4**	**644,231**	**10.5**	**762,630**
Montana		935,670	7.6	944,632	7.6	1,083,050

[1] Counties split by land office boundaries are listed with the land office in which they have the most area.
[2] Excludes 159,355 acres in Yellowstone National Park.
Sources: Montana Department of Commerce (2006a,b); U.S. Census Bureau (2000).

TABLE 4.13-3. EMPLOYMENT BY INDUSTRY FOR EACH COUNTY IN THE PLANNING AREA (2005)

Region Name	Farming/ Mining	Construction/ Manufacturing	Government	Forestry, fishing, related activities	Utilities	Retail/ Wholesale	Transportation and warehousing	Information	Finance and insurance	Real estate and rental and leasing	Professional and technical services & Management	Administrative and waste services	Education, Health, Accommodation, Arts, Food, and Other Services	Total Employment
Beaverhead	674	505	1,117	NA	NA	722	NA	44	141	303	206	84	1,005	**5,671**
Broadwater	314	535	359	NA	NA	213	73	NA	58	109	64	NA	341	**2,377**
Cascade	1,255	4,167	9,460	NA	199	8,467	1,229	NA	3,008	1,651	2,225	1,672	15,861	**50,324**
Deer Lodge	125	406	932	NA	NA	427	NA	41	130	159	163	NA	1,156	**4,420**
Flathead	1,518	10,745	4,910	817	206	8,997	1,386	832	2,229	3,005	3,045	3,907	16,544	**58,141**
Gallatin	1,342	10,895	9,164	599	95	9,745	1,172	934	1,878	3,291	4,925	2,201	16,841	**63,082**
Glacier	710	-	2,393	NA	70	744	116	38	NA	NA	-	NA	1,494	**6,370**
Granite	193	253	289	NA	NA	199	84	NA	NA	NA	-	36	-	**1,825**
Jefferson	336	791	1,011	NA	NA	435	185	30	143	386	288	201	1,156	**5,578**
Lake	1,344	2,225	2,720	214	NA	1,940	NA	177	395	463	567	NA	3,552	**14,245**
Lewis & Clark	678	3,495	9,318	NA	88	5,514	939	935	2,272	1,309	2,950	NA	12,232	**41,531**
Liberty	326	-	170	NA	-	112	NA	NA	NA	NA	22	NA	128	**1,245**
Lincoln	312	1,285	1,493	NA	NA	1,311	260	127	210	418	285	235	1,560	**9,499**
Madison	706	796	563	100	11	400	153	14	132	314	-	148	1,920	**5,660**
Meagher	232	-	176	NA	NA	105	NA	NA	NA	17	-	NA	233	**1,214**
Mineral	98	389	351	93	NA	329	NA	NA	29	80	51	46	443	**2,129**
Missoula	767	8,390	10,555	839	176	12,694	2,693	1,449	2,527	2,953	5,331	3,129	23,560	**75,063**
Park	601	1,459	860	180	43	1,192	165	147	265	426	480	NA	3,519	**9,684**
Pondera	576	384	490	NA	21	516	70	25	88	80	-	NA	369	**3,239**
Powell	350	-	1,116	NA	NA	276	69	NA	78	105	98	NA	292	**3,608**
Ravalli	1,321	3,571	2,234	NA	40	2,653	469	174	581	1,248	1,119	847	5,077	**19,768**
Sanders	597	824	759	253	47	604	200	54	126	285	174	85	827	**5,659**
Silver Bow	156	1,574	2,745	NA	572	3,149	504	391	482	562	1,201	NA	7,104	**20,041**
Teton	737	251	555	NA	49	495	132	215	145	84	93	NA	236	**3,592**
Toole	444	-	720	NA	NA	287	249	64	96	67	-	NA	459	**3,480**
Planning Area Counties[1]	**15,712**	**52,940**	**64,460**	**3,095**	**1,617**	**61,526**	**10,148**	**5,691**	**15,013**	**17,315**	**23,287**	**12,591**	**115,909**	**417,445**

[1] Employment totals for the planning area do not include employment for counties where information was not available (D and L).
Source: Bureau of Economic Analysis (2008).

In 2006, the overall unemployment rate in the planning area was 3.8 percent (Table 4.13-4). Lincoln and Glacier Counties had the highest unemployment rates, both with 6.4 percent unemployment. Beaverhead, Gallatin, Madison, Teton, and Toole Counties had the lowest unemployment rates (less than 3 percent each).

Average per capita income in the planning area was $26,261 in 2005 (Table 4.13-4). This is lower than the state per capita income of $29,015. Cascade, Flathead, Gallatin, Lewis and Clark, Missoula, and Silver Bow Counties had per capita incomes over $30,000, the highest in the planning area. Sanders County had a per capita income of $20,164, the lowest in the planning area.

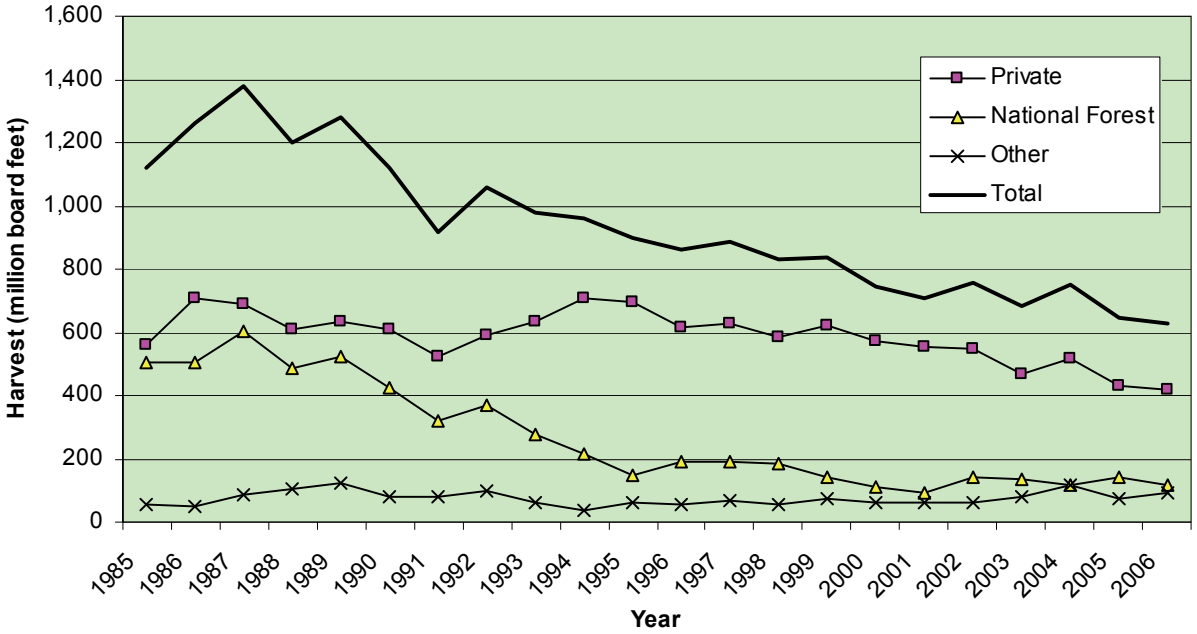
TABLE 4.13-4. UNEMPLOYMENT RATE (2006) AND PER CAPITA INCOME (2005) FOR THE PLANNING AREA

County	Land Office[1]	2006 Unemployment	2005 Per Capita Income
Flathead	NWLO	3.6	$30,008
Lake	NWLO	4.6	$21,726
Lincoln	NWLO	6.4	$21,769
Sanders	NWLO	5.0	$20,164
Deer Lodge	SWLO	4.6	$23,945
Granite	SWLO	4.2	$24,652
Mineral	SWLO	4.7	$22,057
Missoula	SWLO/NWLO	3.0	$30,608
Powell	SWLO/NWLO	4.7	$21,624
Ravalli	SWLO	4.0	$24,758
Silver Bow	SWLO	3.5	$31,324
Beaverhead	CLO	2.8	$27,382
Broadwater	CLO	3.0	$24,398
Cascade	CLO	3.2	$30,647
Gallatin	CLO	2.3	$32,434
Glacier	CLO	6.4	$22,091
Jefferson	CLO	3.4	$29,488
Lewis & Clark	CLO/SWLO	3.0	$31,151
Liberty	CLO	2.9	$26,471
Madison	CLO	2.9	$27,181
Meagher	CLO	4.1	$24,785
Park	CLO	3.1	$26,745
Pondera	CLO	3.8	$25,286
Teton	CLO	2.9	$27,679
Toole	CLO	2.6	$28,161
Planning Area Average[2]		**3.8**	**$26,261**
Montana		3.3	$29,015

[1] Counties split by land office boundaries are listed with the land office in which they have the most area.
[2] Excludes 159,355 acres in Yellowstone National Park.
Sources: Montana Department of Labor & Industry (2008); Montana Department of Commerce (2007).

Historical and Current Statewide Timber Harvest Levels by Ownership

Total statewide timber harvest has declined from a peak of approximately 1,400 million board feet in 1987 to 600 million board feet in 2006 (Figure 4.13-1). Harvest of timber on privately owned lands has accounted for between 66 and 77 percent of the total harvest since 1995. On USFS lands, harvest declined sharply between the late-1980s and mid-1990s. Harvest from the combined BLM, state, and tribal land base has increased from 6.6 percent of the total harvest in 1995 to 14.3 percent in 2006. Total harvest on the combined BLM, tribal, and state lands between 1995 and 2006 have fluctuated between 56.6 and 114.3 million board feet, with no clear trend. As shown in Figure 4.13-1, timber harvest from forested trust lands does not make a large contribution to forestry-related employment in the planning area.



Other includes harvest from tribal, BLM, and state lands.
2006 estimates are preliminary.
Source: Keegan (2007, personal communication).

FIGURE 4.13-1 STATEWIDE TIMBER HARVEST BY LAND OWNER

4.13.1.2 Forest Management Bureau Revenues

This section summarizes the FMB's revenues associated with managing timber resources on trust lands. The FMB oversees forested trust lands to provide income to trust beneficiaries through the sale of forest products. Table 2-3 in Chapter 2 (Environmental and Procedural Setting) shows that more than 80 percent of commercial forestlands are located within the planning area, indicating that most FMB revenues are generated from lands located within the NWLO, SWLO, or CLO.

As discussed in Section 2.2.2 (Trust Land Management Division), the FMB is one of four bureaus within the TLMD that are responsible for managing trust land resources to produce revenues for the trust beneficiaries. Table 4.13-5 summarizes the TLMD's statewide revenues by bureau for fiscal year 2006. Net revenues are those funds available for distribution to the trust beneficiaries. In fiscal

year 2006, the FMB contributed 12 percent of the total net revenues generated, while the Minerals Management Bureau generated more than 60 percent. For fiscal year 2006, the three land offices in the planning area had net trust revenues of $17,349,000 (Table 4.13-6), representing about 25 percent of statewide net trust revenues. Given that most commercial forestlands are located within the planning area, however, the percentage of FMB revenues generated within the planning area is likely much higher.

TABLE 4.13-5. FISCAL YEAR 2006 STATEWIDE TRUST REVENUES FOR THE TLMD

Bureau	Gross Revenues	Net Revenues
Forest Management	$15,875,615	$8,262,120
Agriculture and Grazing Management	$16,852,496	$15,286,727
Minerals Management	$42,716,187	$41,749,704
Real Estate Management	$4,210,017	$2,878,138
Total	**$79,654,315**	**$68,176,688**

Source: DNRC (2006i).

TABLE 4.13-6. FISCAL YEAR 2006 TRUST REVENUES IN THE PLANNING AREA FOR THE TLMD

	NWLO	SWLO	CLO	Planning Area Total
Number of Employees	54	26	17	97
Gross Revenues	$9,960,000	$4,297,000	$9,446,000	$23,703,000
Net Revenues	$6,325,000	$2,741,000	$8,328,000	$17,394,000

Source: DNRC (2006i).

In the planning area in fiscal year 2006, the FMB oversaw 424,311 net forested acres (Table 4.13-7). Net forested acres exclude acres of roads, rivers, and lakes to obtain an estimate that is closer to the actual acres available for timber management. Although these acres are classified forest, revenues generated include those from timber sales, and any other uses that may be occurring on the lands, such as grazing licenses. In fiscal year 2006, the value of net classified forest acres on trust lands in the planning area was $318,156,287. The 10-year average annual net revenue from commodity sales on forested trust lands in the planning area was $3,163,427, and the average rate of return on state classified forests was 1.3 percent (Table 4.13-7).

TABLE 4.13-7. REVENUES EARNED DURING FISCAL YEAR 2006 ON CLASSIFIED FOREST LANDS IN THE PLANNING AREA

	NWLO	SWLO	CLO	Planning Area Total
Net Classified Forest Acres[1]	275,805	126,654	21,852	424,311
Value of Net Classified Forest Acres	$236,513,354	$70,640,235	$11,002,698	$318,156,287
Ten-Year Average Annual Net Revenue from Commodity Sales	$1,590,438	$1,460,370	$112,619	$3,163,427
Average Rate on Return on State Classified Forests (%)	0.8	3.2	0.7	1.3

[1] Net classified forest acres based on land records maintained in DNRC's Trust Land Management System, which do not match GIS-based calculations.

Source: DNRC (2006i).

Between 2000 and 2006, annual timber harvest statewide has fluctuated between 37.8 and 56.5 million board feet, with gross revenues of between $8.2 and $16.6 million (Table 4.13-8). After expenses, the FMB contributed between $3.1 and $9.1 million in net revenues to trust beneficiaries during this period. The FMB's expenses averaged 49 percent during this period, including costs associated with managing forested trust land resources; maintaining roads; and preparing, administering, and monitoring timber sales and permits. On average, the FMB generated $240,392 in gross revenues and $118,933 in net revenues per million board feet of harvested timber while spending $121,459 per million board feet (Table 4.13-8).

TABLE 4.13-8. STATEWIDE TIMBER VOLUMES, REVENUES, AND EXPENDITURES FROM DNRC LANDS

Year	Volume Harvested[1]	Volume Sold[1]	Gross Revenues	Total Expenditures[2]	Net Revenues	Net Revenues as a Percent of Gross Revenues
2000	53.3	44.9	$12,116,479	$4,629,921	$7,486,558	62
2001	37.8	49.1	$8,578,175	$5,046,942	$3,531,233	41
2002	41.8	44.7	$9,686,844	$4,690,832	$4,996,012	52
2003	44.5	43.0	$8,278,792	$5,140,093	$3,138,699	38
2004	46.0	50.1	$11,043,525	$6,260,251	$4,783,274	43
2005	57.3	57.8	$16,596,191	$7,521,180	$9,075,011	55
2006	56.5	53.3	$15,875,615	$7,613,495	$8,262,120	52
Average	**48.2**	**49.0**	**$11,739,374**	**$5,843,245**	**$5,896,130**	**49**
Average of Revenues and Expenditures per Million Board Feet of Volume Harvested			$240,392	$121,459	$118,933	

[1] Volumes are in million board feet.
[2] Total expenditures include revenues collected for DNRC's forest improvement program.
Sources: DNRC (2004g, 2006a, 2006i).

In addition to revenues generated to manage trust lands and for distribution to trust beneficiaries, the timber harvested from forested trust lands also generates forestry sector jobs and associated wages. Table 4.13-9 shows estimated forestry sector jobs and wages sustained by the volume of timber harvested each year from 2000 to 2006. On average, timber harvest on trust lands resulted in nearly 500 direct forestry sector jobs and $19 million in associated wages per year. Given the large proportion of DNRC's commercial forestland located within the planning area, most of these jobs and wages are likely to exist within the NWLO, SWLO, and CLO.

The amount of timber sold on trust lands is directly related to the annual sustainable yield, which is recalculated using a forest management model at least every 10 years under the direction of the legislature and the Land Board. As described in Section 4.2 (Forest Vegetation), the model used to calculate annual sustainable yield seeks to maximize harvest across the planning horizon and optimize present net value (PNV) while meeting management policies and constraints. Optimization of PNV ensures that net income from timber harvested on forested trust lands is maximized for trust beneficiaries over the planning horizon. PNV can vary for the same annual sustainable yield, depending on constraints that can increase or decrease the cost of harvesting the same amount of timber volume.

TABLE 4.13-9. ESTIMATED STATEWIDE DIRECT FORESTRY SECTOR EMPLOYMENT AND WAGES BASED ON ANNUAL VOLUME HARVESTED

Year	Volume Harvested	Number of Jobs[1]	Total Wages[2]
2000	53.3	533	$20,719,842
2001	37.8	378	$14,694,372
2002	41.8	418	$16,249,332
2003	44.5	445	$17,298,930
2004	46.0	460	$17,882,040
2005	57.3	573	$22,274,802
2006	56.5	565	$21,963,810
Average	**48.2**	**482**	**$18,726,161**

[1] Calculated using 10 jobs per million board feet, which is an average of 9 jobs per million board feet for saw logs and pulp and 11 jobs per million board feet for sawtimber harvested and processed (source: Keegan 2008, personal communication).
[2] Calculated as the product of number of jobs and average forestry salary ($38,874).
Source: DNRC (2006a).

In 2004, DNRC recalculated its annual sustainable yield as 53.2 million board feet with a PNV of $146 million (Table 4.2-5). Of the total annual sustainable yield calculated, all but 2.5 million board feet was expected to come from forestlands within the planning area (Table 4.2-6). While the annual sustainable yield is a goal, actual timber harvest fluctuates from year to year based on current price, expected future price, availability of timber from other sources, and periodic events such as fires (DNRC 2006i). Using the annual sustainable yield as an average, and based on the distribution of volume by land office, Table 4.13-10 provides estimates of revenues, expenditures, and direct forestry sector employment and wages that would be expected for that volume of annual timber harvest.

TABLE 4.13-10. ESTIMATED REVENUES, EXPENDITURES, AND DIRECT FORESTRY SECTOR EMPLOYMENT AND WAGES BASED ON ANNUAL SUSTAINABLE YIELD WITHIN THE PLANNING AREA BY LAND OFFICE

	NWLO	SWLO	CLO	Total
Volume[1]	33.2	13.6	3.9	50.7
Gross Revenues[2]	$7,981,008	$3,269,329	$937,528	$12,187,865
Expenditures[3]	$4,032,449	$1,651,846	$473,691	$6,157,986
Net Revenues[4]	$3,948,559	$1,617,482	$463,837	$6,029,878
Number of Jobs[5]	332	136	39	507
Wages[6]	$12,906,168	$5,286,864	$1,516,086	$19,709,118

[1] Volumes are in million board feet from Table 4.2-6.
[2] Using an average of $240,392 per million board feet from Table 4.13-8.
[3] Using an average of $121,459 per million board feet from Table 4.13-8.
[4] Using an average of $118,933 per million board feet from Table 4.13-8.
[5] Calculated using 10 jobs per million board feet as in Table 4.13-9.
[6] Calculated using an average forestry salary of $38,874 as in Table 4.13-9.

4.13.1.3 Recreational License and Residential Lease Revenues

Recreational uses on trust lands generate revenues for the trust through license sales and residential leases. While recreational licenses and residential leases (cabin and home sites) are administered by DNRC's Real Estate Management Bureau, the availability of recreation opportunities on forested trust lands contributes to the revenues generated from these licenses and leases. This section summarizes revenues generated from recreational use licenses and residential leases.

All recreational activities (including hunting, fishing, hiking, camping, picnicking, etc.) on trust lands require a recreational use license from DNRC. The type of license required depends on the type of activity conducted and includes general licenses and special-use licenses. DNRC issues licenses for other activities not included in the general recreation category, such as cutting or gathering wood; collecting valuable rocks and minerals; and collecting or disturbing archaeological, historical, or paleontological sites (e.g., fossils, artifacts, dinosaur bones, old buildings, etc.). Information about revenues from other licenses is not available and is not discussed further.

General Recreational Use Licenses

A general recreational use license is required for most types of non-commercial or non-concentrated activities. People who hunt or fish on trust lands are required to have a general recreational license, as well as the appropriate hunting or fishing license issued by MFWP. From 1992 through February 28, 2004, individuals hunting or fishing on state lands were required to purchase separate licenses for their activities. Many individuals were unaware of the need for a recreational use permit, and revenues from those sales were unrealized. Since March 1, 2004, the recreational use permit fee to use state lands for licensed hunting and fishing has been included in the cost of hunting and fishing licenses. Revenues from general license sales increased by 44 percent from 2003 to 2004 as a result of this change in policy (Table 4.13-11).

TABLE 4.13-11. STATEWIDE GROSS REVENUES FROM RECREATIONAL USE LICENSE SALES, LICENSE YEARS 1998 TO 2006[1]

License Type	1998	1999	2000	2001	2002	2003	2004	2005	2006
General (number sold)	34,035	36,479	37,605	39,089	47,764	50,795	434,106[3]	464,432[4]	446,171
General (revenues) [2]	$336,840	$348,300	$381,740	$387,020	$517,730	$558,690	$801,980	$981,052	$934,035
Special (revenues)	$80,750	$86,170	$98,950	$104,200	$114,600	$91,200	$112,300	$109,378	$103,613

[1] The license year extends from March 1 through the last day of the following February.
[2] Revenues from 2004 through 2006 include those from sales of general license sales and from conservation licenses.
[3] Includes 4,200 general licenses and 429,906 conservation licenses.
[4] Includes 6,029 general licenses and 458,403 conservation licenses.
Sources: DNRC (2005c, 2005d, 2006a).

With the exception of a slight decline between 2005 and 2006, sales of general recreational use licenses increased steadily between 1998 and 2006 (Table 4.13-11). Annual increases generally ranged from 3 percent to 22 percent. The sharp increase between 2003 and 2004 reflects the effect of combining the recreational use permit and conservation license programs. Not all recreational

users of trust lands are aware of the requirement for a recreational use license. Therefore, license sales data likely underestimate the actual amount of recreational use on trust lands. Note also that the values in Table 4.13-11 represent license sales statewide rather than within the planning area. Data on licenses sold or revenues from licenses sold within the planning area specifically are not available. In addition, the location of a license sale does not necessarily reflect the location of the recreation activity; a person purchasing a license in one area is not required to recreate on state land in the same area.

Special Recreational Use Licenses

A special recreational use license, which is available only from DNRC offices, is required for trapping, commercial recreational use (such as outfitting), and concentrated (group) use. Commercial outfitting, most commonly for big game hunting or river rafting trips, accounts for most special recreational use license sales. In 2000-2001, for example, more than 95 percent of the revenue from such sales came from licenses for outfitting (Frickel 2005, personal communication). Revenues from sales of special recreational use licenses are shown in Table 4.13-11 and generally exhibit an increasing trend.

Residential Leases

Statewide, DNRC administers more than 750 cabin site leases, and 668 of these are located within the planning area (DNRC 2005e). Annual lease rates are 5 percent of the appraised land value. The average annual cost for leasing a cabin site in the planning area is approximately $1,500 (DNRC 2005e). Statewide gross revenues from cabin and home site leases for the past 7 years are shown in Table 4.13-12.

TABLE 4.13-12. STATEWIDE GROSS REVENUES FROM RESIDENTIAL LEASES FROM 2000 THROUGH 2006

	2000	2001	2002	2003	2004	2005	2006
Residential Leases[1]	$718,290	$790,030	$854,626	$949,102	$929,995	$1,024,125	$1,129,768

[1] 99 percent of the revenues generated in the residential lease category are from cabin leases.
Sources: DNRC (2003b, 2006a).

4.13.1.4 Natural Amenities and Non-use Value

The presence of natural amenities is a factor that has increasingly been recognized as important in determining the economic prospects of many rural communities. While natural amenities do not directly generate income in the same sense as other factors, such as timber operations or recreation business opportunities, they often attract and retain residents. Natural amenities available on trust lands in the planning area include a variety of forest-related recreational opportunities, such as hunting, fishing, camping, hiking, and wildlife viewing.

Non-use values are assigned by individuals to resources independent of whether they use those resources. Individuals obtain value from knowing that a resource exists, would be available for future use if so desired, and would remain for future generations to inherit. Examples of resources to which individuals may assign non-use values include endangered species or large areas of unmanaged forest.

4.13.2 ENVIRONMENTAL CONSEQUENCES

Quality of life incorporates a number of factors (Center for Rural Affairs 2007), including (1) availability of good-paying jobs; (2) access to critical services, such as education and health care; (3) strong communities; and (4) a healthy natural environment. This section discusses the potential effects on social and economic conditions contributing to quality of life that would occur as a result of changes to DNRC's forest management program for the four alternatives.

4.13.2.1 Introduction and Evaluation Criteria

For this analysis, quality of life is characterized by regional social and economic conditions, including forestry sector employment and contributions from FMB revenues and expenditures, revenues generated from recreational use and cabin leases, as well as the natural amenities provided by and the non-use value attributed to resources in the planning area. Changes in regional social and economic conditions based on forestry sector employment and FMB revenues and expenditures are estimated using annual sustainable yield and PNV, which are provided in Section 4.2 (Forest Vegetation) for each alternative. Changes to recreational revenues, natural amenities and non-use value are qualitatively discussed because specific changes cannot be identified due to the programmatic nature of the changes evaluated in this EIS.

Because the annual sustainable yield provides an estimate of changes in harvest levels from forested trust lands only, future harvest levels for other ownerships in the planning area will not be considered. Also, although DNRC is required to recalculate the annual sustainable yield at least once every 10 years, and thus will vary throughout the Permit term, this analysis is based only on those annual sustainable yields presented in Section 4.2 (Forest Vegetation).

Numbers of direct forestry sector jobs and associated wages have been estimated using the same factors applied in the affected environment discussion (Table 4.13-9) and the annual sustainable yield estimated for each alternative (Table 4.2-14). Non-forestry jobs are discussed qualitatively, including jobs generated by forest-related recreation activities.

Harvest levels and associated income earned by trust beneficiaries are tempered by DNRC environmental and legal commitments, which are specified in the SFLMP and ARMs, and by DNRC's participation in many working groups and cooperatives. Changes in commitments under the three action alternatives would result in changes in the annual sustainable yield, and those commitments that would increase costs to harvest timber have been captured by the PNV for each action alternative. To compare alternatives based on FMB revenues and expenditures, the same factors used in the affected environment discussion (see Table 4.13-10) have been applied to the annual sustainable yield estimated for each alternative (see Table 4.2-14). However, an additional adjustment has been made to expenditures for this analysis to incorporate the changes in PNV among the alternatives because these changes reflect increases or decreases in costs associated with managing and harvesting DNRC's timber resources based on changes to DNRC's management program. As noted above, actual timber harvest fluctuates from year to year based on current price, expected future price, availability of timber from other sources, and periodic events such as fires (DNRC 2006i). For this analysis, annual sustainable yield was used as an average to estimate revenues, expenditures, and direct forestry sector employment and wages that would be expected for that volume of annual timber harvest.

TABLE 4.13-13. AVERAGE ANNUAL DIRECT FORESTRY SECTOR JOBS AND WAGES BY ALTERNATIVE AS ESTIMATED FROM ANNUAL SUSTAINABLE YIELD

	Alternative 1 (No Action)[1]	Alternative 2[1]	Alternative 3[1]	Alternative 4[1]
NWLO	332	390	332	386
Stillwater Unit	101	148	103	149
Swan Unit	67	69	66	68
Other NWLO Units	164	174	162	170
SWLO	136	127	113	129
CLO	39	40	37	41
Total Jobs in Planning Area	**507**	**557**	**482**	**557**
Total Wages ($1,000,000)[2]	**$19.7**	**$21.6**	**$18.7**	**$21.6**

[1] Calculated using 10 jobs per million board feet as in Table 4.13-9 and volumes provided in Table 4.2-14.
[2] Calculated using an average forestry salary of $38,874 as in Table 4.13-9.

Potential effects of the alternatives on license sales are difficult to assess. It could be argued that alternatives that lead to increased access overall, or that open new areas to motorized access, would be expected to result in concomitant increases in sales of recreational use licenses. It is not possible, however, to determine how much of the increase in recreational use would result in additional license sales. People who currently engage in recreational activities on trust lands may simply move their activities to newly opened areas. At a minimum, it is reasonable to assume that alternatives that would lead to increases in recreational use could also lead to increases in formal recreation under license by the state, for example by snowmobile clubs or Nordic skiing groups that conduct trail grooming. However, the magnitude of any such increases in license sales cannot be determined.

4.13.2.2 Alternative 1 (No Action)

Under Alternative 1, existing rules and regulations would be used to manage timber and grazing on HCP project area lands. There could be changes to these regulations but they cannot be identified at this time. DNRC would continue to strive to meet the annual sustainable yield and would not delay harvest based on market values. This management approach provides lumber market stability but can affect DNRC's ability to generate revenues on an annual basis. However, under this alternative that does not include an HCP, DNRC would be subject to increased risk of having to adhere to additional protection measures for federally listed species dictated by the federal government sometime in the future. If more strict requirements are instituted, DNRC would be less able to provide a stable supply of timber annually. Other land uses could also be curtailed, leading to reduced uses of DNRC lands for other activities, such as grazing and recreation.

Of the 53.2 million board feet in annual sustainable yield estimated statewide for Alternative 1 (Table 4.2-14), DNRC would aim to harvest 50.7 million board feet per year within the planning area. Annual direct forestry sector employment from this level of timber harvest would be expected to average 507 jobs and $19.7 million in wages (Table 4.13-13). Most of these jobs would be supported by harvest activities in the NWLO. Additionally, non-forest jobs would continue to support the forestry sector by providing services and supplies to employers and employees. The number of such jobs would be expected to vary over the Permit term based on fluctuations in forestry sector employment.

Table 4.13-14 provides estimates of FMB revenues and expenditures based on the annual sustainable harvest by land office and total PNV estimated for Alternative 1 (see Table 4.2-14). Because management and harvest of timber on trust lands would continue under the existing program for this alternative, estimated expenditures were calculated using the average shown in Table 4.13-8. For the planning area, gross revenues per year are estimated to average $12.2 million, expenditures are estimated to average $6.2 million, and net revenues are estimated to average $6.0 million. More than 65 percent of the revenues and expenditures within the planning area would be generated from forest management activities in the NWLO, reflecting the large amount of annual sustainable yield allocated to this land office.

TABLE 4.13-14. AVERAGE ANNUAL GROSS REVENUES, EXPENDITURES, AND NET REVENUES FROM TIMBER HARVEST BY ALTERNATIVE AS ESTIMATED FROM ANNUAL SUSTAINABLE YIELD

	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Annual Sustainable Yield (million board feet)	53.2	58.0	50.6	58.0
PNV (million)	$146.1	$159.1	$124.5	$160.2
PNV per Million Board Feet (million)	$2.75	$2.74	$2.46	$2.76
Percent Change in PNV per Million Board Feet from Alternative 1	0.0	-0.1	-10.4	0.6
Gross Revenues[1]				
NWLO	$7,981,008	$9,382,492	$7,971,392	$9,286,336
SWLO	$3,269,329	$3,040,956	$2,723,639	$3,110,670
CLO	$937,528	$961,567	$889,450	$980,799
Planning Area Total	**$12,187,865**	**$13,385,016**	**$11,584,481**	**$13,377,804**
Expenditures[2]				
NWLO	$4,032,449	$4,745,972	$4,446,690	$4,664,930
SWLO	$1,651,846	$1,538,215	$1,519,331	$1,562,625
CLO	$473,691	$486,392	$496,163	$492,698
Planning Area Total	**$6,157,986**	**$6,770,579**	**$6,462,184**	**$6,720,252**
Net Revenues[3]				
NWLO	$3,948,559	$4,636,521	$3,524,702	$4,621,406
SWLO	$1,617,482	$1,502,741	$1,204,309	$1,548,045
CLO	$463,837	$475,175	$393,287	$488,101
Planning Area Total	**$6,029,878**	**$6,614,437**	**$5,122,298**	**$6,657,552**

[1] Using an average of $240,392 per million board feet from Table 4.13-8 and volumes provided in Table 4.2-14.
[2] Using an average of $121,459 per million board feet from Table 4.13-8 and volumes provided in Table 4.2-14. Values are adjusted based on the percent change in PNV per million board feet from Alternative 1.
[3] Using an average of $118,933 per million board feet from Table 4.13-8 and volumes provided in Table 4.2-14.

Along with maintaining the relative contribution of the forestry industry to the planning area economy, Alternative 1 is also unlikely to alter the recreation, agriculture and grazing, or mining economic sectors relative to recent trends. As the population in the HCP project area increases, demand for recreational activities is increasing, as are the number of businesses that depend on recreationists, such as hunting and fishing outfitting, off-road vehicles, and snowmobiling.

There would be no additional restrictions on access to areas used by commercial outfitters or other potential purchasers of recreational use licenses under Alternative 1. Also, as described in the environmental consequences analysis for recreation under Alternative 1 (Section 4.10.2.2), opportunities for wintertime recreation would not be expected to change from current conditions. It is likely, therefore, that the number of licensed groups conducting trail grooming would not change substantially from current conditions. For these reasons, sales of recreational use licenses are likely to follow existing trends. As the population of western Montana increases, the number of people interested in these activities would also be likely to increase, potentially resulting in a gradual increase in license sales as well as job opportunities for forest-related recreation businesses.

Because the future land management activities would be very similar to those conducted under the existing program, changes to natural amenities and non-use values would likely continue in a similar pattern as they have since DNRC's current forest management program went into effect. Forest management activities would continue throughout the Permit term, with no changes in policies for managing resources that may provide natural amenities or non-use values. However, with no HCP in place during the next 50 years, unpredictability would remain in terms of the potential for additional protection measures to address federally listed species that could preserve or enhance valued species and areas.

4.13.2.3 Alternative 2 (Proposed HCP)

Implementing the HCP under Alternative 2 would provide greater assurances that a long-term, uninterrupted stream of wood products from trust lands would continue to supply small and large forestry businesses. Even in the event that the federal government institutes additional protection measures for listed species, DNRC would still be able to continue timber harvests as planned under the HCP. The HCP would also help to stabilize availability of good-paying jobs in the forestry and other sectors. Managing forests under the HCP would increase the likelihood that the natural environment aspects that are important for rural quality of life are maintained throughout the 50-year Permit term.

The annual sustainable yield for Alternative 2 is projected to be 58.0 million board feet, which is a 9 percent increase over Alternative 1. With all but 2.3 million board feet allocated to land offices within the planning area, this level of harvest would be expected to generate $21.6 million in annual forestry wages in the planning area. This increased harvest level would also be expected to support 50 more forestry sector jobs each year than Alternative 1. The greatest difference in forestry employment would occur in the NWLO, where harvest levels would increase throughout the land office, resulting in 58 more forestry jobs. Much of this increase in harvest levels would occur in the Stillwater Unit, primarily from making the Stillwater Core more available to active forest management. The SWLO would support 9 fewer forestry jobs as compared to Alternative 1, while the CLO would support 1 more forestry job (Table 4.13-13). Non-forestry jobs that support the forestry sector would also likely increase over Alternative 1.

With a 9 percent higher annual sustainable yield versus Alternative 1, Alternative 2 would also result in 9-percent higher gross revenues generated from DNRC's forest management program (Table 4.13-14). About 70 percent of the gross revenues generated from harvest in the planning area would come from forest management activities in the NWLO. On a per-volume basis, PNV would be slightly lower than Alternative 1, which would likely be reflected in slightly higher costs

associated with harvest activities. After factoring this slight difference into expenditures, Alternative 2 would be expected to require about $6.8 million in expenditures, leaving about $6.6 million for distribution to trust beneficiaries, which is nearly 10 percent higher than Alternative 1 (Table 4.13-14).

Similar to Alternative 1, Alternative 2 would impose no additional restrictions on access to areas used by commercial outfitters or other potential purchasers of recreational use licenses. General recreational use would be expected to increase under the HCP due to increased access in the Stillwater Block. The increase in use could lead to an increase in more formal recreation under license by the state, such as snowmobile clubs or Nordic skiing groups that conduct trail grooming. The implementation of a transportation plan in the Stillwater Block would not be expected to have any influence on sales of recreational cabin leases because no new cabin sites would likely be made available in the blocked lands that make up the Stillwater State Forest. Sales of recreational use licenses, therefore, would likely increase more rapidly under Alternative 2 than under Alternative 1. Similarly, increased access within the Stillwater Block would likely increase demand for recreation-based businesses, such as outfitting, snowmobiling, and off-road vehicles, thus increasing job opportunities within those businesses.

At the landscape level, program changes under Alternative 2 would result in a slightly lower level of effects on natural amenities and non-use value as compared to Alternative 1. Increased conservation commitments for HCP species would likely enhance the natural amenities and non-use values associated with those species and their habitat. On a local scale, however, opening the Stillwater Core to active management under Alternative 2 would affect the character of the natural amenities and non-use values provided by that area. While much of the core is within blocked trust lands and not visible from populated areas and public roads, existing natural amenities offered within the core would be affected by management activities. Additionally, non-use values associated with the area and local wildlife, such as grizzly bear, would be affected by the transition of unmanaged forest into managed forest.

The transition lands strategy proposed as part of Alternative 2 could reduce DNRC's flexibility to manage its land base for maximum revenue generation. The caps applied to the removal of lands from the HCP project area could prevent DNRC from disposing of lands that do not or no longer meet its forest management and revenue objectives. By adhering to these caps, DNRC could also forego sale of some lands within the HCP project area that would be needed to meet projected growth in residential, commercial, and industrial sectors over the Permit term. If non-trust lands are sold to meet these growth needs instead, then revenues from these sales would not be realized by the trust permanent fund.

Under Alternative 2, DNRC response to fires, insect or disease outbreaks, and wind events would trigger salvage harvest as required by MCA 77-5-207. While DNRC's response to these natural event changed circumstances would incorporate HCP commitments into the salvage harvest, the event may also require changes in other DNRC forest management activities to address adverse effects to HCP species resulting from the event. Such changes may include re-scheduling adjacent operations, modifying rest and management cycles, deferring operations in other areas with similar habitat qualities, or implementing additional mitigations to reduce erosion and sedimentation risks to affected streams. These changes may affect DNRC's ability to maximize revenues from its management activities, either by reducing the volume that can be harvested or increasing harvest

costs, as well as its ability to provide a steady source of timber for harvest that supports forestry sector jobs.

Two other natural events, mass movements and flood events, may also increase expenditures by DNRC to assess and mitigate potential risks of erosion, sedimentation, and stream crossing structure failures from these events that are beyond the activities planned under the HCP commitments. Any elements of the changed circumstance processes for these two natural events that are not included in DNRC's existing program would result in increased expenditures and reduced net revenues available to trust beneficiaries.

Changed circumstances due to administrative changes may also affect DNRC's ability to maximize trust revenues. Federal listing of a non-HCP species or occupation of the BE by grizzly bears could require additional conservation commitments and reduce DNRC's ability to manage affected lands for maximum long-term revenues. Conversely, de-listing of an HCP species may remove some restrictions imposed by the conservation commitments for that species and allow DNRC to generate more trust revenues from affected lands. Listing of an HCP species, termination of the Swan Agreement, or changes in the Forest Management ARMs would not be expected to affect DNRC's ability to generate revenues for its trust beneficiaries.

4.13.2.4 Alternative 3 (Increased Conservation HCP)

Alternative 3 would implement the HCP with mitigation measures providing increased levels of conservation. While still helping to ensure a long-term stream of wood products from trust lands, it would actually reduce the statewide harvest level to 50.6 million board feet (5 percent reduction relative to Alternative 1) by increasing areas where harvest would be limited or prohibited (e.g., wider no-harvest buffers on Class 1 streams with HCP fish species). The expected decrease in harvest would reduce by 25 the number of annual forestry sector jobs supported within the three land offices (Table 4.13-13). This level of harvest would translate into $18.7 million in annual forestry wages in the HCP project area, the lowest of any of the alternatives. The greatest difference in forestry employment would occur in the SWLO, where 23 fewer forestry jobs would be generated annually as compared to Alternative 1. There would be slightly fewer forestry jobs in the CLO, while the total number for forestry jobs supported within the NWLO would be the same as Alternative 1 (Table 4.13-13). Increases in non-forestry jobs generated to support harvest activities would be similarly reduced from levels expected under Alternative 1.

Annual gross revenue from DNRC's forest management program under Alternative 3 would be $11.6 million (Table 4.13-14), which represents a 5 percent decrease relative to Alternative 1 and reflects a decrease in annual sustainable yield. About 69 percent of the gross revenues expected under this alternative would be generated from forest management activities in the NWLO, which is more than Alternative 1 and slightly less than Alternative 2. On a per-volume basis, PNV would be more than 10 percent lower than Alternative 1, which would likely be reflected in higher costs associated with harvest activities. After factoring this difference into expenditures, Alternative 2 would be expected to require about $6.4 million in expenditures, leaving about $5.1 million for distribution to trust beneficiaries, which is 15 percent lower than Alternative 1 and 23 percent lower than Alternative 2 (Table 4.13-14). Expected economic effects of DNRC's transition lands strategy and its responses to changed circumstances would be the same as Alternative 2.

The effects of Alternative 3 on recreational use license sales would be similar to those described for Alternative 1. Alternative 3 would also impose no additional restrictions on access to areas used by commercial outfitters or other potential purchasers of recreational use licenses, and this alternative would also not result in increased access in the Stillwater Core. Jobs generated from forest-related recreation activities are also expected to be similar to Alternative 1.

At the landscape level, changes to natural amenities and non-use value over the Permit term under Alternative 3 would likely be less than Alternatives 1 and 2. With additional protection and mitigation requirements for sensitive areas and wildlife species, such as wider no-harvest buffers on Class 1 streams with HCP fish species, natural amenities and non-use values associated with those areas and species would be less affected by DNRC's forest management activities. As under Alternative 1, the Stillwater Core would continue to be managed as it is under the existing program, so that no changes would be expected from DNRC's forest management activities.

4.13.2.5 Alternative 4 (Increased Management Flexibility HCP)

Alternative 4 would implement the HCP with increased levels of management flexibility. Regarding employment, wages, and gross revenues, the effects of this alternative would be very similar to those described for Alternative 2. The projected statewide annual sustainable harvest of 58.0 million board feet, as well as the amount allocated within the planning area, would be the same as Alternative 2, so the total number of direct forestry sector jobs and wages generated would be the same (Table 4.13-13). However, there would be slight variations in numbers of jobs by land office under this alternative as compared to Alternative 2.

Annual gross revenue from DNRC's forest management program under Alternative 4 would be $13.4 million, about $7,200 less than Alternative 2 (Table 4.13-14). As for Alternative 2, about 69 percent of the gross revenues expected under this alternative would be generated from forest management activities in the NWLO. On a per-volume basis, PNV would be about 0.6 percent higher than Alternative 1, which would likely be reflected in lower costs associated with harvest activities. After factoring this difference into expenditures, Alternative 2 would be expected to require about $6.7 million in expenditures, leaving about $6.7 million for distribution to trust beneficiaries, which is 10 percent higher than Alternative 1 and less than 1 percent higher than Alternative 2 (Table 4.13-14). Increases in non-forestry jobs, including jobs generated by forest-related recreation, would be similar to those under Alternative 2. Expected economic effects of DNRC's transition lands strategy and its responses to changed circumstances would be the same as Alternatives 2 and 3.

The effects of Alternative 4 on recreational use license sales would be similar to those described for Alternative 2. Alternative 4 would also impose no additional restrictions on access to areas used by commercial outfitters or other potential purchasers of recreational use licenses. Increased access in the Stillwater Block would likely result in increased recreational use and license sales, compared to Alternative 1.

Effects on natural amenities and non-use value for Alternative 4 are expected to be similar to those under Alternative 2, including changes associated with opening the Stillwater Core to active management.

4.13.2.6 Summary

Alternatives 2 and 4 would result in more forestry sector jobs and associated wages than Alternatives 1 and 3. Other jobs that support the forest industry or workers would be expected to follow the same pattern. Similarly, net revenues generated for trust beneficiaries would be highest for Alternative 4 and slightly less for Alternative 2 due to higher costs associated with more restrictive HCP commitments. Alternative 3 would generate the lowest net revenues.

Revenues from recreational licenses would likely be higher for Alternatives 2 and 4 due to increased access to the Stillwater Core after it is opened up for active management. Similarly, increases in forest-related recreation jobs would also likely be higher for these two alternatives.

Natural amenities and non-use values would likely be least affected under Alternative 3 because it provides protection to sensitive areas and species. Opening the Stillwater Core under Alternatives 2 and 4 would affect the natural amenities and non-use values in that area versus what they currently are and would be during the Permit term under Alternatives 1 and 3.

4.13.3 ENVIRONMENTAL JUSTICE

Environmental justice refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, implementation, and enforcement of environmental laws, regulations, programs, and policies. This section describes the affected environment and environmental consequences of the no-action and three action alternatives on minority and low-income populations in the planning area.

4.13.3.1 Affected Environment

This section describes the regulatory framework regarding minority and low-income populations and summarizes existing conditions for those populations.

Regulatory Framework

Executive Order 12898 (February 11, 1994), Environmental Justice, requires that federal agencies identify and address any disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-white persons are defined as minority populations by the Interagency Working Group convened under the auspices of the Executive Order. Low-income populations are defined as persons living below the poverty level based on total income of $13,359 or lower for a family household of four based on the 2000 Census.

Minority and Low Income Populations

Only 8 percent of the population in the planning area were minorities in 2000 (Table 4.13-15). After white (92 percent), the second most represented race is American Indian (4 percent), followed by Hispanic (2 percent), and multi-racial (2 percent). One percent or less were reported as being Black, Asian, Hawaiian/Pacific Islander, or some other race.

TABLE 4.13-15. RACE AND ETHNICITY IN THE PLANNING AREA IN 2000

	Hispanic[1]	White	Black	Indian	Asian	Hawaiian	Other	Multi	Total (Race)
Beaverhead	246	8,821	17	134	17	4	100	109	9,202
Broadwater	58	4,255	12	51	5	3	15	44	4,385
Cascade	1,949	72,897	900	3,394	652	67	547	1,900	80,357
Deer Lodge	155	9,028	16	167	34	1	17	154	9,417
Flathead	1,061	71,689	113	856	346	44	305	1,118	74,471
Gallatin	1,047	65,251	156	598	606	43	368	809	67,831
Glacier	159	4,693	11	8,186	9	7	24	317	13,247
Granite	36	2,724	0	36	4	1	13	52	2,830
Jefferson	149	9,654	14	127	42	7	38	167	10,049
Lake	668	18,922	31	6,306	79	11	177	981	26,507
Lewis & Clark	843	53,046	111	1,137	287	28	209	898	55,716
Liberty	4	2,141	0	2	7	0	2	6	2,158
Lincoln	271	18,100	21	226	59	7	74	350	18,837
Madison	130	6,647	3	36	18	0	52	95	6,851
Meagher	29	1,878	0	20	3	1	11	19	1,932
Mineral	61	3,673	8	75	20	1	10	97	3,884
Missoula	1,543	90,073	261	2,193	978	80	431	1,786	95,802
Park	288	15,168	63	145	56	5	74	183	15,694
Pondera	54	5,374	6	929	9	3	8	95	6,424
Powell	140	6,643	36	252	31	0	53	165	7,180
Ravalli	678	34,883	49	319	108	35	158	518	36,070
Sanders	159	9,400	13	485	31	1	27	270	10,227
Silver Bow	950	32,998	54	704	149	21	205	475	34,606
Teton	73	6,207	12	98	6	0	27	95	6,445
Toole	61	4,945	8	168	16	1	17	112	5,267
Planning Area Total	**10,812**	**559,110**	**1,915**	**26,644**	**3,572**	**371**	**2,962**	**10,815**	**605,389**
% in Planning Area	2	92	0	4	1	0	0	2	100

[1] Someone of Hispanic ethnicity can be of any race (including white); however, all Hispanics are considered minorities.
Source: U.S. Census Bureau (2000).

In 1999, 14 percent of the people in the planning area lived below the poverty level (Table 4.13-16). Jefferson County had the fewest living below the poverty level (9 percent), while Glacier County had the highest number of people living below the poverty level (27 percent).

Indian Reservations

The primary minority populations in the planning area are American Indians living in and near the Blackfeet and Flathead Indian Reservations (Figure D-3 in Appendix D, EIS Figures). The highest numbers of American Indians are found in Glacier and Lake Counties, where reservations are located (Table 4.13-15). These two counties are located within the planning area.

TABLE 4.13-16. POVERTY STATUS BY COUNTY FOR THE PLANNING AREA IN 1999

County	Total Population	Population with Income below Poverty Level	Percent below Poverty
Beaverhead	8,723	1,491	17
Broadwater	4,310	466	11
Cascade	78,438	10,605	14
Deer Lodge	9,182	1,451	16
Flathead	73,241	9,489	13
Gallatin	64,752	8,319	13
Glacier	13,060	3,568	27
Granite	2,803	472	17
Jefferson	9,807	882	9
Lake	26,015	4,862	19
Lewis & Clark	54,565	5,960	11
Liberty	2,094	425	20
Lincoln	18,568	3,558	19
Madison	6,765	821	12
Meagher	1,901	359	19
Mineral	3,795	598	16
Missoula	92,656	13,691	15
Park	15,556	1,780	11
Pondera	6,347	1,194	19
Powell	5,704	719	13
Ravalli	35,576	4,927	14
Sanders	10,074	1,737	17
Silver Bow	33,577	5,005	15
Teton	6,369	1,056	17
Toole	4,839	624	13
Planning Area Average	**588,717**	**84,059**	**14**

Source: U.S. Census Bureau (2000).

The planning area had an average unemployment rate of 3.8 percent in 2006 (Table 4.13-4). The Blackfeet and Flathead Indian Reservations had unemployment rates of 15 percent and 6 percent, respectively, in 2005 (Montana Department of Labor and Industry 2007). Glacier and Lincoln Counties had the highest unemployment rates in 2006 (both 6.4 percent). The higher unemployment rate in Glacier County is likely due to the high unemployment rate on the Blackfeet Indian Reservation, which covers a majority of Glacier County. There are no Indian reservations in Lincoln County.

Higher percentages of residents on the Blackfeet and Flathead Indian Reservations were low-income compared to the planning area in 1999. The planning area had 14 percent of the population living below the poverty level (Table 4.13-16), while the Blackfeet and Flathead Indian Reservations had 34 percent and 20 percent, respectively, living below the poverty level (U.S. Census Bureau 2000). The relatively high level of poverty coupled with the low level of

unemployment on the Flathead Indian Reservation is likely due to most reservation residents having low wage and/or part-time jobs. Per capita income on the Flathead Indian Reservation in 1999 was $14,503. This is compared to a per capita income of $17,151 for Montana in 1999. Per capita income on the Blackfeet Indian Reservation in 1999 was $9,751. This figure is even lower but less surprising considering both unemployment and poverty rates are high on the Blackfeet Indian Reservation.

Blackfeet Indian Reservation

The 1.5-million-acre Blackfeet Indian Reservation, in northwestern Montana, has approximately 7,000 tribal members living on or near the reservation (Montana Indian Nations 2005). The reservation borders Canada and Glacier National Park. The reservation's resident tribe, the Blackfeet Tribe, has about 14,700 enrolled tribal members.

A pencil, pen, and marker manufacturing plant on the reservation employs many reservation residents (Montana Indian Nations 2005). Ranching and farming are major uses of the land. The principal crops are wheat, barley, and hay. Blackfeet Community College, located on the reservation, offers 2-year associate's degrees in the Arts and Sciences.

Recreational resources that contributed to income and employment in the reservation's tourist industry include the Blackfeet Heritage Gallery, Lodgepole Gallery and Tipi Village, John L. Clarke Western Art Gallery and Memorial Museum, Museum of the Plains Indians, Lewis Fight Site, and the east side of Glacier National Park (Montana Indian Nations 2005). In addition, there are four campgrounds, eight major lakes, and 175 miles of fishing streams on the reservation.

Flathead Indian Reservation

The 1.2-million-acre Flathead Indian Reservation, located north of I-90 between Missoula and Kalispell, has about 3,700 tribal members living on or near the reservation (Montana Indian Nations 2005). The reservation is home to the Confederated Salish and Kootenai Tribes, a combination of the Salish, Pend d'Oreilles, and Kootenai. These tribes have approximately 6,800 enrolled tribal members.

The timber, services, and energy industries form the reservation's economic base. Revenues are paid to the tribes from the co-license with Northwestern Energy for the Kerr Dam facility (Montana Indian Nations 2005). The tribes are partners in a full-service resort and casino in Polson. S&K Holding, a tribal corporation, employs and offers business loans to tribal members. Salish-Kootenai Community College, in Pablo, offers 2- and 4-year degrees.

Recreational resources that contributed to income and employment in the reservation's tourist industry include the Ninepipes Museum of Early Montana, Farenhite Hotglass Studio, The People's Center, Miracle of America Museum, Polson-Flathead Historical Museum, Sandpiper Art Gallery, Garden of the Rockies Museum, Flathead Indian Museum and Trading Post, St. Ignatius Mission, Flathead Lake State Park, Mission Mountain Wilderness Area, the National Bison Range, and Ninepipe and Pablo National Wildlife Refuge and State Wildlife Management Area (Montana Indian Nations 2005).

4.13.3.2 Environmental Consequences

This section describes the differences in potential effects on minority and low-income populations from changes in DNRC's forest management program related to the alternatives, and whether these effects would disproportionately impact low-income and minority populations in the planning area.

Introduction and Evaluation Criteria

Effects on minority or low-income populations could occur in the planning area from changes in the availability of salmonid species or other recreational, subsistence, or ceremonial plant or wildlife species; access to TCPs; or numbers of forestry jobs and associated income. These changes were considered in this analysis and are summarized below based on results presented in their respective resource sections.

The summary comparison of effects of the alternatives on fish and fish habitat (Section 4.8.4.3) states that all of the alternatives are generally effective at maintaining the key habitat components at a level that provides for healthy fish populations. However, the rate of improvement in individual habitat components would vary, as would monitoring and adaptive management mechanisms to ensure proper implementation and effectiveness of the conservation commitments. Overall, Alternative 3 would be most effective at maintaining and improving key fish habitat components, followed by Alternatives 2, 4, then 1.

For plant SOC (Section 4.7, Plant Species of Concern, Noxious Weeds, and Wetlands), current practices as defined in the ARMs and MCA would not change. However, some of the HCP conservation commitments would likely provide greater protection of plant SOC as well. Conversely, the risk of disturbing populations of plant SOC would vary based on locations and amounts of harvest and new road construction.

As discussed in Section 4.4 (Transportation), most roads would generally remain restricted year-round to public access. Changes in total and open road miles would increase over the Permit term, but these changes would not differ much between the alternatives. Additional roaded access would be gained by opening the Stillwater Core to active forest management under Alternatives 2 and 4.

Regarding wildlife and wildlife habitat (Section 4.9), all alternatives would provide some level of protection to wildlife species, including those associated with recreational, subsistence, and ceremonial uses. Specifically, lynx and grizzly bear would receive varying levels of protection based on the commitments in each alternative. For other wildlife species, benefits would be realized where their needs overlap with lynx and grizzly bear. In some cases, however, wildlife species with requirements opposite of those for lynx or grizzly bear may be adversely affected by implementation of the action alternatives.

As noted in Section 4.12 (Archeological, Historical, Cultural, and Tribal Trust Resources), neither tribe expressed any concerns regarding future access to TCPs or cultural use areas on trust lands, and this would not be expected to change over the Permit term for any of the alternatives.

Section 4.13.2 (Socioeconomics, Environmental Consequences) summarizes changes in forestry sector jobs and associated wages based on changes in the annual sustainable yield and PNV for the four alternatives. With higher annual sustainable yields, Alternatives 2 and 4 would result in higher

numbers of forestry sector jobs, as well as non-forest employment supported by the forest industry or its workers. The number of direct forestry sector jobs would be lowest under Alternative 3.

Alternative 1 (No Action)

DNRC's current program does not disproportionately affect minority or low-income populations. Policies regarding management of fish, wildlife, and plant species and their habitat would not change. Native American tribes would continue to have the same level of access to traditional places and usual and accustomed use areas. Employment opportunities and wages from harvest and recreational activities on trust lands would be similar to existing conditions throughout the planning area. Alternative 1 would not be expected to affect employment or quality of life on the Blackfeet Indian Reservation or the Flathead Indian Reservation.

Alternative 2 (Proposed HCP)

Alternative 2 would not disproportionately affect minority or low-income populations in the planning area. Additional measures would be implemented to increase protection and enhancement of habitat for HCP species. Improvements to key aquatic habitat components would likely benefit all fish species. Native American tribes would continue to have the same access to traditional places and usual and accustomed use areas. Additional access would be gained in the Stillwater Block with the opening of the Stillwater Core to active management. Employment opportunities would be increased in the HCP project area, particularly in the NWLO counties with relatively high percentages of minority and low-income residents (Tables 4.13-15 and 4.13-16). Alternative 2 would not be expected to affect employment or quality of life on the Blackfeet Indian Reservation or the Flathead Indian Reservation.

Alternative 3 (Increased Conservation HCP)

Alternative 3 would not disproportionately affect minority or low-income populations in the planning area. Measures more protective than those under Alternative 2 would be implemented to increase preservation and enhancement of habitat for HCP species. Alternative 3 would result in fewer forestry sector jobs throughout the planning area, but these reductions and any indirect effects to non-forest employment are not expected to affect minority or low-income populations more than the general population within the planning area. Native American tribes would continue to have the same access to traditional places and usual and accustomed use areas. Alternative 3 would not likely affect employment or quality of life on the Blackfeet Indian Reservation or the Flathead Indian Reservation.

Alternative 4 (Increased Management Flexibility HCP)

Alternative 4 would have no disproportionate effects on minority or low-income populations in the planning area. Measures for preserving and enhancing habitat for HCP species would be more protective than Alternative 1 but less protective than Alternatives 2 and 3. Direct and indirect employment from timber harvest on trust lands would be similar to Alternative 2, as would Native American tribe access to traditional places and usual and accustomed use areas. Alternative 4 would not likely affect employment or quality of life on the Blackfeet Indian Reservation or the Flathead Indian Reservation.

Summary

DNRC's current program does not disproportionately affect minority or low-income populations. There would be differences among the alternatives regarding changes to the availability of salmonid species or other recreational, subsistence, or ceremonial plant or wildlife species; access to TCPs; or numbers of forestry jobs and associated income. However, these effects are not expected to fall disproportionately on minority or low-income populations for any of the alternatives.

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4.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible commitments are decisions affecting non-renewable resources such as soils, wetlands, unroaded areas, and cultural resources. Such commitments are considered irreversible because the resource would be deteriorated to the point that renewal could occur only over a long period of time or at great expense, or because the resource would be destroyed or removed. Irretrievable commitment of natural resources means loss of production or use of resources because of management decisions associated with an alternative. Irretrievable commitments represent opportunities foregone for the period of time that a resource cannot be used.

The action alternatives primarily represent programmatic plans for the management of forested trust lands in western Montana. Any commitments of resources associated with programmatic elements of a particular alternative would be part of a broad general framework. Such commitments would be evaluated more specifically through project-level analyses as the alternative is implemented.

Some activities that would occur under any of the alternatives represent resource commitments that would preclude future options. For example, most road construction is considered an irreversible action because of the long time needed for a road to revert to its pre-construction condition. Roads also require the irreversible commitment of rock and gravel, which in most cases are extracted from state land. In addition to the programmatic plans presented in all the alternatives, Alternatives 2 and 4 propose a Stillwater Transportation Plan that identifies specific roads to be constructed over the Permit term; however, exact locations of these roads would not be known until they are actually engineered to site-specific conditions. With that said, the amount of anticipated new road construction differs only slightly among the alternatives, with the greatest increase under Alternative 1 (1,408 miles) followed by Alternatives 2 and 4 (1,387 miles each), then Alternative 3 (1,322 miles).

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4.15 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Short-term use usually refers to activities that occur annually, such as livestock grazing, recreational uses, or timber harvest. Long-term productivity refers to the capability of the land to provide resources, such as timber, forage, and high-quality water. Soil and water are the primary factors that determine long-term productivity. Relationships between other resource management objectives and soil and water resources represent the relationship between short-term uses and long-term productivity (USFS 1983).

All four alternatives would protect the long-term productivity of soil and water resources while providing for short-term uses. The alternatives differ in the intensity of short-term uses. Alternative 4, for example, would impose fewer restrictions on road use and timber harvest. This may result in greater impacts on soil, water, and wildlife habitat, compared to Alternatives 2 and 3. Under all alternatives, however, BMPs and other standard practices would ensure the long-term productivity of these resources. Under all four alternatives, long-term timber productivity would be assured while continuing to provide stable and predictable annual timber outputs (see Section 4.2.2.2, Sustainable Yield).