Snow Talon Fire Salvage
Draft
Environmental Impact Statement
Lewis and Clark County, Montana

Lead Agency:	**U.S. Department of Agriculture, Forest Service**
Responsible Official:	**Tom J. Clifford, 2980 Skyway Drive Helena, Montana 59601**
For Information Contact:	**AmberDawn Kamps, 1569 Highway 200 Lincoln, Montana 59639 406-362-4265**

Abstract: This analysis considers the effects of salvage harvesting 2,500 acres of land, yielding approximately 20 to 30 million board feet of commercial timber, within the perimeter of the 37,706-acre Snow Talon fire. The harvest proposals include the use of helicopter, cable, and tractor logging methods. The analysis evaluates the effects of four alternatives: no action, proposed action, an alternative for less harvest than the proposed action, and an alternative for more harvest than proposed. The analysis found that the harvest activities have very few, and short-lived effects in the context of the scale of the effects of the fire. The deciding official for this project is Thomas J. Clifford, Forest Supervisor of the Helena National Forest.

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the *National Environmental Policy Act* process so that it is meaningful and alerts the agency to the reviewers' position and contentions *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement *City of Angoon v. Hodel* (9th Circuit, l986) and *Wisconsin Heritages, Inc. v. Harris*, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 *Code of Federal Regulations* 1503.3).

Send Comments to:	**Dan Seifert, Snow Talon Fire Salvage Interdisciplinary Team Leader 1569 Highway 200 Lincoln, Montana 59639 406-362-4265 dseifert@fs.fed.us**
Date Comments Must Be Received:	**45 days subsequent to publication of the notice of availability of the EIS in the *Federal Register*.**

Summary

The Helena National Forest proposes to salvage harvest trees burned in the Snow Talon fire on the Lincoln Ranger District. In August and September of 2003, the Snow Talon fire burned 37,706 acres in the Copper Creek, Landers Fork, and Falls Creek drainages. The area affected by the proposal includes burned portions of the Copper Creek drainage, approximately 5 miles northeast of Lincoln, Montana. This action is needed because the value of the burned commercial timber products needs to be recovered before it decays and has no commercial viability (*Helena National Forest Land and Resource Plan* [*Forest Plan*], II-1, goals #11 and #16 [U.S. Department of Agriculture 1986]).

A notice of intent to prepare an environmental impact statement for the Snow Talon fire salvage was published on December 2, 2003. The notice of intent asked for public comment on the proposed action. The comment period ran from December 2, 2003, to January 15, 2004. The Helena National Forest also mailed a scoping letter and maps describing the project and public involvement opportunities to approximately 1,312 people and held a public open-house scoping meeting on December 17, 2003.

Issues raised through public involvement included the following:

- Soils Concerns—Negative impacts to soils, sediment delivery, soil productivity, mass wasting, debris flow potential, and erosion.
- Economic Concerns—The economic feasibility of helicopter logging, the feasibility of the project as a whole questioning the value of the dead trees on today's market, and the economic impacts of seasonal logging restrictions.
- General Concerns—The project may affect inventoried roadless areas (IRAs), both as negative effects to roadless characteristics and/or effects on the current boundaries. The project area includes subunits of the Bear-Marshall-Scapegoat-Swan IRA called Silver King-Falls Creek and Stonewall. The IRAs were designated by the Roadless Area Conservation Rule, which has not yet gone into effect. The future of this rule is uncertain and is currently under review by the U.S. Department of Agriculture.
- There were also numerous concerns about capturing the value of the trees before "they brood insects and diseases" and affect adjacent forests as well as concerns that surviving stands of old growth may be attacked by bark beetles. There is also concern that proposed salvage harvest in old growth stands could affect habitat of old growth dependent species.

The issues raised from the public involvement process led the agency to develop two new alternatives and modify the proposed action as follows:

- The published proposed alternative was subsequently modified to ensure it would meet *Forest Plan* direction. Modifications included: removing ground-based logging from areas with potential for mass wasting and debris flows, removing 200 acres from salvage in areas within designated W-1 management areas, removing acres designated as old growth management areas from salvage consideration.
- An alternative (Alternative 3) was developed to address the economic feasibility of helicopter logging and requests for a smaller level of harvest. Comments addressing

the mass failure potential on debris flow prone areas were also incorporated into this alternative by excluding salvage in such hazard zones.

- An alternative (Alternative 4) was developed to address comments that requested the Forest Service consider additional acreage for salvage harvest. Additional areas for salvage opportunities include IRAs and some low/mixed severity burn areas where fire-related mortality (i.e., resulting from factors such as bark beetle invasion or drought) is expected in the next few years. This alternative also addresses comments requesting ground-based logging with minimal seasonal restrictions and addresses mass failure potential on debris flow prone areas by removing these areas from ground-based logging consideration and assigning them to helicopter logging.

Major conclusions include

- The no action alternative would not recover the value of burned commercial timber products before they decay. Economic opportunities for rural communities through a sustainable timer yield would not be realized. The project area would be allowed to naturally regenerate with over 969 acres not expected to regenerate. Tree damaging insects and noxious weed infestations would be anticipated to increase. Jammer trail reclamation, intended to improve overall soil quality and reduce noxious weeds would not take place. Unroaded resource values would not be affected and there would be few if any short-term impacts.
- Alternative 2 would harvest between 20 and 25 million board feet of commercial timber and provide over 400 jobs associated with harvesting, processing, and restoration. Over 969 acres that are not expected to naturally regenerate would be planted.
- Alternative 3 would harvest between 10 and 11 MMBF of commercial timber and provide about 190 associated jobs. About 118 acres not expected to naturally regenerate would be planted. This alternative would have the lease impact of the action alternatives on vegetation and soils due to the lower volume of timber produced.
- Alternative 4 would provide for harvesting between 30 and 35 MMBF of commercial timber and provide for around 600 jobs associated with harvesting, processing, and restoration. Over 969 acres that are not expected to naturally regenerate would be planted. This alternative would result in natural integrity and naturalness roadless characteristics being reduced and would have the highest impacts of the action alternatives on vegetation, and have the greatest decrease in snags and downed wood habitat.
- All action alternatives would have short-term impacts on recreation, vegetation, wildlife, and visual quality objectives. Snags and downed wood would be reduced. Designated snags would be left standing per Northern Region Snag Management Protocol. There is potential of increased noxious weeds infestation and some detrimental soil disturbances. These would be mitigated through BMPs and the restoration of 110 acres of old jammer trails. Based upon the effects of the alternatives, the responsible official will decide not to harvest timber or to harvest specific areas using specific logging systems and applying appropriate mitigation measures.

Contents

Summary ... iii

Contents ... v

Acronyms and Initialisms ... xiii

Document Structure ... xvii

Project Record ... xvii

Chapter 1. Purpose of and Need for Action ... 1-1
- Background ... 1-1
- Purpose and Need for Action ... 1-1
- Proposed Action ... 1-2
- Decision Framework ... 1-2
- Forest Plan Direction ... 1-4
- Forest Plan MAs ... 1-4
  - L1—Nonforested Grazing ... 1-4
  - M1—Minimum Management ... 1-5
  - N1—RNAs ... 1-5
  - P1—Scapegoat Wilderness Area ... 1-5
  - R1—Undeveloped Land Suited for Dispersed Recreation ... 1-5
  - T1—Timber Production Emphasis ... 1-6
  - T3—Big Game and Nongame Wildlife Areas Suitable for Timber Management ... 1-6
  - T4—Timber Production within Visually Sensitive Landscapes ... 1-6
  - W1—Wildlife Habitat ... 1-6
  - W2—Big Game Spring, Summer, and Fall Habitat ... 1-7
- Public Involvement ... 1-7
  - Formal Public Involvement ... 1-7
  - Informal Public Involvement ... 1-8
- Identification of Issues ... 1-8
  - Key Issues ... 1-9
  - Analysis Issues ... 1-10
- Tiered and Referenced Documents ... 1-11
- Other Related Efforts ... 1-12

Chapter 2. Alternatives, Including The Proposed Action ... 2-1
- Introduction ... 2-1
- Alternative Development Process ... 2-1
- Alternatives Considered but Eliminated from Detailed Study ... 2-1
  - Proposed Action ... 2-1
  - Restoration—Only Alternative ... 2-2
  - No Jammer Trail Area Rehabilitation ... 2-2
  - Salvage More Area within the Fire Perimeter ... 2-3
  - Harvest of Nonburned Areas Adjacent to the Snow Talon Fire ... 2-3
  - Harvest of Areas Burned in the Moose-Wasson Fire ... 2-3
- Alternatives Considered in Detail ... 2-4
  - Alternative 1—No Action ... 2-4
  - Alternative 2 ... 2-4
  - Alternative 3 ... 2-5
  - Alternative 4 ... 2-5

Comparison of Alternatives 2-11

Chapter 3. Affected Environment and Environmental Consequences 3-1
Soils 3-1
Affected Environment 3-2
Environmental Consequences 3-8
Effects of Alternative 1 3-16
Introduction to the Action Alternatives 3-24
Effects of Alternative 2 3-26
Effects of Alternative 3 3-33
Effects of Alternative 4 3-37
Hydrology 3-46
Affected Environment 3-47
Environmental Consequences 3-49
Effects of All Alternatives 3-51
Aquatics 3-56
Affected Environment 3-57
Environmental Consequences—Fisheries Habitat 3-63
Effects Common to All Action Alternatives—Fisheries Habitat 3-67
Affected Environment—Fish Populations 3-68
Environmental Consequences—Fish Populations 3-72
Wildlife 3-74
Affected Environment—Snags and Downed Wood Habitat 3-75
Environmental Consequences—Snags and Downed Wood Habitat 3-77
Affected Environment—Corridors and Linkages 3-81
Environmental Consequences—Corridors and Linkages 3-82
Threatened and Endangered Species 3-86
Gray Wolf 3-87
Affected Environment—Gray Wolf 3-87
Environmental Consequences—Gray Wolf 3-88
Bald Eagle 3-91
Affected Environment—Bald Eagle 3-92
Environmental Consequences—Bald Eagle 3-93
Grizzly Bear 3-94
Affected Environment—Grizzly Bear 3-94
Environmental Consequences—Grizzly Bear 3-98
Canada Lynx 3-105
Affected Environment—Lynx 3-105
Environmental Consequences 3-106
Sensitive Species 3-111
Wolverine 3-111
Affected Environment—Wolverine 3-113
Environmental Consequences—Wolverine 3-113
Boreal Toad 3-117
Affected Environment—Boreal Toad 3-117
Environmental Consequences—Boreal Toad 3-117
Black-Backed Woodpecker 3-120
Affected Environment—Black-Backed Woodpecker 3-121
Environmental Consequences—Black-Backed Woodpecker 3-121
Management Indicator Species 3-125
Affected Environment—MIS 3-125
Environmental Consequences—MIS 3-125
Old Growth Species 3-125

Affected Environment—Old Growth Species 3-127
Environmental Consequences—Old Growth Species 3-129
Mature Conifer Forest Species 3-131
Affected Environment—Mature Conifer Forest Species 3-131
Environmental Consequences—Mature Conifer Forest Species 3-132
Affected Environment—Hunted Species 3-134
Environmental Consequences—Hunted Species 3-136
Species of Special Concern Neotropical Migrant (NTM)/Forest and Rangeland Songbirds 3-140
Affected Environment 140
Environmental Consequences—Species of Special Concern NTM/Forest and Rangeland Songbirds 3-142
Forestry 3-144
Affected Environment 3-144
Environmental Consequences 3-149
Effects of Alternative 1 3-150
Effects of Action Alternatives 3-152
Fuels 3-154
Affected Environment 3-154
Environmental Consequences 3-156
Fuel—Effects of Action Alternatives 3-159
Nonconiferous Vegetation 3-159
Affected Environment 3-159
Environmental Consequences 3-164
Effects of Alternative 1 3-164
Effects of Alternative 2 3-167
Effects of Alternative 3 3-170
Effects of Alternative 4 3-172
Sensitive Plants 3-174
Affected Environment 3-174
Environmental Consequences 3-176
Effects of Alternative 1 3-176
Effects of Alternative 2 3-177
Effects of Alternative 3 3-179
Effects of Alternative 4 3-180
Noxious Weeds 3-182
Affected Environment 3-182
Environmental Consequences 3-185
Effects of Alternative 1 3-186
Effects of Alternative 2 3-189
Effects of Alternative 3 3-192
Effects of Alternative 4 3-195
Summary 3-197
Recreation 3-198
Affected Environment—Summer/Fall Recreation Use 3-199
Environmental Consequences—Summer/Fall Recreation Use 3-200
Effects of Alternative 1—Summer/Fall Recreation Use 3-201
Effects of Action Alternatives—Summer/Fall Recreation Use 3-201
Affected Environment—Winter Recreation 3-202
Environmental Consequences—Winter Recreation 3-202
Effects of Alternative 1—Winter Recreation 3-203
Effects of Action Alternatives—Winter Recreation 3-203

Roadless Area 3-204
Affected Environment 3-204
Environmental Consequences 3-205
Effects of Alternative 1 3-205
Effects of Alternatives 2 and 3 3-205
Effects of Alternative 4 3-206
Unroaded Area 3-207
Affected Environment 3-207
Environmental Consequences 3-211
Economics 3-214
Affected Environment 3-214
Environmental Consequences 3-224
Effects of Alternative 1 3-224
Effects Common to All Action Alternatives 3-225
Heritage 3-229
Affected Environment 3-229
Environmental Consequences 3-232
Effects of Alternative 1 3-234
Effects of Alternative 2 3-236
Effects of Alternative 3 3-238
Effects of Alternative 4 3-239
Landscape Aesthetics 3-240
Affected Environment 3-241
Environmental Consequences 3-242
Effects of Alternative 1 3-246
Effects of Alternative 2 3-247
Effects of Alternative 3 3-250
Effects of Alternative 4 3-253

Chapter 4. Consultation and Coordination 4-1
Preparers and Contributors 4-1
IDT Members 4-1
Federal, State, and Local Agencies 4-2
Tribes 4-3
Distribution of the Environmental Impact Statement 4-3

Chapter 5. Literature Cited 5-1

Appendix A—Glossary A-1

Appendix B—Snow Talon Conifer Tree Mortality Estimator B-1

Appendix C—Summary of Applicable Watershed Best Management Practices C-1

Appendix D—Revegetation Plan D-1

Appendix E—Helena National Forest Sensitive Plant Species List E-1

List of Figures and Tables

Figure 1. The Snow Talon fire perimeter is located north of Lincoln, Montana 1-3
Figure 2. Map of Alternative 2 2-17
Figure 3. Map of Alternative 3 2-18
Figure 4. Map of Alternative 4 2-19
Figure 5. Map of jammer trails 2-20
Figure 6. Watershed burn severity within the forest boundary and the Snow Talon fire perimeter 3-3
Figure 7. Proposed salvage units and landtypes within the forest boundary and Snow Talon fire perimeter, and outside the Wilderness Area 3-4
Figure 8. Locations of proposed salvage units in areas at risk for soil mass wasting 3-20
Figure 9. Eight third-order watersheds present within the Snow Talon fire perimeter 3-48
Figure 10. Locations of proposed salvage units and habitat types with potential seeps, springs, or wet areas 3-54
Figure 11. Map of Copper Creek drainage. Locations of bridge and culvert installation and removal are depicted, as well as bull trout spawning areas pre- and post-Snow Talon fire, 2003 3-61
Figure 12. Locations of past harvests areas within the Snow Talon fire perimeter 3-145
Figure 13. Noxious weed distribution within and proximal to the Snow Talon fire perimeter 3-183
Figure 14. Salvage harvest proposed in unroaded areas 3-209
Figure 15. Intensely burned landscape from the Snow Talon fire 3-243
Figure 16. View overlooking Copper Creek Area and clearcuts 3-243
Figure 17. Pre-fire, clear-cut units are visible on slopes above Copper Creek 3-244
Figure 18. View from Copper Creek road showing light colored soils of exposed jammer trails 3-252

Table 1. Effects of implementing each alternative 2-12
Table 2. Comparison of harvest units by alternative 2-14
Table 3. Landtype characterization within the Snow Talon fire perimeter 3-5
Table 4. Predicted 2004 surface erosion within Snow Talon fire area 3-18
Table 5. Predicted area of detrimental soil disturbance by harvest method for Alternative 2 3-27
Table 6. Predicted area of detrimental soil disturbance by harvest method for Alternative 3 3-34
Table 7. Predicted area of detrimental soil disturbance by harvest method for Alternative 4 3-39
Table 8. Accelerated surface erosion predicted to occur on summer logged skyline cable units 3-41
Table 9. Accelerated surface erosion predicted to occur on summer logged tractor units 3-41
Table 10. Modeled annual water yield increases from past harvests, the Snow Talon fire, and all action alternatives 3-52
Table 11. Sediment modeling results for the Snow Talon fire salvage project 3-55
Table 12. Comparison of average sediment data from Copper Creek and Landers Fork, Monture Creek, and the North Fork of the Blackfoot River between 1986 to 2001 3-62

Table 13. Expected concentration of herbicide reaching streams as a result of weed management ... 3-66
Table 14. Estimated density of fish in the Landers Fork estimated by daytime snorkeling ... 3-69
Table 15. Density of fish in Copper Creek estimated by snorkeling ... 3-70
Table 16. Species and rationale for exclusion in the effects analysis ... 3-75
Table 17. Types of corridors identified in Region 1 ... 3-83
Table 18. Threatened and endangered wildlife species within the project area ... 3-86
Table 19. Grizzly bear subunits and habitat status ... 3-96
Table 20. Existing condition moving windows analysis outcomes ... 3-97
Table 21. Existing condition road densities ... 3-97
Table 22. Acres of grizzly bear denning habitat within units by alternative ... 3-100
Table 23. LAUs within the project area ... 3-107
Table 24. Summary of determinations for all sensitive species on the Helena NF ... 3-112
Table 25. Affects of salvage on Black-backed Woodpecker habitat on Helena NF lands ... 3-122
Table 26. Summary effects of all MIS species on the Helena NF ... 3-126
Table 27. Past-fire old growth and replacement within project area ... 3-128
Table 28. Results of Hillis Elk security analysis ... 3-136
Table 29. Past timber management in the silviculture analysis area ... 3-146
Table 30. Dry and moist forests pre- and post-fire age classes ... 3-147
Table 31. Results of Snow Talon old growth assessment process ... 3-148
Table 32. Vegetative composition of the Snow Talon fire salvage analysis area for the fuels resource ... 3-156
Table 33. Terrestrial habitat types present within the Snow Talon fire project area ... 3-160
Table 34. Effects of fire on 11 important understory species in the Snow Talon fire analysis area ... 3-161
Table 35. Vegetative habitat types involved in Alternative 2 ... 3-168
Table 36. Vegetative habitat types involved in Alternative 3 ... 3-171
Table 37. Vegetative habitat types for Alternative 4 ... 3-173
Table 38. Sensitive plant species that could occur in the Snow Talon fire salvage project analysis area ... 3-175
Table 39. Known noxious weed infestation prior to the Snow Talon fire ... 3-185
Table 40. Effects of Alternative 2 on noxious weeds ... 3-191
Table 41. Potential herbicide application in the Snow Talon project area ... 3-192
Table 42. Effects of Alternative 3 on noxious weeds ... 3-193
Table 43. Effects of Alternative 4 on noxious weeds ... 3-196
Table 44. Comparison of alternatives and alternative features and noxious weed infestation risk ... 3-198
Table 45. Vehicle use on Copper Creek Road ... 3-199
Table 46. Copper Creek Campground annual use from 1998 to 2003 ... 3-199
Table 47. Trails accessed via Copper Creek Campground area ... 3-200
Table 48. Project area snowmobile use from 1992 to 2003 ... 3-202
Table 49. Unroaded resource values and roadless characteristics ... 3-208
Table 50. Total industry sector profile—Lewis and Clark County and Montana ... 3-216
Table 51. Basic industry sector profile—Lewis and Clark County ... 3-216
Table 52. Helena NF timber sale program information ... 3-222
Table 53. Distribution of twenty-five percent fund payments to affected area counties ... 3-223
Table 54. Summary of discounted costs and revenues for the project period ... 3-224
Table 55. Employment and income from timber harvest and processing ... 3-227

Table 56. Employment and income from reforestation proposal..... 3-227
Table 57. Employment and income from jammer trail rehabilitation..... 3-228
Table 58. Heritage sites located within Snow Talon proposed salvage units 3-232
Table 59. Comparison of SMS scenic integrity ratings and VQO ratings by burn severity levels within the Snow Talon fire analysis area..... 3-244
Table 60. Alternative 2 logging systems and affected Helena *Forest Plan* VQO acres 3-248
Table 61. Alternative 3 logging systems and affected Helena *Forest Plan* VQO acres 3-250
Table 62. Alternative 4 logging systems and affected Helena *Forest Plan* VQO acres 3-253

Acronyms and Initialisms

ATV	all terrain vehicle
BA	biological assessment
BAER	burned area emergency rehabilitation
BBER	Bureau of Business and Economic Research
BLM	Bureau of Land Management
BMP	best management practice
BMSS	Bear-Marshall-Scapegoat-Swan
BMU	bear management unit
CDFA	California Department of Food and Agriculture
CFR	*Code of Federal Regulations*
CLCAS	*Canada Lynx Conservation Assessment and Strategy*
DBH	diameter [at] breast height
DEIS	draft environmental impact statement
DNRC	Department of Natural Resources and Conservation
EIS	environmental impact statement
EMU	elk management unit
EPA	Environmental Protection Agency
ESA	*Endangered Species Act*
FAR	functioning at risk
FEIS	final environmental impact statement
FR	*Federal Register*
FS	Forest Service
FSH	Forest Service Handbook

FSM	Forest Service Manual
FUR	Functioning at unacceptable risk
GNP	Glacier National Park
HUC	hydrologic unit code
IDT	interdisciplinary team
INFISH	*Inland Native Fish Strategy Environmental Assessment (INFISH), Decision Notice and Finding of No Significant Impact, 1995, Intermountain, Northern, and Pacific Northwest Regions*
IRA	inventoried roadless area
LAU	lynx analysis unit
LSDE	landform sediment-delivery efficiency
LWD	large woody debris
MA	management area
MDEQ	Montana Department of Environmental Quality
MDFWP	Montana Department of Fish, Wildlife & Parks
MIS	management indicator species
MMBF	million board feet
MSU	Montana State University
NCDE	Northern Continental Divide Ecosystem
NEPA	*National Environmental Policy Act*
NF	National Forest
NFMA	*National Forest Management Act*
NHPA	*National Historic Preservation Act*
NOI	notice of intent
NTM	neotropical migrant
OHV	off-highway vehicle

PILT	*Payment in Lieu of Taxes Act*
PNV	present net value
RARE	Roadless Area Review and Evaluation
RD	Ranger District
RHCA	riparian habitat conservation area
RMO	riparian management objective
RNA	research natural area
ROD	record of decision
PCPI	per capita personal income
spp.	species
SMS	scenery management system
TES	threatened, endangered, or sensitive
TMDL	total maximum daily load
TPI	total personal income
UBVHS	Upper Blackfoot Valley Historical Society
U.S.C.	*United States Code*
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFWS	United States Fish and Wildlife Service
VMS	visual management system
VQO	visual quality objective
WEPP	Water Erosion Prediction Project (model)

Document Structure

The Forest Service (FS) has prepared this environmental impact statement (EIS) in compliance with the *National Environmental Policy Act* (NEPA) (42 *United States Code* [U.S.C.] 55 §§ 4321 et seq., 1990) and other relevant federal and state laws and regulations. This EIS discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* This chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the FS informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the EIS.
- *Chapter 5. Literature Cited:* This chapter provides a listing of the research cited throughout the EIS.
- *Appendices:* The appendices provide more detailed information in support of this EIS. Appendix A provieds a glossary of commonly-used, salvage-specific terminology that is provided for reader reference.

Project Record

This EIS hereby incorporates by reference the Project Record (40 *Code of Federal Regulations* [CFR] 28 §§ 1500 et seq., 1502.21). The Project Record contains specialists' reports and other technical documentation used to support the analysis and conclusions in this EIS. These specialists' reports are for soils, hydrology, aquatics, wildlife, forestry, fuels, nonconiferous vegetation, sensitive plants, noxious weeds, recreation, roadless areas, unroaded areas, economics, heritage, and landscape aesthetics for the Snow Talon fire salvage project.

Relying on specialists' reports and the Project Record helps implement the Council on Environmental Quality regulations' provision that agencies should reduce analysis paperwork (40 CFR 28 §§ 1500 et seq., 1500.4), that EISs shall be analytic rather than

encyclopedic, and that EISs shall be kept concise and no longer than absolutely necessary (40 CFR 28 §§ 1500 et seq., 1502.2). The objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternative and how these impacts can be mitigated without repeating detailed analysis and background information available elsewhere. The Project Record is available for review at the Helena National Forest (NF), Lincoln Ranger District (RD), in Lincoln, Montana.

CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

Background

The Upper Blackfoot Valley and the Helena National Forest (NF) experienced a wildfire in 2003. The Snow Talon fire burned 37,706 acres (34,362 on NF lands) in August and September of 2003 in the mainstem of the Copper Creek drainage.

The project area is located on the Lincoln Ranger District (RD) in the Copper Creek drainage in Lewis and Clark County, Montana. The fire perimeter is the overall project area for the Snow Talon fire salvage project. The fire perimeter is shown on the vicinity map in this chapter.

Immediately following the fire, rehabilitation needs were assessed through a burned area emergency rehabilitation (BAER) analysis. The findings of the analysis are documented in the *Snow Talon Fire Burned Area Emergency Response Report* (U.S. Department of Agriculture [USDA] 2003a). This report is available for inspection in the Snow Talon project file and is posted on the Helena NF Internet website at http://www.fs.fed.us/r1/helena/projects/index.shtml. While some of the BAER projects (such as hazard tree felling and some trail, road, and noxious weed treatments) were completed in the fall and early winter of 2003, remaining BAER work (additional trail and road improvements, additional noxious weed treatments, and assessment of the completed BAER work) will continue through spring and summer of 2004.

The Lincoln RD has proposed several post-fire restoration activities beyond those completed or to be completed with BAER. More information about these activities and the overall effort in fire recovery in the Snow Talon fire is addressed later in this chapter.

It is important to note that the purpose of this project is to salvage merchantable timber burned in the Snow Talon fire. While many of the actions proposed also will help restore resources affected by the fire, their primary purpose is to reduce the effects of the salvage activities. It is not the intent of this project to fully address all the effects of the Snow Talon fire.

Purpose and Need for Action

The purpose of this project is to salvage timber in response to the Snow Talon fire of 2003.

- The immediate need is to recover the value of the burned commercial timber products before they decay and have no commercial viability (*Helena National Forest Land and Resource Plan* [*Forest Plan*], USDA 1986, II-1, goals #11 and #16).
- The proposed commercial timber salvage harvest would provide economic opportunities for rural communities and is consistent with *Forest Plan* goals to provide a sustained timber yield that is responsive to local industry and national needs (USDA 1986, goal #11).

Management area (MA) direction for the majority of the proposed for harvest areas designates goals emphasizing cost-effective timber production while protecting soil productivity (USDA 1986, MAs T-1, T-3, and T-4). While some of the actions proposed will help restore resources affected by the fire, the intent of including these actions with this salvage harvest project is to mitigate for the effects of salvage activities. Jammer trail reclamation is included in the proposed action as a mitigation measure that would help improve overall soil quality.

Proposed Action

The Helena NF proposes to salvage harvest dead and dying timber from approximately 2,500 acres of land within the perimeter of the 37,706-acre Snow Talon fire (Figure 1). The proposed salvage activity would yield 20 to 30 million board feet (MMBF) of commercial timber through the percentage use of the following harvest methods: 55% helicopter logging and 45% ground-based logging (20% skyline and 25% tractor). To facilitate harvest and move harvest activities away from roads open to the public, short temporary spur roads (1/2 mile [total]; none exceeding 1,000 feet) and 30 potential helicopter landing areas are proposed. Any temporary spur roads or landing areas used would be rehabilitated following harvest. The installation of two temporary bridges would also be needed and would be removed and the associated areas rehabilitated following harvest activities. Only dead or dying trees as defined in the mortality guidelines presented in Appendix B would be removed; however, a few live trees may have to be cut to facilitate logging access and/or meet safety requirements.

To minimize impacts to burned soils, the proposed action specifies that helicopter and ground-based logging activities occur under winter conditions (either 4 inches of frozen soil and/or 6 inches of packed snow). Reclamation of 110 acres of jammer trails (originally constructed for logging in the 1960s) exposed by the fire would also be conducted as mitigation for salvage activities. Jammer trail reclamation would improve overall soil quality. The proposed action does not include harvest or temporary road construction in any inventoried roadless areas (IRAs), riparian habitat conservation areas (RHCAs), or research natural areas (RNAs).

Best management practices (BMPs) that promote long-term water quality, maintain existing road systems, and minimize erosion are also proposed. The BMP activities would include, but not be limited to, improving road drainage features, installing and replacing ditch-relief culverts, gravelling portions of the road system, revegetation, and other practices to minimize erosion. The BMPs are further described in Appendix C.

Decision Framework

The decision framework refers to the scope of the decision that will be issued at the conclusion of this analysis by the responsible official. The responsible official's decision will be based on information disclosed in the environmental document, information contained in the project analysis file, comments submitted during the scoping of the proposed action and the comment period, comment responses, and applicable laws, regulations, and policies in making the decision and stating the rationale in the record of decision (ROD). The responsible official may decide whether or not to

- Select the proposed action

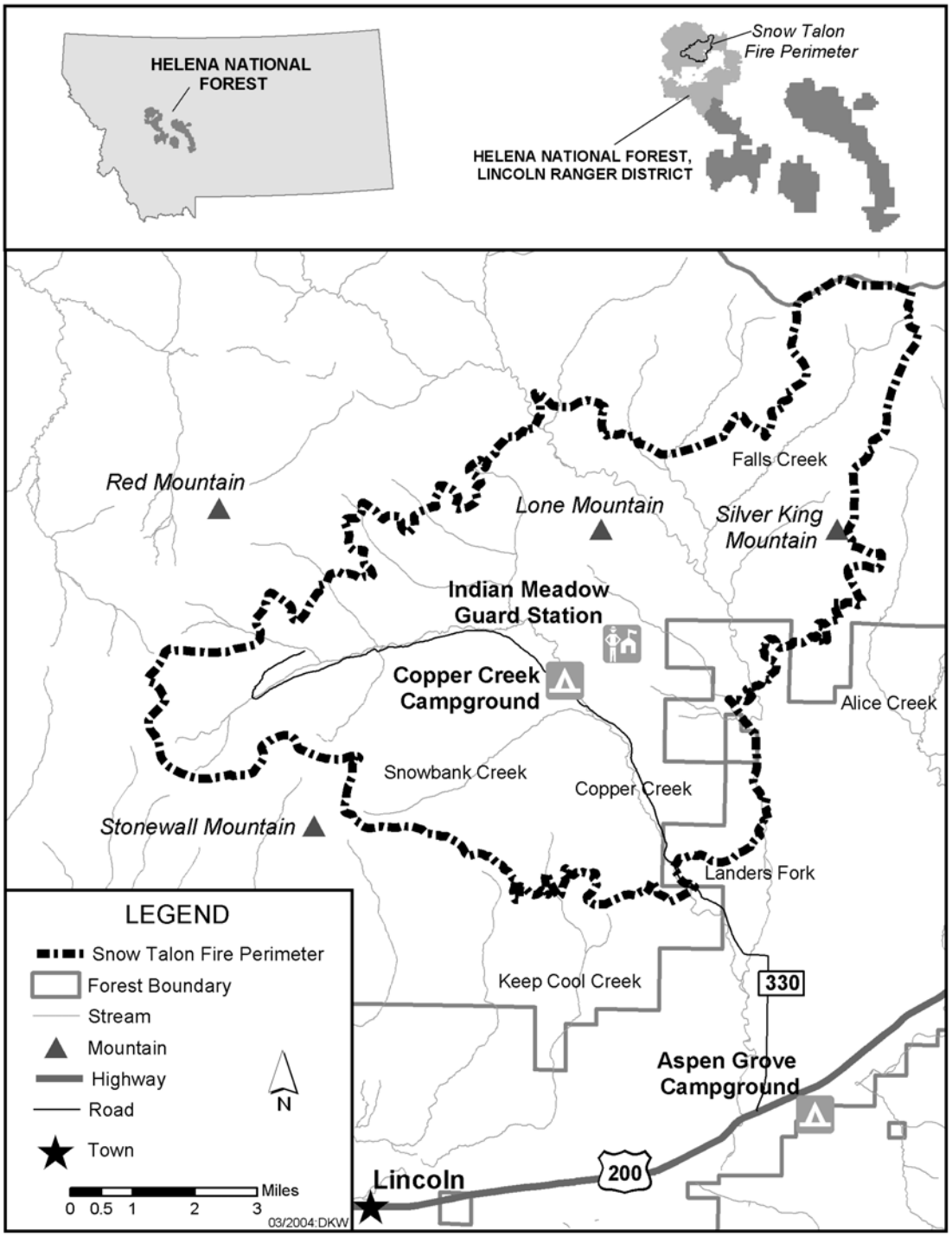

Figure 1. The Snow Talon fire perimeter is located north of Lincoln, Montana.

- Select an alternative to the proposed action
- Select portions from the developed range of alternatives and combine them in a logical package.

In selecting one of the above options, the terms and conditions of the selection will be fully displayed and understood. Within the parameters of this decision space, it will also be determined if a *Forest Plan* amendment would be necessary. The responsible official will take into consideration relationships of alternatives to the identified significant issues. The responsible official for the Snow Talon fire salvage project is Thomas J. Clifford, Helena NF Supervisor.

Forest Plan Direction

The *Forest Plan* divides the NF into MAs, each with different goals, resource potentials, and limitations. MAs are not single, contiguous units; they consist of many individual pieces, each classified with one of the specific MA prescriptions.

Except for congressionally designated areas or special administrative boundaries, MA boundaries are not firm lines and do not always follow easily found topographical features such as mountain ridges. The boundaries are intended to be flexible to ensure that the values identified are protected and to allow for the incorporation of additional information gained through physical reconnaissance and project-level planning.

The intent of this proposal is to harvest timber to at least partially fund tree planting, BMP work, jammer trail rehabilitation, and other identified restoration activities. These commodity-oriented activities would support community stability, a goal stated in the *Forest Plan* (USDA 1986, goal II-1), while protecting other resources such as soil and wildlife. Timber harvest would also meet the goals of those MAs within the suitable timber base (USDA 1986, goals III-30, III-42, and III-46) and forested lands in MAs specified as unsuitable for timber management (USDA 1986, III-5).

Management direction for the project area is found in the *Forest Plan* (USDA 1986). This direction is supplemented by the *Blackfoot Landscape Analysis* (USDA 1995a). The purpose of the analysis was to better understand *Forest Plan* direction at the landscape scale. The *Blackfoot Landscape Analysis* is an example where additional information and understanding has been used to update and refine the direction in the *Forest Plan*.

Forest Plan MAs

The following MA prescriptions are found within the fire perimeter. The goals, emphases, and standards that apply to areas within the fire perimeter are summarized below. For more detail and full text of the direction, refer to the Helena *Forest Plan* (USDA 1986), which is incorporated by reference.

L1—Nonforested Grazing

These areas are within grazing allotments and are generally nonforested, consisting of bunchgrasses, sage, and other shrubs, or sparsely forested areas with Douglas-fir or ponderosa pine as the dominant species. Management goals are to maintain or improve vegetative conditions and livestock forage productivity and to optimize livestock

production through intensive grazing systems, while maintaining other resource uses. Timber harvest may be used as a tool to improve forage production. However, forested land is classified as unsuitable for timber management. Management practices will generally follow guidelines for the maximum modification visual quality objective (VQO).[1]

M1—Minimum Management

These are forest areas where management improvements are currently uneconomical or environmentally infeasible. These lands are considered unsuitable for timber production but may be harvested where access exists. Wildlife habitat improvements may be undertaken when they support projects in adjacent MAs. These areas are generally maintained to a level that meets the objectives of the VQO of *retention*, but the direction is flexible in that VQOs may be varied on a case-by-case basis at the project level.

N1—RNAs

This MA includes the Indian Meadows and Red Mountain RNAs, which were identified on the Helena NF to meet regional targets and designated as RNAs in a 1987 *Forest Plan* amendment. These areas typify important ecosystems in southwestern Montana. The management goal is to provide areas for research, observation, and study of undisturbed ecosystems that typify important forest, shrubland, grassland, alpine, aquatic, and geologic types on the Helena NF. Timber harvest is not permitted in RNAs.

P1—Scapegoat Wilderness Area

This MA consists of the Helena NF portion of Scapegoat Wilderness designated in l972 by the U.S. Congress. The Scapegoat Wilderness area is managed in accordance with the *Wilderness Act of 1964* (16 U.S.C. 23 §§ 1131 et seq., 1964) to maintain an enduring system of high quality wilderness representative of NF ecotypes. This includes a goal to perpetuate the wilderness resource for future generations, and in response to this goal, the VQO is preservation. Timber harvest is not permitted in designated wilderness areas.

R1—Undeveloped Land Suited for Dispersed Recreation

This MA consists of large blocks—greater than 3,000 acres—of undeveloped land suited for dispersed recreation. These areas provide opportunities for semiprimitive nonmotorized recreation and are characterized predominately by natural or natural-appearing environment where there is a high probability of isolation from man's activities. Management goals are to provide a variety of semiprimitive and primitive nonmotorized recreation opportunities and to provide for maintenance and/or enhancement of fishery, big game, and nongame habitat, grazing allotments, visual quality, and water quality. Forested lands are classified as unsuitable for timber management. Management practices will follow the guidelines for the retention VQO. Short-term deviations may occur during construction or reconstruction of facilities or from management activities.

[1] VQOs are defined in Chapter 3 under Landscape Aesthetics.

T1—Timber Production Emphasis

These areas are generally considered suitable for timber harvest. General soils, watershed, and habitat protections are required, but nonharvest projects and activities must not conflict with stand regeneration and management (threatened, endangered, or sensitive [TES] species receive special consideration). Harvest plans must provide for regeneration within five years. The VQO allows for *maximum modification*.

T3—Big Game and Nongame Wildlife Areas Suitable for Timber Management

This MA consists of lands that have primary forage, resting, and security characteristics that provide important spring and summer requirements for all big game species. These lands also supply the habitat needs of a wide variety of nongame forest-dwelling wildlife. In addition, lands within this MA contain productive timber sites that are available and suitable for timber management. The variation in elevation, topography, slope, and aspect, in addition to the often abundant surface water (seeps, springs, etc.), make these areas rich in species diversity and total numbers within species groups. This area also has inclusions of small grassland parks. Management practices will generally follow guidelines for the modification VQO. The portions of this area (if any) that are within the sensitive viewing areas of the roads, trails, and areas listed in Appendix C will be managed to meet the more restrictive VQOs noted in the appendix. Management goals are to

- Maintain and/or enhance habitat characteristics favored by elk and other big game species
- Provide for healthy timber stands and a timber harvest program compatible with wildlife habitat goals for this area
- Emphasize cost-effective timber production, while protecting the soil productivity
- Maintain water quality and stream bank stability
- Provide for other resource objectives where compatible with the big game summer range and timber goals.

T4—Timber Production within Visually Sensitive Landscapes

This MA is productive timberland within the sensitive viewing area of many major travel routes, use areas, and water bodies. On timber lands in visually sensitive areas, timber management is modified to meet VQOs of *partial retention* or *retention*. In areas with this management prescription, other activities such as habitat enhancement may occur when they meet the VQOs and do not conflict with timber production goals. Most of the area is suitable forest land, but there are some inclusions of nonforest and nonproductive forest land.

W1—Wildlife Habitat

This MA contains a variety of wildlife habitat ranging from important big game summer range to big game winter range. Management goals are to optimize wildlife habitat potential, including old growth, over the long term and to provide for other resource uses,

if they are compatible with wildlife management goals. Timber will be harvested only if it can be used as a tool to maintain or enhance wildlife habitat values. Productive forest land within this MA is classified as unsuitable for timber management.

W2—Big Game Spring, Summer, and Fall Habitat

This MA consists of riparian and other lands that have forage, resting, and security characteristics, and provide important spring, summer, and fall requirements for all big game species. Forested land is classified as unsuitable for timber management.

Timber harvest will be used only to maintain or enhance habitat values. Management goals include the following:

- Maintain and/or enhance habitat characteristics favored by elk and other big game species during spring, summer, and fall
- Provide habitat diversity for nongame wildlife species
- Provide forage for both big game and livestock
- Provide for other resource objectives as long as their uses are compatible with the wildlife and livestock objectives.

Public Involvement

Formal Public Involvement

The notice of intent (NOI) to prepare an EIS was published in the *Federal Register* (FR) on December 2, 2003 (68 FR 231, 2003). The NOI asked for public comment on the proposal from December 2, 2003, to January 15, 2004. In addition, as part of the public involvement process, the agency mailed a scoping letter and maps describing the project and public involvement opportunities to approximately 1,312 people, groups, organizations, tribes, government agencies, and local and regional newspapers. A public open-house scoping meeting was announced in the NOI, the scoping letter, press releases, and in paid advertisements to the local newspaper. The open-house meeting was held on December 17, 2003, at the Lincoln RD in Lincoln, Montana, from 4:30 to 6:30 p.m., with seven people representing the public, local agencies, and local groups in attendance.

At the conclusion to the formal public scoping period, a total of 49 individuals provided approximately 326 unique comments/concerns for consideration. Written comments were received in the forms of electronic mails (emails) and letters. A record of communication was used to document each scoping comment received by a telephone call, interpersonal conversation, or during a meeting discussion. A few of the individuals that submitted comments stated they represented larger organizations, often providing specific member counts. Subsequent public scoping content analysis provided for identification of alternatives and key issues for further analysis. The content analysis report and comments received from public scoping are a part of the Snow Talon Fire Salvage EIS project analysis file.

Informal Public Involvement

Related, but not a part of formal public scoping for this EIS, were post-fire tours the District held for the public after the fire in October 2003 and a separate meeting the Lincoln District Ranger had with a local recreation club.

Seven post-fire tours were held with an estimated 150 people in attendance. Forest Service (FS) personnel took tour participants to several locations to see examples of various fire results and fire suppression-related activities. Tour participants were shown damage caused from high-severity fire spread, spruce budworm epidemic, and high-intensity/ high-severity fire. They were also shown the mosaic pattern of some burn areas where "green pockets" of vegetation survived. Tour participants were shown examples of BAER work completed and being planned for spring 2004 and they were also shown segments of rehabilitated heavy equipment and hand crew fireline created during suppression efforts. Tour discussions included: BAER hazard tree reduction along roads and what would occur with the resultant bundles of nonmerchantable and merchantable trees (either salvage or chipping/burning); lodgepole pine and Douglas-fir ecosystems and their patterns of high intensity/infrequent fire regimes; the NF's fire confinement strategy in wilderness areas; the fire's impacts to the area's recreation; the importance of defensible space; and the conflict between societies' values and fire's natural role in the ecosystem. FS personnel also discussed the expected course of natural regeneration and potential future management activities such as timber salvage, tree planting, weed control, and BAER monitoring.

The Lincoln District Ranger also spoke at a meeting of the Ponderosa Snow Warriors Club, a local snowmobile group in Lincoln, after the fire to discuss post-fire activities and possible concerns and options to reduce potential impacts to winter recreation. The focus of this meeting was to examine potential for alternate groomed snowmobile routes in the event of any winter salvage harvest and log hauling occurring in the Copper Creek drainage.

Identification of Issues

The FS separated the issues into two groups: significant and nonsignificant issues. Significant issues were defined as a point of debate or dispute about the effects directly or indirectly caused by implementing the proposed action. Nonsignificant issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, *Forest Plan*, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality *National Environmental Policy Act* (NEPA) regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (40 CFR 28 §§ 1500 et seq., 1506.3)…."

Significant comments were then sorted into categories to facilitate issue tracking and response. The issues were categorized as follows:

- Key Issues—Issues used to develop the alternatives and specific activities of the action alternatives.

- Analysis Issues—Issues addressed in the effects analysis and used to compare alternatives. They are described in detail and analyzed in Chapter 3.
- Issues Not Addressed in Detail—Issues or concerns, which upon further inspection, were already addressed through alternative design or mitigation, were determined to be beyond the scope of the project, or, if addressed, the issue or concern would result in an alternative that does not meet the Snow Talon fire salvage project's purpose and need. Analysis issues are summarized in the "Alternatives Considered but Eliminated from Detailed Study" section in Chapter 2.

Key Issues

The alternatives respond to the following key issues that were identified during scoping. The key issues are specific to the proposed action and the project area. Indicators for each issue will help to evaluate how each of the alternatives addresses the issue. Indicator evaluations are provided later in the "Comparison of Alternatives" section of Chapter 2 and the topics are discussed in detail in the associated resource sections of Chapter 3. Through the issue identification process, the following key issues were raised.

Soils Concerns

- Respondents expressed overall concerns about logging and negative impacts to soils, soil productivity, sediment delivery, and mass wasting/debris flow potential.
- Sediment Delivery—Respondents were concerned about sediment delivery to streams, which can result in negative impacts to bull trout and cutthroat. Respondents suggested the FS address this issue by going beyond standard application of buffers and/or BMPs.
- Indicator to be evaluated by alternative for this issue—Sediment delivery through modeling.
- Soils at Risk for Mass Wasting/Debris Flow Potential—Respondents describe concern about logging on sensitive soils, soils at risk for debris flow and the negative effects of overland erosion and sediment deposition that might occur within the watershed.
- Indicator—Management activity aggravating debris flow potential as described in *An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources* (Environmental Protection Agency [EPA] 1980).

Economic Concerns

Respondents expressed concern about the cost and feasibility of helicopter logging for the market value of the salvage timber and the cost impacts that seasonal restrictions would have on harvest operations. Respondents also expressed that the timber sale would be a stimulus to the local economy.

- Economics—Respondents raised questions on the economic feasibility of helicopter logging. An example comment states, "…high percentage of helicopter logging causes concern because of the high cost of this type of logging." This concern is further defined as a need for contracts to be cost-effective and economically feasible for potential bidders.

- Respondents also ask about the feasibility of the project as a whole questioning the value of the dead trees on today's market. Respondents asked that the nonmarket values of dead trees for other resources such as wildlife habitat or spiritual enhancement also be considered.
- Indicators—Estimated harvest volume, percentage of treatment area by yarding system, and project present net value of activities.
- Seasonal Restrictions—Several comments were received that addressed that requirements for winter logging are too restrictive for loggers, both from an economic standpoint and an implementation standpoint. Respondents disagreed with the need for seasonal restrictions to protect resource concerns. Other respondents mentioned they liked the idea of winter harvesting to limit negative resource concerns.
- Indicators—Seasonal erosion rates and amount of area impacted by compaction and displacement.

Other Concerns

- Logging in IRAs—The public concern expressed is that the project may affect IRAs, including both negative effects on roadless characteristics as well as effects on the current boundaries. The project area includes subunits of the Bear-Marshall-Scapegoat-Swan IRA called Silver King-Falls Creek and Stonewall. The IRAs were designated by the *Forest Service Roadless Area Conservation: Final Environmental Impact Statement*, also known as the Roadless Area Conservation Rule (USDA 2000a), which has not yet gone into effect. The future of this rule is uncertain and is currently under review by the USDA.
- Indicators—Acres of treatment within IRAs and effects of harvest to roadless characteristics within IRAs.
- Insects—Many respondents mentioned the need of treatment to capture the value of trees expected to have beetle mortality. Other respondents agree with the proposed action to remove trees before "they brood insects and diseases" that will affect adjacent forests. Recent insect population monitoring on the Helena NF has demonstrated rapidly increasing insect populations, presumably resulting from the effects of extended drought. Experience in the region since the fires of 2000 has demonstrated increases in tree mortality from bark beetles in fire-weakened trees. The interdisciplinary team (IDT) expects several species of bark beetles to develop populations within the burned area.
- Indicator—Acres of moderate/high-risk bark beetle stands treated.

Analysis Issues

Analysis issues do not result in the development of an alternative; they are addressed in the effects analysis and are used to compare alternatives. Analysis issues often arise in public scoping from similar comments and concerns voiced by multiple respondents. The rationale for determining the following issues as analysis issues rather than key issues can be found in the project file. These issues are described in detail and analyzed throughout Chapter 3.

- Vegetation resources including old growth, native plants, the establishment and/or spread of noxious weeds, and impacts related to forest fuel levels and jammer trail area rehabilitation.
- Wildlife and related resources including grizzly bear and lynx and their habitat, management indicator species (MIS), snags and snag dependant species, and forest habitat corridors and linkages.
- Aquatic resources including bull trout/native fish, riparian resources (such as seeps, wetlands, and springs), and water quality, including compliance with the *Clean Water Act* (33 U.S.C. 26 §§ 1251 et seq., 2000) and total maximum daily load (TMDL) requirements.
- Recreational issues including off-road vehicle and snowmobile activity, snowmobile "play areas" inadvertently created by logging activities, and unroaded areas and wilderness characteristics.
- Economic issues such as the timeliness of conducting salvage before timber value is lost and the size and types of timber sales.
- Impacts to cultural resources in the area.
- Cumulative effects of past management including logging, road building, and grazing.

Tiered and Referenced Documents

Considerable description, study, and analysis already exist. NEPA encourages agencies to tier their EISs to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision. Agencies also are directed to incorporate by reference material when the effect will be to cut down the bulk without impeding the agency and public review of the action. The following documents support this analysis:

- *Helena National Forest Land and Resource Plan* (USDA 1986). The *Forest Plan* guides all natural resource management activities and establishes management standards for the Helena NF. The *Forest Plan* describes resource management practices, levels of resource production and management, and availability and suitability of lands for resource management.
- *Helena National Forest Land and Resource Plan Environmental Impact Statement* (USDA 1986, Appendices A, B, and C). The *Forest Plan* EIS contains the basic resource information and analysis used to support the *Forest Plan*. The Snow Talon Fire Salvage EIS directly tiers to this analysis.
- *Blackfoot Landscape Analysis* (USDA 1995a). This analysis developed practices for implementing the *Forest Plan*, and provides a basis for management activities that sustains the ecosystems from which multiple uses and values are derived. The analysis provides a finer focus on actions needed to advance the areas towards *Forest Plan* goals.
- *Snow Talon Burned Area Emergency Rehabilitation Plan* (USDA 2003a). The *BAER Plan* assesses post-fire conditions, and provides a basis for the no action alternative.

- *Helena National Forest Noxious Weed Control Program Final Environmental Impact Statement* (USDA 1987). This is the NF's plan to control noxious weeds. The EIS addresses the spread of noxious weeds, public awareness, health risks associated with the use of herbicides, and coordination with other landowners and agencies.
- *Keep Cool-Liverpool Sheep and Goat Allotment Management Plan* (USDA 1964). This is the NF's plan to manage sheep and goat grazing in the Keep Cool-Liverpool Allotment.

Other Related Efforts

This section summarizes related ongoing or planned efforts within the project area. Pre-fire efforts included:

- Blackfoot Travel Plan/Blackfoot Travel Plan EIS—The Blackfoot Travel Plan is a proposal to revise the existing travel management on NF system lands in the Blackfoot project area. The Blackfoot Travel Plan was originally part of a NF-wide effort to revise travel management plans for the Helena NF. NF-wide travel planning was originally initiated in December of 2000, was rescinded in March 2003, and was initiated again in April 2003. The decisions to be made focus on what routes (both motorized and nonmotorized) will be open or restricted depending on other resource needs. Signing or other physical structure will be used to implement the decision to reach chosen management objective. No route obliterations or relocations will be analyzed under this decision. A draft environmental impact statement (DEIS) detailing additional alternative development is expected to be released in fall 2005 with a final environmental impact statement (FEIS) and ROD to follow.
- *Copper Creek Road Improvement Environmental Impact Statement*—The Copper Creek Road improvement project proposed action was released in January 2003 and included paving as well as many other road improvements. Prior to the fires of 2003, the DEIS was about to be released for public comment. However, after the Snow Talon fire, much of the road improvement work was completed through BAER. More improvement work is funded this year with fire restoration dollars, except for paving and the realignment and replacement of the bridge at the Indian Meadows junction. As a result all the work accomplished, the release of the DEIS was cancelled (69 FR 50, 2004).
- *Helena National Forest Weed Environmental Impact Statement* (USDA 2003b)—This project proposes to use various methods to treat weeds on approximately 23,000 acres of NF system lands over the next 12 years. In October 2003, a DEIS for this project detailing three alternatives was released for public comment. Following the analysis of comments and completion of alternative development in response to comment, an FEIS and ROD will be released in 2004.

Post-fire efforts included:

- Fire Suppression Rehabilitation—Rehabilitation of fire suppression activities began before the Snow Talon fire was officially declared contained. Suppression rehabilitation work focused on recontouring and revegetating firelines, skidding of felled trees from firelines, seeding of disturbed areas and bladed roads with native seed, and installation of waterbars.

- BAER—Following the fire, a BAER plan was written to address immediate fire rehabilitation needs. Work on emergency rehabilitation needs identified in this plan began immediately and will be ongoing over the next few years. Authorized BAER work includes culvert replacements, bridge replacements, hazard tree felling and removal, noxious weed treatments, installing road and trail drainage features, trail restoration, and continued monitoring of post-fire effects.
- Post-Fire Rehabilitation Categorical Exclusion—Lincoln Post-Fire Rehabilitation Project—The Lincoln RD has developed a plan for several nonemergency fire rehabilitation projects to be implemented over the next several years. Activities proposed include tree and shrub planting in burned areas, use of biological control agents for noxious weeds, insect monitoring and control using pheromones and insecticides, and repair/maintenance of administrative sites.
- Mushroom Harvest—Lincoln Post-Fire Mushroom Harvest Project—The Lincoln RD has developed a plan to manage an anticipated influx of commercial and personal use mushroom harvesters during 2004 and 2005. To manage mushroom harvest, a harvest permit system will be put in place and harvest restriction areas will be designated.
- Flood Preparedness—Resulting from the high percentage of burned area within the Copper Creek drainage, flooding may occur within the drainage and downstream on the Blackfoot River. Lewis and Clark County, in conjunction with the Lincoln RD, has developed a flood preparedness strategy to reduce the chance for property damage or human injury or casualty.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes and compares the alternatives considered for the Snow Talon fire salvage project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences among the alternatives and providing a clear basis for choice. Some of the information used to compare the alternatives is based upon the design of the alternative and upon the environmental, social and economic effects of implementing each alternative.

Alternative Development Process

The FS IDT used information from scoping (see "Identification of Issues" section in Chapter 1) in conjunction with field-related resource information in formulating alternatives to the proposed action. The range of alternatives displayed in this Chapter provides a different response to the significant or key issues; one alternative may respond to more than one key issue but was logically combined in formulating the alternatives. The alternatives were also designed to meet or move the resources and public needs toward the stated purpose and need for the project. Also displayed in this chapter are those alternatives considered but eliminated from detailed analysis and the reasons for their elimination. The alternatives considered in detail and those eliminated constitute the range of alternatives for this analysis.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 28 §§ 1500 et seq., 1502.14). Public comments received in response to the proposed action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of salvaging timber in response to the Snow Talon fire, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered but dismissed from detailed consideration for reasons summarized below.

Proposed Action

The proposed action, as described in Chapter 1, was distributed to the public during the scoping process. In that process, input from the public as well as input from IDT internal review (within the FS) produced a number of issues or concerns described in Chapter 1. In that review, the following issues were brought to light that indicated reasons why this proposal is no longer considered in detail.

- Areas of mass failure potential on debris flow-prone areas were identified within the proposal as tractor and/or skyline harvest methods.
- Harvest was proposed in *Forest Plan* MA direction for W-1 (optimize wildlife habitat potential) within which harvest can only occur if it can be used to maintain or enhance wildlife habitat values were included in the proposal.
- Areas designated for old growth management were identified for harvest and were a part of the proposal.

Resulting from these above concerns, the proposed action was modified and was developed into Alternative 2 as an alternative considered in detail. Therefore, the original proposed action was eliminated from detailed analysis.

Restoration—Only Alternative

Several comments requested that the Helena NF consider an alternative that would not include commercial timber harvest. Comments referred to an alternative that proposes only restoration measures, such as wildlife habitat improvement, noxious weed treatments, and travel management decisions (i.e., closure and reclamation of U.S. Forest System roads) to reduce perceived impacts to wildlife and other resources. Reclamation of the jammer trail areas in the Copper Creek drainage is a restoration measure that is included in all action alternatives proposed in this document.

A "no salvage" alternative was not included for detailed study because it would not meet the purpose and need. The purpose of the project is to recover the value of the burned commercial timber products before they decay and to contribute to the long-term sustained yield of forest products, which is a *Forest Plan* goal. The purpose and need would not be achieved if salvaging of merchantable wood products did not take place.

Other projects are currently being planned or implemented to address restoration and other needs associated with areas affected by the Snow Talon fire. Travel management issues are currently being addressed by the Lincoln RD's district-wide Blackfoot travel plan revision project, which is scheduled to be completed in fall 2005. Noxious weed treatments within the fire perimeter are currently authorized through the *Helena National Forest Noxious Weed Control Program Final Environmental Impact Statement (*USDA 1987), the *Forest Plan* (USDA 1986), and the Snow Talon BAER (USDA 2003a). Additional authorization for noxious weed treatment is expected to be available with the implementation of the Helena NF Weed Treatment Project EIS and the Lincoln post-fire rehabilitation project. The Lincoln post-fire rehabilitation project proposes several additional restoration activities, such as tree and shrub planting, facilities repair and maintenance, and insect treatments to prevent mortality in fire-weakened trees.

No Jammer Trail Area Rehabilitation

Several comments expressed concerns that jammer trail area rehabilitation is not a needed mitigation and that the short-term impacts associated with this rehabilitation may be unacceptable. Region 1 FS policy is to design and implement management practices that maintain or improve soil quality. This policy also specifies that in areas where more than 15% detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration should not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality.

Soil monitoring, in other timber sale areas, documents detrimental soil disturbance that exceeds this 15% guideline in areas with jammer trail networks. Jammer trail reclamation is included in all action alternatives to mitigate for the overall effects of salvage activities to soils in the project area by moving soil quality toward a net improvement.

Salvage More Area within the Fire Perimeter

Some people stated that Alternative 2 does not salvage enough trees in the fire area while other respondents requested that all dead wood be removed from the fire area.

All NF system lands within the Snow Talon fire perimeter were fully evaluated for the recovery of merchantable wood fiber. This evaluation took place during a post-fire reconnaissance, completed in fall 2003.

An alternative was considered that would involve more salvage logging in the burned area. Apart from the proposed treatment areas, there are few other areas within the fire with burned forest that contains trees of merchantable value that could be harvested for wood fiber in an economically viable manner.

Under Alternative 2, about 2,500 acres out of a total of 34,362 (NF system lands only) within the Snow Talon fire are proposed for salvage. Of the remaining 31,662 acres:

- 6,155 acres are wilderness
- 949 acres are within a RNA
- 18,829 acres within an IRA
- 1,861 acres are past regeneration harvests, previously dominated pre-fire by seedlings and sapling-sized trees
- 1,650 acres (approximately) are on lands unsuitable for timber management under the *Forest Plan*. These may include riparian areas, rocky sites, and higher elevation forests.

This leaves roughly 2,200 acres of forest potentially available for salvage with no harvest proposed in any of the alternatives. Most of these areas have environmental concerns associated with potential salvage that influenced the decision not to treat.

Harvest of Nonburned Areas Adjacent to the Snow Talon Fire

One respondent requested that this environmental analysis consider harvest in unburned areas outside the Snow Talon fire perimeter. The respondent noted that such analysis could provide project data necessary for analysis of smaller projects that would be categorically excluded from NEPA documentation. The Helena NF determined that such added analysis beyond the fire perimeter would not respond to the Snow Talon fire salvage project's need, which is to salvage timber in response to the Snow Talon fire.

Harvest of Areas Burned in the Moose-Wasson Fire

Comments referred to considering salvage harvest in areas burned by the 2003 Moose-Wasson fire as part of the Snow Talon fire salvage project. The IDT determined that salvage in the Moose-Wasson fire is outside the scope of the Snow Talon fire salvage

project's Alternative 2. The IDT determined that it would be most appropriate to propose and analyze the effects of any Moose-Wasson salvage harvest in a separate project.

Alternatives Considered in Detail

The FS developed four alternatives, including the no action alternative and Alternative 2, in response to issues raised by the public. Maps of the action alternatives are located at the end of this chapter.

Alternative 1—No Action

Under the no action alternative, current management plans would continue to guide management of the project area. No salvage, BMP upgrades, or jammer trail area rehabilitation would be implemented to accomplish project goals. The existing condition of the project area is discussed within each resource section of Chapter 3.

Alternative 2

It was realized, after the scoping process, that portions of Alternative 2 would not meet specific *Forest Plan* direction. The following steps were taken to revise the proposed action, which is now Alternative 2:

- Areas of mass failure potential on debris flow-prone areas were identified. These areas were removed from ground-based logging consideration and assigned to helicopter logging.
- *Forest Plan* MA direction for W-1 (optimize wildlife habitat potential) within which harvest may occur only if it can be used to maintain or enhance wildlife habitat values. To meet this *Forest Plan* management direction, approximately 200 acres within the W-1 MA were removed from the initial Alternative 2 harvest.
- Areas designated for old growth management were removed from the initial Alternative 2 harvest. Post-burn surviving old growth stands and surviving replacement old growth stands (stands managed to meet old growth characteristics in the future) have been identified, mapped, and designated for management according to the Eastern Montana Zone old growth definitions (Green et al. 1992) and *Forest Plan* standards. No harvest would occur in designated old growth stands that meet or exceed minimum old growth characteristics (Green et al. 1992). In designated replacement old growth stands, no harvest would occur that impacts minimum live tree stand characteristics (Appendix B).

Alternative 2 (Figure 2) would treat approximately 2,500 acres of forest stands burned by the Snow Talon fire. Trees removed would primarily be dead and dying to recover economic value prior to decay. This alternative uses helicopter, skyline yarding, and tractor skidding to implement this action. This alternative includes a combination of natural regeneration and hand tree planting. The following specifics detailed design elements are included in Alternative 2:

- 20 to 25 MMBF of commercial timber would be harvested over approximately 2,500 acres.

- The following yarding methods, by percentage of proposed harvest acreage, would be used: 54% helicopter, 11% skyline, and 35% tractor.
- To facilitate harvest and move harvest operations away from roads open to the public, approximately 0.5 mile (total) of short temporary spur roads (none exceeding 1,000 feet) and 27 potential helicopter landing areas are proposed and would be reclaimed following harvest.
- To minimize impacts to soils affected by wildfire, Alternative 2 specifies that all tractor and skyline logging would occur under winter conditions (either 4 inches of frozen soil and/or 6 inches of packed snow).

Alternative 3

This alternative was created to address comments that agree with salvaging dead and dying material, but question the economic feasibility of helicopter logging. This alternative also addresses the comments received requesting for an alternative that includes "a smaller level of harvest." Comments addressing the mass failure potential on debris flow-prone areas are also incorporated into this alternative by excluding all salvage units within such hazard zones.

Specifically, Alternative 3 (Figure 3) includes:

- Harvest ten to 11 MMBF of commercial timber over approximately 1,150 acres.
- No helicopter yarding would occur. The following yarding methods, by percentage of proposed harvest acreage, would be used: 25% skyline and 75% tractor.
- To facilitate harvest and move harvest operations away from roads open to the public, approximately 0.5 mile (total) of short temporary spur roads (none exceeding 1,000 feet) are proposed and would be reclaimed following harvest.
- To minimize impacts to soils affected by wildfire, Alternative 3 specifies that all tractor and skyline logging would occur under winter conditions (either 4 inches of frozen soil and/or 6 inches of packed snow).
- No harvest would occur in areas of mass failure potential on debris flow-prone areas.
- Post-burn surviving old growth stands and surviving replacement old growth stands (stands managed to meet old growth characteristics in the future) have been identified, mapped, and designated according to the Eastern Montana Zone old growth definitions (Green et al. 1992) and *Forest Plan* standards. No harvest would occur in designated old growth stands that meet or exceed minimum old growth characteristics (Green et al. 1992). In designated replacement old growth stands, no harvest would occur that impacts minimum live tree stand characteristics (Appendix B).

Alternative 4

This alternative was developed to address comments that requested the FS consider additional acreage for salvage harvest. Additional areas included for salvage opportunities include IRAs and approximately 250 acres of low/mixed severity burn areas where fire-related mortality (i.e., resulting from factors such as bark beetle invasion or drought) is expected in the next few years. This alternative also addresses comments

requesting that ground-based logging seasonal restrictions be limited. Also in this alternative, areas of mass failure potential on debris flow-prone areas were removed from ground-based logging consideration and assigned to helicopter logging.

Specifically, Alternative 4 (Figure 4) includes:

- Harvest 30 to 35 MMBF of commercial timber over approximately 3,750 acres.
- The following yarding methods, by percentage of proposed harvest acreage, would be used: 62% helicopter, 8% skyline, and 30% tractor.
- To facilitate harvest and move harvest operations away from roads open to the public, approximately 0.5 mile (total) of short temporary spur roads (none exceeding 1,000 feet) and 30 helicopter landing areas are proposed. These areas would be reclaimed following harvest activities.
- Seasonal restrictions (winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow) would be required only for tractor yarding on areas with ashcap soils.
- Approximately 1,000 acres of timber harvest in IRAs that do not fully meet roadless area criteria would be included. No roadbuilding or temporary road construction would occur within IRAs.
- Post-burn surviving old growth stands and surviving replacement old growth stands (stands managed to meet old growth characteristics in the future) have been identified, mapped, and designated according to the Eastern Montana Zone old growth definitions (Green et al. 1992) and *Forest Plan* standards. No harvest would occur in designated old growth stands that meet or exceed minimum old growth characteristics (Green et al. 1992). In designated replacement old growth stands, no harvest would occur that impacts minimum live tree stand characteristics (Appendix B).

Actions Common to Alternatives 2, 3, and 4

Many concerns expressed in the scoping period are best addressed through development of design features that are common to all action alternatives (Alternatives 2, 3, and 4) and that specifically avoid or reduce potential environmental impacts. These design features are an integral part of each action alternative and, therefore, are considered requirements should an action alternative be selected. They are listed here to avoid repeating them in each alternative description.

Appendix B includes a list of the project-specific BMPs and a table linking each measure to the applicable treatment unit. The BMPs are also features common to all action alternatives, although the location of specific practices varies by alternative.

Heritage Resources

If previously unknown heritage resources are encountered during implementation of the project, activities at the site would be halted and the forest archaeologist would be notified immediately. Activities would not resume until adequate protective measures are developed and specified in the field.

A contractual provision would be included in any timber sale contract that requires identification and protection of known resources and allows for modification or

cancellation of the timber sale or other contracts of necessary to protect resources discovered while project implementation is in progress.

Wildlife/Fisheries

Biological assessments (BAs) for this project were completed for any threatened or endangered species potentially inhabiting the project area.

To reduce potential impacts to fisheries, culvert and bridge installation and removal would occur during the month of August.

The following contract provisions would be included in any timber sale contract:

- Use of Roads by Purchaser—Specifies conditions under which purchaser may use roads for hauling
- Closure to Use by Others—Prohibits hunting, discharging of firearms, transportation of hunters or big game animals by the purchaser within restricted or closed areas
- Protection of Habitat of Endangered Species—For protecting any listed TES species encountered during project implementation
- Conduct of Logging—Sets forth methods of felling, skidding, and any yarding required to implement silvicultural prescriptions and meet other land management objectives.

Duration of Activities

- Timber sale contracts would be awarded for a three-year term, beginning in fall 2004.
- Upon the completion of all harvest activities, stocking surveys of harvest areas would be used to identify planting needs. Tree planting in areas with identified needs would occur thereafter, assuming adequate availability of trees. Planted areas would be monitored to ensure that regeneration would advance to desired stocking levels.
- Jammer trail rehabilitation would be completed by fall 2007.

These dates are tentative, based on anticipated budgets, work force availability, weather, and other conditions.

TES Plants

If unknown populations of sensitive plants were found during project implementation, they would be evaluated and protected as necessary to retain population viability. A contract clause would incorporate this into any timber sale contract. This clause specifies that the contract would be modified to protect these plants if located.

Air Quality

Slash pile burning at landings is the only prescribed burning actions proposed with this project. Prior to burning, a burn plan would be prepared for areas proposed within each action alternative.

Removal of Trees

All action alternatives focus on removing trees that were affected by the fire and exhibit the conditions specified in the conifer tree mortality (fire damage) estimator contained in Appendix B. It is acknowledged that in the following guidelines there may be some trees that are removed that would otherwise live and some trees that are left that may die. The guidelines as developed are generally conservative, erring on the side of leaving trees that might die, rather than taking trees that might live. This recognizes the value that live trees can hold across the landscape.

Trees that exhibit conditions described in the post-fire mortality guidelines in Appendix B and are proposed for salvage removal will be referred to as "dead and dying." Please note that the trees proposed for removal also include trees that are infested with bark beetles.

Retention of Live Trees

The post-fire mortality guidelines in Appendix B provide the criteria for live tree selection that would be followed in all salvage units. Some live trees would likely be cut for logging access or safety reasons. These trees would be left on the ground except where felled to create log landing areas.

Slash Reduction

Logging-created slash would be left within the units. If nonmerchantable material would be needed to be felled, it would be done in such a way that material is contour to the slope and would have contact with the ground. Slash would be evenly distributed in cable corridors in all skyline units; logging slash would also be evenly distributed on skid trails and other concentrated use areas, in all tractor units.

Tree Planting

All salvage units would be reforested through either natural regeneration or tree planting of native conifer species. This would restore the productive capacity of the land in a timely manner.

Riparian

To reduce potential impacts on soils, water quality, wetland, and riparian areas, the following would occur:

- Requirements of the Montana Streamside Management Zone Law and the *Inland Native Fish Strategy Environmental Assessment* (INFISH)*, Decision Notice and Finding of No Significant Impact, 1995, Intermountain, Northern, and Pacific Northwest Regions* (USDA 1995b) would be followed for all treatments within or adjacent to wetland or riparian areas.

Timber sale contracts contain standard clauses that provide for protection for riparian areas, stream management zones, and RHCAs.

Any moist sites located during layout of salvage units would be protected and provided with an appropriate riparian buffer.

Firewood Gathering

Currently, a temporary closure order (up to 1 year) is in place that restricts firewood cutting within the NF portion of the Snow Talon fire area.

Water

All timber sale contracts would require dust abatement measures to minimize the airborne delivery of sediment to streams.

Soils

In reclamation of the jammer trails (Figure 5) to reduce soil impacts across the project area, the following actions would be taken:

Recontour and revegetate approximately 30 miles of jammer trails in upper Copper Creek. These activities would be phased in over a three to four-year period, with the first phase of implementation covering about 10 miles of jammer trails on the south-facing slopes above Copper Creek.

Recontouring would be accomplished using heavy equipment, such as excavators. The goal would be to restore cut and fill material to the original slope contour. First decompacting the prism, which is approximately 10 feet in width, and then replacing fill material into the cutslope would accomplish full recontouring. If available from adjacent areas, large woody material would be placed on recontoured slopes to provide microsites for revegetation and ground cover for erosion control.

Where recontoured areas are crossed by ephemeral drainages, fill material would be pulled away from the drainage bottom and sloped at a stable angle. The drainage bottom would be armored with rock fragments. These measures would ensure loose material is not available for transport as sediment.

Recontouring activities would be implemented in a manner that avoids delivery of sediment to stream channels. This would be to protect bull trout during their critical reproductive period from September 1 through May 15, and to protect cutthroat trout during their critical reproductive period from May 15 to August 1. If there is risk of sediment delivery to streams with implementation of recontouring, fisheries biologists would be consulted for recommendations to minimize impacts to fish eggs.

Native grass seeding, with weed-free straw mulch, would provide vegetation cover for slope stability in the short term. It is estimated that seeding and mulching would be needed to cover reclaimed areas that are approximately 30 feet wide. For 30 miles of jammer trails, this reclaimed area equates to approximately 110 acres. Seeding and mulching would be completed concurrently with recontouring.

Tree and shrub planting would reestablish native vegetation communities in the long term. Planting would occur the following spring after recontouring is completed on south-facing slopes, and early summer on the north-facing slopes. Planting would be accomplished by hand.

Additional management practices to protect soil from erosion and maintain soil productivity would include the following:

- Use ground-based mechanized equipment only on areas where terrain and soil conditions would cause minimal impact to soils (slopes generally less than 35%).
- Designate main skid trails and temporary road access
- To minimize impacts to soils affected by wildfire where winter logging is conducted, either 4 inches of frozen soil and/or 6 inches of packed snow is required
- Winter logging would be done when the ground has enough snow or is frozen enough to protect soils
- To minimize erosion and other detrimental impacts to the soil resource salvage harvest would be completed using the BMPs detailed in Appendix B
- All skyline corridors and ground-based skid trails would have waterbars installed and slash placed on the trails as needed to provide ground cover and reduce soil erosion.

These requirements would be incorporated in to any timber sale contract through the inclusion of the contract clauses.

Noxious Weeds

- All off-road logging equipment would be washed before entering the project area.
- Vegetation would be reestablished on bare ground created by timber harvest activity and jammer trail rehabilitation. Native material would be used where appropriate and available.

Public Safety/Roads

- Contractors would be required to post signs along FS haul roads warning the public of truck traffic and other logging activities.
- Grading may be needed in order to maintain road drainage during any project activities. Dust abatement on open roads and blading would occur as needed on the main haul roads.
- Warning signs and public announcements would be used to notify the public of any logging activities in the area.
- Roads may be restricted for safety purposes during logging operations. Portions of the project area may be restricted to the public during any helicopter logging operations.
- Public access would remain restricted on roads closed to motorized use that are needed to access salvage units. Timber sale contract would contain clauses to ensure that roads remain closed to public.

Landings

Helicopter landings are areas where helicopters would land bundles of logs yarded from helicopter harvest units. Helicopter landings are also called log landings. These log landings need to be large enough and on gentle enough terrain to accommodate access by log trucks and other heavy equipment. One acre is the typical size anticipated for helicopter landings. On sloping terrain, the landing will need to be constructed with cut or fill techniques to create a fairly level area. It is predicted there will be approximately 25–30 helicopter landings needed, and preliminary locations have been identified on a map.

Sites where the helicopter lands for refueling, maintenance, or storage are termed "service landings," and there are one service landing per project area. All locations would be field verified at the time of harvest implementation and may be modified based on need to accommodate harvest operations or protect resources. Landings would avoid areas with concentrations of live trees.

Log landings would also be needed for tractor and skyline cable harvest units. Generally, these log landings would be smaller, perhaps 0.25 to 0.5 acre in size. These landings would generally be located immediately adjacent to a road and do not typically require any kind of construction. The skyline yarder or tractor would stack logs on the slope next to the road, or sometimes on the road prism. The rule of thumb for log landings with tractor or skyline cable harvest units is that there would be about one acre of soil disturbance associated with landings for approximately every 30 acres harvested. The location for tractor or skyline unit landings has not been mapped, because these landings are typically fit to the landscape at the time of harvest implementation.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Table 1 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives. Table 2 provides a tabulation of each harvest unit and the methods that will be used for harvest under each alternative.

Table 1. Effects of implementing each alternative.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Acres treated	0	2461	1129	3718
Volume	0	25.0 MMBF	10.5 MMBF	35.0 MMBF
Present Net Value (PNV)	0	1.01	1.11	0.90
Acres/percent of helicopter yarding	0	1332/54	0/0	2323/62
Acres/percent of winter seasonal restriction	0	1129/46	1129/100	582/16
Accelerated erosion	No change	Negligible	Negligible	Negligible
Mass wasting	No change	No increased risk	No increased risk	No increased risk
Compliance with Region 1 soil quality standards	Not applicable	In compliance	In compliance	Compliance uncertain in summer tractor logging areas
Compliance with Region 1 soil quality guidelines for net improvement in soil quality	Not applicable	In compliance	In compliance	In compliance
Detrimental soil disturbance levels due to timber harvest (displacement, rutting, and compaction)	None	130 acres (reclamation would occur on 86 acres)	100 acres (reclamation would occur on 58 acres)	176 acres (with potentially higher magnitude in summer logged units)
Cumulative detrimental soil disturbance impacts where historic harvest overlaps with new harvest	None	35 acres	15 acres	38 acres
Acres of soil recovery due to jammer trail restoration	None	110 acres	110 acres	110 acres
Soil resource synergistic cumulative effects.	None resulting from harvest	Minimized effects	Minimized effects	Risk for effects in summer tractor logging areas
Water yield (% increase above pristine)	12.9	12.9	12.9	12.9
Peak flows	No increase	No increase	No increase	No increase
Sediment–hillslope	No change	No change	No change	Slight increase
Sediment–road	No change	Reduced	Reduced	Reduced
Aquatics–INFISH	Meets objectives	Meets objectives	Meets objectives	Meets objectives
Fish populations	No impact	No impact	No impact	No impact

Table 1. (continued).

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Snags and downed wood habitat	Short-term increase	Decreased	Less decrease	Greatest decrease
Corridors and linkages	No change	Insignificant impact	Insignificant impact	Insignificant impact
T&E, and sensitive species	Lower impact due to less human presence	Short-term impact	Short-term impact	Short-term impact
Old growth habitat	Higher potential for bug infestation	Insignificant impact	Insignificant impact	Insignificant impact
Hunted species	No change	No change	No change	No change
Forest resource	Natural regeneration, some areas will not regenerate	969 acres planted	118 acres planted	969 acres planted
Nonconiferous vegetation	Indirect increase in noxious weeds	Short-term impact	Less short-term impact	Highest short-term impact
Sensitive plants (if sensitive plants are present in tractor logging areas)	No direct impacts or potential direct impacts	Potential direct impacts	Potential direct impacts	Higher magnitude of potential direct impacts
Noxious weeds	Increased infestation in jammer trail areas	Increased potential for infestation	Less increased potential for infestation	Highest increased potential for infestation
Recreation	No change	Short-term impact during harvest	Short-term impact during harvest	Short-term impact during harvest
Roadless areas	No change	Minimal effects	Minimal effects	Reduced natural integrity and naturalness
Unroaded	No change	Decrease in unroaded resource values	Decrease in unroaded resource values	Decrease in unroaded resource values
Economics–jobs harvest and processing	No change	403	175	567
Economics–jobs reforestation	No change	29	13	29
Heritage sites	No effect	Potential to affect 3 identified sites	Potential to affect 3 identified sites	Potential to affect 3 identified sites
Landscape aesthetics	Fire suppression and emergency treatment Remain visible	Short-term impact from harvest activities. VQOs realized sooner	Short-term impact from harvest activities. VQOs realized sooner	Short-term impact from harvest activities. VQOs realized sooner

Table 2. Comparison of harvest units by alternative.

Unit Number	Number of Acres	Alt. 2 Harvest System	Alt. 3 Harvest System	Alt. 4 Harvest System	Unit in IRA?	Estimated Salvage Harvest Volume (MBF)	Regeneration Method
1	13	H	No harvest	H	No	117	Plant
2	35	H	No harvest	H	No	315	Plant
3	120	H	No harvest	H	No	840	Plant
4	44	H	No harvest	H	No	264	Plant
7	39	H	No harvest	H	No	351	Plant
8	58	H	No harvest	H	No	580	Plant
9	6	H	No harvest	H	No	48	Plant
10	29	H	No harvest	H	No	319	Plant
11	30	H	No harvest	H	No	270	Plant
12	3	H	No harvest	H	No	24	Plant
13	110	H	No harvest	H	No	1,080	Plant
14	24	H	No harvest	H	No	192	Plant
15	42	T	T	T	No	246	Natural
16	225	H	No harvest	H	No	3,825	Plant
17	29	S	S	S	No	348	Plant
18	43	T	T	T	No	602	Plant
19	23	S	S	S	No	414	Natural
20	20	T	T	T	No	220	Natural
21	112	H	No harvest	H	No	1,232	Natural
22	4	T	T	T	No	48	Natural
23	14	S	S	S	No	168	Natural
24	4	T	T	T	No	60	Natural
25	9	T	T	T	No	54	Natural
26	23	T	T	T	No	230	Natural
27	41	S	S	S	No	451	Natural
28	21	S	S	S	No	189	Natural
29	17	S	S	S	No	144	Natural
30	68	H	No harvest	H	No	612	Natural
31	8	T	T	T	No	48	Natural
32	3	S	S	S	No	18	Natural
33	7	S	S	S	No	35	Natural
34	2	T	T	T	No	20	Natural
35	14	H	No harvest	H	No	126	Natural
36	4	S	S	S	No	36	Plant
37	47	H	No harvest	H	No	470	Plant
38	31	H	No harvest	H	No	403	Plant
40	6	T	T	T	No	54	Natural
41	16	H	No harvest	H	No	144	Natural
42	15	H	No harvest	H	No	180	Natural
43	29	S	S	S	No	203	Natural
44	107	T	T	T	No	856	Natural
45	37	H	No harvest	H	No	296	Plant

Table 2. (continued).

Unit Number	Number of Acres	Alt. 2 Harvest System	Alt. 3 Harvest System	Alt. 4 Harvest System	Unit in IRA?	Estimated Salvage Harvest Volume (MBF)	Regeneration Method
46	20	S	S	S	No	220	Plant
47	22	T	T	T	No	374	Plant
48	15	S	S	S	No	135	Natural
49	25	H	No harvest	H	No	200	Natural
50	59	T	T	T	No	354	Natural
51	180	T	T	T	No	1,440	Natural
52	3	T	T	T	No	45	Natural
53	67	T	T	T	No	748	Natural
54	9	H	No harvest	H	No	180	Natural
55	131	H	No harvest	H	No	1,441	Natural
56	1	T	T	T	No	15	Natural
57	22	T	T	T	No	330	Natural
58	36	H	No harvest	H	No	504	Natural
59	6	T	T	T	No	72	Natural
60	32	T	T	T	No	288	Natural
61	18	H	No harvest	H	No	108	Natural
62	7	H	No harvest	H	No	105	Natural
71	135	T	T	T	No	1,080	Natural
72	42	T	T	T	No	420	Natural
73	41	S	S	S	No	328	Natural
74	3	H	No harvest	H	No	9	Natural
75	27	S	S	S	No	189	Natural
76	10	T	T	T	No	60	Natural
77	18	S	S	S	No	180	Natural
101	609	No harvest	No harvest	H	Yes	5,481	Natural
102	16	No harvest	No harvest	H	Yes	96	Natural
103	151	No harvest	No harvest	H	Yes	1,510	Natural
104	92	No harvest	No harvest	T	Yes	828	Natural
106	21	No harvest	No harvest	H	Yes	126	Natural
107	15	No harvest	No harvest	T	Yes	105	Natural
111	29	No harvest	No harvest	T	Yes	290	Natural
112	46	No harvest	No harvest	H	No	414	Natural
113	5	No harvest	No harvest	T	Yes	30	Natural
150	7	No harvest	No harvest	T	No	42	Natural
151	44	No harvest	No harvest	H	No	132	Natural
152	63	No harvest	No harvest	H	No	252	Natural
153	25	No harvest	No harvest	T	No	175	Natural
156	26	No harvest	No harvest	H	No	130	Natural
157	5	No harvest	No harvest	H	No	30	Natural
158	10	No harvest	No harvest	H	No	60	Natural
159	14	No harvest	No harvest	T	No	98	Natural
160	25	No harvest	No harvest	T	No	175	Natural

Table 2. (continued).

Unit Number	Number of Acres	Alt. 2 Harvest System	Alt. 3 Harvest System	Alt. 4 Harvest System	Unit in IRA?	Estimated Salvage Harvest Volume (MBF)	Regeneration Method
161	36	No harvest	No harvest	T	No	252	Natural
162	18	No harvest	No harvest	T	No	108	Natural

Harvest actions common to all alts: Jackpot pile (where needed).
T=Tractor logging
S=Skyline logging
H=Helicopter logging

Figure 2. Map of Alternative 2.

NOTE TO PRODUCTION

This page is a placeholder for a Color 11x17 foldout page

File Name = Chpt_2_alt_11 x 17 figures 2-5.doc/pdf for these pages (figures 2 – 5).

Figure 3. Map of Alternative 3.

NOTE TO PRODUCTION

This page is a placeholder for a Color 11x17 foldout page

File Name = Chpt_2_alt_11 x 17 figures 2-5.doc/pdf for these pages (figures 2 – 5).

Figure 4. Map of Alternative 4.

NOTE TO PRODUCTION

This page is a placeholder for a Color 11x17 foldout page

File Name = Chpt_2_alt_11 x 17 figures 2-5.doc/pdf for these pages (figures 2 – 5).

Figure 5. Map of jammer trails.

NOTE TO PRODUCTION

This page is a placeholder for a Color 11x17 foldout page

File Name = Chpt_2_alt_11 x 17 figures 2-5.doc/pdf for these pages (figures 2 – 5).

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. This chapter also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter. The resource areas are organized in the following order:

- Soils
- Hydrology
- Aquatic
- Wildlife
- Forestry
- Fuels
- Nonconiferous Vegetation
- Sensitive Plants
- Noxious Weeds
- Recreation
- Roadless Areas
- Unroaded Areas
- Economics
- Heritage
- Landscape Aesthetics.

Each discussion includes an introduction to the resource concern, an explanation on how the effects can be measured, options for modifying effects (if any), and an analysis of the change over time resulting from the fire alone so that the direct effects of the actions can be illustrated. Following the discussions of effects by issue, the cumulative effects of all actions are summarized and contrasted among alternatives.

This EIS hereby incorporates, by reference, the soils, hydrology, aquatic, wildlife, forestry, nonconiferous vegetation, sensitive plants, noxious weeds, recreation, roadless areas, unroaded areas, economics, heritage, and landscape aesthetics specialists' reports in the Project Record (40 CFR 28 §§ 1500 et seq., 1502.21). These Specialists' Reports contain the detailed data, methodologies, analyses, conclusions, maps, references, and technical documentation that the specialists relied upon to reach the conclusions in this EIS.

Soils

Wildfires have immediate effects on soil resources during actual burning but also have short- to long-term effects following burning.

The short- to long-term effects to soils from the Snow Talon fire will be detailed in the section describing environmental consequences for the no action alternative. These effects include impacts to soil infiltration rates, accelerated erosion, nutrient cycling, soil microclimate, micro-habitat for soil biota, etc.

Immediate effects to soils from the Snow Talon fire and fire suppression activities are documented in the section describing current conditions. This narrative includes disclosure of soil impacts resulting from fire suppression activities and rehabilitation

measures to reclaim areas of soil disturbance resulting from these activities, a rapid assessment of watershed burn severity completed by a BAER team, and a more detailed evaluation of watershed burn severity using post-fire air photos of the Snow Talon fire area.

Affected Environment

Soils within the project area have been significantly affected by the Snow Talon fire. Approximately 57% of the fire area (Figure 6), outside of wilderness lands, burned with moderate to high severity. In these areas, surface organic material was mostly consumed by fire, and in areas of high severity, 1–2 centimeters of surface soil were charred. Organisms within these top few centimeters of soil likely experienced mortality from soil heating during the fire. A substantial amount of organic nitrogen was likely lost from severely burned areas through volatilization into the atmosphere during burning. These immediate effects from the fire have created conditions where short-term nutrient cycling and long-term soil productivity will likely be affected.

Following control of the Snow Talon fire, 31 miles of dozer line and 25 miles of hand line fire containment lines were rehabilitated. As a result of fire-line construction, soil displacement and compaction occurred. The anticipated long-term trend will be for recovery of soil quality through implementation of reclamation measures.

Landtypes within Snow Talon Fire Area

Landtypes (soils) have been characterized for the nonwilderness portion of Snow Talon fire area in *Soil Survey of Helena National Forest Area, Montana* (USDA 2001a). A summary of key soil characteristics for nonwilderness lands within Snow Talon fire area is displayed in Table 3 and Figure 7.

For the wilderness portion of Snow Talon fire area, landtype associations (soils) are described in *Land System Inventory of the Scapegoat and Danaher portion of the Bob Marshall Wilderness* (USDA 1980). For the purposes of Snow Talon fire salvage project, wilderness lands will not be included in soil resource analyses. Wilderness lands are excluded from soil resource analyses because they are influenced primarily by natural processes and are not subject to impacts from management activities, such as timber harvest or road building.

Fire Suppression Activities: Soil Impacts and Rehabilitation Measures

During the Snow Talon fire, 31 miles of fire containment lines were constructed with heavy equipment and 25 miles of fire lines were constructed by hand. Vegetation and duff were removed during construction of containment lines, and underlying soils were slightly compacted and displaced. Following control of the Snow Talon fire, these containment lines were rehabilitated by respreading soil and duff displaced during construction, installing water diversion structures to minimize erosion, and seeding to rapidly reestablish vegetation cover. Thus, fire line construction has had short-term effects on soils, but the long-term trend will be for recovery of soil quality on these sites. These fire containment lines were constructed on the fire perimeter, and areas of soil disturbance associated with these lines do not coincide with proposed salvage harvest units.

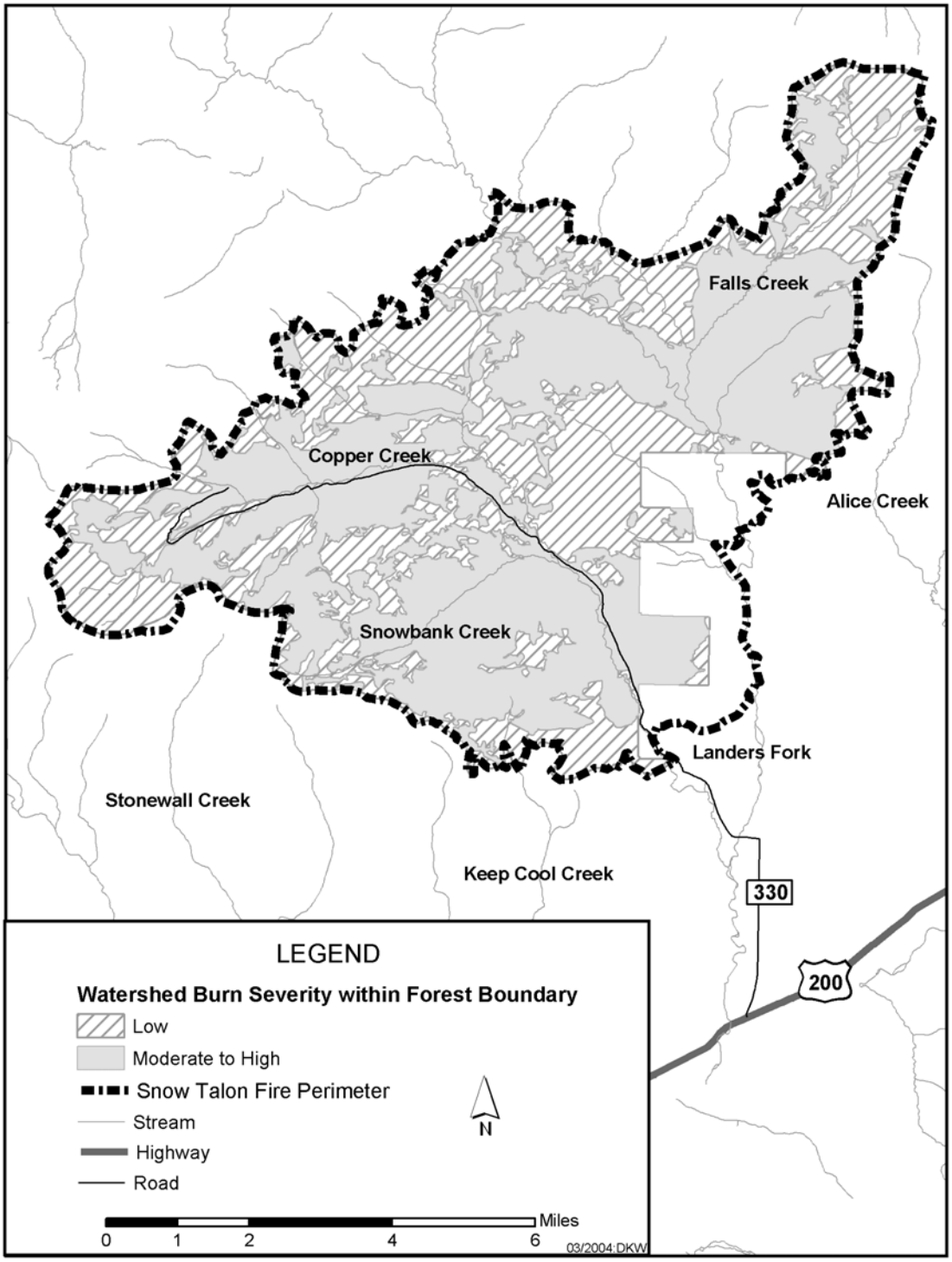

Figure 6. Watershed burn severity within the forest boundary and the Snow Talon fire perimeter.

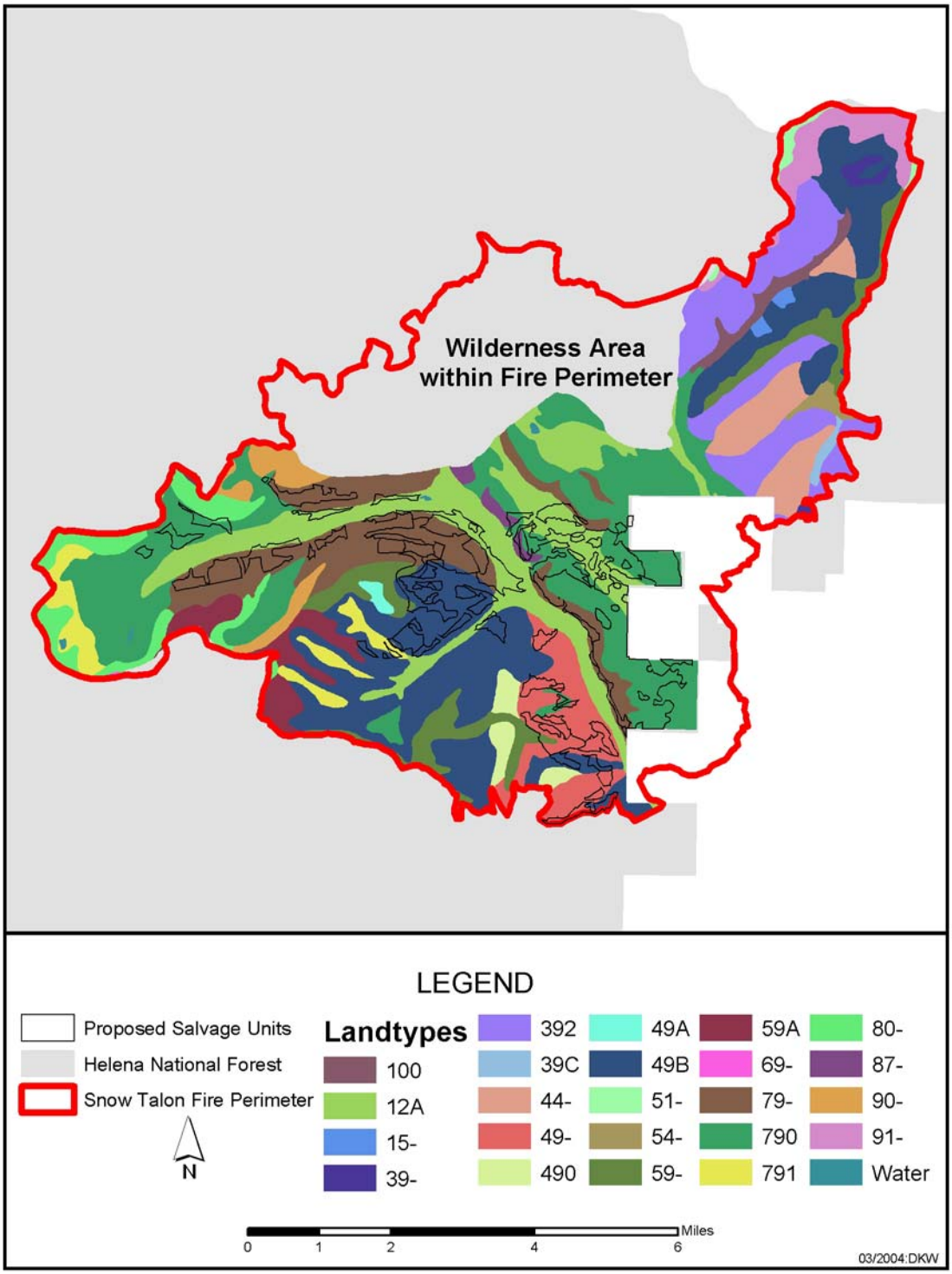

Figure 7. Proposed salvage units and landtypes within the forest boundary and Snow Talon fire perimeter, and outside the Wilderness Area.

Table 3. Landtype characterization within the Snow Talon fire perimeter.

Landtype Number	Landform	Geology	Slope Gradient (%)	Topsoil Texture	Acres Affected
12A	Moraines	Glacial till	10–25	Stony Loam	3291.9
15-	Debris Flows	Limestone, basalt, and metasedimentary rock	10–40	Silty Clay Loam	70.4
39-	Steep Mountain Slopes	Argillites, siltites, and quartzites	40–60	Very Channery Sandy Loam	128.6
39C	Mountain Ridges	Argillites, siltites, and quartzites	10–25	Loam	75.2
44-	Steep Mountain Slopes	Argillites, siltites, and quartzites	40–60	Very Cobbly Loam	1000.1
49-	Mountain Slopes	Argillites, siltites, and quartzites	25–50	Cobbly Loam to Silt Loam	1317.8
49A	Mountain Ridges	Argillites, siltites, and quartzites	10–40	Loam	67.4
49B	Mountain Slopes	Argillites, siltites, and quartzites	40–60	Channery to Very Channery Loam with surface loess influenced by volcanic ash	5396.3
51-	Mountain Ridges Shallow Soils	Limestone and calcareous sandstone	10–25	Very Gravelly Silty Clay Loam	159.2
54-	Mountain Ridges Shallow Soils	Argillites, siltites, and quartzites	10–40	Loam	131.0
59-	Mountain Ridges	Argillites and quartzites	10–40	Channery Silt Loam to Extremely Cobbly Sandy Loam with surface loess influenced by volcanic ash	1462.6
59A	Mountain Ridges	Argillites, siltites, and quartzites	10–40	Loam with surface loess influenced by volcanic ash	803.1
69-	Mountain Ridges	Noncalcareous igneous or metamorphic rock	10–40	Sandy Loam	9.4
79-	Mountain Slopes	Argillites, siltites, and quartzites	40–60	Channery to Very Channery Loam with surface loess influenced by volcanic ash	2727.3
80-	Cirqueland - glacially scoured bedrock	Metasedimentary rock	40–60	Bedrock	1017.8

Table 3. (continued).

Landtype Number	Landform	Geology	Slope Gradient (%)	Topsoil Texture	Acres Affected
87-	Glacial Trough Walls	Metasedimentary rock and basalt	60–90	Very Channery Loam	156.5
90-	Glacial Trough Walls	Metasedimentary rock and basalt	60–90	Silt Loam to Cobbly Silt Loam with surface loess influenced by volcanic ash	524.0
91-	Extremely Steep Structural Breakland	Granite, basalt, Metasedimentary	60–90	Bedrock	668.9
100	Flood plains and Terraces	Mixed alluvium	0–10	Gravelly Silt Loam to Extremely Gravelly Sandy Loam	306.6
392	Mountain Slopes	Argillites, siltites, and quartzites	40–60	Very Channery Loam	2203.7
490	Mountain Ridges	Argillites, siltites, and quartzites	10–40	Channery Loam	326.9
790	Glaciated Mountain Slopes	Glacial till from metasedimentary rock	25–40	Loam with surface loess influenced by volcanic ash	5309.8
791	Cirque Basins	Glacial till from metasedimentary rock	25–40	Loam with surface loess influenced by volcanic ash	672.6
Water	Lakes or Ponds	NA	Flat	NA	29.5
Wilderness					9834.1
				Sum of acres within Snow Talon fire area	37690.9

Table information derived from USDA 2001a.

Burned Area Emergency Assessment and Response

Burn severity mapping was based on criteria defined in *Forest Service Burned Area Emergency Response Handbook*, Forest Service Handbook (FSH) 2509.13, Amendment No. 2509.13-95-7, Section 23.32b (USDA 1995c). Zones are given one of three ratings and mapped accordingly. A zone may be rated low severity if the site factors indicate moderate or low-severity fire effects on the entire area. A zone may be rated as moderate severity if the site factors indicate high severity on less than 40% of area, with the remaining 60% of area with site factors indicating moderate or low-severity fire effects. A zone is rated as high severity if site factors indicating high severity are found on more than 40% of the area.

A rapid preliminary assessment of watershed burn severity was mapped during BAER reconnaissance while the Snow Talon fire was still burning (USDA 2003a). The purpose of the preliminary assessment was to identify if a potential watershed emergency existed.

This assessment was completed primarily from observing conditions during helicopter over-flight, in less than optimal visibility because of the thick wildfire smoke. Results of the assessment indicated approximately 87% of the Snow Talon fire area burned at moderate to high severity. It was determined that no emergency land treatments would be immediately implemented because the cost of such treatments would be relatively high, while the effectiveness and benefit in mitigating fire area erosion and flooding potential would be relatively low. Other types of treatments, such as hazard tree felling along public roads and road culvert removal or replacement to facilitate passage of increased flood flows, were recommended during the BAER process and subsequently implemented.

Soil Conditions Resulting From Wildfire

The preliminary assessment completed during the BAER reconnaissance was subsequently refined for the purpose of providing a more detailed description of fire area existing condition for the Snow Talon fire salvage project analysis. Refinement of watershed burn severity mapping was accomplished through review of color aerial photographs of the Snow Talon fire area taken after the fire was controlled. Results of the refined burn severity mapping indicated that approximately 57% of the Snow Talon fire area (nonwilderness lands only) burned at moderate to high severity, while 43% of that area burned at low severity.

Immediate wildfire effects on soils are primarily dependent on the degree and duration of soil heating during burning. Different soil properties have varying levels of sensitivity to soil heating (DeBano et al. 1998, 80). The degree and duration of soil heating for a specific site during burning is classified as fire severity (USDA 2000, Appendix A-5). Fire severity, with associated soil effects, is defined in the following ways (DeBano et al. 1998, 63).

During fires that burn with low severity, soil temperatures remain relatively low (generally less than 50 degrees Celsius at 1 centimeter depth). Biological components of soil, such as populations of bacteria or mycorrhizal fungi, tend to be most sensitive to soil heating during burning. These organisms tend to experience mortality at soil temperatures as low as 50–100 degrees Celsius. Thus, mortality of soil organisms may occur in the top 1 centimeter of soil during fires that burn with low severity. Partial consumption or char of plant litter and coarse woody material characterizes fires that burn with low severity, but the duff is left intact and the mineral soil is not changed.

During fires that burn with moderate severity, soil temperatures may reach 50–100 degrees Celsius (at 1 centimeter depth). With these temperatures, soil organisms may experience mortality to depths of 3–5 centimeters. Soil properties such as structure, soil organic matter, and nitrogen content tend to be moderately sensitive to soil heating. These soil properties are typically affected by wildfire when soil temperatures reach 100–300 degrees Celsius or more. For example, laboratory studies have shown that 25–50% of organic nitrogen contained in organic material can be volatilized during burning when temperatures reach 200–300 degrees Celsius (DeBano et al. 1998, 112). Typically, little or no organic nitrogen is lost through volatilization during burning of organic material, when temperatures remain below 200 degrees Celsius. When burning occurs at temperatures lower than 200 degrees Celsius, nitrogen typically remains in the soil in a form that is readily available to plants (i.e., ammonium or NH4-N). Thus, plant litter, duff, and woody material (except large logs) may be consumed during fires that burn

with moderate severity. However, mineral soil properties, such as structure, organic matter content and nutrient status, are not altered during moderate severity burning.

During fires that burn with high severity, soil temperatures typically exceed 250 degrees Celsius (at 1 centimeter depth). With these temperatures, soil organisms may experience mortality at soil depths of 9–16 centimeters. Plant litter, duff, and woody material (except large logs) are completely consumed during fires that burn with high severity and mineral soil is altered. Altered mineral soil can show darker color in the surface layer resulting from charred organic material and surface soil texture can be changed (soil particles can be fused together) by extreme soil heating under burned-out logs. Soil properties that are relatively insensitive to soil heating during severe burning include many soil nutrients (i.e., phosphorus, potassium, manganese, calcium or magnesium) and clay mineralogy. These soil properties are not affected by wildfire unless soil temperatures reach extremely high levels of 500–1,000 degrees Celsius or more. For example, up to 60% of phosphorus can be lost to the atmosphere when organic material is completely combusted, which can occur as soil temperatures reach 500 degrees Celsius for the duration of one half hour (DeBano et al. 1998, 107 and 114).

Environmental Consequences

In an effort to achieve legal mandates to sustain site productivity, the FS has developed management policy to guide design and implementation of vegetation management practices in ways that maintain or improve soil quality (i.e., timber harvest, grazing, and prescribed burning). Specifically, this management policy states that new vegetation management activities should not result in detrimental soil conditions on more than 15% of an activity area (USDA 1999a). When operations are planned in areas that do not meet soil quality standards resulting from prior activities, new vegetation management activities should be planned to meet current standards, and designed to ameliorate past detrimental soil conditions, where feasible. For this project, Region 1 soil quality standards will serve as threshold values for determining compliance with legal mandates to sustain site productivity with implementation of management activities.

Intensively developed sites such as mines, recreation sites, administrative sites, and permanent roads and trails are areas dedicated for management uses other than vegetation production. Therefore, soil quality standards are not applied to these areas (USDA 1999). Permanent roads do affect soil hydrologic function; however, road evaluation is more appropriately conducted on a watershed basis and will be evaluated in the hydrology assessment for this project (USDA 1999a; see Chapter 3, “Hydrology”). This analysis will focus on detrimental soil disturbance resulting from FS vegetation management activities within proposed salvage harvest units.

Because Region 1 soil quality standards are intended for application towards design and implementation of vegetation management activities and because wildfire is not a management activity, soil impacts from wildfire burning cannot be designed to comply with soil quality standards. Thus, it is not appropriate to assess soil impacts resulting from wildfire within the context of compliance with soil quality standards. Consequently, this analysis will not evaluate soil impacts resulting from the Snow Talon fire for compliance with Region 1 soil quality standards, *Forest Plan* standards, and legal mandates of NEPA. Nonetheless, soil conditions resulting from wildfire are considered in

this analysis to provide a context for soil impacts by alternative, and for assessment of soil cumulative effects.

Soil quality standards are to be applied to "activity areas" (USDA 1999a). The activity area is considered an appropriate geographic unit for assessing soil environmental effects, because soil productivity is a site-specific attribute of the land. Thus, the activity area will be used as the geographic unit to assess soil environmental effects for all action alternatives.

Activity areas are defined as "a land area affected by a management activity," such as "harvest units within timber sale areas, prescribed burn areas, grazing areas or pastures within allotments." For the Snow Talon fire salvage project, the geographic boundary for the activity area is represented by the treatment unit boundaries for proposed salvage harvest units, locations where temporary roads and log landings would be constructed and past timber harvest units where jammer trails would be reclaimed.

The temporal scope for assessment of soil resource environmental effects will include both short- and long-term impacts. For the purposes of this analysis, short-term effects are defined as those that occur approximately within 1–10 years following the wildfire. Long-term effects are defined as those that occur approximately within 10–20 years, or more, following the wildfire.

Effects Common to All Alternatives

The short- to long-term effects to soils from the Snow Talon fire will be detailed in the section describing environmental consequences for the no action alternative. Post-fire soil effects include reduced soil infiltration rates, increased surface water runoff, accelerated surface erosion, high risk of soil mass wasting, altered nutrient cycling regimes, and loss of micro-habitat for recovery of soil organisms, all of which can influence long-term soil productivity. These post-fire soil effects also occur under all action alternatives, in combination with effects of salvage harvest actions. Combined soil effects resulting from wildfire and salvage harvest activities will be discussed under cumulative effects for the action alternatives.

Effects Common to All Action Alternatives

Both direct and indirect effects to soils from salvage logging can influence long-term site productivity, particularly in combination with effects to site productivity from wildfire. Jammer trail reclamation in past harvest areas would cause soil disturbance in the short term, but a trend for long-term recovery of soil productivity is predicted with this restoration. General soil effects, and those common to all action alternatives will be described in this section. The specific, predicted effects of post-fire salvage associated with the Snow Talon fire salvage project will be described in the soil effects analysis as they vary for each action alternative.

Direct soil effects vary by action alternative resulting from differences in salvage harvest activities. Therefore, only general soil effects from salvage harvest will be described in this section, while specific effects will be evaluated for each action alternative. In general, post-fire salvage logging has potential to directly affect soil resources in the following ways:

- Ground-based salvage logging activities, such as tractor yarding or road and landing construction, can cause soil compaction, rutting, and displacement on main skid trails, temporary roads, and log landings.
- Ground-based salvage logging activities, such as tractor yarding or road and landing construction, can cause accelerated erosion and exacerbate the risk of soil mass movement (i.e., debris flows) resulting from wildfire.
- For ground-based harvest, there is need for logging equipment to operate off the designated network of main skid trails within tractor harvest units. This typically entails one or two passes of equipment, for tree-cutting with a mechanical harvester or tractor yarding of tree bundles to the main skid trail network. When logging on bare ground (i.e., "summer" conditions), this dispersed operation of ground equipment may impact soil and plant recovery on the burned landscape.

Salvage logging activities also have potential to indirectly affect soil resources in several ways. Removal of dead trees may leave insufficient biomass for future nutrient cycling and micro-habitat for soil biota, which play a critical role in soil maintenance and recovery processes. Removal of dead trees may also adversely affect soil microclimate by reducing soil shading, thus increasing soil temperatures. These indirect effects are common to all action alternatives and will, therefore, be evaluated in this section rather than for each individual action alternative.

Biomass and Nutrient Cycling

Removal of biomass through salvage harvest of dead trees can potentially leave insufficient organic material for future nutrient cycling. Researchers have recommended optimum amounts of coarse woody material to retain following timber harvest to sustain nutrient cycling and maintain long-term site productivity (Brown et al. 2003; Graham et al. 1994). For all action alternatives, the Snow Talon fire salvage project has been designed to retain 5–20 tons per acre of coarse woody material on the ground for warm, dry habitat types, and 10–30 tons per acre of coarse woody material on the ground for all other habitat types. Additional woody biomass would be retained on most sites as snags, which would provide for future recruitment of coarse woody material on the ground, as snags decay and fall. Graham and others note, "these recommendations are not designed to immediately replace the present forest floor and mineral soil organic matter, but to ensure their replacement over the next 100 years or more." Thus, retention of recommended amounts of coarse woody material would not reverse effects of the Snow Talon fire, by replacing the forest floor that was consumed during burning, but would ensure sufficient biomass "is left after harvesting for the development and function of the next forest" (Graham et al. 1994).

Micro-habitat for Soil Biota

Micro-habitat for soil organisms can potentially be affected by salvage logging activities. For the Snow Talon fire salvage project, all action alternatives have been designed to retain adequate micro-habitat elements that remain after the Snow Talon fire, and to actively recover micro-habitat elements lost during the wildfire. Specifically, adequate coarse woody material would be retained with logging slash following salvage harvest (Brown et al. 2003; Graham et al. 1994). Thus, salvage harvest is predicted to have a

beneficial effect by promoting more rapid recovery of micro-habitat, and dependent soil organisms, as compared to the no action alternative.

Soil Microclimate

A concern has been expressed that salvage logging may reduce the shade provided by burned timber, and thus further impact soil microclimate. Researchers have documented that even burned trees can still provide shading to help moderate surface microclimate (McIver and Starr 2000, 8). Proposed salvage logging would not harvest all of the standing dead trees. Therefore, there would be some remaining burned trees left standing, in addition to coarse woody material left on the ground, to provide shade following salvage harvest.

Nonetheless, there would likely be a minor reduction in shade following salvage harvest. No research studies, which investigate the effects of post-fire salvage logging on soil temperatures, have been found. Thus, there is some uncertainty as to what the magnitude of this potential effect may be, and how reduced shade would further affect soil temperature. However, the majority of shade and protective cover was lost during the wildfire, and any further reductions in shade from salvage logging would likely be minimal in comparison.

Cumulative Effects Common to All Action Alternatives

Geographic Area for Cumulative Effects Analysis

The appropriate geographic area for soil cumulative effects analysis has been defined as the “land area affected by a management activity” (USDA 1999a). This is because soil productivity is a site-specific attribute of the land. The productivity of one area of soil is not dependent on the productivity of an adjacent area of land. Similarly, if one acre of land receives soil impacts resulting from management activities and a second management activity that may affect soil is planned for that same site, then soil cumulative effects are possible on that site. Thus, cumulative effects to soil productivity are appropriately evaluated on a site-specific basis.

This site-specific productive function of soil is in contrast to the integrated hydrologic function of a watershed, which is dependent on the integrity of the whole system to maintain proper function. Evaluation of cumulative effects to soil productivity does not require an integrated “watershed-type” assessment. A larger geographic area such as a watershed or project area is not considered an appropriate geographic area for soil cumulative effects analysis. This is because assessment of soil quality within too large an area can mask or “dilute” site-specific effects (Nesser 2001). Thus, cumulative effects to soils are evaluated for site-specific activity areas (i.e., proposed salvage harvest units), but are not evaluated for the entire watershed or project area.

Past, Present, and Reasonably Foreseeable Actions

Past, present, and reasonably foreseeable management actions identified for consideration of cumulative effects associated with the Snow Talon fire salvage project include fire suppression activities, hazard tree felling, past timber harvest, tree planting, public firewood gathering, construction of roads and trails, livestock grazing, off-road use of motorized vehicles, and snowmobile use.

Actions Not Considered for Soil Cumulative Effects

Some activities mentioned do not have potential to cumulatively affect soil resources within proposed harvest units. These activities will not be considered for soil cumulative effects for the reasons described.

- Dozer construction of 31 miles and hand construction of 25 miles of fire containment lines did affect soils during the suppression effort for the Snow Talon fire. These fire lines have now been reclaimed to facilitate long-term recovery of soil quality. Fire lines were generally constructed on the fire perimeter, and soils affected by fire line construction do not coincide with the proposed salvage harvest units. For this reason, soil effects from fire suppression activities will not be considered for soil cumulative effects with salvage harvest actions.
- Hazard tree felling occurred along transportation corridors (i.e., designated roads and trails) following the wildfire to reduce public safety hazards associated with dead trees that might topple without warning. However, management activities to remove snags have occurred on areas already affected by road or trail construction, and no additional soil disturbance has been documented.
- Although permanent roads and trails do affect soil resources, "their evaluation is more appropriately done on a watershed basis using models and other watershed analysis techniques" (USDA 1999a). This is because soils associated with permanent roads and trails are dedicated for use as part of the permanent transportation system and are no longer used as productive ground (i.e., these sites are no longer managed for production of vegetation). In this case, the primary effect of roads and trails is on watershed function, and not productivity of soils. Thus, effects of permanent roads and trails will not be analyzed as part of this soil resource assessment but will be analyzed for watershed impacts in the hydrology and aquatics sections of this document.
- No active grazing allotments occur in areas proposed for salvage harvest. Therefore, no cumulative effects of grazing are anticipated in proposed salvage harvest units.
- No residual soil impacts from public use, such as past off-road use of motorized vehicles or snowmobiles, were observed during a field review of current soil conditions within proposed harvest units (conducted in September and October 2003). Future impacts from off-road vehicle or snowmobiling use is not anticipated, because State off-highway vehicle (OHV) law (USDA 2001b, 4) prohibits off-road vehicle use, and because snowmobile use typically occurs when there is sufficient snow to protect soils from impacts. Thus, no cumulative effects from off-road vehicle or snowmobile use are expected to occur within proposed harvest units.

Soil conditions following the Snow Talon fire are now the current baseline condition for soil productivity. It is not possible to restore these fire-affected soils to their pre-fire level of productivity, except with the passage of time and occurrence of recovery processes. It is this current level of soil productivity that must be maintained by proposed management activities, as directed by the *National Forest Management Act of 1976* (NFMA), as amended (16 U.S.C. 36 §§ 1600 et seq., 1988), and the Helena *Forest Plan* (USDA 1986, II/26). Therefore, soil impacts from wildfire are considered as part of the background conditions for soil effects predicted with salvage harvest activities. However, effects of wildfire will not be considered in determining compliance with Region 1 soil quality

guidelines and legal mandates contained in the NFMA and *Forest Plan* for cumulative effects to soil resources. This is because the FS is directed to apply soil management policy and law to management activities, and wildfire is not considered a management activity

Actions Considered for Soil Cumulative Effects

Jammer Trail Restoration in Past Harvest Areas

Extensive networks of jammer trails were originally constructed for logging access in areas of past timber harvest within Snow Talon fire salvage project area. Past harvest practices on jammer trails used a log yarding system that is now antiquated. These trails would not be needed again for modern harvest methods and they have never been part of the forest transportation network, as they are dead-end spurs and do not provide through access.

The Snow Talon fire consumed vegetation previously established on the jammer trails. The trails are currently denuded and subject to post-fire erosion. The trails adversely impact soil productivity and hydrologic function on hill slopes affected by their cut-and-fill construction. Thus, jammer trail restoration is proposed under all action alternatives. Restoration goals are to reclaim long-term soil productivity and restore hydrologic function where soils are currently displaced, and hill slope hydrology is disrupted by cut and fill construction of the jammer trails. Restoration of the jammer trails needs to occur during the time-critical window before vegetation is completely reestablished.

Under all action alternatives, approximately 30 miles of jammer trails in upper Copper Creek would be recontoured and revegetated. It is estimated that reclaimed areas would be approximately 30 feet wide. For 30 miles of jammer trails, this reclaimed area would cover approximately 110 acres.

Recontouring would be accomplished using heavy equipment, such as excavators. The goal would be to restore cut and fill material to the original slope contour. First decompacting the prism, which is approximately 10 feet in width, and then replacing fill material into the cutslope would accomplish full recontouring. If available from adjacent areas, large woody material would be placed on recontoured slopes to provide microsites for revegetation and ground cover for erosion control.

Where recontoured areas are crossed by ephemeral drainages, fill material would be pulled away from the drainage bottom and sloped at a stable angle. The drainage bottom would be armored with rock fragments. These measures would ensure loose material is not available for transport as sediment.

Tree and shrub planting would reestablish native vegetation communities in the long term. Planting would occur the following spring after recontouring is completed on south-facing slopes and early summer on the north-facing slopes. Planting would be accomplished by hand, although shrub plugs and tree seedlings may be flown by helicopter to planting sites if economically practical.

There would be short-term soil disturbance on these 110 acres as jammer trails are reclaimed. Native grass seeding, with weed-free straw mulch, would provide protective cover for slope stability in the short term. Thus, seeding and mulching would be completed concurrently with recontouring.

In the long term, a trend for recovery of soil productivity and hill slope hydrologic function is predicted as the result of jammer trail reclamation on these 110 acres. Thus, there would be a trend for net improvement in soil cumulative effects of past logging in the Snow Talon fire salvage project area. This is in compliance with Region 1 soil guidelines that cumulative detrimental effects from project implementation and restoration should "move toward a net improvement in soil quality" in areas where detrimental soil conditions exist from prior activities (USDA 1999a).

Public Firewood Gathering

Public firewood gathering is a reasonably foreseeable action that may cause soil cumulative effects within proposed activity areas, in combination with effects of the Snow Talon fire and proposed salvage logging. The exact magnitude, degree or extent of possible cumulative effects from public firewood gathering cannot be predicted. However, this potential soil effect can be eliminated by closing the activity areas to public firewood gathering or can be mitigated by limiting vehicle use for public firewood gathering to existing classified forest roads.

Tree Planting

Conifer planting following salvage harvest is another reasonably foreseeable future action that can have beneficial cumulative effect by rapidly reestablishing trees in areas of salvage harvest. Tree planting can ameliorate the almost complete loss of forest cover from wildfire. Planting trees would facilitate rapid reestablishment of the primary photosynthesizing organisms, which produce the major source of carbohydrates and energy on these sites. Planted trees would facilitate more rapid recovery of the soil biotic community compared to the rate of natural conifer regeneration (no action alternative), as they "fuel most of the dynamic and complex belowground energy web" (Kohm and Franklin 1997, 119).

Mitigations Included Under All Action Alternatives

A complete list of soil and water conservation measures, including BMPs and special mitigation measures, can be found in Appendix C. Many of these soil and water conservation measures have been incorporated into harvest designs for this project. Some of the key BMPs and mitigation for all action alternatives that design harvest activities to minimize or avoid detrimental soil disturbance include

- Under all action alternatives, adequate amounts of coarse woody material would be retained within harvest units following salvage logging, based on recommendations by researchers (Brown et al. 2003; Graham et al. 1994).
- Under all action alternatives, suspended log yarding (i.e., helicopter and/or cable skyline) would be implemented on steep slopes (generally greater than 35%).
- Under all action alternatives, detrimental soil disturbance would be avoided in areas at high risk for mass wasting as a result of effects from wildfire. This would be accomplished by helicopter yarding under Alternatives 2 and 4, and by eliminating logging in these areas under Alternative 3.
- Under all action alternatives, establishment of log landings would be limited to affect approximately one acre of soil disturbed by landing construction per 30 acres of harvest area.

- Under all action alternatives, log landings and temporary roads would be reclaimed by recontouring, scattering woody material, and seeding.
- Under all action alternatives, jammer trails in past harvest units would be reclaimed by recontouring, scattering available woody material (if any), and vegetation planting or seeding. This reclamation would cause short-term soil disturbance, but would result in long-term improvement for soil quality in areas affected by past harvest.

Effectiveness of soil and water conservation measures has been evaluated through state audits of BMP implementation associated with timber harvest practices, and is documented in the bi-annual report "*Montana Forestry Best Management Practices Monitoring*" (Montana Department of Natural Resources and Conservation [DNRC] 2000, 1–2 and 61–68). These state audits found that 100% of the 42 timber sale areas reviewed in summer 2000 had implemented the following BMPs in a manner that was effective in providing adequate protection of soil and water resources:

- BMP IV.B.1a, Skidding operation minimizes soil compaction and displacement
- BMP IV.A.6, Suitable location, size, and number of landings.

The effectiveness of BMPs for conserving soil resources during post-fire timber salvage logging has been documented by the Boise NF in monitoring conducted after the Foothills fire salvage logging project (Maloney, Thornton, and Lesch 1995). This monitoring documented that a designated skid trail system minimized soil effects from ground-based logging operations: "acres salvaged with ground-based equipment had approximately 8% of the area utilized as skid roads and skid trails," because "tractor skid roads were normally located by the sale area administrator and harvest inspectors were present to monitor tractor skidding activities which was important in the elimination of accelerated soil erosion." The scientists conducting this evaluation also recorded, "monitoring showed that over a three year period, no accelerated soil erosion and sediment delivery to stream channels was identified as a result of salvage harvest activities when protection measures were correctly implemented.

The BMP monitoring has also been conducted for harvest units in the Maudlow-Toston salvage sale area. The purpose of the monitoring was to determine if prescribed BMPs and mitigation measures had been adequately implemented, and assess if those measures were effective in achieving soil and water conservation objectives. Results of this monitoring are documented in "Unit Log" reports, which describe BMP evaluations completed on January 8, and October 16 and 29, 2003 (USDA 2003c, 2003d, 2003e, and 2003f). Key findings from BMP monitoring in Maudlow-Toston salvage sale area include:

- Adequate amounts of coarse woody material were retained in harvest units, as recommended by researchers (Graham et al. 1994).
- Region 1 soil quality guidelines (USDA 1999a) for limiting detrimental soil disturbance, such as compaction and displacement, were met in helicopter, skyline cable (both summer and winter logging), and winter tractor logging units. Summer tractor logging units have not yet been evaluated.
- Temporary roads and log landings have been successfully recontoured, with adequate amounts of woody material scattered across reclaimed areas and then seeded. Because

seeding of these areas occurred in fall 2003, the seeds had not yet germinated at the time of monitoring.

- Waterbars had not yet been installed in skyline cable yarding corridors at the time of monitoring. However, waterbars were subsequently installed in cable yarding corridors, following feedback from this monitoring effort.

Results of state BMP audits by Montana DNRC and post-fire salvage harvest monitoring on the Boise NF and in the Maudlow-Toston salvage sale area indicate that BMPs and mitigation can be expected to achieve soil and water conservation objectives with the Snow Talon fire salvage project.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

Short-term soil effects following wildfire can include reduced soil infiltration rates with consequent increased surface water runoff with accelerated surface erosion and high risk of soil mass wasting, altered nutrient cycling regimes, and loss of micro-habitat for recovery of soil organisms. Long-term soil effects following wildfire include potential changes in overall soil productivity.

Soil Infiltration Rates

Soil infiltration rates are typically reduced, and consequent surface water runoff rates are increased, following wildfire resulting from several factors (DeBano et al. 1998, 167), which include the following:

- Formation of a water repellent (hydrophobic) layer within surface soils resulting from condensation of organic oils on soil particles during burning
- Collapse of soil structure from volatilization of soil organic material during severe burning and consequent reduction in soil porosity
- Formation of soil surface crusts, which seal surface pores, from raindrop impact on bare soil
- Loss of plant litter and duff layers, which typically act like a sponge to temporarily retain surface water, until it has time to infiltrate to the soil.

Researchers have found that saturated soil infiltration rates may be temporarily reduced by 10–40% with formation of hydrophobic soil layers resulting from high severity burning, compared to undisturbed soil conditions (Robichaud 2000). These researchers noted that soil infiltration on severely burned areas recovered to near normal rates by the third simulated rainfall event conducted for the study. Thus, reduced infiltration rates, with consequent increased surface water runoff, following wildfire are a short-term temporary effect.

Within areas severely burned during the Snow Talon fire, soil infiltration has been reduced compared to pre-fire conditions, and consequently surface water runoff will increase, likely to a degree similar to that documented by researchers. However, soil infiltration and consequent surface water runoff rates are expected to recover to near normal once water repellent soil layers break down and sufficient plant recovery begins to provide adequate protective soil cover (DeBano et al. 1998, 172 and 183). Water

repellent layers typically breakdown after the first substantial precipitation wets the soil, but research has shown water repellent soils can persist for as long as 6 years following fire (DeBano et al. 1998, 97). Plant recovery, which provides adequate ground cover, is expected to occur within approximately 2–10 years (Elliot et al. 2000, 2 and 10).

Accelerated Surface Erosion

Landtypes within proposed salvage harvest units are at risk for accelerated soil erosion following the Snow Talon fire because of consumption of surface organic material and reduced protective soil cover, combined with decreased soil infiltration and increased surface water runoff (DeBano et al. 1998, 180). These soil conditions do not fall within guidelines for retention of adequate effective ground cover to prevent detrimental soil erosion (USDA 1999a). Thus, under current conditions, detrimental soil erosion is expected to occur in areas where effective ground cover was removed during the Snow Talon fire.

The Water Erosion Prediction Project (WEPP) model was used to predict the amount of accelerated surface erosion that may occur within the first year following the Snow Talon fire (Table 4). It should be noted that accuracy of any erosion prediction model, including WEPP, is at best only plus or minus 50% of the true erosion value (Elliot et al. 2000, 14). Thus, the numbers displayed in Table 4 are not intended to be predictions of absolute erosion rates. Rather, the modeled numbers are intended to provide a relative approximation for the expected magnitude of erosion following wildfire, and to aid in determining the significance of predicted erosion.

Under scenarios modeled for high severity burning, the Water Erosion Prediction Project (WEPP) model predicts approximately 90–100% probability that accelerated surface erosion will occur within the first year following the Snow Talon fire. Under scenarios modeled for low severity burning, WEPP predicts lower probability for erosion compared to high severity burning, although under the majority of scenarios this probability for erosion is still relatively high at 40–70%. This high predicted probability is consistent with accelerated erosion observed within the first year following other recent wildfires within the northern Rocky Mountain region (Schultz et al. 1986; USDA 2001c). In fact, researchers have suggested that this cycle of wildfire and consequent accelerated erosion "may be the major land-forming process" in the northern Rocky Mountain region (Schultz et al. 1986). Thus, it is not a question if accelerated erosion will occur, but exactly where, to what actual magnitude, and when.

It needs to be emphasized that accelerated erosion will almost certainly occur following the Snow Talon fire. This emphasis needs to be stressed because many are concerned about accelerated erosion resulting from management activities. Yet researchers have noted, "forest management practices can increase erosion rates, but wildfires have the greatest potential to accelerate erosion" (Everett 1995). As will be discussed in the following paragraphs, accelerated erosion resulting from the wildfire will almost certainly be significant both in magnitude and in extent of area affected. In comparison,

Table 4. Predicted 2004 surface erosion within Snow Talon fire area.

Land types	Slope Range (%)	Surface Soil Texture	Average Surface Rock Content (%)	2004 Predicted Surface Erosion (Tons/Acre) Low Severity Burn	Erosion Probability Low Severity Burn (%)	2004 Predicted Surface Erosion (Tons/Acre) High Severity Burn	Erosion Probability High Severity Burn (%)
100	0–10	Loam	25	1.7	38	11.5	92
100	0–10	Sandy loam	25	1.2	32	7.0	78
39C	10–25	Loam	8	4.2	46	26.8	98
12A	10–25	Loam	25	4.8	46	32.2	98
51-	10–25	Silt loam	45	11.2	86	67.8	98
49A, 54-, 59A	10–40	Loam	8	6.5	46	40.6	98
490	10–40	Loam	25	7.3	48	49.3	98
59-, 69-	10–40	Sandy loam	8	5.0	44	20.8	88
15-	10–40	Silt loam	8	10.2	50	56.8	94
59-	10–40	Silt loam	25	12.1	68	94.4	98
790, 791	25–40	Loam	8	7.1	46	44.7	98
49-	25–50	Silt loam	25	15.2	68	113.7	98
49B	40–60	Loam	25	11.3	48	73.2	98
44-, 49B, 79-, 392	40–60	Loam	45	13.6	70	84.8	100
39-	40–60	Sandy loam	45	10.2	54	54.4	98
87-	60–90	Loam	45	16.9	70	101.4	100
90-	60–90	Silt loam	20	19.7	64	147.1	94

WEPP model input parameters and output values are documented in Snow Talon fire salvage project file.

erosion resulting from salvage harvest is predicted to occur on substantially less area and at lower rates (this conclusion will be discussed in detail in the environmental consequences sections for the action alternatives).

To answer the question of where accelerated erosion will occur following the Snow Talon fire: it is anticipated that surface erosion will occur on all areas within proposed salvage harvest units where the Snow Talon fire left bare soil without protective ground cover (vegetation or plant litter and duff). This means that accelerated erosion, resulting from the Snow Talon fire, will occur on at least 57% of the project area, where ground cover was mostly consumed during moderate to high severity burning.

The question of actual magnitude of accelerated erosion cannot be answered until after the fact, because the erosion outcome will depend on the type of climatic events that occur until the burn area has recovered. However the timing of the greatest magnitude of erosion can be predicted: accelerated erosion is anticipated to be of the greatest magnitude within the first year following wildfire, and will diminish in magnitude over

the next few years (DeBano et al. 1998, 183). The significance of the predicted magnitude of accelerated erosion will be discussed in a later paragraph.

Accelerated erosion will not continue once sufficient plant recovery begins to provide adequate protective soil cover (DeBano et al. 1998, 172). Sufficient plant recovery is expected to provide adequate ground cover within approximately 2–10 years (Elliot et al. 2000, 2 and 10). Thus, accelerated erosion resulting from wildfire is a short-term temporary direct effect. There are also indirect effects resulting from accelerated erosion that may result in both short- and long-term consequences: reduced nutrient holding capacity may affect both short-term nutrient cycling and long-term soil productivity.

Risk of Soil Mass Wasting

A review of color aerial photographs covering the Snow Talon fire area, taken after the fire was controlled, reveals discrete areas of north and east facing, steep slopes above Copper Creek that currently have debris flow channels visible on the landscape. These debris flow channels tend to coincide with landtypes 49, 49B, and 79, and occupy a landscape position on the lower one third of affected hill slopes. These debris flow channels occur in proposed salvage harvest units 7, 15, 38, 39, 41, and 45. For all other proposed harvest units, there are no currently existing debris flow channels visible.

These debris flow channels are evidently remnant landscape features left from previous (fire) disturbance in this watershed, because no mass wasting has yet occurred as a result of Snow Talon fire. Researchers have documented that debris flows will tend to occur in previously established channels (Leopold, Wolman, and Miller 1992, 342). Thus, there is likely risk of future debris flows in these existing channels following the Snow Talon fire.

A standard method was used to assess the magnitude of risk for future debris flows in these areas (EPA 1980, V.26–V.29). From this assessment, a moderately high risk of debris flows is predicted resulting from the fire-removed vegetation cover (refer to Project File for details of debris flow risk assessment). Existing roads also influence risk of mass wasting in these areas. When influence of existing roads is factored into the assessment, risk of debris flows becomes high. Figure 8 shows the areas at risk for mass wasting that are included in salvage units.

As with surface erosion, risk of debris flows is predicted to be greatest during the first year following Snow Talon fire (i.e., 2004). This risk is predicted to diminish as water repellent soil layers break down and vegetation recovers, perhaps within 2–5 years after the wildfire. The actual magnitude of potential debris flows is dependent on climatic events over the next few years. Thus, the magnitude of potential soil mass wasting cannot be accurately predicted.

Biomass and Nutrient Cycling

Short-term nutrient cycling following the Snow Talon fire can be affected in several ways. First, total nutrient holding capacity and nutrient content can be reduced. Second, chemical reactions during soil heating can result in changes in nutrient availability to plants. Third, biological legacies provide biogeochemical mechanisms for recovery or replenishment of soil nutrients.

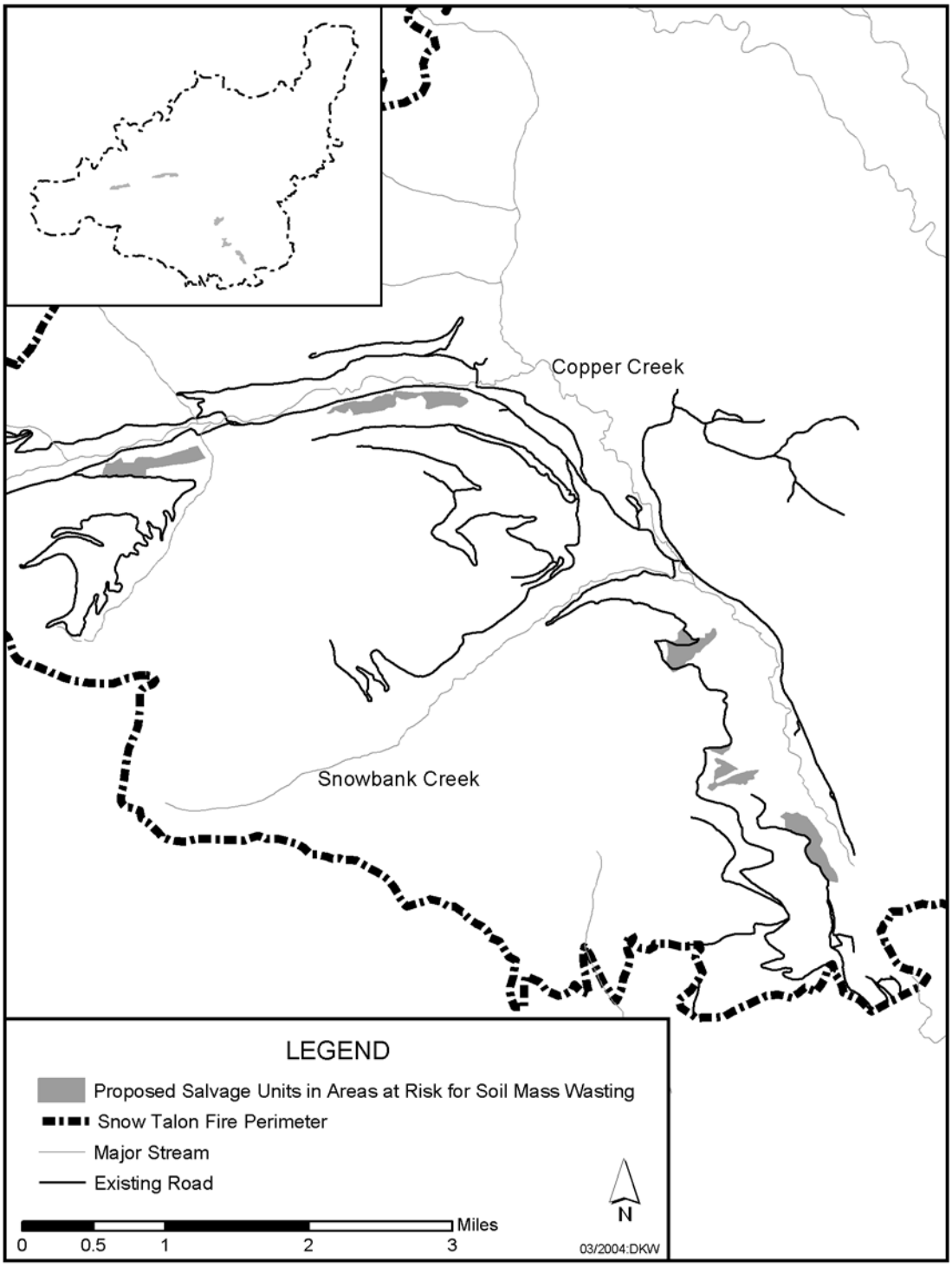

Figure 8. Locations of proposed salvage units in areas at risk for soil mass wasting.

Soil nutrient holding capacity and nutrient content can be reduced resulting from wildfire through a couple of pathways (DeBano et al. 1998, 106–112):

- Consumption of surface organic material and soil organic matter during burning depletes an important source for storage and subsequent cycling of nutrients
- When soil is lost through erosion, that soil's capacity for holding nutrients is diminished.

Nitrogen is typically the most limiting soil nutrient for plant growth in forested ecosystems of the western U.S. (DeBano et al. 1998, 133). Nitrogen is also the soil nutrient that is most sensitive to volatilization and atmospheric loss during burning (DeBano et al. 1998, 80). Fire's affect on other soil nutrients, such as phosphorus or potassium, is typically not as severe compared to nitrogen loss, because these other nutrients are less sensitive to volatilization during burning (DeBano et al. 1998, 80). For these reasons, the significance of how the Snow Talon fire affected soil nutrient status will be evaluated using nitrogen as an "indicator nutrient." Fire's affect on other specific soil nutrients will not be analyzed in detail.

As the Snow Talon fire consumed surface organic material and charred soil organic matter, nitrogen was immediately lost through volatilization into the atmosphere during moderate to high severity burning. Laboratory data suggests this volatilization during burning may account for nitrogen losses ranging from 50–100% within the affected soil layer on severely burned sites. However, field research suggests that not all soil nitrogen is typically lost during burning under natural conditions (DeBano et al. 1998, 112). So, it is likely that the majority of nitrogen, but not all, was immediately lost from severely burned sites within the Snow Talon fire area. Because nitrogen was likely a limiting soil nutrient prior to burning and a majority of nitrogen was lost during burning, the effect of wildfire on soil nutrient status is considered significant.

Erosion by wind and water may cause further loss of nutrients remaining on the soil surface or within the ash layer. Also, any reductions in soil organic matter and/or soil depth tend to diminish that soil's capacity for storage of nutrients (Alexander 1988).

The effects to soil nutrient holding capacity from soil loss resulting from erosion following wildfire are difficult to quantify (Alexander 1988). Thus, the assessment of soil loss effects on soil nutrient holding capacity will remain qualitative. However, it seems reasonable to conclude that nitrogen loss, and possible reductions in soil nutrient holding capacity that may result from predicted erosion, have potential to significantly influence long-term soil productivity.

Chemical reactions during soil heating can result in changes in nutrient availability to plants. Following wildfire, residual nitrogen tends to be present in a form that is more readily available for plant uptake. Thus, post-fire plant growth gives the appearance that nitrogen content and soil fertility has increased, although it has in fact decreased. However, this readily available nitrogen typically does not persist more than 1–2 years following fire (DeBano et al. 1998, 111).

Micro-Habitat for Soil Biota

Several elements of forest ecosystems provide micro-habitat for the soil biotic community, including roots of live trees and understory plant species, coarse woody

material, undisturbed forest floor (i.e., plant litter and duff), and soil organic material (Kohm and Franklin 1997, 118). All of these elements have already been affected by the Snow Talon fire:

- Roots of trees and understory plants have experienced mortality;
- Coarse woody material and the forest floor, found on the ground prior to the wildfire, have been consumed, and;
- Soil organic material has been charred in severely burned areas.

For the short-term, micro-habitat loss will be a limiting factor for recovery of soil organisms. However, it is predicted that recovery of micro-habitat will begin as soon as the first year following wildfire, when understory plant species begin regrowth and fire-killed trees or limbs start falling to the ground. Full recovery of lost micro-habitat including replacement of the forest floor, compared to pre-fire conditions, is predicted to require 20–50 years or more. Thus, loss of micro-habitat for soil organisms is considered a long-term and significant effect.

Soil Microclimate

Fire can substantially change the soil microclimate by removing the insulating cover and shade provided by vegetation canopies and surface organic material. Without this insulating cover and shade, surface soil temperatures can become more extreme, that is hotter when there is incoming solar radiation and colder when there is outgoing long-wave radiation. Soil itself is a very good insulating material. Therefore, this change in microclimate only affects the surface layer of soil, and does not affect subsurface soil layers.

Change in microclimate can indirectly affect soil organisms in the surface soil (DeBano et al. 1998, 131). Soil organisms may experience stress or mortality from changes in surface soil temperatures. During August 2001, researchers from Montana State University (MSU) conducted field monitoring, with subsequent lab assessment, for populations of soil organisms within the Cave Gulch burn area, located in the adjacent Big Belt Mountains. This study found that viable mycorrhizal propagules were present even on severely burned sites, and there was apparently high diversity in bacterial populations with little difference between burn severities (MSU 2001). This study suggests that although the soil microclimate has been altered by the Snow Talon fire, populations of soil organisms are likely still present in the soil surface layer.

Biological Legacies and Soil Recovery

Scientists have documented, “We have learned that fire and other natural disturbances do not destroy everything in their wake. Rather they leave an array of biological legacies that typically provide strong linkages between old and new ecosystems” (Kohm and Franklin 1997, 3). Biological legacies, which are retained following natural disturbances, are defined as “surviving organisms and organically derived structures, such as snags, logs, and soil organic layers” (Kohm and Franklin 1997, 112). These biological legacies are important “to the rapid reestablishment of ecosystems that have high levels of structural, functional, and compositional diversity”. In the case of the Snow Talon fire, it is predicted that these biological legacies will provide biogeochemical mechanisms for recovery or replenishment of soil nutrients. These biological legacies include

- Soil nitrogen recovery through fixation of atmospheric nitrogen gas by nitrogen-fixing plants and surviving micro-organisms (DeBano et al. 1998, 136–137; Newland and DeLuca 2000)
- Replacement of soil organic material and nutrient holding capacity through decomposition of fire-killed woody material by surviving populations of soil bacteria and mycorrhizal fungi (Graham et al. 1994)
- Replacement of eroded soil and associated nutrient holding capacity through biogeochemical weathering of bedrock and primary minerals (Alexander 1988).

Research conducted in the Cave Gulch burn area (burned during summer 2000 in Big Belt Mountains, Helena NF), one year after the wildfire, documented that similar biological legacies were present and functioning within that area of disturbance (MSU 2001).

It is predicted that similar biological legacies will be present and functioning within the first year following the Snow Talon fire. Thus, these mechanisms for recovery following wildfire will begin replenishing soil nutrients, particularly nitrogen, replacing soil organic material and forming new soil in the short-term. However, full recovery of soil properties to pre-fire levels will likely require at least 20–50 years or more (Alexander 1988), and thus, is considered a long-term effect.

Conclusions

The relative significance of decreased soil infiltration, increased surface water runoff, accelerated erosion, and reduced nutrient holding capacity can be assessed by two methods. The first method compares the predicted rate of erosion to benchmark values for soil loss tolerance (USDA 1999a). The second method compares the magnitude of soil loss to the predicted time for replacement of eroded soil through natural soil formation processes (Alexander 1988).

The FS has defined thresholds for detrimental soil disturbance contained in the Region 1 soil quality standards (USDA 1999a). These soil quality standards “provide benchmark values that indicate when changes in soil properties and soil conditions would result in significant change or impairment of soil quality” (USDA 1999a). The soil quality standard for surface erosion defines detrimental soil loss as greater than 1–2 tons per acre per year, over more than 15% of the ground within an activity area (salvage harvest unit). Thus, the magnitude of predicted soil erosion during the first year following the Snow Talon fire is considered significant when compared to soil loss tolerance values.

Research data suggests, “few soils are produced by bedrock weathering at annual rates greater than 1 ton per acre” (Alexander 1988). Thus, the minimum timeframe required for replacement, or natural recovery, of 1 ton of soil loss per acre is at least 1 year. Based on this research data, natural soil replacement for recovery from accelerated erosion resulting from the Snow Talon fire may require as few as 1 or 2 years on gentle terrain that burned at low severity, to at least 150 years on steep slopes that burned at moderate to high severity. It should be emphasized that these estimated soil recovery timeframes represent the minimum potential value, and the actual value may cover much longer timeframes. For a majority of the project area, the timeframe for recovery of soil loss is greater than 10 years. Thus, time required for recovery of soil lost through erosion consequent to wildfire will be a long-term effect, which is also considered significant.

Research scientists have recently concluded that the overall effects of fire on long-term soil productivity are difficult to quantify for two reasons (Neary et al. 1999). First, the components and processes that interact to determine soil productivity are complex and highly variable. Second, "research results are insufficient, lacking or contradictory in regard to the effects of fire on belowground primary productivity."

For the purposes of this assessment, it is recognized that the immediate and short-term effects of the Snow Talon fire on soils within the project area are significant. These immediate and short-term effects will likely influence long-term soil productivity. However, the complexity and variability of factors interacting to determine long-term soil productivity dictate that the magnitude of this influence cannot be quantified. It is predicted that the biological legacies remaining after the Snow Talon fire will lead toward an overall recovery trend for soil productivity, following the Snow Talon fire, especially over the long-term. Nonetheless, the influence of immediate and short-term effects on overall soil productivity is predicted to be significant, based on the fact that recovery will likely require 20–50 years or more.

Long-term Productivity of Alternative 1

Because no management activities are proposed under Alternative 1, there will be no short-term uses to evaluate in comparison to long-term productivity.

Irreversible/Irretrievable Commitments of Alternative 1

Because no management activities are proposed under Alternative 1, there will be no irreversible or irretrievable commitments of soil resources as result of management actions.

Unavoidable Adverse Effects of Alternative 1

Because no management activities are proposed under Alternative 1, there will be no unavoidable adverse impacts to soil resources as result of management actions. However, adverse impacts to soil resources occur as a result of Snow Talon fire, as described in the preceding evaluation of Alternative 1.

Forest Plan Consistency of Alternative 1

Because no management activities are proposed under Alternative 1, there is no need to determine *Forest Plan* consistency in relation to management actions.

Other Required Disclosures Under Alternative 1

No other required disclosures have been identified for soil resources under the no action alternative.

Introduction to the Action Alternatives

The scientific community has documented few scientific studies regarding the effects of post-fire timber harvest on ecosystems and soil resources. Studies that have been conducted have shown varying results in environmental effects of post-fire timber harvest (McIver and Starr 2000). This scientific uncertainty has spawned divergent scientific opinion regarding the appropriateness of conducting post-fire timber harvest and other management activities within recently burned areas (Beschta et al. 1995; Everett 1995).

Beschta and others contend that timber harvest should not be conducted on "sensitive sites," as salvage logging poses risk of significant damage to soils within the burn area. This damage to "sensitive" soils includes effects such as increased erosion and compaction, removal of nutrient sources and organic material, and impacts to soil biota, which promote recovery of site productivity. Beschta and others (1995) propose, "salvage logging by any method must be prohibited on sensitive sites, including: in severely burned areas (areas with litter destruction), on erosive sites, on fragile soils, in roadless areas, in riparian areas, on steep slopes, any site where accelerated erosion is possible." Beschta and others (1995) further recommend that no ground-based harvesting systems (i.e., tractors and skidders) be employed for salvage harvest on any site.

In contrast, Everett (1995) reports, "contrary to the custodial management theme of the Beschta et al. approach there are other scientists that believe intensive science-based management can be used in concert with natural processes to restore sustainability of post-fire eastside forests and is, in fact, required if ecosystems are to be conserved under an ever increasing human population and rising resource demands." Everett (1995) goes on to state, "although minimalist and intensive management groups may disagree on approaches, they share many common goals for the conservation of diversity and site productivity following fire."

In agreement with scientific opinions stated by both Beschta (et al.) and Everett, the IDT for the Snow Talon fire salvage project recognized the critical need for designing this project to achieve those "common goals": conserve existing site productivity and retain those ecosystem elements needed for site recovery following wildfire. To this end, action alternatives for the Snow Talon fire salvage project were designed to minimize or avoid detrimental soil disturbance (i.e., compaction, displacement, rutting, erosion, mass wasting, and inadequate retention of fine organic or coarse woody material) to the greatest extent possible. A description of BMPs and special mitigation measures incorporated into harvest design for the purpose of minimizing or avoiding detrimental soil disturbance are described for action alternatives in Chapter 2, and can also be found in Appendix C.

Action alternatives for this project were also designed to ameliorate effects from past timber harvest within areas affected by Snow Talon fire. Recontouring and replanting old jammer trails, in areas where wildfire removed the stabilizing effects of previous vegetation cover, would improve soil conditions in areas affected by past harvest. With jammer trail reclamation, there would be short-term effects of soil disturbance. However, the long-term outcome would move towards improved soil productivity. This trade-off between short-term soil disturbance and long-term improvement in soil productivity is consistent with recommendations in the report titled, *Citizen's Call for Ecological Forest Restoration: Forest Restoration Principles and Criteria*:

> *"It is important to note that there will be projects where short-term treatment impacts should be accepted because the project will result in long-term positive gains in ecological integrity (e.g., removal of roads, barriers to fish passage, removal of exotic species)."* (DellaSala et al. 2003, 17).

Effects of Alternative 2

Mitigations Included in Alternative 2

A complete list of soil and water conservation measures, including BMPs and special mitigation measures, can be found in Appendix C. For Alternative 2, key BMPs and mitigation for soil conservation include:

- Helicopter logging would be implemented to avoid detrimental soil disturbance in areas at risk for mass wasting (i.e., debris flows)
- All tractor and skyline cable logging would be implemented under winter conditions (i.e., ground is frozen to a depth of at least 4 inches and/or there is at least 6 inches of packed snow) to minimize detrimental soil disturbance.

Direct and Indirect Effects of Alternative 2

Main Skid Trails, Log Landings, and Temporary Roads

Winter logging would be required for Alternative 2, where tractor and skyline cable harvest operations would not begin until the soil is protected by a minimum of 6 inches of packed snow and/or until the ground is frozen to a depth of at least 4 inches. This winter logging requirement is designed to minimize detrimental soil disturbance, such as compaction, rutting, displacement and accelerated surface erosion, on soils already affected by wildfire.

Even with winter logging requirements, detrimental soil disturbance may still occur in limited areas where logging equipment traffic is concentrated, such as main skid trails, log landings, and temporary roads. Soil compaction, rutting and displacement on primary skid trails, log landings and temporary roads will be discussed in the following paragraphs. Accelerated soil erosion on skid trails, log landings and temporary roads will be evaluated in the next section.

Following a review of the major scientific studies regarding post-fire salvage harvest, reviewing editors concluded “log retrieval systems differ substantially in their immediate effect on soils in the post-fire environment, in ways similar to those in green tree stands” (McIver and Starr 2000, 20). These reviewers specifically cited one study describing differing effects to soils depending on method of post-fire harvest and log retrieval system (McIver and Starr 2000, 15–16):

- “Klock (1975) found that tractor skidding over bare ground caused the greatest percentage of area of severe soil disturbance (36%),” with tractor skidding over snow causing about one-third less damage (9.9%)”
- And “ground-based log retrieval (skidding) results in significantly greater areas of bare ground, relative to helicopter, skyline and skidding over snow” resulting from logging impacts to recovering vegetation.

The Klock study documents that winter logging and suspended log yarding methods have less impact to soils compared to tractor skidding over bare ground in a post-fire environment. Results of soil monitoring in the Maudlow-Toston salvage sale area are consistent with these researchers’ findings. Soil monitoring in Maudlow-Toston salvage sale area found that detrimental soil disturbance from tractor yarding occurred on 3% of the unit within winter tractor logged area, which did not include areas of disturbance

associated with log landings or temporary roads (USDA 2003d, 2003e). With this same monitoring, observations suggest detrimental soil disturbance in skyline yarding corridors affected approximately 4–5% of units when harvest occurred under summer conditions (again this does not include areas of disturbance associated with log landings and temporary roads). Also, monitoring observations within helicopter units, and skyline cable units harvested under winter conditions, documented that detrimental soil disturbance was negligible (i.e., not enough to be measurable).

For the Snow Talon fire salvage project, the following detrimental soil disturbance resulting from salvage logging activities is anticipated under Alternative 2:

- Log landing construction is predicted to cause detrimental soil disturbance, such as displacement and compaction, on approximately 39 acres for tractor unit landings, 17 acres for skyline unit landings, and 30 acres for helicopter unit landings.
- Temporary road construction is predicted to cause detrimental soil disturbance, such as displacement and compaction, on approximately 2 acres, based on an estimated width of 25 feet and length of 0.5 miles. Most of the temporary road construction would primarily be used to access a skyline harvest unit.
- Within units harvested by winter tractor yarding, detrimental soil disturbance, such as displacement or compaction, is predicted to occur on approximately 42 acres within 837 acres of tractor logging.
- In units harvested by winter skyline cable or helicopter yarding, detrimental soil disturbance is predicted to be negligible.

Based on the above calculations, the following amounts of detrimental soil disturbance Table 5) are predicted for harvest units by harvest method under Alternative 2.

- Within winter tractor units, detrimental soil disturbance is predicted to affect approximately 9% of the activity area (i.e., approximately 82 acres of detrimental disturbance on skid trails, and log landings, out of 837 total acres harvested).
- For winter skyline logging units, detrimental soil disturbance is predicted to affect approximately 6% of the activity area (i.e., approximately 18 acres of detrimental disturbance on log landings and temporary roads out of 320 total acres harvested).
- For helicopter logging units, detrimental soil disturbance is predicted to affect approximately 2% of the activity area (i.e., 30 acres of detrimental disturbance on log landings and temporary roads out of 1,304 total acres harvested including landing areas).

Table 5. Predicted area of detrimental soil disturbance by harvest method for Alternative 2.

Activity Area Analyzed	Area of Detrimental Soil Disturbance (%)
Helicopter units with helicopter landings	2.3
Winter skyline units with skyline landings and temporary roads	5.6
Winter tractor units with tractor landings	9.2
All units with all landings and temporary roads	5.1

For Alternative 2, a total of approximately 130 acres of detrimental soil disturbance is predicted because of all salvage harvest activities. However, approximately 86 acres of soil disturbance associated with log landing and temporary road construction is considered a short-term effect, because implementation of reclamation measures (i.e., recontouring, scattering woody material, and seeding) would facilitate soil recovery in the long-term. Thus, it is predicted that helicopter, winter tractor and winter skyline logging under Alternative 2 would limit detrimental soil disturbance to affect less than 15% of activity areas for all salvage units, in compliance with Region 1 soil quality guidelines (USDA 1999a). This conclusion is supported by research and monitoring results cited in preceding paragraphs (McIver and Starr 2000; USDA 2003d and 2003e).

Accelerated Soil Erosion

Winter logging is required for all tractor and skyline cable harvest with Alternative 2. Winter logging requirements provide soil protection against surface disturbance with at least 6 inches of packed snow and/or at least 4 inches of frozen ground. In addition, helicopter yarding does not cause measurable surface soil disturbance, because there is no equipment operation on the ground within helicopter units. With this protection against surface soil disturbance, vegetation growth in the spring is not impaired by salvage harvest activities (see environmental effects analysis for “Nonconiferous Vegetation” for additional information). Spring vegetation emergence provides soil cover that minimizes risk of surface erosion.

Surface soil protection and spring emergence of vegetation with harvest under winter conditions and with helicopter yarding is predicted to minimize risk for accelerated erosion because of salvage harvest activities. Thus, accelerated erosion is predicted to be negligible as a result of harvest activities under Alternative 2. This conclusion is supported by monitoring results showing winter logging and helicopter yarding have been effective in minimizing soil disturbance, and preserving vegetation cover for Maudlow-Toston salvage sale area (USDA 2003d, 2003e, 2003f).

As described for Alternative 1, surface soil erosion will still occur resulting from the effects of the Snow Talon fire. Accelerated erosion because of wildfire is predicted to be of greatest magnitude during the first year following fire (i.e., summer 2004). Under Alternative 2, it is predicted that salvage harvest activities would not change the magnitude of erosion anticipated in the first year after wildfire resulting from the effects of burning.

Risk of Soil Mass Wasting

Debris flow channels, which are likely remnants from past watershed (fire) disturbance cycles, occur in proposed salvage harvest units 7, 15, 38, 39, 41, and 45. For all other proposed harvest units, there are no currently existing debris flow channels visible on color aerial photographs taken after Snow Talon fire was controlled.

There is risk of future debris flows in these existing channels following Snow Talon fire (Leopold et al. 1992, 342). A standard method was used to assess the magnitude of risk for future debris flows in these areas (EPA 1980, V.26–V.29). From this assessment, a high risk of debris flows is predicted because of natural conditions resulting from removal of vegetation cover during wildfire combined with influence of existing roads (refer to Project File for details of debris flow risk assessment).

Region 1 soil quality guidelines state, "any mass wasting due to management activities is unacceptable." In compliance with this management direction, the Snow Talon fire salvage project was designed to avoid detrimental soil disturbance, which might exacerbate existing risk of mass wasting resulting from wildfire. Detrimental soil disturbance would be avoided by the following harvest design:

- No log landings or temporary roads would be constructed in areas with high risk for mass wasting.
- Helicopter log yarding would be required in units 7, 38, 39, 41, and 45. EPA recognizes that helicopter yarding does not increase risk of soil mass wasting (EPA 1980, V.28). This is because helicopter yarding does not cause measurable soil disturbance (USDA 2003c, 2003d).
- Winter tractor yarding would be permitted in unit 15, only on slopes less than 30% gradient. It is predicted that tractor yarding in unit 15 would not increase risk of soil mass movement, because this area represents the deposition zone (i.e., a footslope topographic position where slope gradient diminishes) for mass wasting rather than a source zone.

It is predicted that salvage harvest activities would not cause an increase in risk of mass wasting under Alternative 2. Thus, mass wasting is not predicted to occur as a result of salvage harvest activities, in compliance with Region 1 soil guidelines.

As described for Alternative 1, risk of soil mass wasting will be high resulting from the effects of Snow Talon fire and is predicted to be greatest during the first year following the fire (i.e., summer 2004). Under Alternative 2, it is predicted that salvage harvest activities would not change the high risk of soil mass wasting anticipated in the first year after wildfire resulting from the effects of burning.

Operation of Logging Equipment Outside the Designated Network of Main Skid Trails

For ground-based tractor harvest, there is need for logging equipment to operate off the designated network of main skid trails within tractor harvest units. For the purposes of this analysis, operation of logging equipment off the designated network of main skid trail is termed "dispersed operation" of ground-based equipment.

A mechanical harvester would operate in a dispersed pattern within all tractor harvest units. This dispersed operation would typically consist of one pass by the harvester to access and cut a group of trees. In addition, dispersed equipment operation would typically involve one or two passes of log skidding equipment to reach bundles of trees piled by the mechanical harvester. This dispersed skidding would occur in a pattern similar to tree branches on short spurs off the designated skid trail network. When the log skidding equipment moves bundles of whole trees (i.e., limbs and tree tops still attached), the trees tend to drag and "sweep" the ground.

With undisturbed forest conditions, one or two passes of logging equipment does cause minor amounts of soil compaction, but not enough to be considered "detrimental" (USDA 1980, 29–30). However, the cushioning effect of plant litter and duff has been lost during the wildfire. Without this protective layer of plant litter and duff, the soil may

be more vulnerable to compaction with salvage harvest operations (McIver and Starr 2000, 19).

For Alternative 2, winter harvest requirements would provide soil protection with dispersed equipment operation. This soil protection is provided by at least 6 inches of packed snow and/or at least 4 inches of frozen ground. Results of soil monitoring in the Maudlow-Toston salvage sale area (USDA 2003d, 2003e) document that salvage logging under winter conditions is effective in minimizing detrimental soil disturbance with dispersed equipment operation on a burned landscape, which is consistent with findings reported by researchers (McIver and Starr 2000, 15–16).

Soil disturbance has already been predicted because of main skid trails, log landings and temporary roads, but no added detrimental soil disturbance is predicted to occur with dispersed equipment operation under winter conditions. Therefore, the overall amount of detrimental soil disturbance is predicted to comply with Region 1 soil guidelines with dispersed operation of tractor logging equipment in winter. This conclusion is supported by results of soil monitoring in the Maudlow-Toston salvage sale area (USDA 2003d, 2003e).

Long-term Site Productivity

Detrimental soil disturbance, in the form of displacement, rutting and/or compaction, is predicted to occur on approximately 2% of the area associated with helicopter logging units, approximately 6% of the area for winter skyline cable units, and approximately 9% of area with winter tractor logging units. Biological legacies remaining after wildfire (described in the assessment of environmental effects for the no action alternative) may be impacted in areas of detrimental soil disturbance. However, 91–98% of the area within units would not have detrimental soil disturbance following salvage harvest. Thus, biological legacies are predicted to remain intact following salvage activities on the majority of area, where there is not detrimental soil disturbance within harvest units. Because of these biological legacies, the trend for overall soil productivity is predicted to be for long-term recovery, even with effects of salvage harvest within the burned area.

Cumulative Effects of Alternative 2

Cumulative soil effects that are common to all action alternatives are evaluated in a preceding section of this analysis. Soil cumulative effects that are specific to Alternative 2 are evaluated in the following paragraphs. These specific soil cumulative effects relate to areas where past timber harvest spatially overlaps with proposed salvage harvest.

Under Alternative 2, past timber harvest has occurred in portions of four units proposed for salvage harvests. These are proposed salvage harvest units 7, 27, 51, and 56. There is potential for cumulative effects, of detrimental soil disturbance remaining from past harvest combined with detrimental soil disturbance predicted for salvage harvest activities, on a total of 35 acres located within these four units. Each of these four units will be discussed individually in the following paragraphs to evaluate potential soil cumulative effects.

- Salvage Unit 7. Approximately 20 acres of past harvest overlaps with 39 acres proposed for helicopter logging with Alternative 2. The past harvest was completed in 1993 using skyline cable yarding methods. An estimated 6% of the 20 acres

previously harvested may have residual detrimental soil disturbance in the cable yarding corridors. This represents slightly more than 1 acre of residual soil impacts from past harvest. Because unit 7 is proposed for helicopter logging, no new detrimental soil disturbance is anticipated within the salvage unit. The only added soil effects would be construction of a helicopter log landing, which is predicted to cause 1 acre of detrimental soil disturbance. Thus, the amount of cumulative detrimental soil disturbance is predicted to be approximately 2 acres within the activity area. This is equivalent to approximately 5% detrimental soil disturbance within the activity area, which is in compliance with Region 1 soil guidelines.

- Salvage Unit 27. Approximately 8 acres of past harvest overlaps with 41 acres proposed for winter skyline cable logging with Alternative 2. Previous harvest occurred in 1971, likely using tractor yarding methods. It is estimated that detrimental soil disturbance from past logging may remain on approximately 3 acres. Because unit 27 is proposed for winter skyline cable yarding, no new detrimental soil disturbance is anticipated within the salvage unit. Overlap of past harvest with proposed salvage on 8 acres within unit 27 may exceed Region 1 soil guidelines for 15% detrimental soil disturbance simply because of impacts remaining from past harvest. Reclamation actions, such as soil scarification to break up compaction, scattering woody material and seeding or planting, would be implemented to facilitate a long-term trend for recovery of soil productivity in this area.
- Salvage Unit 51. Approximately 6 acres of past harvest overlaps with 180 acres proposed for winter tractor logging with Alternative 2. Previous harvest occurred in 1997, likely using tractor yarding methods. It is estimated that detrimental soil disturbance from past logging may remain on approximately 1 acre. Because unit 51 is proposed for winter tractor yarding, new detrimental soil disturbance is anticipated on approximately 16 acres within the activity (includes impacts on main skid trails and log landings). Thus, the amount of cumulative detrimental soil disturbance is predicted to be approximately 17 acres within the activity area. This is equivalent to approximately 10% detrimental soil disturbance within the activity area, which is in compliance with Region 1 soil guidelines.
- Salvage Unit 56. Approximately 1 acre of past harvest overlaps with 1 acre proposed for winter tractor logging with Alternative 2. Following salvage harvest in unit 56, this 1-acre clearing would be used for a helicopter landing. Resulting from use as a log landing, detrimental soil disturbance is predicted to occur on the entire acre of ground once salvage operations are complete. This 1 acre of detrimental soil disturbance would be considered for cumulative effects with helicopter units that are serviced by this landing. The overall cumulative effect is predicted to cause approximately 2% detrimental soil disturbance in the activity area (i.e., log landing plus helicopter units serviced by that landing). Thus, this activity area, including unit 56, would be in compliance with Region 1 soil guidelines. Reclamation measures would be implemented (i.e., soil scarification to break up compacted soil, recontouring displaced topsoil, scattering woody material and seeding) to facilitate long-term recovery of affected soils.

In summary, there are potential cumulative effects of detrimental soil disturbance remaining from past harvest which spatially overlaps with detrimental soil disturbance predicted for salvage harvest activities on 35 acres located within four salvage units

(7, 27, 51, and 56). However restoration of jammer trails (refer to evaluation for "Effects Common to All Action Alternatives") would facilitate a trend for soil recovery on 110 acres within the project area. Thus, there would be a trend for net improvement in soil cumulative effects with restoration of past logging impacts combined with proposed salvage harvest within the project area. This is in compliance with Region 1 soil guidelines that cumulative detrimental effects from project implementation and restoration should "move toward a net improvement in soil quality" in areas where detrimental soil conditions exist from prior activities (USDA 1999a).

Synergistic Cumulative Effects

Because there are few scientific studies to specifically determine the long-term effects of post-fire salvage logging on soil productivity, there is uncertainty what synergistic cumulative effects wildfire combined with salvage logging may have on site productivity over the long term (McIver and Starr 2000, 22). This uncertainty lies at the heart of the debate generated by the Beschta report (Beschta et al. 1995; Everett 1995), which was discussed in the "Introduction to All Action Alternatives."

Consistent with "common goals" identified during this debate (Beschta et al. 1995, Everett 1995), Alternative 2 has been designed to conserve existing site productivity and retain those ecosystem elements needed for site recovery following wildfire. To this end, Alternative 2 has been designed to comply with Region 1 soil quality standards (USDA 1999a) and the NFMA (16 U.S.C. 36 §§ 1600 et seq., 1988). Specifically, Alternative 2 is predicted to maintain existing soil productivity, by minimizing or avoiding detrimental soil disturbance (i.e., compaction, displacement, rutting, erosion, mass wasting), and by retaining recommended amounts of organic material (Graham et al. 1994) to sustain long-term nutrient cycling as well as provide a substrate to support populations of soil biota (i.e., mycorrhizal fungi, bacteria). With Alternative 2 design, it is predicted that the risk of synergistic cumulative effects has been minimized.

Short-term Uses vs. Long-term Productivity of Alternative 2

Because there are few scientific studies to specifically determine the long-term effects of post-fire salvage logging on soil productivity (McIver and Starr 2000), there is uncertainty what cumulative effects wildfire combined with salvage logging would have on site productivity over the long-term. It is predicted that biological legacies remaining after the fire (Kohm and Franklin 1997; MSU 2001) would likely facilitate a trend for long-term recovery, even with cumulative effects of salvage harvest within the burned area.

Irreversible/Irretrievable Commitments of Alternative 2

Alternative 2 is more likely to successfully result in a long-term trend toward recovery of soil productivity, compared to Alternative 4. This is because Alternative 2 has less direct and indirect effects to soil productivity with winter logging, compared to ground-based tractor logging in summer with Alternative 4. With a long-term trend for recovery, soil productivity would not be irreversibly or permanently damaged.

Unavoidable Adverse Effects of Alternative 2

Detrimental soil disturbance, in the form of displacement, rutting, and/or compaction, is predicted to occur on approximately 2% of the area associated with helicopter logging

units, approximately 6% of the area for winter skyline cable units, and approximately 9% of area with winter tractor logging units. This detrimental soil disturbance would affect approximately 130 acres. However, 86 acres of soil disturbance on log landings and temporary roads would be reclaimed. Thus, there would be a trend for long-term recovery of soil conditions on these 86 acres where reclamation measures are implemented.

Forest Plan Consistency of Alternative 2

With a long-term trend for recovery of soil productivity, the requirements to sustain site productivity with management actions would be met with Alternative 2, as mandated by the NFMA and the Helena *Forest Plan*.

Effects of Alternative 3

Mitigations Included in Alternative 3

A complete list of soil and water conservation measures, including BMPs, and special mitigation measures, can be found in Appendix C. For Alternative 3, key BMPs and mitigation for soil conservation include:

- No logging would occur on areas at risk for mass wasting under Alternative 3
- Under Alternative 3, all tractor and skyline cable logging would be implemented under winter conditions.

Direct and Indirect Effects of Alternative 3

Skid Trails, Log Landings and Temporary Roads

Winter logging would be required in all tractor and skyline harvest units for Alternative 3, which is the same requirement as in Alternative 2. The primary difference for Alternative 3 compared to Alternative 2 is that there would be no helicopter harvest. Without helicopter harvest, approximately 30 acres of detrimental soil disturbance associated with helicopter landing construction would not occur. Thus, the detrimental soil disturbance associated with skid trails, log landings and temporary roads under Alternative 3 would be 30 acres less, but otherwise similar to effects described under Alternative 2.

Specifically, the following detrimental soil disturbance because of salvage logging activities is anticipated under Alternative 3:

- Log landing construction is predicted to cause detrimental soil disturbance, such as displacement, rutting and compaction, on approximately 39 acres for tractor unit landings, and 17 acres for skyline unit landings
- Temporary road construction is predicted to cause detrimental soil disturbance on approximately 2 acres (based on an estimated area of 25 feet by of 0.5 miles), which primarily would be used to access a skyline harvest unit
- Within units harvested by winter tractor yarding, detrimental soil disturbance is predicted to occur on approximately 42 acres within 824 acres of tractor logging
- In skyline cable units harvested under winter conditions, detrimental soil disturbance is predicted to be negligible.

Based on the above calculations, the following amounts of detrimental soil disturbance (Table 6) are predicted for harvest units by harvest method under Alternative 2. Within winter tractor units, detrimental soil disturbance is predicted to affect approximately 9% of the area (i.e., approximately 82 acres of detrimental disturbance on skid trails, and log landings, out of 880 total acres harvested including area of log landings). For winter skyline logging units, detrimental soil disturbance is predicted to affect approximately 6% of the area (i.e., approximately 18 acres of detrimental disturbance on log landings and temporary roads out of 305 total acres harvested). For Alternative 3, a total of approximately 100 acres of detrimental soil disturbance is predicted for all salvage harvest activities.

Thus, it is predicted that salvage harvest under Alternative 3 would limit detrimental soil disturbance to affect less than 15% of activity areas within winter tractor and winter skyline cable logging units, in compliance with Region 1 soil quality guidelines (USDA 1999a). This conclusion is supported by research and monitoring results cited in preceding paragraphs (McIver and Starr 2000; USDA 2003d, 2003e). Further, soil disturbance associated with log landing and temporary road construction is considered a short-term effect, because implementation of reclamation measures (i.e., recontouring, scattering woody material, and seeding) would facilitate soil recovery in the long-term.

Accelerated Soil Erosion

As with Alternative 2, winter logging is required for all tractor and skyline cable harvest with Alternative 3. Surface soil protection and spring emergence of vegetation with harvest under winter conditions is predicted to minimize risk for accelerated erosion because of salvage harvest activities. Thus, accelerated erosion is predicted to be

Table 6. Predicted area of detrimental soil disturbance by harvest method for Alternative 3.

Activity Area Analyzed	Area of Detrimental Soil Disturbance (%)
Winter skyline units with landings and temporary roads	5.6
Winter tractor units with tractor landings	9.2
All units with all landings and temporary roads	8.2

negligible as a result of harvest activities under Alternative 3. This conclusion is supported by monitoring results showing winter logging and helicopter yarding have been effective in minimizing soil disturbance, and preserving vegetation cover for Maudlow-Toston salvage sale area (USDA 2003c, 2003d, 2003e).

As described for Alternative 1, surface soil erosion will still occur resulting from the effects of Snow Talon fire. Accelerated erosion because of wildfire is predicted to be of greatest magnitude during the first year following fire. Under Alternative 3, it is predicted that salvage harvest activities will not change the magnitude of erosion anticipated in the first year after wildfire resulting from the effects of burning.

Risk of Soil Mass Movement

Similar to Alternative 2, Alternative 3 was designed to avoid detrimental soil disturbance that might exacerbate existing risk of mass wasting because of wildfire. Detrimental soil disturbance would be avoided by the following design for Alternative 3:

- No log landings or temporary roads would be constructed in areas with high risk for mass wasting
- No salvage harvest would occur in units 7, 15, 38, 39, 41, and 45.

For Alternative 3, there would be no salvage harvest activities or soil disturbance in areas at risk for soil mass wasting. Thus, mass wasting is not predicted to occur as a result of salvage harvest activities, in compliance with Region 1 soil guidelines.

As described for Alternative 1, risk of soil mass wasting will be high resulting from the effects of the Snow Talon fire and is predicted to be greatest during the first year following the fire. Under Alternative 3, it is predicted that salvage harvest activities will not change the risk of soil mass wasting anticipated in the first year after wildfire resulting from the effects of burning.

Operation of Logging Equipment Outside the Designated Network of Main Skid Trails

As with Alternative 2, winter harvest requirements would provide soil protection with dispersed equipment operation. Soil disturbance has already been predicted because of main skid trails, log landings and temporary roads, but no added detrimental soil disturbance is predicted to occur with dispersed equipment operation under winter conditions. Therefore, the overall amount of detrimental soil disturbance is predicted to comply with Region 1 soil guidelines with dispersed operation of logging equipment in winter under Alternative 3. This conclusion is supported by results of soil monitoring in Maudlow-Toston salvage sale area (USDA 2003d, 2003e).

Long-term Site Productivity

Similar to Alternative 2, detrimental soil disturbance is predicted to occur on approximately 6% of the activity area associated with winter skyline cable logging, and approximately 9% of the activity area with winter tractor logging with Alternative 3. In areas of detrimental soil disturbance, biological legacies remaining after the wildfire (described in the assessment of environmental effects for the no action alternative) may be impacted. However, 91–94% of the area affected by salvage harvest actions would not have detrimental soil disturbance under Alternative 3. Thus, biological legacies are predicted to remain intact following salvage harvest activities on the majority of area, where there is no detrimental soil disturbance within harvest units. Because of these biological legacies, the trend for overall soil productivity is predicted to be for long-term recovery, even with salvage harvest within the burned area.

Cumulative Effects of Alternative 3

Because there are few scientific studies to specifically determine the long-term effects of post-fire salvage logging on soil productivity, there is uncertainty what synergistic cumulative effects wildfire combined with salvage logging may have on site productivity over the long-term (McIver and Starr 2000, 22). It is this uncertainty that is at the heart of

the debate generated by the Beschta report (Beschta et al. 1995; Everett 1995), which was discussed in the "Introduction to All Action Alternatives."

Consistent with "common goals" identified during this debate (Beschta et al. 1995; Everett 1995), Alternative 3 has been designed to conserve existing site productivity and retain those ecosystem elements needed for site recovery following wildfire. To this end, Alternative 3 is designed to comply with Region 1 Soil Quality Standards (USDA 1999a) and the NFMA (16 U.S.C. 1600, 1976). Specifically, Alternative 3 is predicted to maintain existing soil productivity, by minimizing or avoiding detrimental soil disturbance (i.e., compaction, displacement, rutting, erosion, mass wasting), and by retaining recommended amounts of organic material (Graham et al. 1994) to sustain long-term nutrient cycling as well as provide a substrate to support populations of soil biota (i.e., mycorrhizal fungi, bacteria, etc.). With Alternative 3 design, the risk of synergistic cumulative effects has been minimized.

Actions Considered for Soil Cumulative Effects

Cumulative soil effects that are common to all action alternatives are evaluated in a preceding section of this analysis. Soil cumulative effects that are specific to Alternative 3 are evaluated in the following paragraphs. These specific soil cumulative effects relate to areas where past timber harvest spatially overlaps with proposed salvage harvest.

Similar to Alternative 2, past timber harvest has occurred in portions of three units proposed for salvage harvest under Alternative 3. These are proposed salvage harvest units 27, 51, and 56. Each of these three units has been evaluated individually in the analysis for "Cumulative Effects of Alternative 2 on Soil Resource." For this reason, only a summary of cumulative effects in these three units is reviewed in the following paragraph.

There are potential cumulative effects of detrimental soil disturbance remaining from past harvest which spatially overlaps with detrimental soil disturbance predicted for salvage harvest activities on 15 acres located within salvage units 27, 51 and 56. However restoration of jammer trails (refer to evaluation for "Effects Common to All Action Alternatives") would facilitate a trend for soil recovery on 110 acres within the project area. Thus, there would be a trend for net improvement in soil cumulative effects with restoration of past logging impacts combined with proposed salvage harvest within the project area. This is in compliance with Region 1 soil guidelines that cumulative detrimental effects from project implementation and restoration should "move toward a net improvement in soil quality" in areas where detrimental soil conditions exist from prior activities (USDA 1999a).

Short-term Uses vs. Long-term Productivity of Alternative 3

Because there are few scientific studies to specifically determine the long-term effects of post-fire salvage logging on soil productivity (McIver and Starr 2000), there is uncertainty what cumulative effects wildfire combined with salvage logging would have on site productivity over the long-term. Biological legacies remaining after the fire (Kohm and Franklin 1997; MSU 2001) would likely facilitate a trend toward long-term recovery, even with cumulative effects of salvage harvest within the burned area.

Irreversible/Irretrievable Commitments of Alternative 3

As with Alternative 2, Alternative 3 is more likely to successfully result in a long-term trend toward recovery of soil productivity, compared to Alternative 4. This is because Alternative 3 has less direct and indirect effects to soil productivity with winter logging, compared to ground-based logging in summer with Alternative 4. With a long-term trend for recovery, soil productivity would not be irreversibly or permanently damaged.

Unavoidable Adverse Effects of Alternative 3

Detrimental soil disturbance, in the form of displacement, rutting and/or compaction, is predicted to occur on approximately 6% of the area for winter skyline cable units, and approximately 9% of area with winter tractor logging units. This detrimental soil disturbance would affect approximately 100 acres. However, 58 acres of soil disturbance on log landings and temporary roads would be reclaimed. Thus, there would be a trend for long-term recovery of soil conditions on these 58 acres where reclamation measures are implemented.

Forest Plan Consistency of Alternative 3 for Soil Resource

With a long-term trend for recovery of soil productivity, the requirements to sustain site productivity with management actions would be met under Alternative 3, as mandated by the NFMA and the *Forest Plan*.

Effects of Alternative 4

Mitigations Included in Alternative 4

A complete list of soil and water conservation measures, including BMPs and special mitigation measures, can be found in Appendix C. For Alternative 4, key BMPs and mitigation for soil conservation include:

- Under Alternative 4, helicopter logging would be implemented to avoid detrimental soil disturbance in areas at risk for mass wasting (i.e., debris flows)
- Under Alternative 4, tractor logging in harvest units with ash cap soils, which have relatively high vulnerability to compaction, would be implemented under winter conditions
- Tractor units that do not have ash cap soils, along with all skyline units, would not have seasonal harvest restrictions under Alternative 4. In these tractor units, logging would be implemented when soil conditions are generally dry, to minimize risk of compaction.

Direct and Indirect Effects of Alternative 4

Skid Trails, Temporary Roads, and Log Landings

Under Alternative 4, winter logging would be required only where tractor harvest units occur on soils with surface layers influenced by volcanic ash. These soils, termed “ash cap soils” for the purposes of this analysis, have relatively high vulnerability to compaction compared to other types of soil.

In tractor units with ash cap soils, harvest operations would not begin until the soil is protected by a minimum of 6 inches of packed snow and/or until the ground is frozen to a

depth of at least 4 inches. Salvage harvest units where winter tractor logging would occur affect approximately 824 acres, and include units 15, 18, 20, 22, 24, 25, 26, 31, 34, 44, 51, 53, 57, 59, 60, 72, 76, 104, 111, 113, 153, 160, and 162. This winter logging requirement is designed to minimize detrimental soil disturbance, such as compaction, rutting, displacement and accelerated surface erosion, on soils already affected by wildfire.

For all other salvage harvest units (i.e., skyline cable, helicopter and tractor units without ash cap soils), there would be no seasonal harvest restrictions. So, harvest may occur under "summer" conditions, where equipment is operating on soil laid bare by wildfire. Salvage harvest units where there are no seasonal logging restrictions affect approximately 291 acres of tractor units that do not have ash cap soils (i.e., units 40, 47, 50, 52, 56, 71, 107, 159, and 161), 308 acres on all skyline cable units, and 2298 acres on all helicopter units.

Following a review of the major scientific studies regarding post-fire salvage harvest, reviewing editors concluded "log retrieval systems differ substantially in their immediate effect on soils in the post-fire environment, in ways similar to those in green tree stands" (McIver and Starr 2000, 20). These reviewers specifically cited one study describing that tractor skidding over bare ground has greater impact to soils compared to winter logging and suspended log yarding methods in a post-fire environment (McIver and Starr 2000, 15–16):

- "Klock (1975) found that tractor skidding over bare ground caused the greatest percentage of area of severe soil disturbance (36%)," with tractor skidding over snow causing approximately one-third less damage (9.9%)
- And "ground-based log retrieval (skidding) results in significantly greater areas of bare ground, relative to helicopter, skyline and skidding over snow" resulting from logging impacts to recovering vegetation.

Results of soil monitoring in the Maudlow-Toston salvage sale area show that detrimental soil disturbance from tractor yarding occurred on 3% of the unit in winter tractor logged area (USDA 2003d, 2003e). With this same monitoring, observations suggest detrimental soil disturbance in skyline yarding corridors affected approximately 4–5% of units when harvest occurred under summer conditions. Also, monitoring observations in helicopter units documented that detrimental soil disturbance was negligible (i.e., not enough to be measurable). Soil monitoring has not yet been implemented in summer tractor harvest units for the Maudlow-Toston salvage sale area.

Detrimental soil disturbance would occur in limited areas where logging equipment traffic is concentrated, such as main skid trails, skyline cable yarding corridors, log landings, and temporary roads. Soil compaction, rutting and displacement on primary skid trails, skyline cable yarding corridors, log landings and temporary roads will be discussed in the following paragraphs. Accelerated soil erosion on skid trails, skyline cable yarding corridors, log landings and temporary roads will be evaluated in the next section.

For the Snow Talon fire salvage project, the following detrimental soil disturbance because of salvage logging activities is anticipated under Alternative 4:

- Log landing construction is predicted to cause detrimental soil disturbance, such as displacement and compaction, on approximately 39 acres for tractor unit landings, 17 acres for skyline unit landings, and 30 acres for helicopter unit landings.
- Temporary road construction is predicted to cause detrimental soil disturbance, such as displacement and compaction, on approximately 2 acres, based on an area estimated to be 25 feet by 0.5 miles. Most of the temporary road construction would primarily be used to access a skyline harvest unit.
- Within units harvested by winter tractor yarding, detrimental soil disturbance, such as displacement or compaction, is predicted to occur on approximately 41 acres within 824 acres of winter tractor logging under Alternative 4.
- Within units harvested by summer tractor yarding, detrimental soil disturbance, such as displacement or compaction, is predicted to occur on approximately 32 acres within 291 acres of summer tractor logging under Alternative 4.
- In units harvested by summer skyline cable yarding, detrimental soil disturbance is predicted to occur on approximately 15 acres within 308 acres of summer skyline cable yarding with Alternative 4.
- In units harvested by helicopter yarding, detrimental soil disturbance is predicted to be negligible.

Based on the above calculations, the following amounts of detrimental soil disturbance (Table 7) are predicted for harvest units by harvest method under Alternative 4. Within winter tractor units, detrimental soil disturbance is predicted to affect approximately 9% of the area (i.e., approximately 74 acres of detrimental disturbance on skid trails, and log landings, out of 856 total acres harvested including area of log landings). Within summer tractor units, detrimental soil disturbance is predicted to affect approximately 14% of the area (i.e., approximately 43 acres of detrimental disturbance on skid trails, and log landings, out of 302 total acres harvested including area of log landings). For summer skyline logging units, detrimental soil disturbance is predicted to affect approximately 9% of the area (i.e., approximately 29 acres of detrimental disturbance on log landings and temporary roads out of 322 total acres harvested). For helicopter logging units, detrimental soil disturbance is predicted to affect approximately 1% of the area (i.e., 30 acres of detrimental disturbance on log landings out of 2497 total acres harvested including landing areas). For Alternative 4, a total of approximately 176 acres of detrimental soil disturbance is predicted resulting from the effects of main skid trails, skyline cable yarding corridors, log landings, and temporary roads.

Table 7. Predicted area of detrimental soil disturbance by harvest method for Alternative 4.

Activity Area Analyzed	Area of Detrimental Soil Disturbance (%)
Helicopter units with helicopter landings	1.3
Summer skyline units with skyline landings and temporary roads	9.0
Winter tractor units with winter tractor landings	8.6
Summer tractor units with summer tractor landings	14.4
All units with all landings and temporary roads	4.6

It is predicted that effects of salvage logging would be in compliance with Region 1 soil guidelines for limiting detrimental soil disturbance in winter tractor units (824 acres), and all skyline cable (308 acres) and helicopter units (2298 acres). However, there is uncertainty if dispersed equipment operation on bare ground, in tractor units without seasonal harvest restriction, would add to detrimental soil disturbance associated with main skid trails and log landings. This uncertainty will be evaluated in the section titled, "Operation of Logging Equipment outside the Designated Network of Main Skid Trails." This uncertainty about compliance with Region 1 soil guidelines applies only to tractor harvest units that do not have seasonal restrictions (291 acres), and all other harvest units are predicted to comply with Regional soil guidelines under Alternative 4, as stated above.

Soil disturbance associated with main skid trails in summer logging units, and all log landings and temporary roads is considered a short-term effect. This is because reclamation measures (i.e., scarifying compacted areas, recontouring displaced topsoil, scattering woody material, and seeding) would be implemented to facilitate soil recovery in the long-term.

Accelerated Soil Erosion

Winter logging is required for tractor units with ash cap soils (824 acres) under Alternative 4. Winter logging requirements provide soil protection against surface disturbance with at least 6 inches of packed snow and/or at least 4 inches of frozen ground. In addition, helicopter yarding does not cause measurable surface soil disturbance, because there is no equipment operation on the ground within helicopter units (2,298 acres). With this protection against surface soil disturbance, vegetation growth in the spring is not impaired by salvage harvest activities (refer to environmental effects analysis for "Nonconiferous Vegetation" for additional information). Spring vegetation emergence provides soil cover that minimizes risk of surface erosion.

Surface soil protection and spring emergence of vegetation with harvest under winter conditions, and with helicopter yarding is predicted to minimize risk for accelerated erosion because of salvage harvest activities. Thus, accelerated erosion is predicted to be negligible in winter tractor units and helicopter units as a result of harvest activities under Alternative 4. This conclusion is supported by monitoring results showing winter logging and helicopter yarding have been effective in minimizing soil disturbance, and preserving vegetation cover for Maudlow-Toston salvage sale area (USDA 2003c, 2003d, 2003e).

With no seasonal harvest restriction, surface soil disturbance would temporarily remove vegetation cover and leave bare ground on temporary roads, log landings, cable yarding corridors in skyline cable units (approximately 29 acres of disturbance within 322 acres of activity area), and on main skid trails in tractor units without ash cap soils (approximately 43 acres out of 302 acres of activity area). Accelerated surface erosion is predicted to occur on these areas of bare ground in summer skyline cable units (Table 8) and summer tractor units (Table 9). In many of these harvest units, the magnitude of accelerated surface erosion is considered detrimental soil disturbance (i.e., greater than 1–2 tons per acre per year). However, the area affected by accelerated erosion resulting from harvest activities is the same area affected by soil compaction, rutting and displacement on temporary roads, log landings, cable yarding corridors, and main skid trails. Therefore, the amount of area affected by detrimental soil disturbance is the same

Table 8. Accelerated surface erosion predicted to occur on summer logged skyline cable units.

Salvage Unit Number	Landtypes	Surface Soil Texture	2004 Predicted Surface Erosion[a] on Cable Corridors[b] (Tons/Acre)	Probability for Erosion on Cable Corridors (%)
17	79	Loam	5.7	98
19	79 (majority) & 49B	Loam	5.7	98
23	49B	Loam	4.7	92
27	12A & 49B (majority)	Loam	4.4	92
28	49B	Loam	4.5	92
29	12A & 49B (majority)	Loam	5.2	92
32	49B & 791 (majority)	Loam	4.5	78
33	49B & 791 (majority)	Loam	4.2	78
36	12A (majority) & 49B	Loam	3.9	82
43	49 (majority) & 790	Silt loam	7.3	80
46	49 & 49B (majority)	Loam	5.1	92
48	12A, 790, & 87 (majority)	Loam	6.4	98
73	49	Silt loam	7.3	80
75	49B	Loam	1.9	42
77	49B (majority) & 79	Loam	4.8	92

a. Erosion rate based on WEPP model results. Input parameters and output values are documented in the Snow Talon fire salvage project file

b. Length based on recommended water bar spacing from "Water Quality BMPs for Montana Forests" (MSU Extension Service 2001, 30)

Table 9. Accelerated surface erosion predicted to occur on summer logged tractor units.

Salvage Unit Number	Landtypes	Surface Soil Texture	2004 Predicted Amount of Surface Erosion[a] on Tractor Skid Trails[b] (Tons/Acre)	Probability for Erosion on Tractor Skid Trails (%)
40	49	Silt loam	7.7	64
44	49	Silt loam	7.7	64
47	49	Silt loam	7.7	64
50	12A	Loam	2.3	30
51	12A	Loam	3.2	48
52	12A	Loam	1.1	18
56	12A	Loam	1.1	18
71	12A	Loam	2.3	28
104	12A	Loam	2.3	28
159	49	Silt loam	6.8	78
161	49	Silt loam	3.7	40

a. Erosion rate based on WEPP model results. Input parameters and output values are documented in Snow Talon fire salvage project file

b. Length is based on recommended water bar spacing from "Water Quality BMPs for Montana Forests" (MSU Extension Service 2001, 30)

as described previously under Alternative 4: approximately 14% of the activity area with summer tractor harvest and approximately 9% of the activity area with summer skyline cable logging. Under Alternative 4, it is just the magnitude of detrimental soil disturbance that is greater due to accelerated erosion, without increase in the affected area.

As described for Alternative 1, surface soil erosion will still occur resulting from the effects of Snow Talon fire. Accelerated erosion because of wildfire is predicted to be of greatest magnitude during the first year following fire (i.e., summer 2004). Under Alternative 4, it is predicted that salvage harvest activities would not change the magnitude of erosion in winter tractor units and helicopter units anticipated in the first year after wildfire resulting from the effects of burning. However, the magnitude of erosion would increase because of salvage logging activities in summer skyline cable and summer tractor units, as described above for Alternative 4.

Risk of Soil Mass Wasting

As with Alternative 2, debris flow channels occur in proposed salvage harvest units 7, 15, 38, 39, 41, and 45 under Alternative 4. For all other proposed harvest units, there are no currently existing debris flow channels visible on color aerial photographs taken after Snow Talon fire was controlled.

There is risk of future debris flows in these existing channels following Snow Talon fire (Leopold et al. 1992, 342). A standard method was used to assess the magnitude of risk for future debris flows in these areas (EPA 1980, V.26–V.29). From this assessment, a high risk of debris flows is predicted due to natural conditions resulting from removal of vegetation cover during wildfire combined with influence of existing roads (refer to Project File for details of debris flow risk assessment).

Region 1 soil quality guidelines state, “any mass wasting due to management activities is unacceptable.” In compliance with this management direction, Snow Talon fire salvage project was designed to avoid detrimental soil disturbance, which might exacerbate existing risk of mass wasting because of wildfire. Detrimental soil disturbance would be avoided by the following harvest design:

- No log landings or temporary roads would be constructed in areas with high risk for mass wasting.
- Helicopter log yarding would be required in units 7, 38, 39, 41 and 45. EPA recognizes that helicopter yarding does not increase risk of soil mass wasting (EPA 1980, V.28). This is because helicopter yarding does not cause measurable soil disturbance (USDA 2003c, 2003d).
- Winter tractor yarding would be permitted in unit 15, only on slopes less than 30% gradient. It is predicted that tractor yarding in unit 15 would not increase risk of soil mass movement, because this area represents the deposition zone (i.e., a footslope topographic position where slope gradient diminishes) for mass wasting rather than a source zone.

It is predicted that salvage harvest activities would not cause an increase in risk of mass wasting under Alternative 4. Thus, mass wasting is not predicted to occur as a result of salvage harvest activities, in compliance with Region 1 soil guidelines.

As described for Alternative 1, risk of soil mass wasting will be high resulting from the effects of Snow Talon fire. Risk of soil mass wasting because of wildfire is predicted to be greatest during the first year following fire (i.e., summer 2004). Under Alternative 4, it is predicted that salvage harvest activities would not change the high risk of soil mass wasting anticipated in the first year after wildfire resulting from the effects of burning.

Operation of Logging Equipment Outside the Designated Network of Main Skid Trails

A mechanical harvester would operate in a dispersed pattern within all tractor harvest units. This dispersed operation would typically consist of one pass by the harvester to access and cut a group of trees. In addition, dispersed equipment operation would typically involve one or two passes of log skidding equipment to reach bundles of trees piled by the mechanical harvester. This dispersed skidding would occur in a pattern similar to tree branches on short spurs off the designated skid trail network. When the log skidding equipment moves bundles of whole trees (i.e., limbs and tree tops still attached), the trees tend to drag and "sweep" the ground.

There is uncertainty whether dispersed equipment operation would cause detrimental soil disturbances, such as displacement and compaction, as defined in the Region 1 soil quality standards. With undisturbed forest conditions, one or two passes of logging equipment does cause minor amounts of soil compaction, but not enough to be considered "detrimental" (USDA 1980, 29–30). However, the cushioning effect of plant litter and duff has been completely lost during the wildfire. Thus, the soil may be more vulnerable to compaction with salvage harvest operations that occur under "summer" conditions (McIver and Starr 2000, 19).

Based on professional observation in recent salvage harvest projects, it is predicted that this dispersed operation of the harvester, log skidding equipment and tree dragging combined may temporarily remove recovering vegetation within the area affected. This may create bare ground on to 30–40% of the area within proposed harvest units. This is consistent with Klock's research findings, which documented 36% of the soil area within post-fire salvage harvest units was disturbed by tractor logging in summer (McIver and Starr 2000, 15).

If detrimental compaction, or removal of vegetation cover with subsequent accelerated erosion, does occur with dispersed operation of tractor logging equipment during summer conditions, then as much as 30–40% of the area within harvest units may be affected. Thus, there is uncertainty if soil impacts from summer tractor harvest activities would be in compliance with Region 1 soil quality standards with Alternative 4.

Implementing BMP 13.06, "Soil Moisture Limitations for Tractor Operation," can minimize this risk of detrimental soil compaction with dispersed skidding operations during summer conditions. BMP 13.06 should specify timber harvest operations would be limited to periods when the soil is dry, and operations would be suspended when the soil is moist or wet.

Cumulative Effects of Alternative 4

Actions Considered for Soil Cumulative Effects

Cumulative soil effects that are common to all action alternatives are evaluated in a preceding section of this analysis. Soil cumulative effects that are specific to Alternative 4 are evaluated in the following paragraphs. These specific soil cumulative effects relate to areas where past timber harvest spatially overlaps with proposed salvage harvest.

Similar to Alternatives 2 and 3, past timber harvest has occurred on 38 acres in portions of five units proposed for salvage harvest under Alternative 4. These are proposed salvage harvest units 7, 27, 51, 56, and 104. Four of these units (i.e., 7, 27, 51, and 56) have been evaluated individually in the analysis for "Cumulative Effects of Alternative 2 on Soil Resource." For this reason, only unit 104 will be discussed in detail, and a summary of cumulative effects in the other four units will be reviewed in the following paragraphs.

- Salvage Unit 104. Approximately 3 acres of past harvest overlaps with 180 acres proposed for winter tractor logging with Alternative 2. Previous harvest occurred in 1990, likely using tractor yarding methods. It is estimated that detrimental soil disturbance from past logging may remain on approximately 0.5 acre. Because unit 104 is proposed for winter tractor yarding, new detrimental soil disturbance is anticipated on approximately 8 acres within the activity area (includes impacts on main skid trails and log landings). Thus, the amount of cumulative detrimental soil disturbance is predicted to be approximately 9 acres within the activity area. This is equivalent to approximately 10% detrimental soil disturbance within the activity area, which is in compliance with Region 1 soil guidelines.

There are potential cumulative effects of detrimental soil disturbance remaining from past harvest which spatially overlaps with detrimental soil disturbance predicted for salvage harvest activities on 38 acres located within five salvage units (7, 27, 51, 56, and 104). However restoration of jammer trails (refer to evaluation for "Effects Common to All Action Alternatives") would facilitate a trend for soil recovery on 110 acres within the project area. Thus, there would be a trend for net improvement in soil cumulative effects with restoration of past logging impacts combined with proposed salvage harvest within the project area. This is in compliance with Region 1 soil guidelines that cumulative detrimental effects from project implementation and restoration should "move toward a net improvement in soil quality" in areas where detrimental soil conditions exist from prior activities (USDA 1999a).

Synergistic Cumulative Effects

Because there are few scientific studies to specifically determine the long-term effects of post-fire salvage logging on soil productivity, there is uncertainty what synergistic cumulative effects wildfire combined with salvage logging may have on site productivity over the long-term (McIver and Starr 2000, 22). It is this uncertainty that is at the heart of the debate generated by the Beschta report (Beschta et al. 1995), which was discussed in the "Introduction to All Action Alternatives."

Consistent with "common goals" identified during this debate (Beschta et al. 1995; Everett 1995), helicopter, summer skyline cable and winter tractor logging under Alternative 4 have been designed to conserve existing site productivity and retain those ecosystem elements needed for site recovery following wildfire. To this end, helicopter, summer skyline cable and winter tractor logging have been designed to comply with Region 1 Soil Quality Standards (USDA 1999a) and the NFMA. Specifically, helicopter, summer skyline cable and winter tractor logging are predicted to maintain existing soil productivity, by minimizing or avoiding detrimental soil disturbance (i.e., compaction, displacement, rutting, erosion, and mass wasting), and by retaining recommended amounts of organic material (Graham et al. 1994) to sustain long-term nutrient cycling as well as provide a substrate to support populations of soil biota (i.e., mycorrhizal fungi, bacteria, etc.). With helicopter, summer skyline cable and winter tractor logging, it is predicted that the risk of synergistic cumulative effects has been minimized.

There is risk of synergistic cumulative effects for summer tractor logging on soils already impacted by wildfire. This risk of synergistic cumulative effects occurs in units 40, 47, 50, 52, 56, 71, 107, 159, and 161.

Short-term Uses vs. Long-term Productivity of Alternative 4

Detrimental soil disturbance, in the form of displacement, rutting and/or compaction, is predicted to occur on approximately 2% of the area associated with helicopter logging units, and approximately 9% of area with summer skyline cable and winter tractor logging units. In winter tractor, summer skyline cable and helicopter units, biological legacies remaining after wildfire (described in the assessment of environmental effects for the no action alternative) may be impacted on areas of detrimental soil disturbance. However, 91 to 98% of the area within winter tractor, summer skyline cable and helicopter units would not have detrimental soil disturbance following salvage harvest. Thus, biological legacies are predicted to remain intact following salvage activities on the majority of area, where there is not detrimental soil disturbance within winter tractor, summer skyline cable and helicopter harvest units. Because of these biological legacies, the trend for overall soil productivity is predicted to be for long-term recovery, even with effects of salvage harvest within the burned area.

Detrimental soil disturbance would occur on at least 14% of the activity area with summer tractor logging (43 acres of detrimental soil disturbance out of 302 acres within activity areas), and there is uncertainty if additional detrimental soil disturbance would occur as a result of dispersed equipment operation on bare ground. There is risk that detrimental soil disturbance from dispersed equipment operation in summer tractor harvest units could affect up to 30–40% of the activity areas (i.e., in units 40, 47, 50, 52, 56, 71, 107, 159, and 161). There is risk that biological legacies could be impacted on as much 30–40% of the activity area in summer tractor logging units. The long-term trend for soil productivity is uncertain, but may be at risk for impairment resulting from combined effects of ground-based salvage harvest on a burned landscape in summer tractor logging units.

Irreversible/Irretrievable Commitments of Alternative 4

Harvest in helicopter, summer skyline cable and winter tractor harvest units is more likely to successfully result in a long-term trend toward recovery of soil productivity, compared to summer tractor harvest units under Alternative 4. This is because helicopter,

summer skyline cable and winter tractor logging have less direct and indirect effects to soil productivity compared to ground-based tractor logging in summer with Alternative 4. With a long-term trend of recovery predicted for helicopter, summer skyline cable and winter tractor logging units, soil productivity would not be irreversibly or permanently damaged.

Summer tractor logging in harvest units 40, 47, 50, 52, 56, 71, 107, 159, and 161 is less likely to successfully result in a long-term trend toward recovery of soil productivity, compared to helicopter, summer skyline cable and winter tractor logging units in Alternative 4. Because the long-term trend for soil productivity within summer tractor harvest units is uncertain, soils within summer tractor harvest units may be at risk for irreversible or irretrievable effects.

Unavoidable Adverse Effects of Alternative 4

Detrimental soil disturbance, in the form of displacement, rutting and/or compaction, is predicted to occur on approximately 2% of the area associated with helicopter logging units, approximately 9% of the area for summer skyline cable units and winter tractor logging units, and at least 14% of area with summer tractor logging units. This detrimental soil disturbance would affect approximately 176 acres. However, 86 acres of soil disturbance on log landings and temporary roads would be reclaimed. Thus, there would be a trend for long-term recovery of soil conditions on these 86 acres where reclamation measures are implemented.

Forest Plan Consistency of Alternative 4

With a predicted long-term trend for recovery of soil productivity in helicopter, summer skyline cable and winter tractor logging units, the requirements to sustain site productivity with management actions would be met with Alternative 4, as mandated by the NFMA and the *Forest Plan*. Because the long-term trend for soil productivity within summer tractor harvest units is uncertain, soils within units 40, 47, 50, 52, 56, 71, 107, 159, and 161 may be at risk for impaired productivity, and may not meet requirements to sustain site productivity.

Hydrology

This section provides an analysis of the streams and rivers within and downstream of the project area. To evaluate these features one must look carefully at the appropriate source areas (e.g., hillslopes). The two major streams in the project area are the Copper Creek and the Landers Fork. Snowbank and Cotter Creeks and Snowbank Lake are also included in the project area. Both of these streams are fifth-order streams. Below their confluence Landers Fork becomes a sixth-order stream.

This analysis has the purpose of evaluating potential detrimental impacts of the Snow Talon fire salvage project on the physical and chemical aquatic system. These impacts may result from cumulative effects of past, proposed, and foreseeable future activities and this analysis accounts for all of those categories of activities. The watershed effects analysis for this project was performed on two drainage basins: Landers Fork and Copper Creek. Copper Creek is a fifth-order tributary to Landers Fork which in turn flows into the Blackfoot River. The downstream analysis boundary was at the downstream extent of the NF boundary.

The objective of this analysis was to evaluate the potential for cumulative watershed effects from the Snow Talon fire salvage project that are measurably greater than those already anticipated from the fires. To accomplish this objective the potential impacts from the fires and proposed salvage operations are analyzed separately.

Affected Environment

The Copper Creek watershed is approximately 26,000 acres while the Landers Fork watershed (excluding Copper Creek) is approximately 58,000 acres. Approximately 15,500 acres burned to some extent in the Landers Fork watershed while approximately 20,500 acres burned in Copper Creek. Figure 9 shows the third-order water sheds present within the Snow Talon fire perimeter.

Wetlands

Wetlands in the analysis area include several in Indian Meadows and along the upper reaches of Copper Creek.

Groundwater

Available well data from Montana's on-line Groundwater Information Center (Montana Bureau of Mines and Geology 2003) indicate that groundwater in the analysis area occurs in shallow alluvial deposits as well as at depth. Wells in alluvial deposits have static water levels ranging from 16 to 66 feet. Groundwater also occurs at depth, with static water levels at 50 to 60 feet in most domestic wells along Landers Fork.

Groundwater in the analysis area is used for domestic purposes as well as livestock watering. Two wells associated with Copper Creek Campground are designated as "public water supply" (Montana Bureau of Mines and Geology 2003). However, these wells are not identified as public water systems under Montana's Source Water Protection Program (Montana Department of Environmental Quality [MDEQ] 2003a). These wells are sampled monthly by Helena NF personnel.

Water Quality

The Landers Fork and Copper Creek have a B-1 water-use classification under Montana State Water Quality Standards. B-1 streams "…are to be maintained suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply" (Administrative Rules of Montana 17.30.623, 2002). The B-1 water quality standards include the following:

- Fecal coliform bacteria concentration
- Dissolved oxygen concentration
- Hydrogen ion concentration (pH)
- Naturally-occurring turbidity
- Water temperature
- Naturally-occurring concentrations sediment and suspended sediment
- Naturally-occurring color

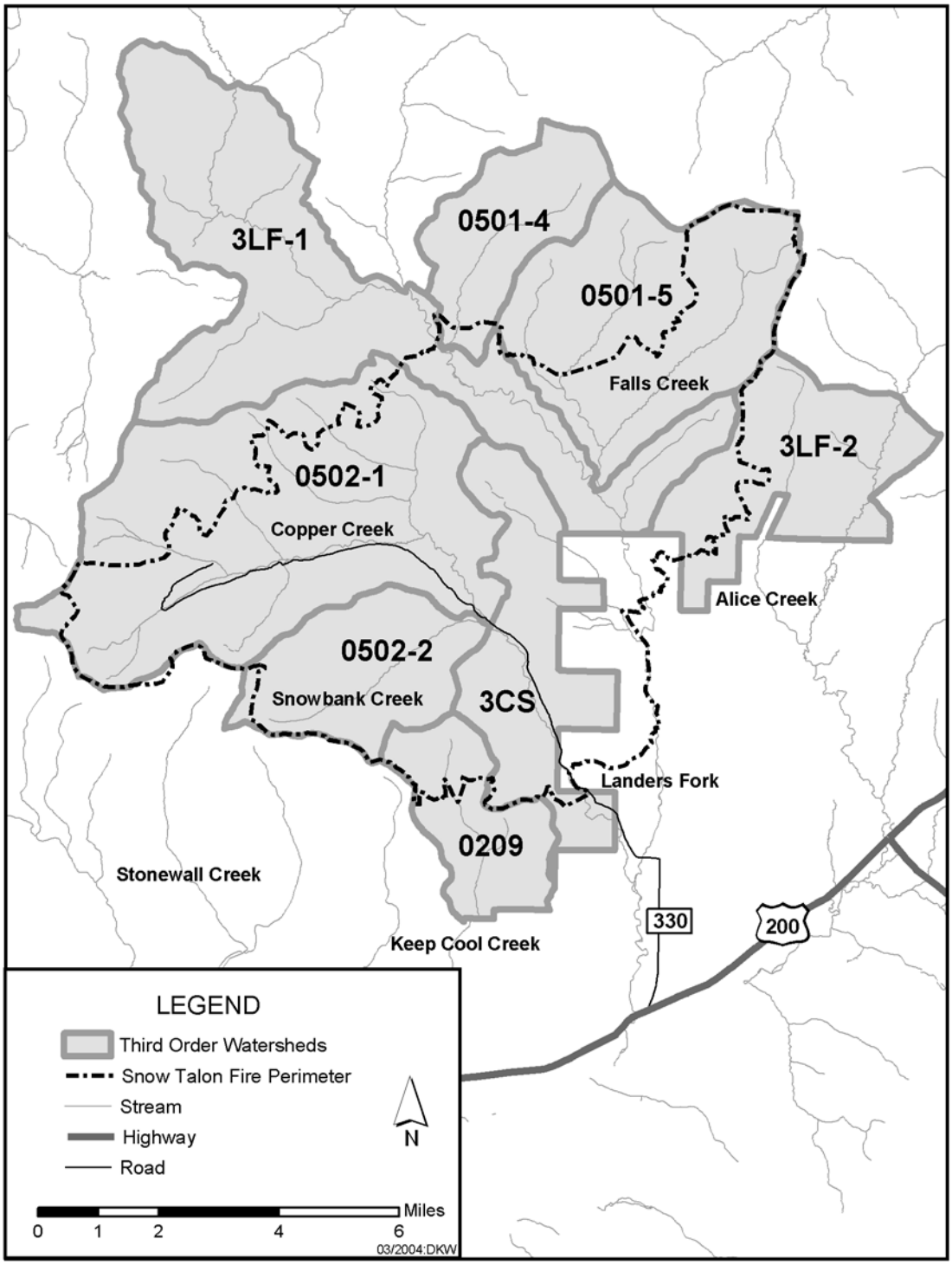

Figure 9. Eight third-order watersheds present within the Snow Talon fire perimeter.

- Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters.

Baseline water quality data for Copper Creek and Landers Fork are limited to data collected from studies of bull trout and westslope cutthroat trout habitat. These data are discussed under the aquatic habitat section.

The analysis area is included under the Blackfoot Headwaters TMDL Planning Area. The draft TMDL for the Planning Area was released for public comment in December 2002. Neither Landers Fork nor Copper Creek are listed as impaired or threatened under *Clean Water Act*, Section 303(d) (MDEQ 2003b).

The MDEQ performed an analysis of Landers Fork geomorphology and sediment loading in 2002. They concluded that, in general, the stream channel lacks woody debris and complex habitat features for fish such as deep pools, overhanging banks, and riparian vegetation. They further state that local residents have reported that following the 1964 flood, the Army Corps of Engineers commissioned removal of woody debris and dozing in both the Landers Fork and the aggraded reach of Blackfoot River to facilitate sediment transport in these streams (MDEQ 2002).

The MDEQ evaluation determined that

> *"...geologic conditions and natural disturbance [were] the overwhelming influences on the Landers Fork. As a result, most of the load to the Blackfoot River from the Landers Fork is considered as natural, thus influencing fisheries habitat expectations in some of the Blackfoot reaches exhibiting significant negative impacts from Landers Fork. Also, sediment TMDL development is not required for the Landers Fork, consistent with the finding of full support of beneficial uses on the 2002 303(d) list."* (MDEQ 2002).

Environmental Consequences

Flow Regime—Annual Water Yield

Changes in annual runoff have been documented after removal of live conifer vegetation (Bosch and Hewlett 1982; Burton 1997). Similar studies have been conducted on the effects of prescribed fire on runoff (Moody and Martin 2001a). Whether from natural disturbance such as wildfire or from timber harvest, removal of living vegetation can increase water yield and is generally proportional to the amount of vegetation and tree canopy removed from a site (Reinhard et al. 1963; Rothacher 1970). Increasing site moisture results from decreased evapo-transpiration and increased rates of snow accumulation. This site moisture may become available for runoff and is then conventionally referred to as water yield.

This water yield increase alone is not likely to cause detrimental impacts on the aquatic resources. It may actually increase late-summer flows and could therefore be considered beneficial. This increase may, however, give some indication of the potential for increased peak flows that can cause damage. Because there is not a good way to directly predict the size of increase peak flows we model water yield increase as a surrogate.

Flow Regime—Peak Flows

Peak flow increases after fires have ranged from 145 to 870% (Anderson 1974 and Sinclair and Hamilton 1955, as cited in Moody and Martin 2001a). Increased peak flows are the result of a complex set of factors that can be generalized into two categories:

Spatial factors

- Elevation of the burned or harvested stands
- Aspect of the burned or harvested stands
- Relative position of the stands to each other.

Meteorological factors

- Intensity, duration, and magnitude of precipitation events
- Occurrence of rain-on-snow events
- Degree to which the ground under the snowpack is frozen.

One or more of these factors may encourage greater peak flows to occur in a given basin. Predicting precisely when and if such peak flow events will occur, however, is beyond current scientific capabilities.

Water Quality

There are three aspects to the water quality issue in this analysis:

- Temperature—The effect of fire on water temperature is analogous to the effects of timber harvest. Removal of vegetation allows for direct heating of the water surface by solar radiation. The primary concern related to increase water temperatures is the coincident reduction in dissolved oxygen concentrations available for aquatic biota.
- Water Chemistry—The concentration of major cations and anions in stream water in the Northern Rockies is typically low. As fire reduces uptake by vegetation and increases sedimentation, these concentrations increase. Direct leaching of ash may bring about increases in phosphorus and nitrogen concentrations (Spencer and Hauer 1991).
- Sedimentation—Numerous studies have demonstrated increased overland flow and erosion rates after wildland fire. These studies have spanned temporal and spatial scales from small (Benavides-Solorio and MacDonald 2001; Helvey 1980; Johansen, Hakonson, and Breshears 2001; Johansen et al. 2001; Marcos et al. 2000) to moderate-sized (Morales et al. 2000) to large (Beeson et al. 2001; Meyer et al. 2001, Meyer and Pierce 2003). Erosion rates have been shown to decline rapidly after fire (Moody and Martin 2001a, b: apparent recovery in four years) with some showing a correspondence to regrowth of vegetation (Benevides-Solorio and MacDonald 2001: nearly complete recovery in 6 years; Heede et al. 1988).

It should be emphasized here, however, that erosion by itself is not relevant to this analysis. This analysis focused on the eroded sediment only if it is delivered to a stream. This may occur by dispersed overland flow from areas adjacent to streams or may occur from channelized flow (e.g., rill erosion or debris flows).

Debris flows were not modeled but were addressed by explicit avoidance of debris flow-prone areas such as topographic depressions. Debris flows may be initiated when surface runoff converges (Canon et al. 2001) or as a result of debris slides during large storm events (Meyer et al. 2001; Nakamura Swanson and Wondzell 2000).

Research has determined that whether moving in overland flow or in a debris flow, sediment eroded from hillslopes is likely to be deposited in alluvial fans or on floodplains where it may be stored for hundreds to thousands of years and not reach streams (Clayton and Megahan 1997; Meyer, Wells, and Jull 1995; Moody and Martin 2001a; Trimble and Crosson 2000). In addition Spina and Tormey (2000) found that (possibly as a result of a low precipitation year) pools within stream channels below a burned watershed did not suffer from sediment deposition and subsequent habitat degradation.

Sediment delivery from overland flow was evaluated using the WEPP model. Debris flows, occurring mainly as a result of rainstorms are difficult to predict. They have been documented to have resulted from fires (e.g., Cannon et al. 2001) but salvage harvest has not been demonstrated to exacerbate them or increase their frequency.

Effects of All Alternatives

As noted above, modeling was used to evaluate the environmental consequences associated with past actions and the three action alternatives. These for water yield the Equivalent Clearcut Acre water yield model (Galbraith 1975) was used to quantitatively describe existing forest crown conditions and to estimate potential water yield increases resulting from forest crown removal (i.e., timber harvest, wildfire, road construction, insect and disease).

To estimate the existing and potential volumes of sediment that would be produced from the various proposed activities in this EIS, the Disturbed Watershed Erosion Prediction Project (WEPP) model (Laflen et al. 1997) was used. To calculate the sediment volumes actually delivered to waterbodies, sediment delivery ratios have been determined by the project hydrologist with the assistance and collaboration of a number of qualified watershed scientists. These sediment deliver ratios are draft at this point and will be refined between the draft and the final to allow us to better approximate the amount of sediment delivered to various waterbodies. This model is intended to assist in the evaluation of impacts on water resources caused by nonchannelized erosion. Debris flows and other episodic erosional events are stochastic in nature. It is beyond the capabilities of existing science to predict precisely if and when and to what extent these events will occur. Their occurrence largely depends on the occurrence of precipitation events. This model does not address these types of events. Neither does this model address sediment from roads. That issue will be addressed separately.

Several assumptions were used in the implementation of these models on a large scale without obfuscating the results with excess complexity. These include the following:

1. Areas outside of a 1,200-foot zone on either side of streams will be designated as noncontributing areas.
2. For the purposes of determining if sediment is delivered to a stream we used the geographical information system layer provided by the Helena NF that contained all perennial streams.

3. The soil texture utilized in the model is loam throughout the project area. This texture is considered to be accurate for much of the project area and has an erodibility in the mid-range of possible values.
4. All model runs use the same climate data set.

Annual Water Yield

Table 10 shows the modeled annual water yield increases from past harvest and the Snow Talon fire. Increases associated with the Snow Talon fire can be anticipated to recovery back to pre-fire levels within 30–60 years (Callahan et al. in press).

Table 10. Modeled annual water yield increases from past harvests, the Snow Talon fire, and all action alternatives.

Analysis Area	Annual Water Yield Increase (Percent Above Pristine Conditions)		
	Before 2003 Fires	Existing	All Action Alternatives
Copper Creek	1.3	10.3	10.3
Landers Fork	0.3	2.6	2.6

There is no evidence that removal of timber from a burned forest reduces the already low interception capability (Kershaw 2001). In addition, the removal of burned trees does not further reduce site evapo-transpiration. Therefore, no increases in water yield are anticipated from any of the proposed activities. The results shown in Table 10 are the same for all alternatives.

Peak Flows

In general, it is reasonable to assume that there will be increases in peak flows in streams within the project area as a result of the 2003 fires. The precise magnitude and duration of these increases cannot be predicted as they depend largely on the intensity and duration of rainstorms for summertime floods and on snowpack accumulation.

When peak flows increase erosive energy is increased. This may cause channel instability in even the most healthy streams and rivers. The degree of channel adjustment can vary based on channel type and more importantly, channel-floodplain interaction and inherent structural integrity of the river. Naturally functioning stream channels may withstand increased peak flows by a variety of methods. In some channel types, erosive energy is dissipated on well-developed floodplains. Other channel types, with coarse gravel or cobble bed material can minimize damage by peak flows because of the frictional resistance provided by channel bed materials. In these channels, energy is dissipated through turbulence at the channel boundary rather than lateral erosion or undercutting of channel banks.

Rain-on-snow events may also bring about damaging peak flows. However, these types of events are more common in areas where maritime (warm and moist) weather patterns are prevalent like the Pacific Coast and even Northwest Montana. Rain-on-snow events are not common and not a driving geomorphic force in the project area.

The morphology of the stream network will adjust to differing alterations in flow regime. The shape of the stream channels will adjust to increased peak flows. Riparian vegetation will respond to higher water tables.

All of these potential impacts are associated with the fires of 2003. No increase in peak flows is anticipated from the proposed activities.

Water Quality

Temperature—Increases in water temperature in streams within the fire perimeter are likely to occur as a result of the fires of 2003. The proposed activities will adhere to INFISH and will only be removing dead or dying trees. The reduction in shade resulting from these activities therefore is expected to be negligible. Additionally, the fires will increase annual water yield in the affected streams and this will offset any temperature increases and could even lower water temperatures under favorable runoff scenarios (e.g., if the increases in water yield show up during late summer when streamflow levels are typically at their lowest).

Water Chemistry—Overland flow of nutrients that are sorbed to sediment particles and reduced uptake by vegetation, along with direct leaching of ash may bring about increases in phosphorus and nitrogen concentrations in streams. These effects, however, are expected to recovery quickly with vegetation regrowth (Spencer and Hauer 1991).

Sedimentation—Table 11 shows the results of the sediment modeling conducted for the alternatives. The results show that there is not significant difference in the sediment yield from hillslopes among alternatives. As previously noted, the model does not address debris flows and other episodic erosion events which are stochastic in nature. The results do show a net decrease in sediment yield of road sediment from the action alternatives. This is attributed to the removal of jammer trails. The removal of the jammer trails is likely to cause a short-term pulse of sediment, but in the long term the removal of trails will remove the potential for both chronic and mass failure sedimentation.

Mitigations Included Under All Action Alternatives

- All seeps and wetlands would be avoided during implementation of the project. This would be written into the agreement with the chosen contractor. During implementation, the project administrator and hydrologist or botanist would identify and clearly mark any such sites that they encounter. Figure 10 shows the location of salvage units relative to seeps and wet areas.
- Logging and equipment operation would be explicitly excluded from areas that are determined by FS personnel to be likely locations of debris flows (for example topographic depressions).
- All roads to be utilized during this project would be brought up to full compliance with Montana BMPs. Required action may include installation of drainage structures such as drain dips to minimized sediment delivery to streams and installation of rock, log or other structures to minimize erosion at stream crossings.
- Helicopter logging is being considered as a mitigation measure so that salvage operations can be implemented without increase risk of erosion from new roads and ground-based logging.

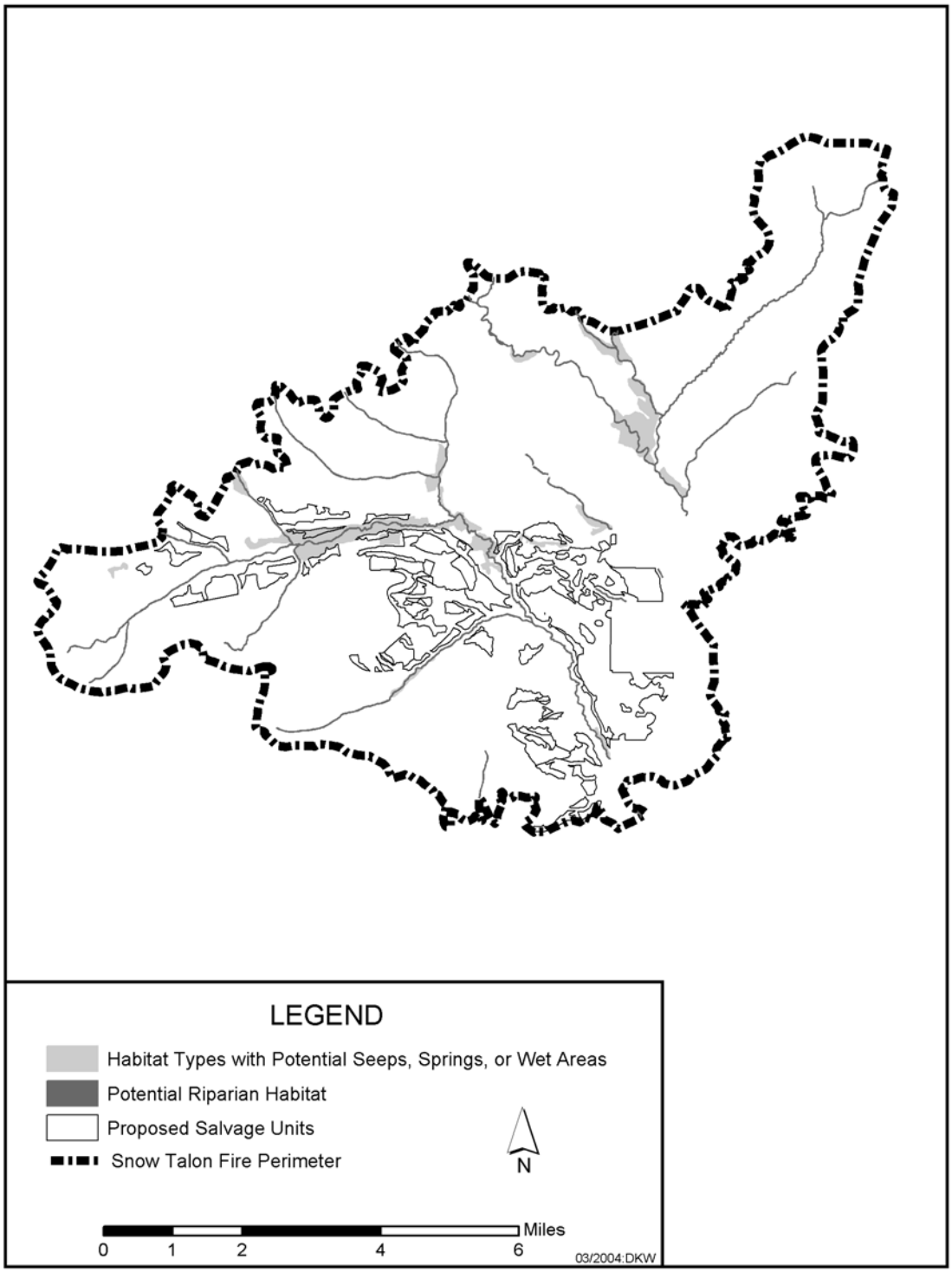

Figure 10. Locations of proposed salvage units and habitat types with potential seeps, springs, or wet areas.

Table 11. Sediment modeling results for the Snow Talon fire salvage project.

		Pre-2003 Fires	Existing Condition No Action	Alt.2	Alt. 3	Alt.4
Copper Creek Analysis Area (hydrologic unit code, 0103)	Hillslope Sediment Yield ($t/mi^2/yr$)	0.00	194.90	194.90	194.90	196.32
	Road Sediment Yield (t/yr)	31.60	31.60	23.70[a]	23.70[a]	23.70[a]
	Total	31.60	226.50	218.6	218.6	220.02
Landers Fork Analysis Area (hydrologic unit code 0104)	Hillslope Sediment Yield ($t/mi^2/yr$)	0.00	55.25	55.25	55.25	55.29
	Road Sediment Yield (t/yr)[b]	26.55	26.55	26.55	26.55	26.55
	Total	26.55	81.80	81.80	81.80	81.83

a. Reduction in Copper Creek road sediment numbers assumes eventual sediment yield of 0 t/yr from jammer trail removal.
b. Road sediment does not decrease in Landers Fork as no jammer trail removal is occurring in that watershed.

- Under all action alternatives, suspended log yarding (i.e., helicopter and/or cable skyline) would be implemented on steep slopes (generally greater than 35%)
- Under all action alternatives log landings and temporary roads would be reclaimed by recontouring, scattering of woody materials and seeding.
- Under all action alternatives, jammer trails in past harvest units would be reclaimed by recontouring, scattering of available woody material (if any), and vegetation planting or seeding.
- Under Alternatives 2 and 4, helicopter logging will be implemented in areas at risk for mass wasting (i.e., debris flows), while no logging will occur on areas at risk for mass wasting under Alternative 3.
- Under Alternatives 2 and 3, tractor and skyline cable logging will be implemented under winter conditions
- Under Alternative 4, only tractor logging on ash cap soils, which have relatively high vulnerability to compaction, will be implemented under winter conditions.

Aquatics

Cotter and Snowbank Creeks are first-order streams that flow into Copper Creek, a third-order stream. Copper Creek then flows into the Landers Fork, which is a fourth-order tributary of the Blackfoot River. Both the Landers Fork and Copper Creek originate on NF System land on the Helena NF in Lewis and Clark County. These streams flow through a glacially influenced valley just south of the Scapegoat Wilderness Area.

The immediate project areas are primarily associated with the Landers Fork, Copper, Snowbank and Cotter creeks, as well as Snowbank Lake. Bull trout that use Copper Creek are migratory, moving between Copper Creek, the Landers Fork, and the mainstem Blackfoot River, upstream of Nevada Creek. Therefore, the analysis area for fisheries must include considerations of conditions in the upper mainstem Blackfoot River as well.

Critical Habitat Designation

Copper Creek, the Landers Fork, and the Blackfoot River all contain bull trout, a species listed as "threatened" under the ESA. These streams have all been proposed to be designated as critical habitat in the *Proposed Designation of Critical Habitat for the Klamath River and Columbia River Distinct Population Segments of Bull Trout* (67 FR 230, 2002). Critical habitat is defined in the ESA as:

> (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species, and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

"Conservation" is defined by the ESA as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary" (16 U.S.C. 35 §§ 1531 et seq., 1988).

Critical habitat receives protection under Section 1536(a) of the ESA through the requirement that federal agencies shall, in consultation with the United States Fish and Wildlife Service (USFWS), ensure that any action authorized, funded, or carried out is not likely to result in the destruction or adverse modification of critical habitat (16 U.S.C. 35 § 1536, 1988). To be included in a critical habitat designation, the habitat must be "essential to the conservation of the species." Critical habitat designations identify, to the extent known and using the best scientific data available, habitat areas that provide at least one of the physical or biological features essential to the conservation of the species. For the proposed bull trout critical habitat, the lateral extent of critical habitat for each proposed stream reach is the width of the stream channel as defined by its bankfull elevation (Rosgen 1996). Critical habitat extends from the bankfull elevation on one side of the stream channel to the bankfull elevation on the opposite side. Adjacent floodplains are not proposed as critical habitat.

The specific critical habitat for bull trout in the Landers Fork and Copper creek as proposed by the USFWS (2002a) is; Landers Fork, from its confluence with the

Blackfoot River upstream 11.2 miles to a barrier falls near the junction of Byrnes Creek (just downstream from the Scapegoat Wilderness), and Copper Creek, from its junction with Landers Fork upstream 14.9 miles to its headwaters. These streams provide spawning and rearing habitat for the Landers Fork local population (Montana Bull Trout Scientific Group 1995; Pierce, Peters, and Swanberg 1997; USFWS 2002).

Affected Environment

Copper Creek drains into the Landers Fork, which then enters the Blackfoot River. Adult fluvial bull trout migrate from the mainstem Blackfoot River into the lower portions of the Landers Fork and then into Copper Creek. Each fall, Copper Creek contains the majority of the spawning bull trout found in the upper Blackfoot River drainage. Therefore, while Copper Creek contains important bull trout spawning habitat, the Landers Fork contains critical migratory habitat that allows for the movement of migratory bull trout to and from the Blackfoot River into Copper Creek.

Landers Fork

The Landers Fork is a fourth-order stream and a major tributary to the upper Blackfoot River. It originates in the Scapegoat Wilderness and flow approximately 28 miles to the confluence of the Blackfoot River. The upper 16 miles of the Landers Fork is entirely on public land (Helena NF). Silver King Falls, located approximately 11.2 miles upstream of its confluence with the Blackfoot River is the only known barrier on Lander's Fork.

The Landers Fork is within two 6th code hydrologic units (HUCs) (see Figure 9). The FS prepared an assessment of the suitability of both portions of the Landers Fork watershed (HUC #170102032901 and 170102032601) for bull trout after the bull trout ESA listing. These assessments were completed prior to the Snow Talon fire.

For the upper Landers Fork watershed (HUC #170102032901), the FS concluded that all habitat indicators in the Landers Fork are functioning at risk (FAR) except for chemical contaminants and nutrients. There are no known toxic inputs into any of the streams within the drainage (Helena NF unpublished file data).

The FS considered large woody debris (LWD) to be FAR in the Landers Fork because of past stream “cleaning” efforts that took place in the drainage to remove wood from the stream channel. Pools in the Landers Fork number ten per mile, so pool frequency, quality, large pools, and refugia were considered to be FAR. Wetted width is FAR because of the wide stream channel. Streambank condition is FAR because of many areas of mass wasting.

Overall, the watershed was found to be functioning at unacceptable risk (FUR) because of the very low densities of bull trout present, the presence of a complete barrier to fish movement at Silver King Falls, the lack of bull trout upstream from the barrier, the threat of hybridization from brook trout located in the downstream reaches (below this HUC) of Lander's Fork, the reduced pool habitat, and the high summer temperatures (above 70°F) in the portion of the drainage above the Copper Creek confluence.

The Snow Talon fire burned 20% of the Landers Fork Watershed at high severity. All of the burned areas are in the upper Landers Fork watershed. Therefore, the habitat assessment information describes the pre-fire conditions. The current and future conditions have not been assessed.

The land adjacent to the Landers Fork from the Copper Creek confluence to the Blackfoot River is within a mixed ownership. Timber harvest, roading or tracking activities grazing, and a proposed mine (currently inactive) occur along this reach (Burns 2003). For the lower Landers Fork watershed (HUC #170102032601), all the habitat variables were ranked as FAR, except for four variables that were ranked FUR. These variables included chemical contaminants and nutrients because recent mining exploration resulted in large amounts of deep groundwater with elevated arsenic levels entering the shallow groundwater aquifer prior to entering Lander's Fork and the Blackfoot River.

Physical barriers are ranked FUR because of the low flows that occur, impeding fish passage. Bull trout outmigrants cannot reach the Blackfoot River when this stream reach is dry. Bull trout mortalities of both adult and juvenile fish have been documented in this reach. Flow intermittency and lack of connectivity to the mainstem Blackfoot River are suspected to be the major limiting factors for bull trout in the upper Blackfoot River drainage

Change in peak/base flows was rated FUR for the HUC because of roading, livestock grazing, mining, and timber harvest, and water diversions. Road density and location was rated FUR for the HUC because road density is 1.11 mile per sq mile on Forest lands and there are many road miles on private land.

However, in comparison to the Landers Fork in upstream areas, habitat diversity improves within the reach between Copper Creek and the mouth. Woody debris within this reach is somewhat more common. Increasing amounts of riparian vegetation allow for undercut bank formation. There are several large, high-quality pools, and spawning gravels are present. Fine sediment levels averaged 27% in spawning gravels at a sample site near the mouth (Helena NF unpublished file data). Rosgen's (1996) channel type[2] was measured as C4 in one location within this reach close to the confluence with the Blackfoot River (Hillman and Chapman 1996).

Copper Creek has a cooling effect on the Landers Fork. Copper Creek has a maximum August temperature of approximately 18°F cooler than the Landers Fork (Pierce, Podner, and McFee 2002). The cooling effect of Copper Creek extends downstream to the confluence with the Blackfoot River. In 1998, maximum monthly temperatures in the Landers Fork at the Highway 200 crossing were 7–10°F cooler than maximum temperatures recorded in the Blackfoot River upstream of the Landers Fork. Therefore, the lower Landers Fork may provide important thermal refuge for native fish in the upper Blackfoot River (Pierce and Schmetterling 1999).

The Snow Talon fire did not directly affect the lower Landers Fork HUC. However, upstream areas were burned, with a high percentage (60%) of Copper Creek burned severely. Therefore, impacts from the fire are likely to occur in downstream areas of the Landers Fork. The past habitat evaluation will need to be updated to reflect future conditions.

[2] The Rosgen classification system of natural rivers is based on a number of delineative criteria associated with a stream's morphology, such as entrenchment, width/depth ratio, sinuosity, slope, and channel material. The system is further detailed in *Wildland Hydrology* (Rosgen 1996).

Copper Creek

The Snow Talon fire of 2003 undoubtedly changed the aquatic, riparian, and upslope habitats within a large proportion of the Copper Creek drainage. Approximately 60% of the Copper Creek drainage was burned with high severity. No aquatic habitat surveys have been conducted since the fire occurred; therefore, all habitat information on the Copper Creek drainage was collected prior to the Snow Talon fire. The most immediate short-term concern to fisheries and the aquatic habitat since the fire occurred is the high probability of debris flows and extreme sedimentation during rain on snow events during spring runoff or during summer thunderstorms (USDA 2003a). Although the fire may cause short-term negative impacts to fish habitat, fire is one of the primary causal agents in the recruitment of wood to streams (USDA 2003a). Therefore, although the fire may have short-term negative impacts to the aquatic habitat, it may also have long-term benefits. Below is a description of the pre-fire habitat in the Copper Creek drainage.

Prior to the Snow Talon fire, the overall fish habitat in Copper Creek was good. Bull trout survival-to-emergence can be reduced by high fine sediment levels in spawning gravels. Streambed core samples indicate that fine sediment levels (material <6.35 mm) in Copper Creek below the Copper Creek bridge averaged 29.3% between 1986 and 2001, while above the Copper Creek Bridge fine sediment levels averaged 26.5% between 1993 and 1997 (Helena NF, Lincoln RD file data). While these levels may be slightly elevated over comparable sediment levels in pristine streams, fine sediment levels <35% are generally considered to be good for bull trout. However, Helena NF fisheries biologists do not expect sediment levels to remain stable in the short term resulting from the impacts of the 2003 Snow Talon fire.

Stream discharge in Copper Creek measured 35.5 cfs on August 30, 1989, by the Montana Department of Fish, Wildlife & Parks (MDFWP) (Peters 1990). This represented 37% of the flow in the Landers Fork, 4.1 miles above the confluence of the Blackfoot River. Temperatures taken in July 1996 in the lowest reach of Copper Creek measured 45 to 55°F (Hillman and Chapman 1996). Temperatures taken downstream of Snowbank Lake in August 1997 were very low with an average maximum of 52.5°F (Pierce and Schmetterling 1999). Water temperature monitoring in 1999 found Copper Creek had the coldest summer stream temperatures of any of the sampled streams in the Blackfoot River watershed (Pierce and Podner 2000).

The headwaters reach of Copper Creek extends from the headwater basin to approximately 1.0 mile downstream from Red Creek confluence. The majority of this reach was Rosgen's channel type B3 prior to the fire (Burns 2003). In the headwaters reach of Copper Creek, past timber harvest and roads are located within the RHCA and in the RHCAs of the tributaries to Copper Creek that also support fish. Overall road density for the drainage is 1.42 miles per square mile with a substantial amount of the roads within the RHCAs (Burns 2003).

Two mines, Copper Camp and Cotter Basin, which are both inactive, are located within the headwaters. The Copper Camp mine was obtained by the FS in a land trade. Waste rock material at the mines is not highly toxic. Water leaving the mine sites does not contain metals at levels that exceed acute or chronic levels for aquatic life (Burns 2003).

The stream flows intermittently at the lower end of this reach. Habitat quality and diversity is good. Spawning gravels are limited. In the 1980s, woody debris was

selectively removed from Copper Creek to prevent bridge washout. In spite of that, upper Copper Creek prior to the fire contained a number of reaches with high-quality pools formed by woody debris. A natural barrier to fish movement exists on the North Fork of Copper Creek in that the lower reaches go subsurface during most years (Burns 2003).

Prior to the fire, the middle and lower reaches of Copper Creek basin had been affected by timber harvest, roading and tracking, and recreation. The Copper Creek Road is in close proximity to Copper Creek in many locations. This road has and will continue to limit LWD recruitment to Copper Creek in areas where the road intrudes into the riparian zone. Copper Creek Campground is located within this reach and prior to the fire received high recreational use, which included fishing.

Some culvert crossings within the Copper Creek Watershed were suspected of impeding fish movement prior to the 2003 Snow Talon fire. In response to the Snow Talon fire BAER report issued in August 2003, the Helena NF planned on removing a large proportion of the culverts within the burned area. In particular the FS planned for removing 12 culverts in the Fall-Winter of 2003 and replacing them with upsized culverts in 2004 (Figure 11). In addition, 20 culverts will be replaced with upsized culverts and overflows, while one culvert will be replaced with a bridge (USDA 2003a).

A water diversion is present on Snowbank Creek, which provides water to Snowbank Lake. This diversion is a complete barrier to upstream fish movement for Copper Creek fish attempting to enter Snowbank Creek (Burns 2003).

Prior to the fire, Rosgen's channel type was measured for four locations within this reach. The uppermost reach near the Snowbank Creek confluence was considered a C4 type. The rest of the locations were measured within or downstream from Section 23 and all were considered E4 channel types (Hillman and Chapman 1996). Habitat quality and diversity in the middle and lower reaches of Copper Creek are good to excellent. Spawning gravels are common.

Landers Fork and Copper Creek Habitat Quality Monitoring and Assessment

No spawning habitat quality surveys have been done in Copper Creek or the Landers Fork following the 2003 Snow Talon fire. Spawning habitat quality surveys in the middle reaches of Copper Creek were conducted from 1986 to 2001. The amount of fine sediment in Copper Creek remained relatively stable prior to the fire (Helena NF, Lincoln RD, unpublished file data). Two factors were used to assess habitat quality: the percentage of fine sediments and the Fredle Index. Fine sediment averaged 29.3% in the sampling site downstream of the Copper Creek Bridge and averaged 26.5% in the sampling site upstream of the Copper Creek Bridge (Table 12).

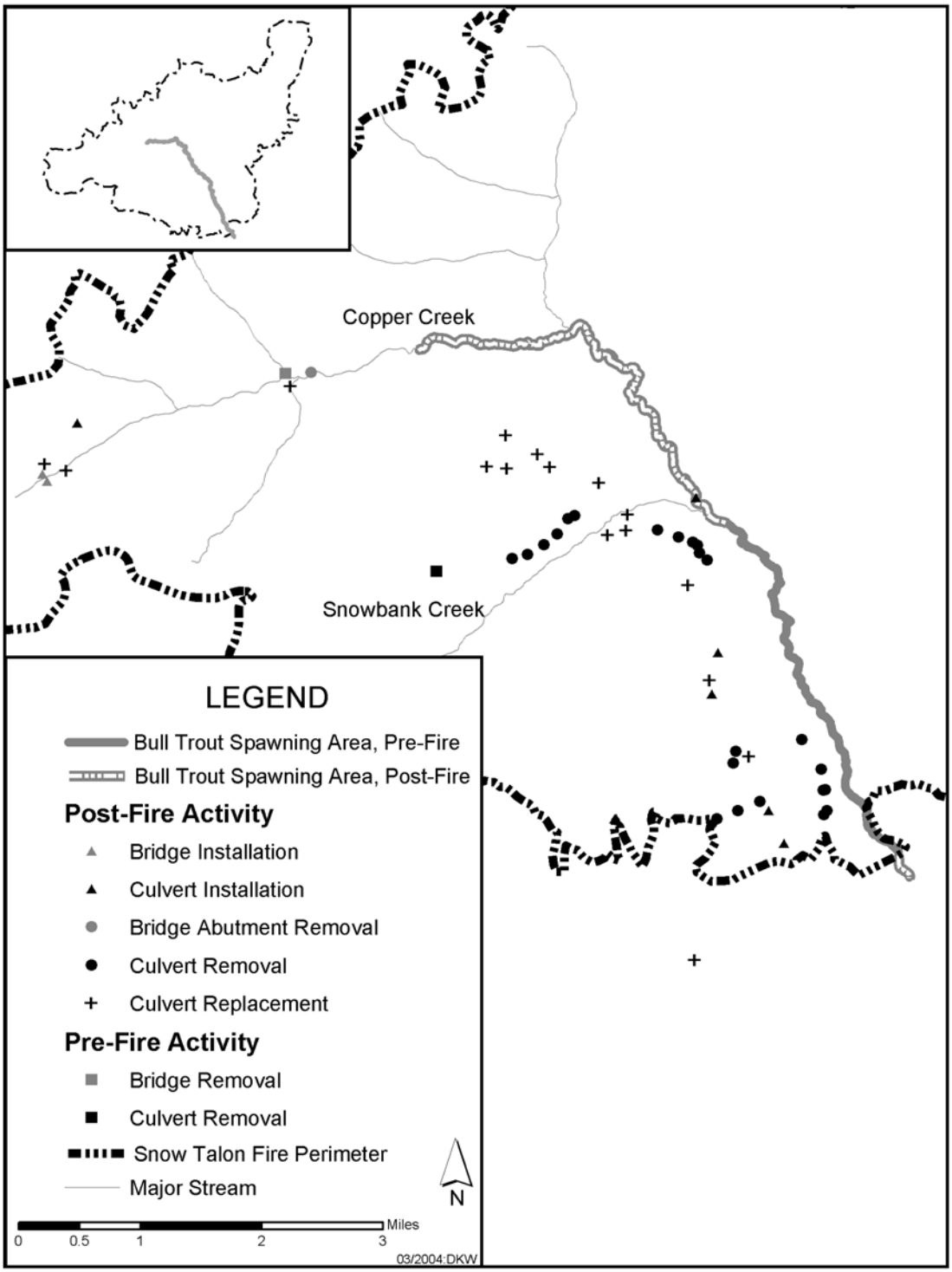

Figure 11. Map of Copper Creek drainage. Locations of bridge and culvert installation and removal are depicted, as well as bull trout spawning areas pre- and post-Snow Talon fire, 2003. Note: all area represented by post-fire spawning areas were used by bull trout before the 2003 fire.

Table 12. Comparison of average sediment data from Copper Creek and Landers Fork, Monture Creek, and the North Fork of the Blackfoot River between 1986 to 2001.

Location	Avg. Number of Cores	Avg. % Fines <6.35 mm	Minimum % Fines <6.35 mm	Maximum % Fines <6.35 mm	Avg. Fredle Index
Copper Creek below bridge	7.7	29.3	19.6	37.4	4.9
Copper Creek above bridge	6.0	26.5	14.9	34.1	6.0
Landers Fork	4.7	31	26.4	35.1	5.1
Monture Creek—upper	10	29.3	NA	NA	4.95
Monture Creek—lower	10	29.25	NA	NA	4.99
N. Fork Blackfoot River—upper	10	25.67	NA	NA	5.96
N. Fork Blackfoot River—lower	10	8.17	NA	NA	19.77

Source: Helena NF unpublished file data, Lolo NF unpublished file data
NA = not available
Note: not all sites were sampled an equal number of times.

The Fredle Index (Lotspeich and Everest 1981) is a ratio of the quality of salmonid spawning gravel obtained by dividing geometric mean diameter particle size by the sorting coefficient as shown in Equation (1)

$$(1) \quad f_i = \frac{d_g}{S_o}$$

where

d_g = geometric mean particle size (measure of mean particle size of substrate materials)

S_o = sorting coefficient, $(d_{75}/d_{25})^{1/2}$; d_{75} is the particle diameter at the 75th percentile of cumulative particle weight and d_{25} is the diameter at the 25th weight percentile (Armantrout 1998).

The mean Fredle Index for Copper Creek below Copper Creek Bridge was 4.9 and for Copper Creek above the bridge was 6.0 between 1986 and 2001 (Table 12). The Fredle Index fluctuated between approximately 4 and 6.5 over the years, with no apparent trend. The relationship between the Fredle Index and survival-to-emergence of salmonids has not been documented experimentally. However, using existing data, Lotspeich and Everest (1981) estimated that a Fredle Index of 4 corresponds to a survival-to-emergence of 60% for coho salmon (*Oncorhynchus kisutch*) and 75% for steelhead (*Oncorhynchus mykiss*). Larger Fredle Indices indicate better conditions for salmonid survival (Lotspeich and Everest 1981).

Deposited sediment data from the Landers Fork are limited, with only 2 years sampled at three different locations. The overall average for the three sample sites is 31% fines <6.35 mm (Helena NF, Lincoln RD, unpublished file data). Data collected in the

wilderness area had lower sediment levels than the two sample sites downstream of the wilderness, possibly reflecting the impacts of human activity in the watershed downstream. Other streams in the area that have been sampled include Monture Creek and the North Fork of the Blackfoot.

As can be seen in the comparison shown in Table 12, prior to the fire, Copper Creek upstream of the bridge had, on average, a lower percentage of fines and a higher average Fredle Index than any of the other sites, except for the North Fork of the Blackfoot River. In fact, Copper Creek upstream of the bridge had lower average percent fines and a higher average Fredle Index than the Landers Fork within the wilderness area.

These data indicate that prior to the fire, spawning gravels in Copper Creek upstream of the bridge were close to the baseline natural amounts that would be expected in pristine conditions. However, caution should be exercised in interpreting these data, because of small the sample size, particularly with the Landers Fork comparison site. Copper Creek downstream of the bridge may have had slightly elevated fine sediment in comparison to a pristine baseline, although numbers were comparable to the overall average for all sites sampled in the Landers Fork and Monture Creek.

The average Fredle Index in Copper Creek ranges from 4.9 to 6. Based on the available information, the Fredle Index for Copper Creek corroborates the conclusion that Copper Creek substrate was in “near natural” condition, with better conditions in Copper Creek upstream of the bridge than Copper Creek downstream of the bridge.

Environmental Consequences—Fisheries Habitat

Effects Common to All Alternatives

Impacts to Bull Trout Critical Habitat

Significant changes to bull trout habitat in the Copper Creek and Landers Fork drainages have and will likely continue to occur resulting from the 2003 Snow Talon fire. The response of aquatic ecosystems during and after a fire can be highly variable and dependent on a host of physical and biological factors (Kershner et al. 2003).

Stream macroinvertebrate abundance, richness, and diversity as well as periphyton biomass may decline during the period directly following a wildfire depending on the severity of the fire and the local site characteristics (Kershner et al. 2003; Minshall et al. 1997). Although initial decreases are often observed in aquatic macroinverebrate biomass and diversity, increases above the pre-fire state often occur between 2–5 years after a fire (Gresswell 1999).

In areas that are intensively burned during a fire, complete streamside removal of vegetation can occur (Kershner et al. 2003). The reduction or removal of the overhead canopy in riparian areas is frequently associated with increased stream temperatures (Gresswell 1999). Subsequently, water temperatures decrease as streamside vegetation and the overhead canopy reestablish. In addition, increases in solar exposures to a stream can cause increased algal productivity, which in turn may result in changes to the aquatic invertebrate community.

Fires can result in LWD accumulating in streams (Minshall et al. 1997). LWD contributes greatly to high quality aquatic environments and accompanying fish species

(Dollof 1994; Keller et al. 1985; Minshall and Brock 1991). Large wood in streams has a major impact on many biological processes in streams, such as substrate type, water depth, water velocity, primary production, and macroinvertebrate biomass (Dolloff and Warren 2003). LWD has been documented as an important habitat feature for bull trout at the local habitat scale (Muhlfeld et al. 2003; Rich et al. 2003).

Sediment Sources

As a result of the Snow Talon fire of 2003, erosion and water yield have increased, resulting in increased sedimentation rates.

The short-term effects of the 2003 Snow Talon fire will likely include increases in sediment and water yield. Surface erosion processes including raindrop and rill erosion and dry ravel during wetting-drying and freezing-thawing cycles may transport large volumes of sediment and organic debris from the slopes to the stream channels (Swanston 1991). Fire also increases the potential for debris flow for up to five years after the event due to the decay of anchoring and reinforcing root systems (Swanston 1991). Watershed effects induced by the fire also include an increased sensitivity to further soil disturbance (McIver and Starr 2000). Regional sediment yield models suggest sediment yield from disturbance events begin to return to natural levels following the first year after the disturbance event and attain baseline levels beyond the sixth year (Cline et al. 1981).

The response of aquatic ecosystems during and after a fire can be highly variable depending on a variety of factors including fire severity and weather conditions. Rieman and others (1997) documented increased surface erosion and large pulses of sediment entering streams after large fires on the Boise NF, Idaho. In many cases, pools were virtually filled with new material. In areas that are severely burned, runoff and erosion rates can increase by several orders of magnitude (Kershner et al. 2003).

Therefore, high levels of sediment are expected in the Copper Creek and Landers Fork drainages as a result of the Snow Talon fire. This will occur regardless of the alternative that is chosen, including the no action alternative.

The Hydrology section of this report discusses the projected levels of fine sediment that are expected to enter Copper Creek and the Landers Fork under the different alternatives. This analysis indicates that total sediment entering Copper Creek will be lower under the action alternatives than under the no action alternative. The total sediment entering the Landers Fork is anticipated to be the same under all alternatives.

The action alternatives result in less sediment entering Copper Creek because of the reclamation of the jammer trails. This reclamation will not occur under the no action alternative. Therefore, the net effect of the action alternative is to reduce sediment in Copper Creek. There will be no effect from the action alternatives on the Landers Fork.

Flow

The Hydrology section of this report evaluated the effects of the proposed project on stream flow. This analysis concluded that streamflows will increase as a result of the fire, but the proposed timber sale will not result in a measurable increase in flow.

Channel Stability

Several authors have noted decreased in-stream channel stability following wildfires. Rieman et al. (1997) found that post-fire stream channels were highly dynamic. Some instream habitats were lost or altered by the loss of old wood and filling of pools with sediment, while other instream habitats were created by the formation of new pool, channels, and undercut banks. Debris flows scoured some small high gradient channels, reducing channel complexity, but also added a substantial volume of coarse materials to channels downstream. Minshall et al. (1997) noted substantial alteration of stream channels and major restructuring and movement of LWD occurred in fire impacted sites, as compared to reference streams. Stream channels in the area of the Hayman fire in Colorado were deeply incised by runoff events caused by relatively small rainstorms in the months following the fire (Kershner et al. 2003).

It is expected that stream channels in the project area will be destabilized as a result of the Snow Talon fire under all alternatives. The proposed project will only be removing burned trees from outside the RHCA. Therefore, the proposed project will not further impact stream channel stability.

Instream LWD

Large wildfires can substantially alter the amount and quality of wood in streams over a long period of time after the fire. Depending on the severity of the fire, the wood that is already present in the streams during the fire may or may not be burned (Nakamura and Swanson 2003; Rieman et al. 1997). Riparian trees may be killed outright by the fire, or may later succumb to insect outbreaks or disease (Benda et al. 2003). After the fire, dead trees topple over after one or two decades as their root systems decay (Benda et al. 2003). In addition, mass wasting may bring large amounts of wood to the stream in localized areas (Benda et al. 2003). During this period, new growth in the riparian zone will contribute little large wood to the stream. As the new growth matures, additional wood of increasing mass and diameter will begin to accumulate in streams (Nakamura and Swanson 2003). This process can take approximately 300 years in some ecosystems, depending on the site specific conditions such as the growth rate of trees and the fire recurrence interval (Benda et al. 2003; Nakamura and Swanson 2003).

Therefore, burned areas of Copper Creek and the Landers Fork will likely have an increased amount of LWD entering the stream for several decades after the fire. After that time, there may be a period when LWD recruitment will decline because the riparian zone contains few mature trees. This is the case for all of the alternatives.

The action alternatives are not expected to have an impact on LWD in the streams, in either the short or long terms. All action alternatives include provisions that will exclude timber harvest from the RHCAs. The proportion of wood that enters a channel declines with increasing distance from the channel edge (Benda et al. 2003). Murphy and Koski (1989) investigated the distance the source of LWD is from stream channels. They found that almost all (99%) identified sources of LWD found in stream channels were within 30 m of the stream bank. The Forest Ecosystem Management Assessment Team (1993) concluded that the probability of wood entering the active stream channel from greater than one tree height is generally low.

The RHCAs for this project were set based on the criteria in INFISH. For fish bearing streams, the buffer width has been set at 300 feet except in areas where the 100-year floodplain was wider than 300 feet. In these areas, the buffer width was increased to the width of the 100-year floodplain. In all cases, the buffer width is wider than one tree height, thereby protecting the future recruitment of LWD.

Water Quality

Wildfires are known to affect water quality in streams, particularly temperature and nitrate-nitrogen (Minshall et al. 1997). This effect is expected under all alternatives.

In addition, weed treatments will occur under all alternatives. An analysis was conducted of the expected concentration of herbicide reaching streams as a result of weed management. The results are displayed in Table 13. Expected concentrations range from 0.019 ppm for the no action alternative to 0.024 ppm for Alternative 4. All of these concentrations are below the threshold identified in the Helena NF Draft Weed EIS of 0.075 ppm.

Table 13. Expected concentration of herbicide reaching streams as a result of weed management.

	No Action	Alternative 2	Alternative 3	Alternative 4
INFILTRATION DOMINATED (acres)	640	688	671	766
Total herbicide (lb)	160	172	167.75	191.5
Maximum yield of herbicide (lb)	1.60	1.72	1.68	1.915
Minimum dilution capacity (lb of water)	86,303,232	86,303,232	86,303,232	86,303,232
Maximum concentration of herbicide (ppm)	0.0185	0.0199	0.0194	0.0222
OVERLAND FLOW (acres)	–	9	9	9
Herbicide (lb)	–	2.25	2.25	2.25
Maximum yield of herbicide (lb)	–	0.045	0.045	0.045
Minimum dilution capacity (lb of water)	–	21,575,808	21,575,808	21,575,808
Maximum concentration of herbicide (ppm)	–	0.002	0.002	0.002
Total maximum concentration of herbicide for infiltration dominated and overland flow (ppm)	0.019	0.022	0.022	0.024

Effects Common to All Action Alternatives—Fisheries Habitat

Compliance with INFISH

Timber Management Guideline TM-1 listed in INFISH (USDA 1995b) prohibits timber harvest, including fuelwood cutting, in RHCA, except as described below.

Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in RHCAs only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other riparian management objectives (RMOs), and where adverse effects can be avoided to inland native fish. For priority watersheds, complete watershed analysis prior to salvage cutting in RHCAs.

Apply silvicultural practices for RHCAs to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard attainment of RMOs and that avoids adverse effects on inland native fish.

None of the action alternatives consist of salvage logging within the RHCAs. Therefore, it is believed that salvage logging will be consistent with INFISH Timber Management Guideline TM-1.

Roads Management guideline RF-2 listed in INFISH (USDA 1995a) states: For each existing or planned road, meet the RMOs and avoid adverse effects to inland native fish by:

- Completing watershed analyses prior to construction of new roads or landings in RHCAs within priority watersheds
- Minimizing road and landing locations in RHCAs
- Initiating development and implementation of a Road Management Plan or a Transportation Management Plan.

Alternative 2 or its alternatives do not include temporary road construction in RHCAs. All landings will be outside of RHCAs. Therefore, the proposed road construction is believed to meet the RMOs described in INFISH.

Salvage Logging

Under most circumstances, both timber and fish can be managed in the same watershed as long as measures are taken to protect water quality and fish habitat (Chamberlin et al. 1991). However, poorly designed timber harvest activities can lead to increased sedimentation and embeddedness in streams within managed watersheds (Eaglin and Hubert 1993). In addition, timber harvesting within the riparian zone can alter fish habitat by increasing stream temperatures, reducing the amount of LWD, and altering soil conditions (Belt, Laughlin, and Merrill 1992). However, no riparian harvest is proposed in this project.

No research has been published to date on the impact of post-fire salvage logging on fisheries, although some research is currently being conducted (Rieman, Intermountain Research Station, personal communication, February 2004). The principal aquatic consequences of timber felling and yarding, in general, are changed rates of sediment and nutrient delivery, and altered levels of temperature and dissolved oxygen (Meehan 1991). Expected changes to these habitat variables are described in the sections above. The

effects of the fire are expected to far exceed the effects of salvage logging. In fact, the action alternatives are expected to reduce sediment as a result of the reclamation of the jammer trails. No additional impacts to aquatic habitat from the logging are anticipated.

Cumulative Effects

As the action alternatives are not expected to have an impact on fisheries resources, no cumulative effects of the project are anticipated.

Mitigation Measures Included under All Action Alternatives for Fisheries Habitat

The following mitigation measures apply to the Snow Talon fire salvage project.

Fisheries biologists would approve mitigation measures before implementation and ensure compliance with the BA (USDA and U.S. Department of Interior [USDI] 2001).

No timber harvest will occur within any RHCA. If the location of a stream channel should change, the location of the adjoining RHCA will change as well.

Projects that may affect the natural or existing shape of any stream or its banks or tributaries would require a Stream Protection Act 124 permit. All special conditions in that permit would be followed.

Cumulative Effects

As the action alternatives are not expected to have an impact on fisheries resources, no cumulative effects of the project are anticipated.

Affected Environment—Fish Populations

Landers Fork

The Landers Fork supports predominately native fish species, including westslope cutthroat trout, bull trout, mountain whitefish, and sculpins. Occasional non-native fish, brook trout and brown trout, have been caught in the lower reaches of the Landers Fork (Pierce, Peters, and Swanberg 1997). Tailed frogs (*Ascaphus truei*) have been observed in the Landers Fork, approximately 0.5 miles upstream of Falls Creek (Walsh 2003).

Cutthroat trout are the most abundant species in the upper Landers Fork, with bull trout the most abundant species directly downstream from the Copper Creek confluence (Pierce 2003). A bull trout telemetry study found the lower reach of Landers Fork to be a critical migration corridor between the Blackfoot River and Copper Creek. This study also found the timing of migration is critical because the Landers Fork seasonally dewaters. Fish density estimates, from 1996, are depicted in Table 14.

No bull trout redds have been found in surveys that were conducted every other year in the drainage downstream from Silver King Falls from 1991 to 1996; however, in 1986, three bull trout redds were found just upstream from the Highway 200 bridge (Burns 2003).

The Landers Fork provides an important migration corridor for upper Blackfoot River fluvial bull trout during mid to late summer and mid to late fall. A section of this migratory corridor went dry in the fall of 1996, stranding an out-migrant adult bull trout, as well as a number of juvenile bull trout and sculpin. These fish froze in a riffle area just

Table 14. Estimated density of fish in the Landers Fork estimated by daytime snorkeling.

Species	Number per 100 m^2	Comment
Westslope cutthroat	0.349–0.978	Juveniles <8 inches made up the greatest % of the total
Mountain whitefish	0.152–0.427	Juveniles made up the least % of the total
Bull trout above Copper Creek confluence	0.000–0.046	>8 inches most common
Bull trout below Copper Creek confluence	0.072	>8 inches most common
Brook trout just above Blackfoot River confluence	0.031	Mostly juveniles
Mottled sculpin	0.014–0.29	Underestimated
Information from Hillman and Chapman (1996)		

upstream of the dewatered area. The lack of water in the Landers Fork during the critical migration period makes it important that land-use activities not alter the timing and amount of discharge in this stream (Swanberg and Burns 1997).

Hillman and Chapman (1996) found daytime bull trout densities in the Landers Fork above the Copper Creek confluence to range from 0.0 to 0.046 per 100 square meters.

Daytime snorkel estimates for bull trout below the confluence of Copper Creek were estimated at 0.031 per 100 square meters. Less than 50% of the bull trout found in the Landers Fork were smaller than 8 inches. The researchers speculated that the small bull trout found in the Landers Fork were out-migrating juvenile bull trout. Three large bull trout (19–25 inches) were found in the Landers Fork in 1997. These may have been fluvial fish migrating to Copper Creek to spawn (Hillman and Chapman 1996). However, the presence of both juvenile and adult (>8 inches) bull trout in the Landers Fork upstream of the confluence with Copper Creek indicates that the Landers Fork is used for juvenile bull trout rearing and possibly supports a resident population in addition to being used as a migratory corridor.

Copper Creek

In order of abundance, Copper Creek supports westslope cutthroat trout, bull trout, and sculpin and whitefish in the lower reaches. No non-native species have been found in the Copper Creek drainage. Bull trout from Copper Creek have been analyzed and found to be genetically pure. However, there are no physical barriers to upstream movement of brook trout from the lower Landers Fork. A sample of cutthroat trout taken in Copper Creek found no introgression with rainbow trout or Yellowstone cutthroat trout (Pierce and Podner 2000).

Copper Creek is the only tributary in the upper Blackfoot River that receives more than incidental spawning use by bull trout. A telemetry study that took place from 1996 to 1998 detailed the use of Copper Creek as a tributary used for spawning by fluvial bull trout. Fish density estimates from daytime and nighttime snorkel surveys made in 1996 and presented in Hillman and Chapman (1996) are depicted in Table 15.

Table 15. Density of fish in Copper Creek estimated by snorkeling.

Species	Number per 100 m^2 (day sampling)	Number per 100 m^2 (night sampling)	Comment
Westslope cutthroat	0.724 to 1.359	0.589 to 3.102	Mostly juveniles
Mountain whitefish	0.205 to 0.365	NA	Mostly adults
Bull trout	0.202 to 1.277	0.184 to 3.466	Mostly juveniles
Mottled sculpin	NA	0.080 to 0.456	Underestimated

Source: Hillman and Chapman 1996
NA = not available

Many juvenile bull trout use Copper Creek for rearing. Both large adults (over 19 inches) and small adults (7–11 inches) were found in Copper Creek, potentially indicating the presence of both a fluvial and a resident population (Hillman and Chapman 1996).

From 1984 to 1993, annual bull trout redd surveys were conducted in Copper Creek from the confluence with the Landers Fork to Copper Creek Campground. No surveys were conducted in the heavy fire year of 1988. Because no redds were observed in the lower reach of Copper Creek, the survey was shortened to exclude the 1.5 miles directly above the confluence with the Landers Fork in the surveys completed from 1993 to 1996 and again in 1998, 1999, 2001, and 2002. With no redds historically found downstream from the "Copper Canyon" located in Section 26, the redd count was shortened to just downstream from the mouth of the canyon in 2000.

In 1996, bull trout were also found to be in the reach extending from Section 4 NW upstream to an intermittent area in Section 1. Redd counts have been conducted in this reach since 1996. In 1998, a 4.5-foot-tall debris jam formed in Copper Creek in the spring. In 2002, the barrier collapsed to approximately 3.0 feet in height (Burns 2003).

In 2003 the Snow Talon fire burned throughout the majority of the Copper Creek drainage. The 2003 redd survey included the entire drainage from the headwaters culvert located in T15N R9W S10 to the confluence with Lander's Fork. The majority of the bull trout redds were located in areas that where the fire had burned at a lower intensity. Four bull trout redds were found in the index site during 2003, while 14 were observed in the upper reach. All redd count survey data from 1984 to 2003 are shown in Figure 2. Although fluctuations in redd counts occur from year to year, no discernable trend is apparent, with the exception that the 2003 count is substantially lower than any previous count.

MDFWP is currently working on a radio telemetry study of bull trout in the upper Blackfoot River drainage. This study is ongoing and a final report is not available as of the time of this assessment. However, preliminary results are finding that bull trout move upstream in the Blackfoot River from as far away as the confluence with Nevada Creek and enter Copper Creek. Several bull trout over-wintered in Copper Creek in the winter of 2002–2003. These results may indicate that Copper Creek is an even more important tributary stream to the overall Blackfoot River bull trout population than was previously thought (Pierce 2003).

Flow intermittency and lack of connectivity to the mainstem Blackfoot River are suspected to be the major limiting factors for bull trout in the upper Blackfoot River drainage (Pierce 2003).

Project activities take place in the vicinity of two tributaries of Copper Creek. Cotter Creek supports sculpin, and Snowbank Creek supports westslope cutthroat trout.

Snowbank Lake

Snowbank Lake is stocked by MDFWP with legal, catchable-sized cutthroat trout. Piping around the outlet culvert was discovered at the time a screen was installed over the outlet pipe to prevent fish from escaping. The outlet was grouted; however, the piping is reoccurring and more grouting is needed (Burns 2003).

Headwaters of Copper Creek

The headwaters reach of Copper Creek supports westslope cutthroat trout, sculpin, and a bull trout was observed at the confluence of Cotter Creek. In 2002, an abundance survey was conducted downstream from the culvert crossing on Road #330 (T15N R9W Sections 3, 10). Cutthroat trout, sculpin, and tailed frogs were present. Cutthroat trout >6.0 inches were estimated at 20 per 1,000 feet and cutthroat <6.0 inches in length were estimated at 56 per 1,000 feet (Helena NF unpublished file data).

North Fork Copper Creek

The main channel of the North Fork is dry from the confluence of Copper Creek upstream for approximately 0.5 miles. Where the stream does have flow, westslope cutthroat trout are present. The abundance of cutthroat in 2002 was estimated to be 31 per 1,000 feet (fish <6 inches) and two per 1,000 feet (fish >6 inches) (Helena NF unpublished file data).

Unnamed Tributary of Copper Creek

The unnamed stream located in T15N R9W, Sections 2 and 3, contains westslope cutthroat trout at the lowest reaches. An abundance survey in 2002 found cutthroat <6 inches, 22 per 1,000 feet and cutthroat, >6 inches, two per 1,000 feet (Helena NF unpublished file data). Fine sediment in spawning gravels measured 38% in the unnamed tributary to Copper Creek (Helena NF unpublished file data).

Cotter Creek

An abundance survey was attempted in Cotter Creek in 2002 from the Road #330 culvert to approximately 500 feet upstream, and no fish were observed. The culvert was a vertical barrier during low summer flows; however, this culvert was removed post-fire. Two cutthroat trout <6 inches were observed below the Road #330 crossing prior to the fire. There is very little available streamflow or fish habitat above the culvert (Helena NF unpublished file data). Sculpin have been found in Cotter Creek.

Snowbank Creek

Snowbank Creek supports westslope cutthroat trout.

Red Creek

Cutthroat trout are present in downstream portions of Red Creek. An abundance survey in 2002 found 20 per 1,000 feet (cutthroat <6 inches) and 6 per 1,000 feet (cutthroat >6 inches). Two 10-foot waterfalls create an impassible upstream fish passage barrier (UTM 0372081/5216056). Above the waterfalls there is a steep stream gradient. No fish are present above the waterfalls and gradient change (Helena NF unpublished file data).

Fine sediment in spawning gravels measured 32% in Red Creek (Helena NF unpublished file data).

Environmental Consequences—Fish Populations

Effects Common to All Alternatives—Fish Populations

Effects of Fire

During and directly after a fire, direct mortality to salmonids may occur resulting from elevated water temperatures and abrupt alternations of water chemistry (Minshall et al. 1997). Additional mortality can occur following the first precipitation event due to debris flows (Kershner et al 2003). Increased erosion, debris torrents, and other physical processes may negatively impact fish habitat, therefore reducing the stream carrying capacity for salmonids (Rieman et al. 1997). In addition, salmonid abundance may decrease at the local scale resulting from both mortality and immigration to adjacent stream reaches where water quality conditions are more suitable (Rieman et al. 1997). Local populations of fish may be extirpated (Rieman et al. 1997), but usually show a positive response during the initial 5-year period post wildfire when populations exhibit good connectivity with key refuges throughout the watershed (Gresswell 1999).

Although the effects of fire may be catastrophic in the short term, Rieman et al. (1997) found dramatic recovery of redband trout (*Oncorhynchus mykiss*) and bull trout after a large intense fire reduced salmonid abundance and occurrence in the Boise NF, Idaho. Rieman et al. (1997) identified two important mechanisms that were important in the quick reestablishment of native salmonids: (1) refounding from local or internal refuges; and (2) refounding through complex life histories and overlapping generations. Fish will generally immigrate into fire-affected habitats within the first 5 years after a fire, as long as barriers do not limit movement (Kershner et al. 2003).

Overall fish populations within Copper Creek and Landers have and will likely continue to undergo drastic changes within the next few years resulting from the Snow Talon fire of 2003. The speed at which the fish populations reestablish is likely contingent on how watershed level processes reshape fish habitat. In addition, the number and proximity of refuge areas where fish continued to reside during and or after the fire will be an important factor for the time scale that fish populations can reestablish within the drainages.

Effects Common to All Action Alternatives

Salvage Logging

As described under Fisheries Habitat, one of the most widely reported effects of logging is an increase in sediment. Suspended sediment can affect adult bull and westslope cutthroat trout by changing behavior, reducing available habitat, increasing stress, and reducing food supply. Salmonid fishes would avoid areas with turbid water. In streams where turbidity is elevated over a long distance or for a long period of time, this can result in reaches of stream devoid of fish (Waters 1995). In addition, high levels of suspended sediment can result in the loss of visual capability, leading to reduced feeding and depressed growth rate (Waters 1995).

Direct mortality of fish from suspended sediment has been documented, but generally only at either very high levels of suspended sediment or a long duration of increased suspended sediment. It seems likely that fish have evolved behavioral or physiological adaptations to temporary high concentrations of suspended sediment to survive short-term conditions caused by natural floods (Waters 1995).

The exact levels of suspended sediment at which sublethal effects occur are unknown. It is known that both the concentration of sediment and the duration of exposure affect the response of the fish (Newcombe and MacDonald 1991). For this reason, it is best to make every effort to reduce both the amount of suspended sediment produced and the duration of the sediment increase.

High levels of deposited sediment can deplete benthic invertebrates' populations, reducing the available food supply for fish (Waters 1995). Sediment can fill pools and blanket structural cover, reducing the available summer habitat for adult salmonid (Waters 1995).

Three specific effects of deposited sediment on salmonid reproduction have been recognized:

- Filling of interstitial spaces in the redd by depositing sediment, thus reducing or preventing further flow of water through the redd and the supply of oxygen to the embryos or sac fry
- Smothering of embryos and sac fry by high concentrations of suspended sediment particles that enter the redd
- Entrapment of emerging fry if an armor of consolidated sediments is deposited on the surface of the redd (Waters 1995).

As described above, the Hydrology section of this report states that all the action alternatives result in lower amounts of sediment entering Copper Creek than the no action alternative. Landers Fork will receive the same levels of sediment under all alternatives. Therefore, no impacts to fish populations as a result of the action alternatives are anticipated.

Logging can have a wide array of other impacts to fish populations when the logging occurs within the RHCA. No logging within the RHCA is proposed for any of the action alternatives. Therefore, no riparian impacts are anticipated.

Mitigation Measures Included under All Alternatives for Fish Populations

Mitigation measures for fish populations are the same as those applied to fish habitat, please see previous discussion.

Cumulative Effects

As the action alternatives are not expected to have an impact on fisheries resources, no cumulative effects of the project are anticipated.

Conclusions

Under the no action alternative, current management plans would continue to guide management of the project area. No salvage, BMP upgrades, or jammer trail area rehabilitation would be implemented to accomplish project goals. The amount and

duration of sediment entering creeks would remain unchanged from that expected with natural vegetative recovery of burned areas.

Action alternatives would likely have decreased short-term sediment loads resulting from jammer trail reclamation. Water quality would remain unchanged under all alternatives.

Wildlife

The proposed project would occur within the burned portion of the Copper Creek drainage on FS-managed public lands. Pre- and post-fire wildlife habitat conditions within the Copper Creek watershed have been described in the BAER report (USDA 2003a). The proposed project would only directly affect a relatively small proportion of the fire area within Copper Creek.

The Copper Creek drainage provides habitat for ungulates, carnivores, and most of the avian, small mammal, and amphibian species known to occur on the forest. Examples include: year-round range for mule deer, white-tailed deer, elk, grizzly bear, lynx, and wolverine. A wide variety of forest cover types and successional stages including ponderosa pine and Douglas-fir; lodgepole pine; spruce/subalpine fir; and whitebark pine occur within the drainage. The Snow Talon fire caused significant habitat changes in the upper half of the Copper Creek drainage. The existing condition of the burned area is that of a “beginning” forest. Assuming no reburn occurs within the next 100 years, most of the land that was a live forest before the fire can be expected to produce another forest.

However, not all acres are equal in their potential to receive, germinate, and grow tree, shrub, grass, and forb seeds, so variations in the continuity, coverage, and species composition of the next generation of forests should be expected. Similarly, many factors (e.g., disease, predation, weather-related mortality, human influences) affect which, when, and how wildlife species reoccupy and persist in a regenerating post-fire landscape. Salvage logging, tree planting, and jammer trail rehabilitation can be expected to affect wildlife recolonization, habitat use, and persistence in various ways. How much and with what level of severity the burned area is managed could influence which and when wildlife species would be successful at repopulating and persisting in the area. Wildlife species that used habitat within the fire area are expected to return when conditions are favorable and their habitat needs can be met again.

Criteria used for determining which species not to carry forward into the analysis phase included: (1) no habitat exists for the species, (2) it is unlikely (based on known habitat requirements) that the species existed in the area, and (3) potentially suitable habitat for the species within the project area would not be affected by the project. Excluded species and the rationale for their exclusion are shown in

Table 16.

The *Forest Plan* lists the following as wildlife MIS: all TES species, river and lake suitability species, habitat effectiveness species, old growth habitat species, mature conifer forest species, competition from domestic stock species and hunted species. This wildlife report contains a section titled “Management Indicator Species,” and each species occurring within the project area, or for which habitat exists in the project area, is addressed.

Suitable habitat for mature conifer and old growth-associated wildlife species currently occurs in or adjacent to proposed salvage sites in Alternative 4. Because old growth was

Table 16. Species and rationale for exclusion in the effects analysis.

Excluded Species	Rationale for Exclusion
Fisher	Burned forests are unsuitable habitat for fisher; therefore each of the alternatives in this project would have "No Impact" on fisher or their habitat.
Northern goshawk	Burned forests are unsuitable habitat for goshawk; therefore each of the alternatives in this project would have "No Impact" on northern goshawks or their habitat.
Harlequin duck	No suitable habitat occurred within the proposed salvage area; therefore, each of the alternatives in this project would have "No Impact" on harlequin ducks or their habitat.
Northern leopard frog	No suitable habitat occurred within the proposed salvage area; therefore, each of the alternatives in this project would have "No Impact" on leopard frogs or their habitat.
Flammulated owl	All proposed salvaging would occur in unsuitable habitat; therefore each of the alternatives in this project would have "No Impact" on flammulated owls or their habitat.
Townsend's Big Eared Bat	No suitable habitat occurred within the proposed salvage area; therefore, each of the alternatives in this project would have "No Impact" on Townsend's big-eared bats or their habitat.
Northern bog lemming	No suitable habitat occurred within the proposed salvage area; therefore, each of the alternatives in this project would have "No Impact" on bog lemmings or their habitat.
Columbian Sharp-tailed Grouse	No suitable habitat occurred within the proposed salvage area, therefore, each of the alternatives in this project would have on "No Impact" Columbian sharp-tailed grouse or their habitat.
Peregrine falcon	No nesting habitat in or adjacent to the burned area; therefore, each of the alternatives in this project would have "No Impact" on peregrine falcon or its habitat.
Competition with Livestock MIS Group (*Bighorn sheep*)	No suitable habitat occurred within the proposed salvage area; therefore, each of the alternatives in this project would have "No Impact" on Bighorn sheep or their habitat.

identified as an issue during public scoping, old growth MIS species are discussed in the MIS section below. The snag and downed wood portion of this analysis provides a discussion on the effects of the proposed salvaging on wildlife that depend on or use snags and downed logs as habitat.

Affected Environment—Snags and Downed Wood Habitat

Nation Forest system lands within the Snow Talon fire area were considered for the evaluation of direct and indirect effects on snags and downed woody material habitat. This 34,362 acres is large enough to include the home range of numerous wildlife species using snag and downed woody material habitats. All actions proposed are contained within this area. The remaining Snow Talon fire area was added to the above for

consideration of cumulative effects. Data used in this analysis included pre- and post-fire aerial photography, stand exams, field surveys, fire severities and road locations. This analysis covered standing and downed dead wood resource in terrestrial areas. See also sections “Old Growth MIS” and “Black-backed Woodpeckers” in this chapter.

Snags, broken-topped live trees, downed logs, and other woody material are required by a wide variety of species for nesting, denning, roosting, perching, feeding, and cover. Dead trees have many ecological roles in a landscape recovering from wildfire (Beschta et al. 1995). The number, species, size, and distribution of available snags strongly affect snag-dependent wildlife. Too few suitable snags may limit or eliminate populations of cavity-using species (Thomas 1979). Snags with old nesting cavities, broken tops, and decay are most likely to be used. Large diameter snags are considered an especially important component of a burned landscape. Large snags (especially western larch and ponderosa pine) remain standing longer, increasing the chance that suitable decay conditions will develop for cavity-using species. Although smaller creatures can use many sizes of dead trees, larger birds and mammals require larger snags. The pileated woodpecker builds cavities that are then used for years by many other species, but it has very low nestling survival in any snag or tree smaller than 20-inch diameter [at] breast height (DBH). The various species of cavity nesters all appear to use different microhabitats. Any one stand would not be expected to provide habitat for all cavity-using species. Vegetation and snag conditions are naturally diverse across a forested landscape, including the fire area. Maintaining this diversity would provide a wide variety of habitat conditions for bird and mammal use.

Scattered live islands of mature overstory stands within the fire’s perimeter were not burned. Current snags and numerous replacement, or future snags occur within these stands. However, little of the area can be expected to have significant numbers of large diameter snags because of the stand and habitat types. Other unburned areas include pole-sized stands, seedling/sapling stands without a significant overstory, or other nonforested areas such as shrubfields, rock, and wetlands. Such areas often make little contribution towards snag habitat. Several previously harvested clearcut, seedtree, or shelterwood units were left unburned, or burned at low intensity levels. These stands will serve as future mature trees, snags and eventually downed wood habitat, although these stands may potentially be lost because of beetle outbreaks within a few years post fire.

Downed trees and other woody material are also critically important for many species. For instance, marten often den and forage in the under-snow cavities that occur under downed logs. Canada lynx dens found in the Seeley-Swan area are associated with abundant woody debris, usually large diameter logs. Several amphibians and reptiles make use of LWD for shelter and breeding sites (Bull, Parks, and Torgersen 1997). Many ant species that need large-diameter downed logs prey on defoliating insects such as western spruce budworm (Torgersen and Bull 1995). Longer and larger-diameter downed trees are generally most important because they provide stable and persistent structures as well as better protection from weather extremes. A variety of sizes and decay classes are needed in downed wood in order to conserve functional processes that foster sustainable forest ecosystems. Dead wood habitat management in post-fire situations differs from that of live forests in several ways. Often, few or no live trees exist to replace snags that fall over time. Snags in such stands would not become available again until a new forest develops that has trees that are large enough and with sufficient decay. Some species,

such as black-backed woodpeckers appear to respond positively to the high densities of snags in burned forests and may depend on them. Hutto (1995) found that 15 species of birds were more frequently found in post-fire habitats than in any other major cover type in the northern Rockies.

Whitebark pine was historically a major species in most stands at the upper elevations in the Copper Creek drainage, but mountain pine beetles and introduced blister rust have killed many of the whitebark pine trees. During the winter of 1988–1989, a large-scale frost kill killed thousands of acres of overstory timber. The overall pre-fire availability of snag habitat was high, after the fire, snag availability is now extremely high. On lands administered by the Helena NF, the fire burned approximately 11% of the area at low intensity, 29% at moderate-intensity and 60% at high-intensity. Several pre-fire harvest units also burned, killing the trees that had been left for seed trees or shelter. The fire area is currently open to firewood cutting and will remain open throughout implementation.

Across the Helena NF within the last 4 years, large acreages of snags have been created by wildfires such as the Cave Gulch, Maudlow-Toston, High Ore Snow Talon, and Moose-Wasson fires. During the winter of 1988–1989 within the project area, extensive acreages of trees were frost killed. This frost kill resulted in an extremely high level of available snags within the area. Many of these snags are still standing post-fire. Insect and disease outbreaks have also occurred within the last few years across the entire Helena NF. Resulting from large amounts of pre-fire insect and frost-killed trees within the project area, many areas burned by the Snow Talon fire still currently provide adequate downed wood habitat in different stages of decay. Species like the marten, which appear to depend on living forests that are rich in large downed wood (Ruggiero et al. 1994) should have large amounts of high-quality habitat in the future as regenerating stands begin to mature. Within the Snow Talon fire area, considerable acreages of dead trees occur in areas outside of the timber base and will provide well-distributed habitat. The 3,342 acres of snag and downed wood habitat on state and private lands within the Snow Talon fire area should have a higher percentage salvaged than the 34,362 acres on NF land. The 1,800-acre Moose-Wasson fire, 20 miles west of the Snow Talon fire, will not be salvage harvested.

Environmental Consequences—Snags and Downed Wood Habitat

Chapter 1 identified snags and down wood habitat as an analysis issue. The following effects indicators were used to focus the analysis and disclose relevant environmental effects:

- Acres of timber salvage in snag and downed wood habitat areas.
- Vulnerability to loss of snag habitat on NF system lands because of firewood cutting.

Effects Common to All Action Alternatives

In all action alternatives, all live trees and designated snags would be left standing wherever possible, following snag retention guidelines. This would exclude hazard trees and areas such as landings, skid trails, and skyline corridors. If live trees, nonmerchantable trees, or specified snags require felling for logging access or safety, they would be left onsite except on landings. No snags or logs would be salvaged from

the RHCAs in any alternative. Within salvage units, large-diameter downed wood habitat would come from: dead trees left in groups or as individuals, live trees, nonmerchantable material, and downed material that existed before the fire. Trees felled during the logging operation but not removed from the site would be left as intact as possible. Bark beetle infestations would be expected to increase over the next few years. As in Alternative 1, most mammal and bird species that use snags and coarse woody debris for denning, feeding, and dispersal would increase over time as vegetation recovers.

The *Northern Region Snag Management Protocol* (USDA 2000b) would be implemented under all alternatives. Snags would be left in bunches within and adjacent to units. All snags not harvested and all sub-merchantable snags would be left within units as well, except for snags fallen for safety purposes. Meeting the protocol would exceed *Forest Plan* standards for snag retention (average of two snags per acre within each third-order drainage).

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. These areas burned high-intensity. All live or dead trees would be cleared from the temporary road and nearby hazard trees would be felled. The only other temporary road segments would be short "jump up" spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet.

Two temporary bridges would be needed to access harvest units and rehabilitation activities. These bridges would be removed after implementation. Placement and removal of these bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits for a multitude of resources.

Jammer trail rehabilitation should have insignificant effects. Snags and down wood habitat quality is low along the existing trails. The 110 acres of rehab work would put the old trails back to contour. The long-term effect of restoring the area would be a beneficial effect.

Tree planting would meet the restocking requirements of NFMA. Natural regeneration as well as hand planting will be used to meet the standards. Acres of hand planting within salvaged units will be determined within a few years. Regeneration would be completed over most of the burned area by using available seed sources and planting where seed sources are not available. Considerations of whether to plant a site will include: its productivity, available access, aspect (north, south, etc.), potential shrub competition, and available funds. Monitoring the success of planted and naturally regenerating trees will determine future planting proposals. In areas where heavy snag overstories are removed and little seed source is available, planting will likely be proposed for 2005 and 2006. On most sites, regeneration would be accomplished through a combination of natural regeneration and hand planting. Quicker regeneration from hand planting combined with high levels of downed dead material would make these areas suitable for overhead cover dependent species such as marten much faster than under the no action alternative.

Direct and Indirect Effects of Alternative 1

The effects of the no action alternative would vary over time. In the short term, this alternative would favor species associated with recent burns and the resulting large numbers of snags and woody debris. Black-backed, three-toed, and hairy woodpeckers

would find an abundance of habitat and would excavate cavities for many secondary cavity nesters. As snag attrition occurs and vegetation succession proceeds, the abundance of bird species associated with the recent burn would decline. Mammals and birds that use coarse woody debris for denning, feeding, and dispersal would increase, especially as vegetation recovers. As the new forests mature and age, the remaining large snags and downed logs would make the fire area suitable for pileated woodpeckers, brown creepers, northern flying squirrels, southern red-backed voles, and many of the other species identified as old growth associates (Warren 1998).

The downed wood habitat areas are expected to have large amounts of persistent, large downed wood in 15–50 years. Some areas of riparian spruce bottoms along Copper Creek currently have extensive blowdown. Downed logs, shading from snags, and lack of seed sources may delay the regeneration of new trees in some stands.

In this alternative, no additional snags would be felled except where they pose a serious threat to human safety, such as along trails and near administrative sites. No additional downed logs would be removed. Spruce beetle and Douglas-fir beetle populations would be expected to increase, with many of the surviving Douglas-fir trees killed by beetles over the next few years. This would create more snags over a larger landscape. In most areas, the bulk of the fire-killed trees are expected to be down within 15–50 years. Larger, wind-throw resistant Douglas-fir snags may stand for over 50 years. By that time, some of the trees not injured by the fire would also have become snags.

Loss of snag habitat from firewood cutting should be minimal. During fire rehabilitation efforts, hazard trees within 1 tree length of all roads within the project area were removed. Available firewood snags are limited within the road buffer. Firewood cutting would be prohibited within 100 feet of any live stream, river, or lake. This should protect snags and downed wood along Copper Creek. Firewood cutters could potentially access standing or downed dead trees along the open roads within the fire area.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Helicopter logging would occur on 1,332 acres, requiring felling of additional snags and other hazard trees in and near units and up to 27 helicopter landings. In general, this would require felling of hazard trees within 1.5 tree lengths, with additional distance required for landings needing clearing for a flight path. Skyline logging would occur on 307 acres, requiring felling of all trees, live or dead within cable corridors, as well as the felling of nearby hazard trees. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units, supporting cavity-nesting birds such as the hairy woodpecker. Because of the treatment, black-backed woodpecker habitat would be expected to decline within these units, as described in the black-backed section.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Helicopter logging would not occur with the implementation of this alternative. Skyline logging would occur on 307 acres. This alternative would harvest fewer acres than any other alternative and would have the least direct effects on snags and downed wood. Dead and dying trees would be

removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units as in Alternative 2. Effects to cavity-nesting birds would be similar to Alternative 2, with fewer overall acres being treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Helicopter logging would occur on 2,323 acres. Skyline logging would occur on 307 acres. This alternative would harvest more acres than any other alternative and would have the greatest direct effects on snags and downed wood. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented. Effects to cavity-nesting birds would be similar to Alternatives 2 and 3, with more overall acres being treated.

The approximately 930 acres of harvest within IRAs would increase the acres treated and would further reduce acres available to serve as high-quality snag and down dead wood habitat. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees as a snag and down dead wood resource would be outweighed by the potential of retaining the remaining live trees within the stand.

Cumulative Effects Common to All Alternatives

Across the Helena NF, wildfires, insects, disease, and other natural processes have created innumerable snags and downed logs. Minimal salvaging has occurred within these areas. Large acreages of snag and downed wood habitat were created by wildfires such as the Cave Gulch, Maudlow-Toston, High Ore, and Moose-Wasson fires. During the winter of 1988–1989 within the project area, extensive acreages of trees were frost killed. This frost kill resulted in an extremely high level of available snags within the area. An extensive amount of dead trees still occur within these areas in wilderness, roadless and other areas not in the timber base. Proposed and ongoing salvage, and firewood cutting are expected to reduce snags within the fire area. Open roads provide access for firewood cutters. The chance of firewood collection is greatly reduced within the fire area because the hazard tree removal during rehab, but firewood cutting could still minimally reduce overall snag and downed wood within the fire area. The Copper Creek campground is expected to continue to operate, leaving snags and downed wood in short supply nearby. Approximately 4,500 acres of Wilderness burned by the Snow Talon fire, where timber salvage and firewood cutting is excluded. The 3,342 acres of snag and downed wood habitat on state and private lands within the Snow Talon fire area should have a higher percentage salvaged than the 34,362 acres on FS land. The 1,800-acre

Moose-Wasson fire, 20 miles west of the Snow Talon fire, would not be salvage harvested.

Other actions have and are expected to continue directly affecting snag habitat. Fire suppression efforts in 2003 for the Snow Talon fire affected snag and downed wood habitat through fireline construction, mop-up activities, etc. In addition, hazard tree felling along 14 miles of roads in 2003 amounted to approximately 3,000 tons of wood product removal. Fire suppression would continue within the area. Insects and diseases would continue, sometimes modifying stand conditions drastically. The potential of bark beetle-caused mortality in stands outside the burn perimeter may result in further actions in the future. State and private live-timber and salvage harvest in the surrounding area is expected to continue.

Some actions would have minor or negligible effects on snags and downed wood habitat. These include precommercial thinning, tree and shrub planting, Christmas tree harvesting and noxious weed treatment. Road maintenance and trail maintenance would cause some hazard trees to be felled and fallen trees to be cleared from travel ways. As the new post-fire forests mature and age, the remaining large snags and downed logs in salvage units and across the landscape would again make the fire area highly suitable for species identified as old growth associates.

Conclusions

The effect of the action alternatives on snag-dependent species at larger scales can be considered by comparing unsalvaged burns against the historic average, assuming that wildfires are the major process that recruits snags. At the Helena NF scale, *Forest Plan* standards provide direction for the management of old growth forests. Direction is to manage old growth to retain 5% of each third-order drainage as old growth. As old growth forests provide the best opportunities for snag recruitment, there is excellent potential for long-term recruitment of snag habitat for snag-dependent species, consistent with historic conditions at the Forest scale. At the Helena NF scale, fires within the last 4 years have occurred at a higher frequency than historic conditions. When we consider the substantial amount of burned forests at the Forest scale, and the small percentage reduction in snag habitat at the project scale (4–12%), we can conclude that at the Helena NF scale, snag habitat is being both recruited and retained (after natural events) at higher-than-normal levels. Consequently, we can assume that the Snow Talon fire salvage alternatives are consistent with sustaining the viability of snag-dependent species at the NF scale.

Affected Environment—Corridors and Linkages

A corridor is an area just used for travel, while a linkage zone is a broad area of seasonal habitat where animals can find the food, shelter and security they need to successfully move between larger habitat blocks (i.e., moving from the NCDE to the Yellowstone Ecosystem) (Servheen, Waller, and Sandstrom 2001). Large carnivores such as the grizzly bear would rarely move from one ecosystem to another by the way of a simple travel corridor; carnivores moving between ecosystems require habitats that support feeding and behavioral needs (Servheen, Waller, and Sandstrom 2001). Linkage zones will support low densities of carnivore populations seasonally as they move through the area (Servheen, Waller, and Sandstrom 2001). The potential for the project area to serve

as a linkage zone is low. The majority of the district serves as a source population and yearlong, occupied habitat for many species, including TES species such as grizzly bear, lynx and wolverine. This area is the occupied habitat, yearlong resident animals live here and radiate away from the area. The project area falls within the NCDE, this area is yearlong habitat. In general, any corridors and linkage zones for animals would not be located within the project area and the surrounding impacted areas; they would be riparian bottoms, ridges, etc., connecting the project area to other areas of quality habitat.

The FS National Carnivore Conservation Program has completed and posted broad scale lynx linkage areas on the FS Forest Carnivore website. As documented in a Deputy Regional Forester's letter (McAllister 2003), the Lynx/Wolverine Steering Committee reviewed and approved the lynx linkage maps in November 2003. These broad scale coarse maps are to be used as a beginning point for land management and consultation efforts (McAllister 2003). The Snow Talon fire salvage project area is not identified as a linkage zone. The project area made up pre-fire habitat for a resident population of lynx. The map identifies a linkage zone across the Blackfoot Valley, connecting known populations of lynx from the north side of Highway 200 to known populations on the south side of the highway. The linkage zone contains Highway 200, the town of Lincoln, the Blackfoot River and the open rangeland valley floor.

Lynx populations have been documented on each side of Highway 200 for years. Tracks have also been verified on each side of the highway within the linkage zone. Movement from north to south across Highway 200 has not been documented and the Seeley Lake lynx project did not document movement across the highway from their collared individuals. However, because of the proximity of the populations and the frequency of verified tracks occurring on the peripheries of the two populations, movement through the linkage zone across Highway 200 is probable.

Big game animals migrate elevationally in this area between summer and winter range, grizzlies are known to live permanently as well as travel through the area and wolves are known to use the area at various times of the year. MDFWP and Lincoln RD personnel have documented grizzly bear and lynx tracks and sightings since the 1970s. A project to trap and radio collar lynx on the Lincoln RD (part of a larger project started in the Seeley Lake area) found numerous tracks in the Copper Creek area during the winter of 2000–2001. Several lynx were trapped and radio collared in this area. These lynx were part of the research being conducted through the U.S. FS Research Station and the University of Montana. These verified sightings and animals make up a population of lynx in the project area. Because of the abundance of lynx in the surrounding area, it's likely that Copper Creek and the surrounding area serves as a source habitat, or a core area. Lynx can disperse from the project area to colonize new locations.

Environmental Consequences—Corridors and Linkages

Chapter 1 identified corridors, linkage zones and fragmentation as analysis issues. The following effects indicators were used to focus the analysis and disclose relevant environmental effects:

- Effects of removing dead and dying trees on corridors and overall forest fragmentation within the project area.

- How the removal of dead and dying trees would affect the linkage zone joining the project area to habitat south of Highway 200.

Corridor Analysis

In the case (*Marel Mt. Audubon Soc. Vs. Rice* 914 F.2d 179) five criteria (plants can propagate, genetic interchange can occur, populations can move in response to environmental changes and natural disasters, and individuals can colonize habitats from habitats from which populations have been locally extirpated) serve to evaluate land as a wildlife corridor (USDA 1997a). The "Connectivity Protocol" is based on the following steps:

- Assessing historic patterns in vegetation and relative connectivity.
- Assessing historic patterns in vegetation and relative connectivity including the impacts of human disturbance or physical barriers (highways, croplands, etc.).
- Compare historic and current patterns and relative connectivity. Consider measures to restore historic animal movement using the following steps: review each of the five corridor types as outlined below when raised as an issue in the forest and project planning process, consider the need for each type of corridor based on its ecological function as outlined below, recommend application of the concept where an ecological function served by a corridor type can be clearly documented with minimal negative consequences, and provide a consistent and well-documented justification for the application of the concept (USDA 1997a).

It is recognized that there is little or no empirical information available with regard to species use of the landscape as it relates to connectivity. Connectivity refers both to the abundance and spatial patterning of habitat and to the ability of members of a population to move from patch to patch of similar habitat (USDA 1997a). Table 17 shows the types of corridors identified in Region 1.

The overall objective on Helena NF lands is to improve corridor and linkage zones locally to the extent possible while providing for integrated accepted social and economic uses of NFs**.**

Table 17. Types of corridors identified in Region 1.

Type of Corridor	Number of Species	Spatial Scale	Function of Corridor
Biogeographic	Many and often unrelated taxa	Continental, Transcontinental	Evolution and Distribution
Season Migration (Cyclic)	Groups of related species, Single species	Continental, Transcontinental-Local and Elevational	Behavioral and physiological for ecological survival
Dispersal and Emigration	Population	Varies by species	Use unoccupied habitat, Maintain current habitat, Optimal fitness
Travel	Individual	Within a home range	Daily life history requirements
Invasive	Exotic and Alien species	All scales: Transcontinental site	Extend ranges of non-native species

Effects Common to all Alternatives

Four of the five types of corridors discussed in the Northern Region "Connectivity Protocols," season migration, dispersal and emigration, travel and invasive corridors are pertinent to the effects of this proposal. There is no evidence of this area playing a role as a biogeographic corridor.

Season Migration, Dispersal and Emigration, Travel Corridors—The project area is remote, has a low open-road density and currently has moderate levels of public activity. Activity is concentrated along Copper Creek Road #330; the main route is open to motorized vehicles throughout the year. Only two other roads are open to travel throughout the year within the FS portion of the drainage. Migrating, dispersing and traveling animals have abundant remote habitat within and adjacent to the project area. Roadless areas, effective road closures and rough terrain provide wide-ranging animals with substantial areas where they can move undisturbed from one place to another.

Invasive Corridors—With increased traffic occurring as a result of harvesting activity, weeds management and the area serving as an invasive corridor is an issue that would be resolved by an increased effort in weeds treatments. Full implementation of the Snow Talon BAER rehabilitation would involve weeds management to a level that should improve the area's existing condition.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. The only other temporary road segments would be short "jump up" spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely

rehabilitated and recontoured. Short-term increases in human disturbance could have effects on wildlife movement, but no long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits. Rehabilitation would move the areas toward their premanagement state, which would benefit wildlife movement within the areas.

Jammer trail rehabilitation should have insignificant negative effects. Short-term increases in human disturbance would be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would beneficially effect wildlife movement within the project area.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for wildlife movement quicker than the no action alternative.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in

Chapter 2 would be implemented. Salvaging on such a small percentage of the affected area should have insignificant effects on the movement and dispersal of large animals such as grizzly bears and elk. At a finer scale, removal of snags within individual units could have slight negative effects on movement of small animals. However, sufficient woody debris would be left within units and is a design criterion common to all units. Adding the amount of material left behind from the salvaging operations to the large amounts of pre-fire snags and down dead wood within most of the project area, removal of snags within the individual units should insignificantly affect movement and dispersal of even small animals such as rodents, amphibians, etc., throughout the majority of the project area. Areas where woody debris is limiting and material cannot be hauled back on the sight would have poor potential to facilitate small wildlife movement; however, these areas were poor pre-fire and their poor post-fire condition is unrelated to the salvage operations.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect because of the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated and would further reduce acres available to serve as high-quality snag and down dead wood habitat. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees would be outweighed by the potential of retaining the remaining live trees within the stand. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage and human disturbance-related effects would last longer with implementation resulting from more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect because of the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to all Alternatives

Actions associated with the project would have immeasurable/insignificant cumulative effects on adjacent linkage zones connecting the NCDE and its populations of lynx, grizzly bear, etc., to other areas of high-quality habitat. No activities are proposed to occur within the linkage zone identified for lynx. The area would not change from the existing condition. Movement through the identified lynx linkage zone is probable under the existing condition. Present, proposed and/or reasonably foreseeable actions should not degrade the area's ability to provide for lynx movement.

Threatened and Endangered Species

The BA will analyze the potential effects of the proposed Snow Talon fire salvage project on threatened, endangered, and proposed terrestrial species. *The Endangered Species Act of 1973*, (ESA) as amended, requires all federal agencies to review any project authorized, funded or carried out to determine the action is not likely to jeopardize the continued existence of any proposed, threatened or endangered species. FS policy requires that all FS programs and activities need to be reviewed for possible effects on proposed, threatened or endangered species (FSM 2672.4)

The purpose of the BA is to make a determination regarding the likely effects of this action on the status of these species and determine whether formal consultation or conference with USFWS is required. The project area contains suitable habitat for four listed species known to occur on the Helena NF. These species, shown in Table 18 will be evaluated in this section.

Table 18. Threatened and endangered wildlife species within the project area.

Species Biological Assessment	Summary of Conclusion of Effects and Determination
Gray Wolf (Threatened)	**No Effect**; potential resident/transient (recent sightings verified within the project area). Suitable habitat is present. No known denning or rendezvous sites within project area.
Bald Eagle (Threatened)	**No Effect**; migrant/foraging/resident (closest known nest is along the Blackfoot River, 15 miles to the west). Limited habitat may be present in the vicinity. Project area does not meet the definition of Zones I, II, or III, nor is it adjacent to a foraging area (USDI 1994).
Grizzly Bear (Threatened)	**May Effect, Likely to Adversely Affect**; resident (recent sightings verified within the project area). Suitable habitat is present. Project area is located within NCDE, within Management Situation 1 and 2 lands (IGBC 1986).
Lynx (Threatened)	**May Effect, Not Likely to Adversely Affect**; resident/transient (recent sightings verified within the project area). Suitable habitat is present. All standards and guidelines of the *Canada Lynx Conservation Assessment and Strategy* (Ruediger et al. 2000) will be met. No acres of suitable habitat being moved to an unsuitable condition.

Consultation and Coordination

In accordance with the ESA, Section 7, and FSM 2671.4, the Helena NF is required to request written concurrence with respect to the determination of effects (other than "No Effect" determinations) on gray wolf, grizzly bear, bald eagle, and Canada lynx.

Gray Wolf (Canis lupus)

Recovery Plan and Forest Plan Objectives

Northwest Montana Natural Population Recovery Area: The Snow Talon fire salvage project occurs within northwest Montana where the gray wolf population is listed as threatened under the ESA. The recovery plan population objective is to establish a minimum of ten breeding pairs, or approximately 100 wolves, in the Northwest Montana Recovery Area for three successive years. Gray wolves were down-listed to threatened when minimum objectives were met. The Gray Wolf Recovery Plan was approved in 1987 (USFWS 1987). The plan delineated three recovery zones within Idaho, Montana and Wyoming. On November 18, 1994, the nonessential experimental rules became effective which addressed wolves reintroduced into Yellowstone National Park and Central Idaho. On the Helena NF, wolves east of I-15 are considered a nonessential experimental population. Wolves occurring west of I-15, including the Lincoln RD, are given full protection under the ESA.

There are no *Forest Plan* standards for road density or vegetation cover related to habitat security for gray wolf habitat, therefore, the potential effects of these habitat variables relied on relevant research findings. The main Gray Wolf Recovery Plan standard for wolf protection related to logging activities requires no activities within 1 mile of known or suspected denning and/or initial rendezvous sites during denning season.

Affected Environment—Gray Wolf

Population, Habitat Status and Species Occurrence

Wolves are wide ranging carnivores primarily preying on elk and deer. No denning or rendezvous sites have been detected in the project area or elsewhere on the Lincoln RD. Within the past few years, reports document wolves in the Nevada Creek, Beaver Creek/Huckleberry Pass, and Alice Creek areas on the district. Reports have also documented wolves within the Scapegoat Wilderness during the summer months, along the mainline trail. Sightings have also occurred on private lands south of the project area. These reports may indicate transitory behavior by several individuals, or possible the Alice Creek pack traveling through the area. While monitoring in the late 1990s, the USFWS suspected one reproducing pack inhabited the Alice Creek area, east of the project area. Since their initial report, individuals and pairs of wolves have been reported, but a reproducing pack has not been verified. Investigations continue by district staff, USFWS, and MDFWP. Adequate populations of ungulate prey are available in and around the project area. Prey species in and around the project area are primarily elk, mule deer and moose.

Overall the project area is remote with low open road densities. The Red Mountain Grizzly Bear Subunit incorporates all proposed activities within the Copper Creek

drainage and the Snow Talon fire salvage project. Within the subunit, the FS-owned lands have a road density of 0.47 mile per square mile.

Environmental Consequences—Gray Wolf

No key issues or analysis issues specific to the gray wolf were identified in Chapter 1. The following effects indicators were used to focus the gray wolf analysis and disclose relevant environmental effects:

- Adherence to the Gray Wolf Recovery Plan
- The effect on ungulate habitat and habitat security.

Direct and Indirect Effects of Alternative 1

This alternative would maintain the status quo of the overall habitat condition, which would mostly allow for natural recovery. Ungulate habitat carrying capacity would remain low but would increase with time as forage and cover resources. Habitat security would generally be low in the short term, until vegetation recovery occurs sufficient to provide cover (10–15 years). Motorized access in the analysis area, especially during the big game hunting season is low; therefore, the lack of vegetation cover creates a relatively low risk of mortality. Until vegetation cover returns, habitat security should be low along open roads and relatively unaffected in the numerous remote areas within the project area. If Alternative 1 were implemented, no old jammer trails would be rehabilitated. Open-road density would remain unchanged. Disturbances associated with all action alternatives, primarily increased short-term human activity, would not occur with this alternative.

Direct and Indirect Effects Common to Action Alternatives

Important habitat components for wolves include a sufficient, year-round prey base of big game or alternate prey, suitable and somewhat secluded denning and rendezvous sites, and sufficient space with minimal exposure to humans (USFWS 1987). These are factors analyzed to determine effects to the gray wolf.

Prey Base. The primary prey species within the project area are elk, mule deer, and white-tailed deer. Elk and deer populations within the project area appear to be stable or increasing. Elk and deer vulnerability during hunting season would remain constant. Alternative 1 would not rehabilitate any jammer trails, while Alternatives 2, 3, and 4 would recontour 110 acres. Wolves and their prey would have adequate displacement and/or undisturbed areas available throughout the project area and throughout implementation. Blocks of forested cover and several drainages with no ongoing activities within and outside the fire perimeter are expected to provide security. As post-fire succession produces an increase in grass and forb communities, prey species can be expected to maintain and/or improve in numbers. Because of low open-road density during hunting season, loss in hiding cover should not adversely affect prey vulnerability. Post-fire succession and activities associated with all action alternatives should improve ungulate habitat, therefore, carrion should continue to be available for wolves.

Denning and Rendezvous Sites. There are no known denning or rendezvous sites within the project area. Physiographic features characteristic of denning sites appear to include southerly aspects on moderately steep slopes in well drained soils, usually within 400 yards of surface water and at an elevation overlooking low-lying areas (USFWS 1987).

Rendezvous sites are resting and gathering areas used by wolves during summer and early fall after the natal den has been abandoned. These sites are usually complexes of meadows and adjacent timber with surface water nearby which may include bogs, abandoned and revegetated beaver ponds and streams (USFWS 1987). Limited sites are available in the project area, because of the fire. Possible denning and/or rendezvous sites would not be affected by the activities proposed in the area.

Risk of Mortality. Road access is assumed to be a direct index of the potential for human caused wolf mortality. The potential for human caused wolf mortality is greatest during the hunting season as roads within the analysis area receive the greatest use. However, open-road density within the project area is low during the hunting season. In addition, numerous remote areas are available for secluded wolf habitat. The grizzly bear moving windows analysis determined >69% of the Red Mountain Subunit was made up of core habitat, an area >0.5-mile away from a road and >2,500 acres in size. Because of no new permanent road construction, public access being limited within harvest areas and current low open-road density, mortality risk would remain unchanged.

Management activities affecting ungulate availability/survivability would indirectly affect wolves. Each of these alternatives would affect ungulate habitat as discussed for elk/mule deer habitat. The allowance of winter logging in these alternatives could add stress to wintering ungulates. However, resulting from the lack of winter range habitat within the project area, wolf use is also expected to be low during the winter months. The potential effect on ungulate calving/fawning habitat would be insignificant because of the low density of animals suspected in the area during implementation and the calving/fawning time period (mid-May to mid-June) occurring within the normal spring breakup time, when logging operations shut down. Residual hiding/screening cover values of standing dead trees provide insignificant amounts of hiding cover along Copper Creek road. All other roads within the drainage are closed during hunting season; therefore, reduced hiding/screening cover would insignificantly affect prey base availability for wolves.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. The only other temporary road segments would be short “jump up” spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely rehabilitated and recontoured. Short-term increases in human disturbance could have effects on wolves, but no long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits. Rehabilitation would move the areas toward their premanagement state, which would benefit wolf use and movement within the areas.

Jammer trail rehabilitation should have insignificant negative effects. Short-term increases in human disturbance would be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would beneficially affect wolf use and movement within the project area.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for wildlife movement quicker than the no action alternative.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect resulting from the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees as hiding cover would be outweighed by the potential of retaining the remaining live trees within the stand. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage and human disturbance related effects would last longer with implementation because of more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect because of the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Past road building and timber harvesting may have initially had negative effects on ungulate populations because of increased and more effective access by hunters.

However, the conversion of mature forests into early succession habitats has generally provided increased levels of forage and higher population potential for ungulates. An increased emphasis on road closures over the last 15 years has probably had a positive effect on ungulate survivability during hunting seasons.

Wolf-habitat issues related to the absence of cover involve the effect on ungulates (prey base) and habitat security (risk of mortality). Absence of cover can result in lowered habitat security and when this is coupled with roads open to motorized use in preferred habitats, risk of mortality increases. However, if the prey base is low, wolf use of the area would also be expected to be low. During the hunting season, hunting regulations for deer and elk only allow males (bucks and bulls) to be harvested. As males constitute a relatively small proportion of the population, the potential reduction in prey base would be insignificant. Each of the action alternatives would improve habitat when compared to the existing situation by rehabilitating old jammer trails.

Ongoing and foreseeable management actions in the Copper Creek drainage are not expected to affect wolves unless they occur near denning or rendezvous sites; however, wolf denning or rendezvous activities are not expected to occur within the project area. If it does, restrictions would be imposed to protect wolves.

Conclusion/Determination

Implementation of the actions associated with the Snow Talon fire salvage sale would have “No Effect” on the gray wolf and its habitat. This determination is based on prey would remain unchanged within the area during and after the activities, potential denning and rendezvous sites would be unaffected and remain available across the landscape, and total miles of open roads would remain unchanged or decrease even though there would be a short-term increased activity from the project implementation.

Bald Eagle (Haliaeetus leucocephalus)

Recovery Plan Objectives

The recovery goals established in the Montana Bald Eagle Recovery Plan (USDI 1994) include: a minimum of 800 pairs nesting in the 7-state recovery area; an annual average of 1.0 fledged young per pair, with an average success rate per occupied site of not less than 65 percent over a 5-year period; to meet recovery goals within at least 80% of the management zones with nesting potential; and no evidence of persistent, long-term decline in any sizeable wintering aggregation.

Management of bald eagle breeding territories may be accomplished by protecting nesting stands and feeding sites and minimizing human activities (USDI 1994). Guidelines have been developed to provide management direction for bald eagles where there is little information on actual use areas. Three zones within bald eagle areas for which these guidelines apply where developed for Montana by the Montana Bald Eagle Working Group:

- Zone I—Nest Site Area: Zone I includes the area within 0.25 mile (400 meters) radius of active nest sites in the breeding area that have been active within five years or until an active nest is located. Then Zone I applies only to the active nest.

- Zone II—Primary Use Area: Zone II includes the area 0.25 mile (400 meters) to 0.5 mile (800 meters) from active nest sites in the breeding area where it is assumed that 75% of activities (foraging, loafing, bathing, etc.) of a bald eagle breeding pair occur.
- Zone III——Home Range: Zone III includes all suitable foraging habitats within 2.5 miles (4 kilometers) of active nest sites.

Affected Environment—Bald Eagle

Population, Habitat Status and Species Occurrence

The Snow Talon fire salvage project area lies within the Upper Columbia Basin Recovery Zone as identified in the Montana Bald Eagle Management Plan (USDI 1994).

Bald eagles in Montana occupy riparian habitat almost exclusively during the breeding season, but occasionally exploit upland areas for food and roost sites, especially during winter. Food habits are eclectic, reflecting the opportunistic behavior of many large raptors. Prey includes fishes, ground-dwelling scuirids (squirrels, chipmunks, marmots, etc.), waterfowl, ungulate carrion and lagomorphs (rabbits and hares). Use of domestic livestock carcasses is common and although depredations by eagles have been recorded they are rare and usually associated with golden eagles. Nest sites are commonly distributed around the periphery of lakes and reservoirs greater than or equal to 80 acres in area and linearly along forested corridors of rivers, usually within 1 mile of shore. Bald eagles usually choose older, large diameter trees of a variety of species for nesting (USDI 1994). Nest sites are usually as close to maximum foraging opportunities as possible, mitigated by avoidance of human activity. Density of breeding pairs is highest along sinuous and braided sections of rivers and eutrophic lakes. Some pairs include both rivers and lakes in their home ranges. Bald eagles often forage year round near reservoirs; eagles use shallow areas, associated with wetlands, littoral zones with gently sloping shorelines and confluences of peripheral streams (USDI 1994). Bald eagle winter habitat is mostly associated with areas of open (ice-free) water where fishes are available and/or waterfowl congregate. In Montana, wintering eagles are indeed associated with unfrozen portions of large lakes and free flowing portions of rivers, but are also scattered through upland areas feeding on ungulate carrion, game birds and lagomorphs. Although large, communal roosts of over 100 eagles are often associated with bald eagle wintering areas, none have been discovered in Montana (USDI 1994). The project area is used during the fall and winter by bald eagles. These eagles feed on the ungulate carrion, usually hunter and winter-killed big game. Mortality of these feeding eagles is uncommon.

There are no known nest sites within the project area. Suitable habitat for nesting within the project area is extremely limited. No nest sites have ever been recorded in or around the project area. The closest known nest is 15–20 miles west of the project area on the Blackfoot River on private land. This nest has been active for approximately 15 years. It is unlikely the pair would take up residence in the project area.

Bald eagles are common along the Blackfoot River area south of the project area. Use by bald eagles appears to be associated with fish in the Blackfoot, as well as winter and road killed ungulates along Highway 200. There are no known bald eagle nests within the project area and only low-quality nesting habitat is present in the project area. The project area does not meet the definition of Zone I, II, or III, nor is the project area adjacent to a

foraging area (USDI 1994). Eagles may use the project area during migration and for foraging during the fall and winter.

Environmental Consequences—Bald Eagle

No key issues or analysis issues specific to the bald eagle were identified in Chapter 1. The following effects indicator was used to focus the bald eagle analysis and disclose relevant environmental effects:

- Adherence to Montana Bald Eagle Management Plan nest territory guidelines.

Direct and Indirect Effects Common to all Alternatives

No alternatives propose activities close to any active eagle nests. Therefore, the no action alternative would not reduce effects to critical eagle habitats. There are no bald eagle nests within the project area. The closest known eagle nests occur approximately 15 miles west of the project area along the Blackfoot River. As no management activities related to tree salvaging would occur along the river corridor, disturbance would not be an issue to nesting bald eagles. Nest site, primary use, and home range areas would be unaffected. Bald eagle use of the area is generally associated with incidental overflights, migration, or use of carrion from winterkilled ungulates. The project area contains small, high-elevation lakes, these sites have low potential to serve as foraging habitat for eagles. The project area does not meet the definition of Zone I, II, or III, nor is the project area adjacent to a foraging area (USDI 1994). This project would not affect foraging habitat and would not increase the likelihood of bald eagle road kills. Nest site, primary use, and home range areas would be unaffected. The area's ability to provide habitat components would remain constant, with no net loss of habitat resulting.

Post-fire succession and activities associated with all action alternatives should improve ungulate habitat, therefore, carrion should continue to be available for eagle foraging. Increased human activity associated with all action alternatives would not change habitat use by the eagles. The increased activity should not impede use or migration as a whole.

Cumulative Effects Common to All Alternatives

Loss of bald eagle nesting trees from salvage and/or predicted beetle outbreaks would be insignificant resulting from the extremely low nesting potential within the area. The upper reaches of the Blackfoot River has a relatively low level of river-related recreational pursuits, including fishing, floating (using a variety of crafts), and camping as compared to the downstream reaches. Because of this, disturbance-related impacts that may be affecting bald eagle behavior and use of the river occur at low levels and should continue to occur at low levels in the foreseeable future. This alternative would not cumulatively add or detract from the human recreational uses of the river corridor. Also, no other reasonably foreseeable actions that would occur within the river corridor are likely to affect eagle ecology and use of the Blackfoot.

Within the Copper Creek drainage, a wide variety of forest management activities have occurred including road construction, timber harvesting, prescribed burning, recreation facilities improvements, and fish habitat improvements. However, because these activities have occurred outside the primary interest area of bald eagles (rivers or lakes) during the breeding season, it is unlikely that they have had any discernible effects on bald eagle presence or absence in potential nesting habitat. As this project would be

neutral in terms of adding to or taking away from the current recreational uses humans make of the river, none of the alternatives would cumulatively be additive to this little understood potential impact on bald eagles.

Reasonably foreseeable actions are proposed to occur in upland sites and as such have little potential for impacting river resources, including bald eagles or their nesting habitat. Therefore, no adverse cumulative effects are expected from such things as mushroom picking, trail maintenance/reconstruction, and roadwork. The insignificant potential direct and cumulative effects from any of the alternatives analyzed, it is unlikely that any kind of a threshold would be crossed that would produce adverse effects on bald eagles or their use.

Conclusion/Determination

The implementation of the actions associated with the Snow Talon fire salvage sale would have "No Effect" on the bald eagle and its habitat. This determination is based on distance from the project area to an active nest, no change in suitable forage habitat associated with riparian zones, and the lack of effect on migrating eagles or on the availability of carrion.

Grizzly Bear (Ursus arctos)

Recovery Plan and Forest Plan Objectives

Recovery Plan Objectives: The overall goal of the Grizzly Bear Recovery Plan is to remove the grizzly bear from threatened status in each of the occupied or reintroduced ecosystems in the 48 conterminous States. The following goals have been prepared for the Northern Continental Divide Ecosystem (NCDE) (USDA 1993): "Ten females with cubs inside Glacier National Park (GNP) and 12 females with cubs outside GNP over a running 6-year average both inside and outside the recovery zone and within a 10-mile area immediately surrounding the recovery zone, excluding Canada; 21 of 23 bear management units (BMUs) occupied by females with young from a running six-year sum of verified sightings and evidence, with no two adjacent BMUs unoccupied; and known human-caused mortality not to exceed four percent of the population estimate based on the most recent 3-year sum of females with cubs. Furthermore, no more than 30% of this four percent mortality limit shall be females. These mortality limits cannot be exceeded during any two consecutive years for recovery to be achieved. Furthermore, recovery cannot be achieved without occupancy in the Mission Mountains portion of the ecosystem."

Forest Plan Objectives: "In occupied grizzly habitat, to minimize man-caused mortality, the open-road density will not exceed the 1980 density of 0.55 miles per square mile." The recovery goal for the Helena NF's portion of the NCDE was set at 18 grizzly bears; the maximum potential of the Helena NF was determined to be 19 grizzly bears (USDA 1986).

Affected Environment—Grizzly Bear

Population, Habitat Status and Species Occurrence

The grizzly bear was listed as threatened throughout its range in the lower 48 states on July 28, 1975. The Grizzly Bear Recovery Plan was approved in 1982, updated in 1990

and 1992, and revised is 1993 (USFWS 1993). Seven grizzly bear ecosystems were identified in which recovery is to be accomplished, one of which lies in part on the Helena NF; the NCDE.

The proposed Snow Talon fire salvage project would occur within the NCDE, within the Red Mountain Sub Unit. The proposed project falls within the NCDE and is managed under Management Situations 1 and 2, under the guidelines of the Grizzly Bear Recovery Plan. Management Situation 1 land is defined as such: "The area contains grizzly population centers (areas key to the survival of grizzlies where seasonal or yearlong grizzly activity under natural, free-ranging conditions is common) and habitat components needed for the survival and recovery of the species or a segment of its population." Management direction within these areas: "grizzly habitat maintenance and improvement and grizzly and human conflict minimization will receive the highest priority (FSM 2603). Management decisions will favor the needs of the grizzly bear when grizzly habitat and other land-use values compete." Management Situation 2 land is defined as: "Current information indicates that the area lacks distinct population centers; highly suitable habitat does not generally occur, although some grizzly habitat components exist and grizzlies may be present occasionally." Management Situation 2 areas either are unnecessary for survival and recovery of the species, or the need has not yet been determined but habitat resources may be necessary. Management direction for the area states, "The grizzly bear is important, but not the primary, use of the area. In this management situation, managers would accommodate demonstrated grizzly populations and/or grizzly habitat use in other land use activities if feasible, but not to the extent of exclusion of other uses" (USFWS 1993). While the entire project area falls within MS 1 and 2 lands, only parts of units 1 and 2 and an area of jammer trail rehabilitation would occur within MS 1 land. All other proposed salvage units and rehabilitation work would occur within MS 2 land.

All seasonal habitat components defined by the Interagency Grizzly Bear Guidelines were found within the project area pre-fire (Interagency Grizzly Bear Committee 1986). The surrounding area is mostly forested with open, bunchgrass parks on south and west facing aspects, riparian areas in the draws as well as scree slope feeding sites are available. Fruit producing shrubs were present within the project area, pre-fire. Fruit producing shrubs would be limited for the first few years post-fire, but 3–5 years post fire, shrubs should increase dramatically. Limited carrion for grizzly bears in the area would be from hunter and winter killed ungulates. There is potential and high potential denning habitat available in the project area under the existing condition.

Data collected from radio-collared grizzly bears from 1989 to 1992, in response to the Yellowstone fires of 1988, showed that bears tended to avoid burned sites during 1989, but not during subsequent years. Based on 867 locations of 44 grizzly bears between 1989 and 1992, bears used burned habitats in proportion to their availability within their ranges (Blanchard and Knight 1993). Also, their pooled locations indicated avoidance of burned sites during 1989, especially by females with cubs-of-the-year, but not during subsequent years. The 1988 fires had no apparent harmful short-term effects upon Yellowstone grizzly bears and were, in fact, likely beneficial, largely because from increased production of grizzly bear diet items such as forb foliage and tuberous root crops. Similar landscapes that have evolved with fire should be expected to undergo

similar biological responses, and is what is expected for the Snow Talon fire affected area.

The Monture Landers Fork BMU is the Helena NF's only BMU. This BMU is made up of the Arrastra Mountain, Red Mountain and Alice Creek Subunits (Table 19). The majority of the Snow Talon fire burned within the Red Mountain Subunit. The southwestern edge of the Alice Creek Subunit (mostly private land) was burned and the Arrastra Mountain Subunit was unaffected by the fire. All proposed salvage activities would only occur within the Red Mountain Subunit. Given this, the direct and indirect effects analysis will focus on the Red Mountain Subunit. The cumulative effects analysis will look at all three subunits. The Snow Talon fire burned mainly in the Red Mountain Subunit, creating extensive areas devoid of "live" cover. The subunit is the area in which the status of grizzly bear habitat security, as affected by motorized access, is evaluated and used for determining cumulative effects. Activities contained in Alternative 2 and its alternatives are contained within one grizzly bear subunit: Red Mountain.

Table 19. Grizzly bear subunits and habitat status.

Bear Management Unit	Sub-unit	Visual Sightings	Den Sites	Mortality	Within Project Area
Monture Landers Fork	Red Mountain	Yes	Unknown	Unknown	Yes
	Arrastra Mountain	Yes	Unknown	Unknown	No
	Alice Creek	Yes	Unknown	Yes[a]	No

a. In 2002, an adult male grizzly was captured on private land in the southern part of the subunit. The bear was injured, killed several sheep, displayed aggression towards humans and was euthanized. In 2003, an adult male grizzly was captured in the same area as the 2002 bear. The bear killed sheep and was euthanized.

The surrounding area has been used by grizzly bears and since the 1960s, documented sightings have occurred in the project area. Grizzly bears have been documented within the project area as well as within the adjacent Scapegoat Wilderness. These individuals in addition to other individuals use the surrounding areas for seasonal and/or permanent residence.

Moving Windows Analysis/Road Densities

In accordance with the NCDE Grizzly Bear Access Management Protocol and the Flathead NF Amendment 19 (the accepted grizzly-road management protocol for all forests within the NCDE), a moving windows analysis was conducted. The Protocol Paper was followed (NCDE 2002). A complete moving windows analysis will measure total motorized access route density (guideline: ≤19%); open road and open motorized trail route density (guideline: ≤19%); and percentage of analysis areas in core areas (guideline: ≥68%). Results of the existing condition moving windows analysis are located in Table 20.

Under the existing condition, the Red Mountain Subunit is close to meeting NCDE Grizzly Bear Access Management Protocol road density guidelines, while the other 2 subunits meet protocol guidelines. Within the Red Mountain Subunit, core area and total route density guidelines are met, but the open motorized route density is 5.7% above the

Table 20. Existing condition moving windows analysis outcomes.

Subunit	Percent Total Motorized Route Density (Guideline: ≤19%)	Percent Open-Road Density (Guideline: ≤19%)	Percent Core Areas (Guideline: ≥68%)
Red Mountain Subunit	17.9	24.7	69.3
Arrastra Mountain Subunit	16.5	15.1	74.5
Alice Creek Subunit[a]	19.5	15.8	74.8

a. Alice Creek Subunit contains ≤75% federal ownership. Therefore, the 19/19/68, NCDE Grizzly Bear Access Management Protocol road density guidelines do not have to be met. If the subunit is below guidelines, a "No Net Increase" in road densities is the guideline for the area.

guideline. During fire rehabilitation efforts, the total route density was lowered during. Several segments of roads had culverts permanently removed and other roads had bridges burned and will not be replaced. These roads are effectively closed and impassable under the existing condition. Within the Arrastra Mountain Subunit, all 19/19/68 guidelines are not only met, but are significantly exceeded. Within the Alice Creek Subunit, even though 19/19/68 guidelines are not required, the subunit is extremely close to meeting them anyway and two of the three significantly exceed guidelines. The Alice Creek total road density is within 0.5% of the guideline. The total route density is the least critical guideline and is hard to achieve because of all roads, including yearlong restricted roads, are counted in the total route density. The only way to reduce the total route density is to obliterate and/or make roads impassable by pulling culverts, etc.

Despite the existing condition within the Red Mountain Subunit being close to meeting the access management thresholds, and the other two subunits within the cumulative effects area meeting and/or exceeding the guidelines, the Red Mountain Subunit is currently at a "degraded condition" resulting from not meeting road density guidelines. Formal consultation with the USFWS will be completed. A resulting temporary Incidental Take Statement will be issued to the Helena NF by the USFWS.

The *Forest Plan* standard for open-road density within occupied grizzly habitat is 0.55 mile per square mile. Existing condition open road density for the FS portions of the three subunits is located in Table 21. Open road densities for the FS portions of all three subunits, independently as well as cumulatively, are well below *Forest Plan* standards.

Table 21. Existing condition road densities.

Subunit	Existing Condition (Standard is 0.55)
Red Mountain Subunit	0.36
Arrastra Mountain Subunit	0.47
Alice Creek Subunit	0.14
Total (Cumulative Effect Area)	0.34

Environmental Consequences—Grizzly Bear

Chapter 1 identified the grizzly bear as an analysis issue. The following effects indicators were used to focus the analysis and disclose relevant environmental effects:

- Whether *Forest Plan* standards/guidelines, and FWS recommendations related to the grizzly bear would be met
- The potential loss of habitat values associated with dead trees.

Direct and Indirect Effects of Alternative 1

As a large proportion of a grizzly bear's diet is plant material including roots/tubers, leaves of grasses and forbs, and a variety of berries, the post-fire condition of the Snow Talon fire affected area should be expected to be relatively attractive to grizzly bears. The affected area likely would not be used much by grizzly bears during the first year post-fire (2004), as the Yellowstone study showed, but during subsequent seasons (approximately 10 years) the affected area would produce increases in forage production. In this context, this alternative would provide a relatively disturbance-free (i.e., no salvage logging) landscape condition that grizzly bears could exploit. Ungulate carcasses are going to remain available to grizzly bears as in the past, providing available meat for grizzly bears and other opportunistic carnivores.

Road Densities

This alternative would not change the existing condition and NCDE Grizzly Bear Access Management Protocol road density guidelines would not be met for Red Mountain Subunit. *Forest Plan* open road densities would be met. Access management would not be implemented by this alternative. Compared to the action alternatives, Alternative 1 would have lower levels of human activity over then next three years (no harvest or related actions), but potentially higher levels over the long-term because jammer trail rehabilitation would not. Because of access management guidelines not being met within the Red Mountain Subunit, formal consultation with the FWS would still be required under this alternative.

Direct and Indirect Effects Common to Action Alternatives

Forest Plan guidelines would be met under all alternatives and would not change the existing condition. Salvaging dead and dying, standing trees would reduce residual levels of cover within the proposed treatment sites. The effects of removing dead standing trees on 4-12% of the burned portion of the Snow Talon fire on NF land would insignificantly affect risk of mortality.

A review of literature on dead trees, including the Grizzly Bear Compendium (Interagency Grizzly Bear Committee 1987), did not yield any information on burned dead-standing trees and grizzly bear habitat potential, indicating no obvious relationship. Occasionally bears tear into older decaying logs in search of invertebrate food resources. However, the literature does not highlight logs as an important potential source of food for bears. This being the case, it could be concluded that the removal of a relatively small proportion of burned dead trees (when compared to what would be left within the affected area) would have insignificant effects on grizzly bears or grizzly bear habitat potential. If grizzly bears depend on dead trees for invertebrate proteins, then each of the alternatives would remove some of this potential food resource. However, given that the

maximum number of acres to be treated represents only 4–12% of the burned portion of the Snow Talon fire on NF land, this should be insignificant. Additionally, the important riparian areas, which contain large-diameter standing and downed trees, would be left intact and available.

Road Densities

The 110 acres of nonsystem jammer trails would be rehabilitated under all action alternatives. These roads are currently untraveled, nonsystem, old skid trails. They are not counted in the moving windows analysis as system roads and currently have no use associated with them. Therefore, rehabilitating the trails would not have direct beneficial effects. However, indirectly, these jammer trails could potentially serve as a pathway for illegal all-terrain vehicle (ATV) use if someone cleared their way into the areas to use the old roadbeds. Rehabilitation would eliminate the chance of these activities occurring. Jammer trail rehabilitation should have insignificant negative effects. Short-term increases in human disturbance would be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would beneficially affect grizzly use and movement within the project area.

Because of slide potential, the Cotter Creek Road # 330B1 has been closed to motorized with a temporary emergency closure. This closure would have significant benefits to grizzly bears and would produce significant changes in the outcomes of the moving windows analysis. However, the road was analyzed as open during the moving windows analysis because the closure was only temporary. Throughout the implementation of the project the road would remain closed to public use. After implementation is completed and if the road has not been naturally closed because of slides, the road would be reopened for public use. The area would serve as a remote drainage head for grizzlies during implementation.

Grizzly Bear Denning Habitat

Grizzly bear denning habitat was mapped for this project. Parameters used for the Lincoln RD were based on three studies of grizzly bear denning habitat in the NCDE, numerous other literature reviews, discussions with numerous wildlife biologists and on-the-ground knowledge of the District's unique habitat and elevational characteristics. The three studies used were Servheen (1981), Aune and Kasworm (1989), and Mace and Waller (1997). The grizzly bear denning habitat map includes all three grizzly bear subunits. "Potential" as well as "high potential" grizzly bear denning habitat was mapped. Denning habitat will be analyzed at the project area, subunit and BMU scale.

Potential Grizzly Bear Denning Habitat Parameters:
>6,200 feet in elevation.
>35% and <100% slope.
All cover types except for rock.

High potential Grizzly Bear Denning Habitat Parameters:
>6,200 feet in elevation.
>35% and <100% slope.
All cover types except for rock.
N, NE, and NW aspects.

These parameters were chosen in order to map the elevational band of habitat most commonly used by denning grizzly bears (higher elevation slopes steep enough and shaded enough to retain snow throughout the denning season, that contain cover types where grizzly bears can excavate den sites). These parameters were consistent with denning habitat mapping efforts on the Rocky Mountain Front on the Lewis and Clark NF. Of the 176,673 acres in the cumulative effects area (FS land within all three subunits), 60,532 acres are considered potential grizzly bear habitat with 21,071 acres considered to have a high potential. As shown in Table 22, within the project area 9,666 acres are considered to provide potential denning habitat with 4,133 considered a high potential.

Table 22. Acres of grizzly bear denning habitat within units by alternative.

Alternative	Acres of Potential & High Potential Denning Habitat within the Project Area	Acres of Potential & High Potential Denning Habitat within Salvage Units	% Denning Habitat Acres within the Project Area within Units (Potential & High Potential)
2	9,666 & 4,133	524 & 301	5.4 & 7.3
3	9,666 & 4,133	112 & 87	1.2 & 2.1
4	9,666 & 4,133	584 & 316	6.0 & 7.6

Alternative 4 proposes to treat more acres than any other alternative. Under Alternative 4, 584 acres of potential and 316 acres of high potential denning habitat would fall within units. The majority of the units containing potential denning habitat are proposed helicopter units; therefore, Alternative 3 would have much fewer acres of overlap, with only 112 acres of potential and 87 acres of high potential denning habitat within units. Acres of denning habitat directly overlapping with salvage units would be low. All alternatives would treat <8% of the potential and high potential denning habitat within the project area. All alternatives would treat <2% of the potential and high potential denning habitat within the cumulative effects area. The analysis results for each alternative are presented in Table 22. None of the potential denning habitat is anticipated to be moved to unsuitable conditions because of the any of the action alternatives.

Salvage logging would not directly affect the suitability and quality of a site to potentially serve as grizzly bear denning habitat. grizzly bear denning habitat is not based on cover type, grizzly bear den on higher elevation slopes, steep enough and shaded enough to hold snow throughout the denning period, that contain soil types conducive to den excavation (Aune and Kasworm 1989; Mace and Waller 1997; Servheen 1981). Salvage harvesting would not alter denning habitat and the implementation of the salvage would occur during the denning period. Helicopter harvesting could indirectly affect grizzlies depending on the timing and location of activities. Grizzlies could potentially be disturbed and displaced by harvesting activities such as helicopter overflights and machinery. However, because timing of grizzly emergence from den sites usually occurs in April, disturbance from helicopter logging activities should be low at this time. Spring breakup is usually occurring at this time and activities within the entire drainage should be low.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of

units 44 and 45. The only other temporary road segments would be short "jump up" spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely rehabilitated. Short-term increases in human disturbance could have effects on grizzly bears, but no long-term adverse effect will result from temporary road segments being built. Temporary road segments would occur within road buffers, be temporary on the landscape, and would not increase travel ways open to the public; therefore, the segments would have "No Effect" on the outcomes of the moving windows analysis.

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term beneficial effects. Rehabilitation would move the areas toward their premanagement state, which would benefit grizzly bear use and movement within the areas.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for hiding cover quicker than the no action alternative.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect because of the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees would be outweighed by the potential of retaining the remaining live trees

within the stand. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage and human disturbance related effects would last longer with implementation due to more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect because of the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects of Alternative 1

Within the cumulative effects analysis area (all three subunits), past management activities have altered habitat conditions. Probably the most significant management activity influencing grizzly bear habitat use has been road construction. Roads have facilitated human access into grizzly bear habitat, during denning and nondenning seasons. The grizzly bear study in the Swan Mountains of Montana (Mace and Waller 1997) demonstrated relationships between roads and grizzly bear habitat use patterns. After 10 years of radio-collared grizzly bear locations the researchers concluded that bears tended to avoid roads, especially those open to motorized traffic. Given the relatively large home range sizes of grizzly bears, its probably unavoidable for any bear to not have any roads within their home ranges ("wilderness" bears may be an exception), as a result, the study showed a "preference for" habitat use away from roads, not "no use" of habitat adjacent to roads. Since the 1980s, open road densities have steadily decreased within the subunits. Grizzly bear use has occurred within the area throughout the years no matter what the road densities were at the time. Road densities were low in the 50s, increased from the 60s through the 80s and then decreased during the 90s until the present. Grizzlies have been abundant throughout the years within the area and currently have more remote habitat available than in previous decades. Resulting from the fire and the rehabilitation efforts, road densities were improved from pre-fire conditions. Recently, the Plum Creek Timber Company has placed yearlong restrictions and/or earth and berm closures on many of their roads, significantly reducing the open and total road densities within the private land portions of the subunits. These same areas could potentially be involved in a land exchange with the Nature Conservancy. This would reduce road densities and increase core habitat even more. The Red Mountain Subunit is slightly above one of the three access management guidelines; however the other two subunits are extremely remote and significantly exceed guidelines.

Mushroom picking is another forest activity with potential to displace grizzly bears from portions of the Copper Creek drainage. This activity would occur during the summer of 2004 and would bring hundreds of people to the Copper Creek drainage. This may result in displacement of grizzly bears, but should not result in any human-bear conflicts. The increased law enforcement during the picking season should help in reducing human mistakes relative to food and food storage. The mushroom picker's campsites would not be located on FS land, they would be located outside of the project area on private land, however, food storage orders would be in place and enforced. The emergency road closure order that is in effect would further reduce the open road density for the subunit. This should further help to reduce human disturbance in the drainage. Mushroom picking would decline sharply after the first post-fire year, as conditions for edible mushroom growth decline; therefore impacts from this activity should be insignificant during 2005.

Spring black bear hunting is expected to continue in the fire area, the risk of shooting of grizzly bears because mistaken identity is low, but possible. Administrative uses of closed roads, for reforestation or road-related work, may also affect grizzly use of the area. These and other activities such as routine road maintenance, watershed improvements, and trail reconstruction are foreseeable actions scheduled to occur. Human use in the drainage is expected to generally increase, at least in the short-term for activities such as firewood cutting and mushroom harvesting. Motorized access density levels would remain at current conditions. Within the project area, grizzly bears have persisted alongside a wide array of human activities. Activities such as road building, timber harvesting, tree-thinning of plantations, spring black bear hunting, firewood cutting, berry picking, camping (Copper Creek campgrounds and dispersed sites), mountain biking, ATV riding, hiking, big game hunting, gathering forest products and recreational driving all have effects on grizzly bears. In addition to regularly occurring recreation activities, the associated disturbances associated with fire suppression efforts and post-fire BAER rehabilitation activities probably had some level of displacement effects on grizzly bears. Given the condition of the post-fire landscape, there probably will not be much of an attraction for bears to be within the burned landscape during this time; the displacement effect should be low. All of these activities have and do occur within the Copper Creek drainage, yet grizzly bears persist; this is evidence of the ability of grizzly bears to adapt and share space with humans.

Grizzly bear habitat modifications in the form of timber harvesting, has had a variety of habitat effects. Some effects have included the reduction of hiding cover along open roads, short-term decreases and long-term increases in huckleberry production, providing easier human access into grizzly bear habitat with associated road building for hauling out logs, and past timber harvesting has increased vegetation diversity. Hazard tree felling along roads that occurred during fire suppression activities probably insignificantly reduced screening cover adjacent to roads resulting from the steep topography of the drainage.

There have been many forest management and recreational activities in the Copper Creek drainage, which affect grizzly bears and their habitat use. The fire displaced bears that were able to get out of its way as it burned nearly 40,000 acres. It is unknown what the sum total of effects of associated fire suppression activities had on grizzly bears. The large number of people that will engage in mushroom picking in the spring and summer of 2004 will likely have some level of displacement effect on bears. In addition, the proposed salvage harvesting may take 2–5 years to complete. Watershed restoration and reforestation activities would occur and involve administrative use of restricted roads.

The NCDE Grizzly Bear DNA Study will begin in the spring of 2004. Field crews will be collecting DNA samples throughout the project area and throughout the Helena NF's entire portion of the NCDE. Effects of this project should be insignificant and restricted to incidental, low intensity disturbances of individual bears.

Each action alternative would salvage trees and make those parts of the landscape where trees would be removed more open. Bears using these sites for foraging could become more vulnerable to being illegally killed. How much more vulnerable is unknown. Certainly, the further away from an open road the lower the mortality risk and probably the less need grizzly bears would have for cover. Because of the low open road density within the project area, especially during the hunting season, reductions in screening and

hiding cover should insignificantly affect grizzly bears. Habitat availability and security would be improved over time as a result of the Helena Forest Travel Plan Revision because of additional motorized access restrictions. This would continue the forest-wide trend of providing more security for bears through motorized access restrictions. The net cumulative effect would be that habitat availability and security would be improved, moving the Red Mountain Subunit closer to the NCDE Motorized Access Management guidelines.

NCDE and Forest Scale Assessment

Helena NF lands comprise only the southern tip of the NCDE. Helena NF land ownership occurs within one grizzly bear BMU and three grizzly bear subunits, the NCDE Grizzly Bear Motorized Access Management Protocol (North Continental Divide Ecosystem 2002) is used to provide direction and helps manage the three subunits. Habitat effectiveness is very high in all wilderness portions of the subunits with no high use trails affecting grizzly bears. On FS land, core areas are abundant and road densities are low. As you move closer to Highway 200 and the town of Lincoln on privately managed land, road densities increase and core habitat decreases.

The Arrastra Mountain subunit has abundant secure habitat. The subunit exceeds all three Amendment 19 guidelines. The Alice Creek subunit has NF System ownership <75% and has a “No Net Increase” guideline on NF System lands and therefore, the 19/19/68 guidelines do not have to be met. Despite this, the Alice Creek Subunit is still extremely remote, open route and core area guidelines for the entire subunit are significantly exceeded, while the total route density is within 0.5% of meeting the guideline. The FS portion of the Alice Creek subunit is even more remote. *Forest Plan* open road densities are exceeded. Access management guidelines are exceeded, met, or extremely close to being met for the entire Monture Lander Fork BMU. Progress in closing and decommissioning roads would continue across the Helena’s portion of the NCDE with the completion of the ongoing travel plan revision. The forest would continue to move towards meeting the NCDE Motorized Access Management guidelines.

The NCDE-wide Food Storage Order would minimize the risk of mortality resulting from conflicts with humans and human associated foods. The food storage special order was signed on April 15, 1998, and applies to NF system lands within the NCDE (including parts of the Flathead, Lewis and Clark, Lolo, and Helena NFs). The purpose of the restrictions is to minimize grizzly bear/human conflicts and thereby provide for visitor safety and recovery of the grizzly bear. The food storage order contains requirements for storage and handling of bear attractants such as human foods and garbage, livestock feed, and wildlife and livestock carcasses.

The Helena Forest has cooperated with MDFWP to help fund a grizzly bear management specialist position with MDFWP since inception of the position in northwest Montana. The position works on both public and private lands to correct problem situations and educate people about how to live with bears and minimize the potential for conflicts. The management specialist has pioneered efforts in rapid and complete cleanup of railroad grain spills, the use of aversive conditioning techniques to educate bears including the use of Karelian bear dogs, and the hazard and necessity of the cleanup of large and small attractants at private residences. The work may lead to an increased ability of grizzly

bears to utilize habitats in areas currently having high mortality risk and low use potential.

Grizzly bear population monitoring using a DNA sampling technique was carried out in 1998 and 2000 in approximately the northern one-third of the NCDE within the Greater Glacier area. The population estimates from this study area cannot be simply extrapolated to the rest of the NCDE, but it does serve to indicate a healthy population exists in the study area that is contributing substantially to the NCDE-wide population goal. This study will be expanded in 2004 to the entire NCDE. Within a few years a population estimate and trend should be determined for the entire NCDE. The Grizzly Bear Recovery Plan (USFWS 1993, 62) identifies a minimum NCDE-wide grizzly bear population of 391. Continuing progress towards meeting road density guidelines and ongoing consultation with USFWS will contribute to recovery and maintenance of long-term viability.

Conclusion/Determination

Implementation any alternative "May Effect, Likely to Adversely Affect," grizzly bear and its habitat within and adjacent to the project area.

Canada Lynx (Lynx lynx)

Recovery Plan and Forest Plan Objectives

The Canada lynx is listed as threatened under the ESA in 2000. In the final rule, the FWS concluded the factor threatening the lynx in the continental United States is the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of lynx in NF Land and Resource Management Plans and Bureau of Land Management (BLM) Land Use Plans.

Although a recovery plan has not been prepared, lynx analysis units (LAU) have been identified and mapped on NF Lands. The size of the LAU represents the approximate home range of a female lynx. The project area is located within lynx habitat as defined in the *Canada Lynx Conservation Assessment and Strategy* (CLCAS) (Ruediger et al. 2000).

Affected Environment—Lynx

Population, Habitat Status and Species Occurrence

Lynx have been documented, historically and currently, throughout the Rocky Mountains of Montana, from the Canadian border through the Yellowstone area. The Seeley-Swan lynx research study area ranges in elevation from approximately 3,900–6,900 feet. Lynx generally occur in moist subalpine fir habitats, above the dry ponderosa pine and Douglas-fir habitat types, and below the alpine zones. In summary, primary lynx habitat in Montana west of the Continental Divide is defined as subalpine forests generally between 4,000–7,000 feet. Cover types may be mixed species composition (subalpine fire, Douglas-fir, grand fir, western larch, lodgepole pine, and hardwoods) as well as stands dominated by lodgepole pine. Moist Douglas-fir and moist grand fir habitat types, where they are intermixed with subalpine fir habitat types, also provide habitat for lynx (Ruediger et al. 2000). Based on field reconnaissance by the Lincoln RD wildlife

biologist, the live islands of timber that survived the fire and the surrounding areas fit criteria for lynx habitat, but are disconnected by large areas of unsuitable burned forests.

Timber harvest on adjacent state and private land has been common. Those forested lands are in various stages of succession depending on the timing of the harvest. Generally, forested cover is less available on private lands as compared to adjacent NF lands. The difference is due in part to past timber harvest but also to the inherent difference in habitat types between low and higher elevations. Open bunchgrass and sagebrush habitats are more common in the lower elevation, privately owned areas and the higher elevation forested habitat types are more commonly NF lands. Access to private land varies, but for the most part is limited and controlled by a few individual landowners. Timber harvest and grazing activities on private lands can be expected to continue throughout the foreseeable future. The bordering private lands are not lynx habitat, consisting of low elevation, dry Ponderosa pine/Douglas-fir and open bunchgrass habitat types.

Verified sightings have been reported within the Copper Creek drainage for years. Post-fire reconnaissance completed by the wildlife biologist found lynx habitat still present in the project area, but the ability to serve as yearlong habitat is marginal because of the amount of acres that went to an unsuitable condition from stand replacement wildfire. During the post-fire reconnaissance in the winter of 2004, lynx tracks were verified along the fire perimeter.

LAUs in the Project Area

LAUs should generally be 16,000–25,000 acres in contiguous habitat and likely should be larger in less contiguous, poorer quality, or naturally fragmented habitat; LAUs should approximate the size of a female's home range and encompass all seasonal habitats (Ruediger et al. 2000). The LAUs will likely encompass both lynx habitat (may or may not be currently in suitable condition for denning or foraging habitat) and other areas (such as lakes, low-elevation ponderosa pine forest, and alpine tundra). In addition, the CLCAS states that conservation measures generally apply only to lynx habitat within the LAUs. The fire affected portions of four LAUs; however, only two LAUs have any activities proposed within them (Table 23). LAUs BL-03 and BL-04 have no proposed activities within or adjacent to them, and will have no direct or indirect affects associated with the salvage harvest. LAU BL-06 and BL-08 were significantly altered because the fire, do contain proposed activities within them, and will be analyzed for direct and indirect effects.

The majority of the fire burned within LAU BL-06, with a small portion of BL-08 being affected as well. All proposed salvaging would occur within BL-06. Unsuitable habitat for this project has been defined as past regeneration harvest units and wildfires logged or burned between 1989 to the present, including the Snow Talon fire of 2003. Field reconnaissance prior to the fire by the wildlife biologist found suitable foraging and/or denning habitat within the project area and the LAU as a whole. After the fire however, only small, unconnected patches of primary lynx habitat remain in a suitable condition.

Environmental Consequences

Chapter 1 identified lynx as an analysis issue. The following effects indicators were used to focus the analysis and disclose relevant environmental effects:

Table 23. LAUs within the project area.

LAU	Acres Habitat in LAU	Acres of Habitat within Fire Perimeter	Acres of Habitat within Fire Perimeter with Mod- to High-Burn Intensity	% of the LAU Unsuitable (post-fire)
BL-03	18,372	5,656	3,826	21
BL-04	10,968	140	103	0.9
BL-06	12,126	9,496	7,034	58
BL-08	22,012	11,770	10,072	48

- Adherence to applicable conservation measures contained in the CLCAS (Ruediger et al. 2000).

Direct and Indirect Effects of Alternative 1

Under this alternative there would be no harvest and burned areas would recover naturally into combinations of foraging and denning habitat as vegetation establishes and trees fall to create patches of cover across the burned area. This alternative should provide a high level of den habitat material (i.e., downed logs). As tree seedlings and shrubs recover across the burned areas, snowshoe hares should begin to colonize the area creating foraging habitat for lynx within 10–15 years. This habitat component would be expected to decline when trees and shrubs begin to self-prune and grow out of reach of hares, or until another disturbance occurs. Under this alternative, additional insect-killed trees are likely in the future but the long-term effects on this disturbance dependent species are not likely to be negative because additional beetle-killed trees would supply denning habitat material and increase conifer seedling and shrub habitat favored by snowshoe hare, a primary lynx prey species. All applicable lynx conservation standards would be met under this alternative. The possibility of lynx using the area would remain constant. Disturbances associated with all action alternatives such as harvesting and increased human activity would not occur. All 27,071 acres of potential lynx habitat within the fire perimeter would remain untreated. There would be no direct, indirect, irreversible, and/or irretrievable effects to lynx under this alternative.

Direct and Indirect Effects Common to Action Alternatives

Proposed salvage logging treatments would occur in habitat currently in an unsuitable condition (moderate- to high-intensity burned areas), or in stands that burned at low or mixed severities. Only dead and dying trees would be removed. Salvage treatments would not affect currently suitable habitat, nor would they affect the ability of sites to eventually become suitable habitat.

The maximum harvesting alternative (Alternative 4) would harvest 3,980 acres of dead and dying trees. Of the 27,071 acres of potential lynx habitat within the project area, 23,991 acres (89%) would remain unharvested. The 89% of the potential lynx habitat left untreated would provide extensive levels of downed woody debris for potential denning habitat across the analysis area. Leave trees and coarse woody debris would also be left in groups scattered within and adjacent to units. Untreated burned areas and areas within units where snags and coarse woody debris were retained would be sufficient actions to meet the intent of the LCAS standard of maintaining suitable denning habitat in patches

larger than 5 acres over at least 10% of the area (Ruediger et al. 2000). Well over 10% of the affected acres within LAUs would be left in patches greater than 5 acres. Only 4–12% of the FS lands affected by the fire would be treated and within those acres design criteria would ensure adequate snags and woody debris would be left onsite to provide potential lynx denning material. Potential foraging and denning habitat still occurs within the project area within live islands.

Unburned and/or unharvested leave areas left to meet the needs of snag dependent species through snag retention (and dead and down woody material) standards would serve to retain future denning habitat surrounded by future foraging habitat. These enhancement activities would improve the area's capability to provide lynx prey habitat as well as serve as traveling habitat between patches of primary lynx habitat within the project area. This would allow a dispersing individual to travel through the project area regardless of harvest activities removing some dead and dying trees within the units. In the project area, desirable habitat conditions for lynx would be produced by natural post-fire succession and project activities. Salvage units would produce a natural mosaic, leaving islands of untreated live and/or untreated burned trees with units dispersed throughout the predominantly untreated burn area. These types of features are recommended in the CLCAS.

All temporary road segments would be completely rehabilitated. Short-term increases in human disturbance would have insignificant effects on lynx because of the areas being currently unsuitable lynx habitat. No long-term adverse effect will result from temporary road segments being built. The area will be in an unsuitable condition for lynx and lynx use of the area during the temporary road construction/rehabilitation timeframe should be limited. The 110 acres of nonsystem jammer trails would be decommissioned under all action alternatives. These roads are currently untraveled, nonsystem, old skid trails. Jammer trail rehabilitation and temporary road construction/rehabilitation could affect other animals in the area, but there is little information available on the effects of roads and trails on lynx or its prey (Ruediger et al. 2000). Lynx are not known to be sensitive to roads and are generally tolerant of human activity (Ruediger et al. 2000). Lynx appear to tolerate moderate levels of snowmobile traffic, readily cross highways and establish home ranges in proximity to roads; several studies have been conducted in areas of dense rural populations and agricultural development, suggesting lynx can tolerate moderate levels of human disturbance (Lynx Biology Team 1999).

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term beneficial effects. Rehabilitation would move the areas toward their premanagement state, which would benefit lynx use and movement within the areas.

All action alternatives would speed recovery of lynx foraging habitat by planting conifer seedlings. Seed sources for recovery are available, but planting is expected to speed recovery and enhance production of cover, travel, and foraging habitat within lynx habitats. Natural post-fire bursts of early successional forage plants should increase the effectiveness of the area for future potential lynx habitat.

Conservation Standards and Guidelines

All applicable standards and guidelines mentioned in the CLCAS have been met via the harvest unit designs, prescriptions and/or mitigation measures.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Of the 27,071 acres of potential habitat within the fire perimeter, only 2,198 acres (8.1%) are identified for harvest. This alternative would leave 91.9% of the potential lynx habitat untreated.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Of the 27,071 acres of potential habitat within the fire perimeter, only 1,083 acres (4.0%) are identified for harvest. This alternative would leave 96% of the potential lynx habitat untreated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Of the 27,071 acres of potential habitat within the fire perimeter, only 3,080 acres (11.4%) are identified for harvest. This alternative would leave 88.6% of the potential lynx habitat untreated.

The approximately 930 acres of harvest within IRAs would increase the acres treated and would further reduce potential snags and dead wood that could contribute to denning habitat structure. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees would be outweighed by the potential of retaining the remaining live trees within the stand. Because of the lack of live stands within the LAUs, any efforts to retain live stands would be a beneficial effect. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage, and human disturbance-related effects would last longer with implementation resulting from more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of a LAU within the project area effect because of the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Cumulative effects on lynx have been varied. Timber harvest activities that clearcut forests temporarily removed both snowshoe hare and red squirrel habitat, thereby reducing prey densities. The harvests also regenerated the forest and provided the early successional forests needed by snowshoe hares. Shelterwood harvests and other selective tree removal methods opened the forest floor to sunlight, most likely stimulating shrub and conifer seedling growth that favored snowshoe hares, yet retained overhead mature cone producing trees needed by red squirrels. Other human developments in lynx habitats such as the Copper Creek campground, hiking trails, and road development within the

drainage probably had very minor direct effects because lynx are for the most part tolerant of human presence (Ruediger et al. 2000). Indirectly, snowmobile use of road systems may create pathways for other predators to reach lynx prey species, previously excluded by deep snows. The possibility of competing predators accessing lynx habitat via compacted snow trails and then out-competing lynx directly or indirectly is a disputed theory. No peer-reviewed, in-depth study has looked at this possible effect. The possibility of a competing predator accessing the project area is possible; however, once the predator leaves the trail, because of snow depths, the predator would insignificantly affect lynx and/or lynx prey. If a coyote or bobcat accessed the area, once they left the confines of the trail their movement would be drastically impaired because of their small foot pads that are inadequately adapted to traveling on top of the snow as lynx due. Lynx pads are adapted to snow travel and during the winter when snow depths within the project area are deep and fluffy, lynx would continue to have an advantage and any potential competition from predators would be insignificant. Despite current debate over whether or not this issue is valid, the CLCAS standard of allowing no net increase would still be met under this project.

The effects of past management activities probably degraded habitats to some degree but in other cases served as a substitute disturbance for suppressed fires. Overall, it is difficult to define past habitat characteristics for lynx on this landscape. The proposed alternatives, however, would mitigate any additional loss of denning habitat by retaining snags and coarse woody debris across all treated units. When combined with unharvested riparian zones and the remainder of the unharvested but burned watershed acres, this should provide an adequate quantity and quality sufficient to meet den habitat requirements for denning female lynx. Lynx have been known to den under singletree stumps and shrubs, or even root wads (Ruediger et al. 2000).

Action alternatives would not cause suitable habitat to become unsuitable and the project would improve habitat suitability by rehabilitating jammer trails and speed recovery of foraging habitat by planting conifers. Displacement of lynx is not expected because lynx are not likely to utilize the burned areas until recovery of foraging habitat occurs. Although the effects of this project would not cumulatively affect lynx or lynx habitat and habitat would remain suitable, habitat would be affected.

No irreversible and/or irretrievable effects would result under any alternative.

Multi-Scale Assessment

Lynx are a disturbance-dependent species (Ruediger et al. 2000). Stands 0–15 years old, while unsuitable to lynx in the short-term, are needed to provide foraging habitat in the future. Levels of unsuitable habitat exceed the standard at the LAU (where we would fully expect such effects from large, naturally occurring fires, such as the Snow Talon fire of 2003) scale for two of the four LAUs directly affected by the fire. Fires of 2000, 2001 and 2003 have provided a substantial “pulse” of unsuitable habitat that would provide foraging habitat within 15 years. Denning habitat appears to not be a limiting factor. While other factors outside of the FS’s control (nontarget trapping mortality, high competing predator populations, etc.) may impede lynx recovery, the actions taken in the Snow Talon fire salvage project are fully compatible with recovering lynx to nonlisted status and consistent with maintaining habitat for viable populations of lynx at the Regional scale.

Conclusion/Determination

Implementation of the actions associated with the Snow Talon proposed salvage sale "May Affect but are Not Likely to Adversely Affect" the Canada lynx and its habitat. This determination is largely based on the fact that all applicable standards and guidelines of the CLCAS are met. Plans that incorporate the standards and guidelines of the CLCAS, and projects that implement them are generally not expected to have adverse effects on lynx, and implementation of these measures across the range of the lynx is expected to lead to conservation of the species (Ruediger et al. 2000). Management activities would move 0 additional acres of lynx habitat to an unsuitable condition. More than adequate potential denning habitat will be maintained within each LAU. Alternative 2 would not alter the current existing condition of the project area to a level that prevents lynx use and dispersal.

Sensitive Species

Summary of Determinations

There are currently 12 terrestrial species identified as "Sensitive" that are known or suspected to occur on the Helena NF (USDA 1999b). These species are listed in Table 24 with determinations and effects summary. Corresponding narratives of basic biology and effects are available in the "wildlife" section of the project record. Analysis of the three sensitive species with habitat present in the project area is analyzed following the table.

Wolverine (Gulo gulo)

Biological Requirements: Wolverines range widely from subalpine talus slopes to big game winter ranges, occupying higher ranges in the summer and riparian habitat in the spring. Ruggiero et al. (1994) believed that wolverines used higher elevations in the snow-free season to avoid high temperatures and human activity. Wolverine habitat is best defined in terms of adequate year-round food supplies in large sparsely inhabited areas, rather than in terms of particular types of topography or plant associations. No particular habitat components or habitat management techniques can presently be singled out for wolverine, success of wolverine may relate to the availability of large areas of remote, rugged uplands that are difficult to access by humans (Hatler 1989). Preferred habitat appears to be large, isolated tracts of land supporting a diverse prey base. Wolverines occur in low densities in all places they have been studied (Ruggiero et al. 1994). This is generally attributed to naturally low reproductive rates and delayed sexual maturity of the species. Food availability seems to be the primary factor determining movement and specific habitat use.

Wolverines are generally solitary animals, which exhibit some fidelity to particular areas for months or years. However, the species is thought to have a flexible behavioral system when changing environmental conditions (e.g., food supply), this supersedes boundary considerations (Hatler 1989). The wolverine is primarily a scavenger, although it will procure most of its own food during the summer months. The eggs and young of ground nesting birds, burrowing rodents, snowshoe hares and berries are favorite summer foods. Wolverines rely on carrion in the winter months; therefore, they rely heavily on the presence of other predators. Wolverines will also search for caches made by itself, other wolverines, or other carnivores during the winter.

Table 24. Summary of determinations for all sensitive species on the Helena NF.

Species	Determination and Summary of Conclusion of Effects
Wolverine (Sensitive)	**May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species**; *Suitable habitat present*. No acres of suitable habitat being moved to an unsuitable condition and no disturbance-related effects occurring. Further analysis of direct, indirect, irreversible, irretrievable and cumulative effects below.
Boreal Toad (Sensitive)	**May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species**; *Suitable habitat present*. No acres of suitable habitat being moved to an unsuitable condition and no disturbance-related effects occurring. Further analysis of direct, indirect irreversible, irretrievable and cumulative effects below.
Black-backed Woodpecker (Sensitive)	**May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species**; *Suitable habitat present*. Large blocks and overall majority of burned acres would be left untreated. Foraging and nesting habitat would remain abundant. Further analysis of direct, indirect irreversible, irretrievable and cumulative effects below.
Fisher (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Northern Goshawk (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Harlequin Duck (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Northern Leopard Frog (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Flammulated Owl (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Townsend's Big-eared Bat (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Northern Bog Lemming (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Columbian Sharp-tailed Grouse (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.
Peregrine Falcon (Sensitive)	**No Impact**; *Habitat not suitable*. No direct, indirect, irreversible, irretrievable, and cumulative effects associated with this project resulting from lack of habitat and species not present. No further analysis is needed.

Affected Environment—Wolverine

Area Use: Wolverine sightings have occurred in the upper portions of the project area. Areas around the head end of drainages, in high, secluded basins within the project area, such as Copper Creek, Red Creek and Cotter Creek were known to be good, pre-fire, wolverine habitat. Post-fire wolverine habitat in the project area remains in the uppermost reaches of these basins, where the fire burned spotty and at lower intensities.

The most far-reaching effect of past management activities has been the development of road systems, recreational trails and sites that improved access and promoted human use in remote areas. Snowmobile use and other motorized vehicles have reduced the remoteness of the premanaged landscape. The Snow Talon fire created temporarily unsuitable conditions for a period of time until vegetation recovers and small mammals and birds begin to repopulate the burned area. Wolverine habitat continues to exist within the watershed and prey population diversity and quantity have been reduced temporarily until vegetation recovers. As studies of wolverine are few and inconclusive, it is difficult to determine the exact effects past management actions have had on wolverine within the watershed. Generally, it is likely that unroaded remote areas are better than roaded and "heavily-used-by-humans" habitats, and activities that enhance the ungulate prey base are better than those that reduce the ungulate prey base.

Environmental Consequences—Wolverine

No key issues or analysis issues specific to the wolverine were identified in Chapter 1; however, sensitive species as a whole were identified as an analysis issue. The following effects indicators were used to focus the wolverine analysis and disclose relevant environmental effects:

- An assessment of effects on potential prey species of wolverine (big game).
- Levels of potential disturbance during the denning period.

Direct and Indirect Effects of Alternative 1

Under this alternative, short-term effects on potential carrion sources would be variable. Short-term effects of limited availability of forage (1–3 years) and loss of thermal cover may benefit wolverine because of potential over-winter mortality of big game animals. The potential mortality is entirely dependent on weather patterns that determine forage production levels (growing season precipitation) or/and winter caloric requirements of big game animals (extreme winter temperatures). Because of the lack of winter range within the project area, these effects should be insignificant. This alternative would have no direct impacts on wolverine.

Additional losses of cover could occur as a result of possible beetle outbreaks within the remaining live stands. These effects should be negligible.

Direct and Indirect Effects Common to Action Alternatives

Actions associated with the project would move 0 acres of habitat to an unsuitable condition. Wolverine use and movement would not be affected. Blocks of land left unmanaged, adequate displacement areas and long-term improvements in big game foraging conditions would result in the wolverine being unaffected and/or benefited.

Wolverine denning habitat parameters were produced for the Lincoln RD based on Copeland's (1996) study of wolverine denning habitat, Heinemeyer and other's (2001) denning habitat model and survey, numerous other literature reviews, discussions with numerous wildlife biologists and on-the-ground knowledge of the District's unique habitat and elevational characteristics. Wolverine denning habitat was analyzed and included the entire Lincoln RD, north of Highway 200. "Potential" as well as "high potential" wolverine denning habitat was mapped.

Potential Wolverine Denning Habitat Parameters:

- All rock cover types >6,200 feet in elevation
- All open meadow cover types >6,200 feet in elevation
- SAF, WBP, ES, SAL and open meadow cover types within 500 feet of 1 and 2
- >35% and <100% slope.

High potential Wolverine Denning Habitat Parameters:

- All rock cover types >6,200 feet in elevation
- All open meadow cover types >6,200 feet in elevation
- SAF, WBP, ES, SAL and open meadow cover types within 500 feet of 1 and 2
- >35% and <100% slope
- N, NE, NW and aspects.

These parameters were chosen in order to map the elevational band of habitat most commonly used by denning female wolverines (high-elevation, cirque basins at or above timberline and the subalpine meadows and/or subalpine forest types within 500 feet below these basins on slopes where snow would remain throughout the denning season).

Only 20 acres of potential denning habitat falls within the proposed units, of which, 0 acres are considered high potential denning habitat. The unit containing potential denning habitat is a proposed helicopter unit; therefore, Alternative 3 would have 0 acres of potential denning habitat within units while Alternatives 2 and 4 would have 20 acres. The direct effect of removing snags by salvage logging would not affect wolverine denning habitat. Wolverine den in high-elevation slopes, steep enough and shaded enough to hold snow throughout the denning period. Habitat type and forest structure is not thought to influence wolverine denning preference, wolverine seem to key in on site location, not specific habitats (Copeland 1996). Salvage harvesting would not directly alter denning habitat structure components. However, harvesting could indirectly affect wolverine depending on the timing and location of activities. Wolverine could potentially be disturbed and displaced by harvesting activities such as helicopter overflights and machinery.

Implementation would occur during summer and winter seasons under all alternatives. Salvaging should not directly affect wolverine habitat, but disturbance related effects could indirectly affect wolverine. Helicopter logging would occur during summer months, outside of the denning period (early February to late March). Therefore, no disturbance and displacement related affects from helicopter logging operations should occur during the critical denning period. Summer helicopter operations could possibly create occasional disturbance related effect to individual wolverines.

Ground-based salvage activities should insignificantly affect wolverine through disturbance-related effects because of the salvaging occurring in the lower portions of the Copper Creek drainage away from high-quality, high-elevation habitat located at the head ends of the basins. If wolverines moved through the lower reaches of the drainage during the ground-based salvaging activities, individual wolverines could be displaced to other areas from the increased human activity. The overall remoteness of the drainage, numerous displacement areas, roadless areas, the Scapegoat Wilderness and areas with no activity occurring should provide adequate hiding and traveling areas for wolverines moving through the area. These abundant remote areas would remain available throughout implementation and no activities would affect wolverine during their critical denning season. Disturbance and displacement related affects would be extremely rare events confined to incidents with individual traveling wolverines and would therefore, be insignificant.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. The only other temporary road segments would be short "jump up" spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely rehabilitated and recontoured. Short-term increases in human disturbance could have effects on wolverines, but no long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits. Rehabilitation would move the areas toward their premanagement state, which would benefit wolverine use and movement within the areas.

Jammer trail rehabilitation should have insignificant negative effects. Short-term increases in human disturbance would be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would beneficially affect wolverine use and movement within the project area.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for wildlife movement quicker than the no action alternative.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in

Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect because of the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The roadless area identified for harvest does not provide quality remote habitat, as do other roadless areas and untreated areas within the project area. Other areas such as the head end of the Red Creek and Copper Creek basins contain live, forested stringers, head ends of basins, and are connected to even larger remote areas outside of the project area. This roadless area is surrounded on three sides by heavily managed private land. The area is marginal in its roadless quality and would not provide security like other areas within the project area. Harvesting within this burnt landscape would not increase effects on wolverine because of the area not containing suitable wolverine habitat. The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees as cover would be outweighed by the potential of retaining the remaining live trees within the stand. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage and human disturbance-related effects would last longer with implementation because of more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect due to the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Cumulative effects on wolverine have been varied. Past vegetative manipulations probably had minor direct effects on this habitat generalist. Past forest management harvest activities benefit wolverine by providing early seral conditions preferred by big game species, an important food source for wolverine. This successional plant stage provided the needed forage in a landscape where fires were being actively suppressed. Harvesting created a diversity of conditions: berry patches, ground and tree squirrel habitat and other foraging sources for wolverine. Human developments such as the Copper Creek campground, hiking trails, and road development within the drainage probably had more effects by increasing human access into once remote areas. Roads that accessed high-elevation basins probably reduced habitat quality the most. Mushroom

picking is an activity with potential to displace or influence wolverine within the burned portions of the drainage. This activity would occur in the spring/summer of 2004 and should bring hundreds of people to the drainage. Snowmobiling occurs throughout the Copper Creek watershed and this recreational activity may be having displacement effects on wolverines. Copeland (1996) believed that over-snow vehicles and increased interest in winter recreation has likely displaced wolverines from potential denning habitat in central Idaho.

All action alternatives would have similar effects on prey availability for wolverine and all action alternatives would decommission old jammer trails. The environmental baseline during winter and non-winter appears to be suitable to sustain wolverine use. Recreational activities may have had displacement effects on wolverine with their introduction to the area, but these activities have been present for decades and seem to be remaining constant. Recreation activities did reduce the habitat quality of certain remote areas, but many large remote areas still exist. Wolverines have been documented in the area for many decades and should remain as long as current conditions do not drastically change. No alternative would have long-term adverse cumulative effects on wolverine or habitat suitability.

Conclusion/Determination

All alternatives would have "May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species," on the wolverine or its habitat.

Boreal Toad (Bufo Boreas Boreas)

Biological Requirements: Recent years have shown a drastic decline in populations across the west, which is largely thought to be a result of unknown atmospheric factors. Nonfunctioning and functioning at risk conditions of riparian areas could be a factor in local declines. Toads normally breed in shallow, muddy portions of ponds and slow streams. Adults inhabit a variety of terrestrial habitats from valley bottoms to high elevation. Progress toward the watershed, fisheries, and riparian desired conditions is used as the primary measure of habitat for this species.

Affected Environment—Boreal Toad

Area Use: Pre-fire sightings of boreal toad were common in and around the project area by Lincoln RD personnel. Suitable habitat is available in the vicinity of the project area, but would not be changed. Reichel's (1995) amphibian and reptile survey of the Helena NF found no boreal toads in any of the four areas surveyed within the Snow Talon fire area. Post-fire habitat has been drastically altered. Toad habitat is now confined to live stringers of timber, riparian areas, wet meadows, etc.

Environmental Consequences—Boreal Toad

No key issues or analysis issues specific to the boreal toad were identified in Chapter 1; however, sensitive species as a whole were identified as an analysis issue. The following effects indicator was used to focus the boreal toad analysis and disclose relevant environmental effects:

- Extent of activities that could cause direct mortality of boreal toads in terrestrial habitats

Direct and Indirect Effects of Alternative 1

The only possible boreal toad habitat in the project area is along creeks and other riparian areas. These areas would remain untreated under Alternative 1. Disturbances associated with all action alternatives would not occur under Alternative 1.

Direct and Indirect Effects Common to Action Alternatives

Implementation of any action alternative would have minimal effects on boreal toads or their habitat. The only possible toad habitat in and around the project area is along riparian areas. These areas would remain untreated due to meeting INFISH standards, guidelines, and BMPs.

The INFISH standards and guidelines would be followed for all treatments within or adjacent to wetland or riparian zones. This would include delineation of the boundaries of identified wetlands. Buffer zones ranging from 100 feet to the 100-year flood plain would be identified around streams and riparian areas within units. No activity would occur within these zones. No harvesting is planned close enough to riparian areas and toad habitat to alter the availability of downed wood recruitment in potential toad breeding habitat. Roadside ditches that hold water long enough into the summer to provide breeding sites would not be protected unless they were associated with streams or other protected sites. These breeding sites would be vulnerable to seasonal dry-up, road maintenance, temporary road construction and rehabilitation and jammer trail rehabilitation. Individuals could be affected by any of these if they occurred while tadpoles were still dependent on water availability. If adult boreal toads were present, individual mortality could occur during harvest or site preparation by vehicles, logging machinery, or road equipment. Individual mortality would be infrequent and the worst-case scenario. Insignificant individual mortality and isolated roadside ditch and puddle habitat effects would not be expected to affect core population levels of boreal toads within the primary, long-term functioning habitats of the project area.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. The only other temporary road segments would be short “jump up” spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely rehabilitated. Construction and rehabilitation could directly affect boreal toad habitat by directly disturbing toad habitat along the roadways. Because of the low habitat capabilities of the area within the next few years, these direct effects should be insignificant. No long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Placement would not alter potential toad habitat. The bridges will be placed and removed following INFISH standards and guidelines, no ground disturbance would occur. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits. Rehabilitation would move the areas toward their premanagement state, which would benefit toad habitat within the areas.

Jammer trail rehabilitation should have insignificant negative effects. Short-term increases in ground disturbance would be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would beneficially affect boreal toad habitat within the project area.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for amphibians quicker than the no action alternative.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect because of the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, INFISH, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees would be outweighed by the potential of retaining the remaining live trees within the stand. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect because of the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Past timber harvest, road construction and maintenance, fires, and fire suppression have likely affected boreal toad habitat in this area. Periodic road maintenance, specifically cleaning out roadside ditches, has probably impacted boreal toads if tadpoles were present and still dependent on ditch water. A reasonably foreseeable Snow Talon fire restoration project would improve road drainage and culverts throughout the drainage. This would produce further short-term effects on tadpoles, depending on the season and location of work. Another reasonably foreseeable action would be measures to control weed species. With INFISH compliance, these reasonable foreseeable actions should improve amphibian habitat in the long-term. Fires probably rarely burn in this species' breeding habitat, although water quality and quantity varies after large fires upstream. Toad reproductive habitat is very well distributed across the Lincoln RD; most is protected by adherence to INFISH.

Conclusion/Determination

Alternative 2 would have "May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species" on the boreal toad or its habitat.

Black-Backed Woodpecker (Picoides arcticus)

Biological Requirements: The black-backed woodpecker is a primary cavity nester inhabiting northern coniferous forests from central Alaska, through most of Canada and into the mountains of the Pacific Northwest, Montana, Idaho, and Wyoming. Black-backs excavate holes in snags and live trees with heart rot. Any abundance of dead and dying trees will provide adequate nesting and foraging sites. The presence of dead and dying trees in open feeding areas (typically, recent burns) and forested communities is a prerequisite for the species. Thomas (1979) suggests they are similar to northern three-toed woodpeckers: approximately 75 acres per breeding pair. Thomas (1979) listed an abundant supply of dead trees with deteriorating heartwood as a special habitat requirement.

Hutto (1995) reported periodic stand replacement fires were very important to black-backed and northern three-toed woodpeckers. Both species became abundant in burned areas the first year after fires. The black-backed woodpeckers quickly colonize forested areas having a large disturbance (stand replacement fire, and insect and disease outbreaks) (Cherry 1997; Hutto 1995). In these instances, dead and dying trees (and associated woodborers and larvae) are abundant enough to allow several woodpecker pairs to nest successfully within an area normally supporting only a single pair prior to the disturbance (Thomas et al. 1997). Use of burned areas decrease significantly after 6 years (Hutto 1995). Once a disturbance has taken place, black-backs may move to areas outside their normal elevation range.

Black-backed woodpeckers utilize a variety of forest size and age classes ranging from poles through old growth. East of the Continental Divide, most suitable unburned habitat is below 7,500 feet; west of the Divide, most is below 6,000 feet (Cherry 1997). Most studies in the northern Rockies have focused on the use of forests that have been hit by stand replacement fire, which is considered optimal habitat. Black-backs will also nest and forage outside large disturbed areas. They are able to find food in live forest habitat

when patches of trees are weakened or killed by insects, disease, small burns, extreme temperatures, rising water tables, and/or other factors. Occurrences of black-backed woodpeckers in these areas are uncommon or rare, and overall population densities in live habitat are low (Hutto 1995).

Affected Environment—Black-Backed Woodpecker

Area Use: Field reconnaissance by the wildlife biologist in the fall of 2003 found suitable habitat present. Sightings should begin to increase and remain common for up to 6 years post-disturbance, peaking in years 3 and 4 (Hutto 1995). No black-backed woodpecker sightings have occurred in the project area since the fire. It is assumed the prey species (wood-boring larvae) for black-backed woodpeckers are or will be present in the project area. Conditions affecting insect population's ability to colonize a post-fire burn include source populations providing the insect colonizers from surrounding areas and overall burn intensity (Powell 1990). Nest site availability may be very high as black-backed woodpeckers frequently excavate nests in hard, intact-topped snags (Powell 1990). Typical black-backed woodpecker nest sites consisted of relatively small, hard snags in unharvested units with high tree densities >50 snags (>9-inch DBH) per acre.

McIver and Starr (2000) reported that of four species monitored in four studies, only black-backed woodpeckers showed a consistent response to logging, with significantly more nests found in unharvested sites. Black-backed woodpeckers occupy salvage logged areas at much lower densities than unharvested, burned forests (Powell 1990) or favored unharvested controls (Saab and Dudley 1998). Literature recommends avoidance or postponement of post-fire logging for 3–5 years after fire (Cherry 1997; Dixon and Saab 2000), or, if harvest begins prior to this time, retain large portions of the dead and dying trees. Specifically, Cherry (1997) recommends retaining 50% of the burned areas when the fire is less than 5,000 acres, leaving 40% of the burned acres when the fire is 5,000-10,000 acres and leaving 30% of the burned acres in fires over 10,000 acres. Other recommendations include treating blocks of land and leaving blocks of land (Hutto 1995) and retaining an average of 0.59 snags per acre >12 inch-DBH and 1.21 snags per acre >10 inch-DBH in clumps (Thomas 1979).

High potential black-backed woodpecker habitat was determined to be pre-fire stands of 80+ age stands that burned at moderate-high intensity. Other stands within the fire area could serve as habitat for the black-backs, but these parameters were chosen to show the higher quality habitats. The Snow Talon fire burned a total of 37,706 acres. 34,362 acres burned on FS land, with 3,342 acres burning on private and state lands. Of the 34,362 acres of FS affected lands, approximately 16,697 acres of potential black-backed habitat exists within the project area. Additional potential habitat exists, but cannot be accurately estimated, within the 3,342 acres of private and state land.

Environmental Consequences—Black-Backed Woodpecker

Chapter 1 identified black-backed woodpecker as an analysis issues. The following effects indicator was used to focus the black-backed woodpecker analysis and disclose relevant environmental effects:

- Acres and percent of habitat left remaining within the fire and project area.

Chapter 1 identified snags and down wood habitat as an analysis issue. How the removal of snags would effect the black-backed woodpecker is included in this section. Effects to snag and downed wood habitat (in general) are described above.

Direct and Indirect Effects of Alternative 1

In this alternative, no additional snags would be felled except where they pose a serious threat to human safety, such as along trails and near administrative sites. Spruce beetle and Douglas-fir beetle populations would be expected to increase, creating more potential black-backed woodpecker habitat over a larger landscape. Within approximately 6 years, black-backed woodpecker populations would naturally decline in the burned areas, following the decline in beetle larvae. All habitat recommendations would be met. This alternative would retain the maximum amount of habitat for black-backs.

Direct and Indirect Effects Common to Action Alternatives

Salvage units within potential black-backed woodpecker habitat would reduce the area's ability to serve as black-backed woodpecker habitat. Even with following snag retention guidelines, salvaged units would not provide high-quality habitat after implementation. Based on research in the Northern Rockies (Hutto 1995), many of the leave patches within units may be too small for use by black-backed woodpeckers, but other cavity nesters would use these areas. Following the guidelines from Hutto (1995), this analysis determined high-quality habitat to be pre-fire 80+ age stands, which burned at mod-high intensity. Stands meeting these criteria that are salvaged would still provide habitat for black-backs, but these stands will not be counted as high-quality acres.

As shown in Table 25, 80 to 95% of the available high-quality, black-backed woodpecker habitat would remain untreated, depending on which action alternative was implemented. This does not include habitat within the private land portion of the fire perimeter, which may also be providing black-backed woodpecker habitat.

Table 25. Affects of salvage on Black-backed Woodpecker habitat on Helena NF lands.

Alternative	Acres of Pre-fire 80+ age Stands which Burned Mod-High Intensity (Potential Habitat)	Acres of Potential Habitat within Harvest Units	% of Suitable Habitat Remaining
2	16,697	2,055	87.7
3	16,697	855	94.9
4	16,697	2,896	82.7

Forest Plan standards for snag management and guidelines of the Northern Region Snag Management Protocol would be met and followed for all alternatives (USDA 2000b). The Northern Region Snag Management Protocols would be followed, leaving clumps of snags within and/or adjacent to units. This follows Thomas' (1979) recommendations as well as Cherry (1997) and Hutto (1995). Depending on the size of untreated clumps within the salvage units, it is unlikely that black-backed woodpeckers would utilize these retained snag clusters to any degree, but snag clusters within units would benefit other local cavity nesters. Unharvested areas surrounding harvest units would provide high-quality habitat for black-backs. In addition to snag retention standards within and

adjacent to salvage units, all nonmerchantable timber would be left standing and available for use by black-backed woodpeckers.

The construction of temporary road segments would have insignificant effects. Dead and dying trees would be removed to build the 1,000-foot section of temporary road. This would not remove additional high-quality habitat because of the road segment being located within salvage units. Other temporary "jump up" road segments would not remove black-back habitat, these short segments would occur within the road buffer zone where dead and dying trees have already been removed during fire rehabilitation. All temporary road segments would be completely rehabilitated. No long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Placement would not alter potential habitat.

Jammer trail rehabilitation should have insignificant effects. Snags and down wood habitat quality is low along the existing trails. The 110 acres of rehab work would put the old trails back to contour. The long-term effect of restoring the area would be a beneficial effect.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area recover quicker than the no action alternative. Tree planting would speed succession and produce a mature stand of timber quicker than the no action alternative; this would produce a long-term benefit.

Direct and Indirect Effects of Alternative 2

Of the 16,697 acres of potential black-backed habitat, 2,055 acres would be treated. Only 12.3% of the high-quality habitat would be treated, leaving 87.7% of the available, high-quality, black-backed habitat untreated. No additional effects are specific to Alternative 2 other than what is described above.

Direct and Indirect Effects of Alternative 3

Of the 16,697 acres of potential black-backed habitat, 855 acres would be treated. Only 5.1% of the high-quality habitat would be treated, leaving 94.9% of the available, high-quality, black-backed habitat untreated. No additional effects are specific to Alternative 3 other than what is described above.

Direct and Indirect Effects of Alternative 4

Of the 16,697 acres of potential black-backed habitat, 2,896 acres would be treated. Only 17.3% of the high-quality habitat would be treated, leaving 82.7% of the available, high-quality, black-backed habitat untreated. All snags and down dead wood would not be removed within units, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units, supporting cavity-nesting birds such as the hairy woodpecker. Because of treatment, black-backed woodpecker habitat would be expected to decline within units, but throughout the project area, only 17.3% of the potential black-backed habitat would be treated.

The approximately 930 acres of harvest within IRAs would increase the acres treated and would further reduce acres available to serve as high-quality habitat. Design criteria

would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Removing these dead and dying trees would reduce habitat quality for black-backs within the beetle salvage units and increase total acres treated by the alternative.

Alternative 4 would reduce the most acres out of all alternatives. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees). Alternative 4 meets and exceeds recommendations from: leave 30% of the burned acres in fires over 10,000 acres untreated (Cherry 1997); treat blocks of land and leave blocks of land (Hutto 1995); and retain an average of 0.59 snags per acre >12 inch-DBH and 1.21 snags per acre >10 inch-DBH in clumps (Thomas 1979).

Cumulative Effects Common to All Alternatives

Across the Helena NF within the last 4 years, large acreages of black-backed woodpecker habitat were created by wildfires such as the Cave Gulch, Maudlow-Toston, High Ore, and Moose-Wasson fires. During the winter of 1988-1989 within the project area, extensive acreages of trees were frost killed. This frost kill resulted in an extremely high level of available snags within the area. Many of these snags are still standing and should contribute important nesting habitat for black-backs. Insect and disease outbreaks have also occurred within the last few years.

Considerable acreages of dead trees occur in areas outside of the timber base, and would provide well-distributed habitat for this species for 5–6 years. The 3,342 acres of potential black-backed woodpecker habitat on state and private lands within the Snow Talon fire area should have a higher percentage salvaged than the 34,362 acres on FS land. The 1,800-acre Moose-Wasson fire, 20 miles west of the Snow Talon fire, would not be salvage harvested.

Black-backed woodpecker monitoring surveys were initiated in response to the Cave Gulch fire (USDA 2003g). The monitoring protocol used Dudley and Saab's (2003) field monitoring protocol as a reference and template in order to design the site-specific model for the two large fires on the Helena NF during the fire season of 2000. Black-backs were monitored visually and aurally in years 2, 3 and 4 post-fire, year 5 in ongoing. Observations were plotted and analyzed for areas of recurring activity to determine black-backed concentration areas. Transects were monitored in a control (unsalvaged) area and a prescription (salvaged) area. Results showed similar conclusions as referenced literature. Black-backs were observed in salvaged and unsalvaged areas, but black-backs concentrated on unsalvaged areas. Findings showed black-backed woodpeckers moved into the fire area, foraged throughout the fire area, but concentrated on unsalvaged stands. Similar results are expected in the Snow Talon fire area. Because of the extremely low percentage of acres treated by this project, black-backed woodpeckers should be minimally affected.

Conclusion/Determination

Alternative 2 "May Impact Individuals or Habitat, but Will Not Likely Result in a Trend Toward Federal Listing or Reduced Viability for the Population or Species" of the Black-

backed Woodpecker or its habitat. The harvest prescription associated with the project would comply with Hutto (1995) recommendation of treating blocks of land and leaving blocks of land; Thomas' (1979) recommendations that to achieve 100% capacity for black-backs, retain 0.59 snags per acre >12-inch DBH and 1.21 snags per acre >10-inch DBH in clumps; and Cherry (1997) recommendation of retaining 30% of the burned acres in fires over 10,000 acres.

Management Indicator Species (*Forest Plan*)

All MIS identified in the Helena NF Plan are addressed below.

Affected Environment—MIS

MIS species analyzed on the Helena NF are (USDA 1986):

- Endangered species, river and lake suitability—Bald Eagle
- Threatened species, habitat effectiveness—Grizzly Bear
- Old growth Habitats- Pileated and Hairy Woodpecker and Northern Goshawk
- Mature Conifer Forests—Pine Marten
- Competition from domestic stock—Bighorn Sheep
- Hunted species—Elk, Mule Deer, Moose, Mountain lion.

Of the 11 MIS species listed in the *Forest Plan*, ten of the species have suitable habitat present in and around the project area. No Bighorn sheep habitat exists within the project area. There would be no direct, indirect, irreversible, irretrievable, and/or cumulative effects associated with this project resulting from lack of habitat and species not being present. No further analysis is of Bighorn sheep is needed. Bald eagle and grizzly bear direct, indirect, irreversible, irretrievable and/or cumulative effects are analyzed above in the threatened and endangered species section. *Forest Plan* standards for all MIS species habitat would be met under all alternatives of the Snow Talon fire salvage project. The remaining three MIS guilds are analyzed in detail below.

Environmental Consequences—MIS

Chapter 1 identified MIS species as a whole as an analysis issue. Old growth habitat and old growth MIS were identified in Chapter 1 to be a key issue. MIS species are addresses under separate MIS habitat group sections in Table 26. Endangered species and threatened species have been covered in previous sections. Competition with domestic stock group is not covered because no bighorn sheep habitats exist in the project area.

Old Growth Species

Pileated Woodpecker (Dryocopus pileatus)

The pileated woodpecker is the largest woodpecker in North America and was selected as a MIS species for many NFs because its highest densities occur in old growth conifer forests (Bull, Holthausen, and Henjum 1990). Because of pileated woodpecker's large size, they need large dead trees for nesting, roosting and foraging. East of the Cascades,

Table 26. Summary effects of all MIS species on the Helena NF.

MIS Species Group	Acres of Habitat within Project Area/Analysis Area.	*Forest Plan* Standard (USDA 1986) to Ensure Habitat Viability	% Reduction of the *Forest Plan* Standard	Meets – Does Not Meet – N/A (*Forest Plan* Standard)
Endangered Species Group (*Bald Eagle*)	34,362 acres. Incidental overflights could occur over the entire project area.	No Loss of Active Nest Success	0	Meets
Threatened Species Group (*Grizzly Bear*)	34,362 acres. The entire project area could serve as grizzly habitat.	No More that 10% Reduction in Habitat From Previous Measurement	0	Meets
Old growth Species Group (*Pileated and Hairy Woodpecker and Northern Goshawk*)	3,797 acres of old growth and replacement old growth remains.	No More that 10% Reduction in Habitat From Previous Measurement	Alternative 4– 3.4% 0	Meets
Mature Conifer Forest Group (*Pine Marten*)	7,896 acres of post-fire, mature conifer forests remains in isolated live islands within the burn area.	No More that 10% Reduction in Habitat From Previous Measurement	0	Meets
Competition with Domestic Stock Group (*Bighorn Sheep*)	No Bighorn sheep habitat exists. Sheep are not known to inhabit the area.	No More that 10% Reduction in Habitat From Previous Measurement	0	N/A
Hunted Species Group (*Elk, Mule deer, Moose, and Mountain lion*)	34,362 acres. The entire project area could serve as big game habitat.	No More that 10% Reduction in Habitat From Previous Measurement	0	Meets

pileated woodpeckers excavate a dome shaped nest cavity with an entrance 4–5 inches high and 3–4 inches wide, typically in dead Ponderosa pine or western larch (Bull 1987). The cavity is 8–10 inches wide, approximately 24 inches deep and 30–60 feet off the ground (Bull, Holthausen, and Henjum 1990), once the woodpeckers abandon these cavities, many other secondary cavity nesters may use them, including owls such as the Northern Saw-whet owl. An active nest can be easily detected from late March until mid-May resulting from nest excavation producing very conspicuous, 30-foot radius of wood chips surrounding the nesting tree. Pileated woodpeckers primarily forage in dead or dying snags where carpenter ants (*Camponotus* species [spp.]) are found.

Hairy Woodpecker (Picoides villosus)

The hairy woodpecker is a primary cavity nester in coniferous and deciduous forests. Beetle larvae, ants, caterpillars and adult beetles account for the majority of their diet. In the winter, foraging for seeds is also prominent. Hairy woodpeckers may concentrate in areas of insect outbreaks responding to increases in food source, similar to black-backed woodpeckers. They are opportunistic, feeding on tree trunks, stumps, exposed roots, snags, downed logs and logging debris (Thomas 1979). Hairy woodpeckers use

Douglas-fir and Ponderosa pine forests and riparian areas. They use a variety of age classes, but do not usually nest in younger stands (Thomas 1979). Hairy woodpeckers use tree cavities for roosting, winter cover, nesting and rearing young. Thomas (1979) recommended minimum DBH of 10 inches and height of 15 feet for hairy woodpecker nesting trees, while optimum diameter range for nest trees would be 9.8–13.7-inch DBH and height of 20–40 feet. Thomas (1979) also found 180 snags per 100 acres, or 1.8 per acre, was necessary to support the maximum number of hairy woodpeckers.

Northern Goshawk

Goshawks are fast and maneuverable, and often hunt by perching in cover followed by short, sudden attacks on prey or by fast flights through forest openings or along forest edges (The Wildlife Society 1996). Douglas-fir and western larch have been reported to be the preferred species of nesting trees for goshawks in the northern Rockies; however, Hayward (1983) and Patla (1990) noted use of lodgepole pine. Lodgepole pine was used as nest trees 61% of the time on the Beaverhead NF, usually in close proximity to openings and water sources (Lemke 1994). The primary prey of goshawks in the Northern Region include red squirrels, ground squirrels, snowshoe hares, woodpeckers, flickers, jays, grouse, robins and other passerine species (Warren 1990). Goshawks are opportunistic, taking an extremely wide variety of birds and mammals.

Goshawk sightings occurred in the project area pre- fire. As described above, the goshawk will not be analyzed in detail. Burned forests are unsuitable habitat for goshawk; therefore each of the alternatives in this project would have “No Impact” on northern goshawks or their habitat. However, in addition to being a sensitive species, goshawk in a MIS species for old growth habitat and limited suitable old growth habitat remains in unburned patches of the project area. These remaining patches of live old growth are unconnected and not currently large enough to provide yearlong goshawk habitat. These small patches of old growth will be analyzed in this section however. Long-term, as succession moves towards mature stands of timber, the mosaic burn of the area should benefit goshawk, as well as, all old growth habitats in the future. There will be no further discussion specific to goshawk.

Affected Environment—Old Growth Species

The Pileated and Hairy Woodpeckers and the Northern Goshawk are MIS species for old growth habitats. *Forest Plan* standard for old growth habitat viability is no more than 10% reduction in habitat from previous measurement within an analysis area (USDA 1986). The *Forest Plan* identifies old growth as stands characterized by high levels of standing and down, dead and rotting woody material. Green et al. (1992) provides a further description of NF-specific definitions by cover type and old growth types. Old growth types identified in Green et al. (1992) were used to create long-term old growth management guidelines. *Forest Plan* standard for old growth is to manage 5% of each third-order drainage for old growth. Old growth acres should be prioritized as lands identified below 6,000 feet, located in riparian zones and mesic drainage heads, and occur within MAs emphasizing wildlife habitat (USDA 1986). The old growth MIS analysis will analyze all watersheds directly affected (burned) by the Snow Talon fire. All eight watersheds directly affected by the fire will comprise the direct, indirect and cumulative effects analysis area for old growth MIS species habitat.

The Snow Talon fire burned much of the area's old growth forests, removing the old growth character, transitioning stands from old growth to snag habitat and moving many of the watersheds below the *Forest Plan* standard for old growth management. To bring old growth management into *Forest Plan* standards, replacement old growth stands (stands managed to meet old growth characteristics in the future) were identified, mapped and designated. These stands are extremely close (within 5–10 years) to meeting Green and other's (1992) definition for old growth resulting from a large disturbance affecting the project area approximately 195 years ago. These identified and mapped stands will be managed for old growth, meeting *Forest Plan* standards. Table 27 identifies the past-fire old growth in the project area.

The analysis area will comprise 66,206 acres. Currently, 3,797 acres within the analysis area (all eight watersheds directly affected by the fire) meet the East-Side Montana Zone criteria for old growth and replacement old growth. The entire Helena NF is considered an eastside forest, including the Lincoln RD (Green et al. 1992).

Pre-fire stands within the project area had substantial snag components present. Copper Creek was dominated by lodgepole pine/subalpine fir stands on north and east slopes, lodgepole pine/Douglas-fir stands on south and west slopes and whitebark/fir/lodgepole stands in the higher elevations along the ridges. Because of an extreme cold spell in the late 1980s, frost-killed snags were widespread throughout Copper Creek. The majority of these snags were lodgepole pine, subalpine fir and some spruce, most of which were marginally suited for pileated habitat. The project area had substantially more snags present than recommended in the *Northern Region Snag Management Protocol* for the clusters most appropriate for the area (USDA 2000b). Pre-fire, VRU Clusters 3, 4, 6, and 7 were present to some extent within the project area, the majority of the area however, was made up of VRU Clusters 3 (cool, Douglas-fir on steep slopes) and 6 (high-elevation spruce/fir/lodgepole pine). Pileated and hairy woodpeckers were known to use the area pre-fire. Substantial hairy habitat was present; however, limited high-quality pileated woodpecker habitat was present. Low-elevation old growth stands such of ponderosa pine and larch do not exist within the project area. Pileated woodpeckers used Douglas-fir dominated stands.

Table 27. Past-fire old growth and replacement within project area.

Drainage	Total Acre	Old Growth (Acre)	% Old Growth
Keep Cool Cr. (209)	3,538	417	11.8
Look Out Cr. (501-4)	4,067	248	6.1
Baking Powder/Falls Cr. (501-5)	9,686	523	5.4
Upper Copper Cr. (502-1)	16,927	948	5.6
Snowbank Cr. (502-2)	4,832	246	5.1
Lower Copper Cr. (3CS)	6,223	317	5.1
Lower Landers (3LF-1)	14,696	749	5.1
Tom's Gulch (3LF-2)	6,237	349	5.6

Environmental Consequences—Old Growth Species

Chapter 1 identified old growth habitat and old growth MIS as a key issue. The following effects indicators were used to focus the old growth analysis and disclose relevant environmental effects:

- Adherence to the *Forest Plan* standards for old growth management
- Adherence to the *Forest Plan* standards for old growth MIS habitat reduction.

Direct and Indirect Effects of Alternative 1

All old growth and replacement old growth habitat within the analysis area would remain untreated under Alternative 1. Disturbances associated with all action alternatives would not occur under the Alternative 1. Spruce beetle and Douglas-fir beetle populations would be expected to increase, which would result in further reductions of old growth habitat over a larger landscape. No pheromone traps would be used with this alternative, which could lead to higher levels of susceptibility of the remaining patches of old growth.

Direct and Indirect Effects Common to Action Alternatives

All alternatives would meet *Forest Plan* standards for old growth management and MIS old growth species. No reduction of old growth MIS habitat would occur under any alternative. Post-burn surviving old growth stands and surviving replacement old growth stands were identified and designated for long-term management to meet *Forest Plan* old growth management standards. No harvest would occur in old growth or replacement old growth stands that meet or exceed minimum old growth characteristics. Any units with live islands of old growth and/or replacement old growth stands would not have their old growth or replacement old growth character reduced through harvesting. Pileated and Hairy woodpecker and Northern Goshawk and their representative guild of species would be unaffected by these alternatives. No suitable habitat present would be treated under these alternatives and there would be no direct and/or indirect effects on old growth. All 3,797 acres of old growth MIS habitat within the eight watersheds in the analysis area would remain untreated.

The construction of temporary road segments would have “No Effect.” No old growth would be removed during construction and/or rehabilitation of temporary roads. No long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have no direct and indirect effects. Placement would not alter old growth habitat.

Jammer trail rehabilitation should have insignificant effects. No old growth habitat exists within the old logging units where the rehabilitation would occur. The 110 acres of rehabilitation work would put the old trails back to contour. The long-term effect of restoring the area would be a beneficial effect.

Tree planting would initiate quicker regeneration than the no action’s natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area recover quicker than the no action alternative. Tree planting would speed succession and produce old growth stands quicker than the no action alternative; this would produce a long-term benefit.

Snag and woody debris retention guidelines implemented for all alternatives would retain adequate amounts of dead woody components to facilitate old growth habitat in the future. As tree planting and natural regeneration begin to transition into older forested types once again, stands within the project area as well as within harvest units could become old growth stands once again.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. This alternative would harvest more acres than any other alternative. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units, retaining essential old growth components for future old growth stands in the area.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. These proposed units would only be salvaged if the stands were infested and killed by beetle outbreaks. The beetle outbreaks would be a natural disturbance in response to the weakened trees. This disturbance, similar to the fire, would kill old growth stands and therefore, remove the stands' old growth character. Salvaging dead and dying trees from these stands would not reduce old growth habitat because the stands no longer provide old growth habitat. Beetle infestations would move stands from old growth habitat to snag habitat, salvaging would remove snag habitat, but would not remove any acres of suitable, live, old growth habitat. *Forest Plan* standards for old growth management and old growth MIS species would be met. No reduction in MIS habitat would occur.

Approximately 130 acres of old growth and/or replacement old growth stands fall within proposed salvage units. If salvaged, the stands' could potentially be treated in a manner that reduces old growth characteristics, if so, the stands would no longer meet old growth definitions and would no longer serve as old growth MIS habitat. This would reduce old growth MIS habitat from 3,797 acres to 3,667 acres. This would result in a 3.4% reduction in old growth MIS habitat, well under the *Forest Plan* Standard of no more than a 10% reduction in habitat within an analysis area. For further *Forest Plan* old growth compliance information, see the forestry section.

Alternative 4 would treat more acres than any other alternative. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Forest Plan guidelines were followed to delineate old growth stands. These stands were identified, mapped and designated as long-term old growth MAs. These areas make up ≥5% of each drainage. *Forest Plan* standards for MIS species would be met, 3.4% reduction in old growth MIS habitat would occur under any Alternative 4. Alternatives 1, 2, and 3 would reduce 0 acres of old growth MIS habitat.

No irreversible and/or irretrievable effects would result under any alternative.

Mature Conifer Forest Species

Pine Marten (Martes americana)

Pine marten is an indicator species used to monitor the quality of large continuous blocks of mature cover. Ruggiero and others (1994) found marten used a variety of structures to make their dens, trees, logs and rocks accounted for 70% of the den sites. In virtually all cases where den sites involved standing trees, logs and snags, dens were found in large structures characteristic of late-successional forests. Pine marten occur at low densities in the higher elevations and they prefer mature forests, especially during the winter. This is related to snow depths and density of preferred prey. Marten associate closely with mesic, late-successional coniferous forests and generally avoid habitat that lack overhead cover (Ruggiero et al. 1994).

Affected Environment—Mature Conifer Forest Species

MIS Guild Habitat Viability

Pine marten is a MIS species for mature conifer suitability. *Forest Plan* standard for pine marten habitat viability is no more than 10% reduction in habitat from previous measurement within an analysis area (USDA 1986). Mature conifer forests are forests 120+ age stands. These stands provide adequate canopy cover and down dead wood habitat to provide species such as marten with foraging, denning, resting, and hiding cover.

Pre-fire: Suitable pine marten habitat existed within the project area under pre-fire conditions. The wildlife biologist verified tracks along the lodgepole benches east of Indian Meadows Guard Station and along Stonewall Ridge.

Post-fire: The project area contains isolated islands of mature conifer and old growth forests, surrounded by stand-replacement burned areas. Because of marten preferring habitats with overhead canopy structure and ground cover, marten use within the moderate- and high-intensity burn areas should be unlikely for several years post-fire. Marten could use the mature conifer forests that survived the fire; however, marten use of an isolated patch of mature timber surrounded by a large high-intensity burn area void of overhead cover is unlikely for several years post-fire. Marten will most likely avoid the project area and not be able to safely move from one surviving mature conifer stand to another until regeneration occurs to a level providing overhead cover. At this time, marten will move from surviving stands of mature conifer forests by utilizing downed wood habitat and regeneration for overhead cover. Marten could reoccupy riparian areas sooner than other burnt stands within the project area.

Approximately 21,903 acres of 120+ age conifer stands occurred within the project area pre-fire. The fire reduced these areas to approximately 7,896 acres. These 7,896 acres make up the remaining mature conifer forest habitat. The majority of these acres occur around the periphery of the fire and within islands of live timber that is surrounded by large burned areas. For in-depth information on vegetation types see the nonconiferous vegetation effects analysis section, located in Chapter 3.

Environmental Consequences—Mature Conifer Forest Species

Chapter 1 identified MIS species as a whole as an analysis issue. Mature conifer forest MIS species were not specifically identified as a key issue or an analysis issue in Chapter 1. The following effects indicators were used to focus the mature conifer forest analysis and disclose relevant environmental effects:

- Acres of mature conifer forest habitat left remaining within the fire and project area
- Adherence to the *Forest Plan* standards for old growth MIS species habitat reduction.

Direct and Indirect Effects of Alternative 1

All mature conifer forest habitat in the project area would remain untreated under Alternative 1. Disturbances associated with all action alternatives such as harvesting and increased human activity would not occur under the Alternative 1. Spruce beetle and Douglas-fir beetle populations would be expected to increase, which would result in further reductions of mature conifer habitat over a larger landscape. No pheromone traps would be used with this alternative, which could lead to higher levels of susceptibility of the remaining patches of old growth.

Direct and Indirect Effects Common to Action Alternatives

The pine marten and its representative guild of species would not be affected by this project. Of the 7,896 acres of mature conifer forest stands within the project area, 0 acres would be removed. *Forest Plan* MIS standards would be met under all alternatives, no reduction in mature conifer forest habitat would occur.

The construction of temporary road segments would have insignificant effects. No mature conifer forests would be removed during construction and/or rehabilitation of temporary roads. No long-term adverse effect will result from temporary road segments being built.

Placement and removal of the two temporary bridges would have insignificant direct effects. Placement would not alter mature conifer habitat.

Jammer trail rehabilitation would have insignificant effects. No mature conifer habitat exists within the old logging units where the rehabilitation would occur. The 110 acres of rehab work would put the old trails back to contour. The long-term effect of restoring the area would be a beneficial effect.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area recover quicker than the no action alternative. Tree planting would speed succession and produce stands of mature conifers quicker than the no action alternative; this would produce a long-term benefit.

Snag and woody debris retention guidelines implemented for all alternatives would retain adequate amounts of dead woody components to facilitate mature conifer and high-quality marten habitat in the future. As tree planting and natural regeneration begin to transition into older forested types once again, stands within the project area as well as within harvest units could become high-quality marten habitat once again.

Direct and Indirect Effects Common to Alternatives 2 and 3

The remaining islands of mature conifer's ability to provide habitat components would remain constant. 0 acres of habitat would be reduced to an unsuitable condition. Any units with live islands of timber would not be harvested. By following INFISH guidelines, no riparian areas would be altered. The area's ability to provide habitat components would remain constant, with no net loss of habitat resulting with the implementation of any alternative. The <1,000 feet of temporary road would not be built through mature conifer habitat. The majority of the area targeted for harvest did not underburn, but stand-replaced at a moderate- to high-marten or any mature conifer dependent species.

Marten and their representative guild of species would be unaffected by these alternatives. No suitable habitat present within the project area would be treated under these alternatives and there would be no direct and/or indirect effects on old growth.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. This alternative would harvest more acres than any other alternative and would have the greatest direct effects on snags and downed wood. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units, retaining adequate essential components for future mature conifer stands and marten habitat in the area.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Removing these dead and dying trees would reduce the possibility of beetle infestations spreading and could potentially benefit the remaining mature conifer stands. Adequate amounts of standing dead and down dead material would be left on site within units, retaining the areas suitability to serve as marten habitat. These proposed units would only be salvaged if the stands were infested and killed by beetle outbreaks. The beetle outbreaks would be a natural disturbance in response to the weakened trees. This disturbance, similar to the fire, would kill the mature conifer stand and therefore, remove the stand's mature conifer forest character. Beetle infestations would move the stands from mature conifer forest habitat to snag habitat. Salvaging would remove snag habitat, but would not remove any acres of suitable, live, mature conifer forest habitat. Overall *Forest Plan* standards for old growth would be met and MIS standards would be met as well. No reduction in MIS habitat would occur.

Alternative 4 would treat more acres than any other alternative. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Forest Plan standards for MIS species would be met, no reduction would occur under any alternative. The remaining islands of mature conifer stand's ability to provide habitat components would remain constant. No acres would be reduced to an unsuitable condition with the implementation of any alternative. Live islands of timber would not be harvested under any alternative. By following INFISH and BMP guidelines, no riparian areas would be altered under any alternative.

Within the last several years across the Helena NF, wildfires, frost kills, insects and disease have created large acreages of snags. Many of these snags are still standing post-fire. Resulting from large amounts of pre-fire insect and frost killed trees within the project area, many areas burned by the Snow Talon fire still currently provide adequate downed wood habitat in different stages of decay. Marten should have large amounts of high-quality habitat in the future as regenerating stands begin to mature within the heavy downed and dead wood areas.

No irreversible and/or irretrievable effects would result under any alternative.

Affected Environment—Hunted Species

Elk (Cervus elaphus)

The Bob Marshall Complex elk management unit (EMU) is located within the Snow Talon fire salvage project area. The EMU meets previous *Forest Plan* standards for elk security. Highway 200 borders the EMU to the south and the Continental Divide to the east. Any activities occurring within the project area would take place in the Bob Marshall Complex EMU only (MDFWP 1992). The *Forest Plan* defines elk hiding cover as cover that hides 90% of an elk at 200 feet or a stand of coniferous trees having a crown closure of greater than 40% (USDA 1986). In addition, elk hiding cover does not necessarily provide security; stands not meeting hiding cover definitions may provide security, given local conditions of topography, location and size. In order to better address elk vulnerability, the Helena N.F. has opted to implement the Hillis (et al. 1991) method of determining elk security. The Hillis Paradigm states for an area of hiding cover to be considered secure, an area must be ≥250 acres and be ≥0.5-mile from an open road during general hunting season (Hillis et al. 1991). It is recommended that security areas comprise ≥30% of the analysis unit. For this analysis, the Hillis Paradigm was used to calculate security area habitat. Overall, the project area is secure because if the low open-road density. Because of the effects of the fire, hiding cover has been significantly reduced. No new, permanent roads would be constructed under any alternative.

Elk use of the project area is light, but occurs throughout the entire drainage during the summer and fall. Winter range within the project area is very limited, only the lower portions of the project area are used in light snow years as winter range habitat. No proposed activities would occur within elk winter range. The majority of elk use within the area is during the summer and fall where elk spend time in the upper basins within the drainage.

Mule Deer (Odocoileus hemionus)

Mule deer use of the project area is similar to elk use. Mule deer use the entire drainage during summer and fall; spending the majority of their time on drier, more open timbered ridges.

Moose (Alces alces)

The Shiras moose, a northern Rocky Mountain subspecies, is native to Montana. Moose are found at low densities throughout the Blackfoot River Valley. Because of their solitary nature coupled with a lack of moist early successional or riparian habitats, moose densities in the areas outside of the river bottom are low. Although moose do use nearly all types of mountainous habitats, moose densities seem to be roughly correlated with the extent of swampy, boggy, riparian types found in a general area (Whitaker 1996).

During winter, moose sightings are concentrated south of the project area. During winter field surveys the past several winters, the wildlife biologist has verified cutting units from the 1970s, in Township 15N; Range 8W; Sections 26, 27, and 22, to be moose winter range. Moose concentrate along Copper Creek and feed on brush species within the old clearcuts during the winter months. These wintering areas are south of the project area. Throughout the rest of the year, moose inhabit the project area, concentrating in wet, boggy, brushy habitat around Indian Meadows and Copper Creek.

Mountain Lion (Felis concolor)

Mountain lions are solitary animals and known to inhabit the Blackfoot River Valley, as well as the project area. Mountain lion numbers are probably higher now than they were decades ago. The heavy winter of 1996-1997 produced a severe winter-kill of deer that affected mountain lion's prey availability. A limited harvest of lions based on a quota system is allowed in the Blackfoot area. Lions are distributed by the way their prey is distributed. The lions' primary diet element is deer; however, elk can also be a large portion of their diet, depending on availability. By maintaining areas of seclusion and a solid prey base, a viable population would continue to be maintained. There is little doubt that the current large elk and white-tailed deer populations have contributed to an increasing mountain lion population. This is a classic example of predator prey relationship whereby abundant prey allows for expansion of the respective predator. The current status of the mountain lion in the Blackfoot River Valley is not definitive, but generally thought to have stable numbers and displaying a larger proportion of younger age classes. The Blackfoot River Valley is a popular place for mountain lion hunters resulting from historically healthy mountain lion population.

Occasional sightings of mountain lions occur around the project area. Because of the mountain lion's reliance on elk and mule deer within the project area for prey, lion habitat would overlap and mirror elk and deer habitat.

Hillis Big Game Security Area Analysis

The entire fire and project areas fall within the Bob Marshall Complex EMU. Many years of MDFWP radio telemetry data, MDFWP and FS winter flight data and professional knowledge of the area exists for the big game herds within the project area. By using this site-specific data, MDFWP and FS biologists were able to analyze the project area at a finer scale by delineating individual analysis units within the project and cumulative effects areas. Three analysis units were identified within the fire-affected area, the Beaver

Creek, Keep-Cool and Landers Fork analysis units. No activities are proposed within the Beaver Creek analysis unit. A hiding cover and security area analysis was completed for the three analysis units.

To provide a reasonable level of bull survival, Hillis and others (1991) recommend that each block of hiding cover ≥250 acres in size and ≥0.5-mile from any open road should collectively equal ≥30% of an analysis area. Direct and indirect effects will analyze each elk analysis unit independently, while cumulative effects will combine the three elk analysis units affected by the fire and analyze them collectively. When analyzing the units independently (Table 28), the Keep Cool unit falls below the standard (17.8%), while the Beaver Creek (38.2%) and Landers Fork (40.4%) units exceed the recommendation. When combining the three elk analysis units affected by the fire and looking at the area cumulatively, security area recommendations made by Hillis and others (1991) are met (33.0%).

Big game hiding cover was reduced within the fire area because of the direct effects of the fire. The elk analysis units as a whole still provide adequate cover (>30% security habitat). In addition to meeting the Hillis recommendation, a majority of the analysis units contain extremely remote and secure habitat. A substantial portion of the Landers Fork unit is secure, but does not meet the MDFWP definition of hiding cover yet because of the 1988 fire. Although this area does not meet the definition, the area is extremely remote and dense with regeneration, providing big game with effective hiding cover. However, the habitat was not counted towards the total acres of hiding cover resulting from the parameters of the analysis.

HD 281: Hunting District 281 falls within the 6,250 square-mile Bob Marshall Complex EMU, north of Highway 200. The Bob Marshall Complex EMU is the only EMU affected by the fire. The EMUs are also used to evaluate mule deer, moose and mountain lion populations in Montana.

The FS land under analysis is a watershed bordered by private land to the East and South. This area is primarily used during the summer and fall by elk, mule deer, moose and mountain lion. The project area provides extremely limited amounts of winter range. No winter range occurs close to any proposed activities.

Environmental Consequences—Hunted Species

Chapter 1 identified MIS species as a whole as an analysis issue. Hunted MIS species were not specifically identified as a key issue or an analysis issue in Chapter 1. The

Table 28. Results of Hillis Elk security analysis.

Elk Analysis Unit	Acres	% Secure Areas (≥0.5-mile from a road)	% Hiding Cover (≥40% canopy closure)	% Hiding Cover that is Secure	Open Road Density
Beaver Creek	19,528	53.4%	75.1%	38.2%	0.8 mi./sq.mi.
Keep Cool	30,251	41.8%	40.8%	17.8%	0.7 mi./sq.mi.
Landers Fork	101,965	91.9%	44.7%	40.4%	0.1 mi./sq.mi.
Total	116,776	77.0%	47.8%	33.0%	0.3 mi./sq.mi.

following effects indicators were used to focus the hunted species MIS analysis and disclose relevant environmental effects:

- Hillis and others (1991) elk security area analysis
- Adherence to the *Forest Plan* standards for old growth MIS species habitat reduction.

Elk, mule deer, moose, and mountain lion are MIS species for hunted species; *Forest Plan* standard for all hunted species habitat viability is no more than 10% reduction in habitat from previous measurement within an analysis area (USDA 1986). During the formulation of *Forest Plan* standards for elk the hunted MIS species, it was assumed that standards designed for elk would also be adequate for all species because they tend to use similar habitats.

The main effects of the Snow Talon fire on hunted species MIS relates mostly to the resulting proliferation of quality forage (grasses, forbs, and shrubs) and the elimination of cover. The main habitat-changing management activity that may occur is the removal of dead standing trees that provide some residual value as hiding cover. These effects are difficult to quantify, therefore, effects are presented in a qualitative context. Effects are discussed on habitat use that could be affected by management activities such as winter logging, and the value of standing dead trees as hiding/concealment cover. The Hillis Paradigm was used to calculate big game security area habitat for fall security and vulnerability during the hunting season.

Direct and Indirect Effects of Alternative 1

Because of the extremely low amounts of winter range within the project area, differences between action alternatives and the no action alternative would be insignificant and discountable. Natural recovery would occur under this alternative. Populations would experience short-term decreases in forage availability and reduced hiding cover. As vegetation recovers over the long-term, shrub components, other forage species and hiding cover would move to levels higher than pre-fire conditions. There would be no disturbance effects from winter logging operations. All standing dead and dying trees could function as residual hiding cover, until such time as trees begin to fall to the ground and/or more effective vegetation hiding cover begins to develop (3–10 years). Predicted outbreaks of Douglas-fir bark would most likely attack and kill the remaining live trees along the fire perimeter and within live islands that survived the fire. This would further reduce cover.

Hunting season security areas and vulnerability to hunting pressure would remain consistent with the existing condition. Jammer trails would not be decommissioned under this alternative. No tree planting would occur under this alternative, delaying the time it takes for hiding cover to establish in certain areas.

Direct and Indirect Effects Common to Action Alternatives

No acres of suitable habitat for elk, mule deer, moose, and/or mountain lion would be moved to an unsuitable condition under any alternative. *Forest Plan* standards for hunted MIS would be met under all alternatives. Because of all alternatives meeting INFISH standards and guidelines, and no live timber being treated, the activities associated with the project would not affect riparian areas, moose, or moose habitat.

Regenerating cutting units providing moose with winter range habitat would not be treated under any alternative. Winter hauling along Copper Creek Road #330 should have insignificant disturbance related effects on the wintering moose resulting from the best moose foraging habitat being located on the opposite side of the drainage as the road. Also, moose have wintered within the vicinity of the road and its associated volumes of winter snowmobiling traffic for many years.

No alternative would affect areas used by mountain lions. Big game prey (mule deer and elk) would remain prominent, therefore, so would mountain lions.

The construction of temporary road segments would have insignificant effects. Approximately 1,000 feet of temporary road would be constructed along the border of units 44 and 45. The only other temporary road segments would be short "jump up" spurs, connecting a road to a landing just off the road. All of these segments combined would equate to <2,000 feet. All temporary road segments would be completely rehabilitated and recontoured. Short-term increases in human disturbance could have effects on big game, but no long-term adverse effect will result from temporary road segments being built.

Proposed jammer trail rehabilitation should have insignificant negative effects short-term effects of increased human disturbance. This short-term effect should be outweighed by the long-term benefit of returning the areas to a natural state. The 110 acres of rehabilitation work would reduce the possibility of the old jammer trails facilitating illegal ATV use during the hunting season and would beneficially affect big game use and movement within the project area.

Placement and removal of the two temporary bridges would have insignificant direct effects. Indirectly, these bridges would facilitate rehabilitation work that would produce long-term benefits. Rehabilitation would move the areas toward their pre-management state, which would benefit big game use and movement within the areas.

Tree planting would initiate quicker regeneration than the no action's natural regeneration only methods. Hand planting combined with natural post-fire succession would make the area suitable for wildlife movement quicker than the no action alternative. Big game hiding cover would reestablish itself sooner than the no action alternative under any action alternative.

Hillis Big Game Security Area Analysis

Because of direct effects of the fire, hiding cover was reduced below *Forest Plan* standards. The three elk analysis units do however meet the Hillis recommendation for security areas. Hiding and security cover would not be reduced under any alternative. Only dead and dying trees would be harvested. Large stands identified as hiding and security cover that burned at low- to no intensity may contain salvage units within the stand's perimeter. These salvage units are smaller, sub-set stands within the larger blocks of live forest cover and would only target dead and dying trees. No stands of hiding and security cover would be removed within the larger stands of live hiding and security cover. The majority of the units identified within security areas would be harvested via helicopter. Security areas are ≥0.5-mile from roads; therefore, no motorized access would occur.

Although the salvage units do not qualify as hiding cover, further reductions of standing dead trees would make these sites more open. Depending on the density of trees, even standing dead trees can provide some level of cover and concealment that can help an animal avoid being shot or viewed. These alternatives would remove standing dead trees and the net effect would be the reduction of the residual hiding cover value that dead trees provide. While not true hiding cover as in a live forest, each of the alternatives would produce a more open condition. With more open conditions resulting from salvage harvest, animals during hunting season may be slightly more vulnerable to being hunter-harvested. This effect would be short term until revegetation provides hiding cover (3–10 years). Because of the high amounts of remote security habitat, low open road density during hunting season and the overall low numbers of hunted species within the project area during the hunting season, effects of removing screening cover on 4.5–12% of the area would be minimal. Even though some screening cover would be eliminated through salvage operations, habitat security should not change as a direct result of removal of dead trees.

Direct and Indirect Effects of Alternative 2

Timber salvage would occur on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented.

Direct and Indirect Effects of Alternative 3

Timber salvage would occur on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. The effects of Alternative 3 would be the same as Alternative 2, but would have less of an effect because of the reduction in acres treated.

Direct and Indirect Effects of Alternative 4

Timber salvage would occur on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented.

The approximately 930 acres of harvest within IRAs would increase the acres treated. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees as hiding cover would be outweighed by the potential of retaining the remaining live trees within the stand. By possibly retaining the surviving live trees within the stand, hiding, security and thermal cover could be retained. This would be the only

alternative potentially treating infested stands and trying to retain the live stands for cover. This could be a beneficial affect. Implementation could potentially last 2 years longer under this alternative. Direct habitat modification effects would be similar to burned tree salvage and human disturbance-related effects would last longer with implementation because of more acres being treated.

The effects of Alternative 4 would be similar as Alternatives 2 and 3, but would have more of an effect due to the additional acres treated and duration of implementation. This alternative would increase implementation duration from 2 years (salvage of burned trees) to 4–5 years (salvage of burned and beetle-killed trees).

Cumulative Effects Common to All Alternatives

Past timber harvesting activities that created open forage conditions were beginning to shade out palatable forage species and were dominated by shrubs and saplings. The Snow Talon fire would create an abundance of forage over the next few years. Snowmobile use of the area has and should continue to have insignificant effects on big game because of the lack of winter range habitat within the area. What winter range is available on the southern border of the project area is relatively removed from the Copper Creek Road #330 and is confined to a few open ridges and old cutting units. Effects to wintering animals from motorized use in this area have been and should continue to be minimal.

Mushroom picking is an activity that may displace or influence big game use of the burned portions of the Copper Creek drainage. This activity would occur in the spring/summer of 2004 and should bring hundreds of people to the drainage and is expected to have some level of impact on big game. Impacts should be limited to disturbance effects from pickers jumping animals out of bedding and feeding areas, etc. This effect should be minimal because of the probable low use of the area by big game animals the first summer post-fire.

Restoration and rehabilitation work is scheduled to begin in 2004. The work consists of: improving road drainage on approximately; upsizing culverts; and bridge replacement. It is likely that work related to this project would take from 3–5 years to complete. None of this work would occur during spring, late fall, or winter; therefore, for the most part no significant adverse impacts from this activity would be expected.

No irreversible and/or irretrievable effects would result under any alternative.

Species of Special Concern Neotropical Migrant (NTM)/Forest and Rangeland Songbirds

Affected Environment

Bird populations that migrate each year between temperate breeding areas and tropical winter areas would be defined as NTM birds. The trend for many of these populations has been declining over the past few decades in the United States and Canada. The loss of nesting habitat has been a major cause of these declines. Forest fragmentation is cited as one primary reason for declines. Many bird species are negatively affected by the edge effect of even aged management. Nest predation is higher along the edge of managed stands of forest conifers. Raccoons, skunks, and jays are among the species that utilize the edges of clearcuts and prey on the NTMs. Other reasons for the decline in populations

can be related to the loss of habitat in the winter/tropical portion of their range (USDA 1995d).

Approximately 150 species of songbirds occur within the Northern Region, not all of which occur within the project area. Assessing this quantity of species presents a near impossible task, as each species is unique to one extent or another. In the development of the Helena *Forest Plan*, the forest did not designate a MIS representative of migrant songbirds. There has been a growing concern for the viability of many of these species and the effect of land management activities upon them in recent years. Some member species of grassland, shrub-steppe, and riparian areas have shown precipitous declines. This group has no protective status, other than individuals, which may be classified as sensitive. Therefore, the wildlife biologist analyzed how different management activities associated with this project may affect different categories or guilds of NTM and/or Forest and Rangeland Song Birds.

This is a highly diverse group of species, found in an equally diverse range of habitats across the project area. The greatest diversity of these species may be found in the riparian areas or ecotones along riparian areas. These areas are vital to species such as belted kingfishers, yellow warblers, warbling vireo, and MacGillivray's warbler. The structural diversity provided by aspen, willows, and shrubs provide a range of niches for nesting and foraging. Effects of historic mining, historic grazing practices, and road building have reduced the amount of available habitat for these species. The uplands of the area present somewhat less diversity in the number of species to be found using the available habitat. However, there is a large group of species, which use the uplands. Upland use follows suit with riparian areas in the fact that bird species are associated with structural niches provided by juniper, sagebrush, bitterbrush, and grassland cover variety. Species, which may be found in these areas, include lazuli bunting, savannah sparrow, mountain bluebird, and chipping sparrows. Fire suppression on public lands has lead to a loss of upland habitat to conifer encroachment, and agricultural/urban development on private land has lead to a loss of grassland habitat in the lowlands.

Species of birds can be combined into five major categories or guilds:

- Area or edge-sensitive species (Northern goshawk, red crossbill, and Townsend's warbler)
- Cavity nesting and bark foraging species, (red-naped sapsucker, brown creeper, and red-shafted flicker)
- Canopy gleaning species (Clark's nutcracker, western tanager, and MacGillivray's warbler)
- Ground foraging and understory gleaning species (American redstart, bobolink, grasshopper sparrow, and dark-eyed junco)
- Early successional species (loggerhead shrike, rufous-sided towhee, and black-chinned hummingbird) (USDA 1995d).

A coarse filter approach analyzing management activity's effects on five categories of birds would be conducted. This would cover the array of different bird species present and how they would be affected by management activities without conducting a fine filter, single-species analysis for each and every bird species present in the analysis area.

Different silvicultural prescriptions have different effects on the many bird species. Approximately 70% of the species would be negatively affected by 0–10 year old clearcuts, 50% would be positively affected by 10–20 year old clearcuts, 40% would be positively affected by 20–40 year old clearcuts, and 60% would be negatively affected by partial cuts (USDA 1995d). These effects can be lessened to some species if a mix of silvicultural practices are used (even and uneven aged) and reserving some areas from harvest, deciduous and coniferous components are mixed in the stands, harvest shape and tree densities are mixed or varied, shorten or lengthen rotation ages depending on the targets species (i.e., shorten the age for early successional species or lengthen for the area or edge sensitive species), and retain snags and residual trees in regeneration cuts (USDA 1995d).

Many birds, NTMs as well as year round resident song birds, feed upon insects that can have negative effects on conifer trees and forests. Western spruce budworms and Douglas-fir tussock moths are preyed upon by chipping sparrows (NTM), ruby-crowned kinglets (NTM), western tanagers (NTM), black-capped chickadees (resident), and red-breasted nuthatches (resident). These bird species help control levels of insects in forested environments.

Habitat for these species can be maintained or improved by reducing edges between forested areas and manmade openings. Thinning of the edge can provide useful habitat and reduce predation by mimicking natural opening as they blend into the forest.

Environmental Consequences—Species of Special Concern NTM/Forest and Rangeland Songbirds

Chapter 1 identified NTM birds as analysis issues. The following effects indicator was used to focus the NTM bird analysis and disclose relevant environmental effects:

- Effects of activities on the different guilds of songbirds
- Direct, indirect, irreversible, irretrievable, and cumulative effects for NTM bird species
- Direct and indirect effects common to all alternatives.

Of the five guilds of NTM species in the project area, Guilds 2 and 5 should benefit in the new habitat created by the fire. However, Guilds 1, 3, and 4 would be adversely affected because the fire moved the majority of their habitat to an early successional stage. Implementation of action alternatives would reduce snags within the proposed salvage units. Effects to NTM Guilds 2 and 5 would be similar to the effects described in the above snag and downed wood habitat and the black-backed woodpecker sections above.

The overall project area's ability to provide habitat components for cavity nesting, snag foraging and early succession species would be minimally reduced. Only 4.5–12% of the available habitat for cavity nesting, snag foraging and early succession bird species would be treated under any alternative. Snag habitat would be provided within the proposed treatment areas by meeting forest and regional snag management guidelines. No alternative would remove any acres of live timbered habitat that survived the fire. NTM Guilds 1, 3, and 4 require these stands and would not be affected under any alternative. The effect of the fire creating edge habitats of mosaically placed live timber and burned

timber would decrease the area's ability to provide quality habitat for NTM Guild 1. No action under any alternative would further increase this effect.

Direct and Indirect Effects of Alternative 1

Alternative 1 would reduce 0 acres of habitat and would retain 100% of the available habitat for cavity nesting, snag foraging and early succession species.

Direct and Indirect Effects of Alternative 2

Alternative 2 would salvage dead and dying timber on approximately 2,461 acres. Dead and dying trees would be removed on 8% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 8%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units, supporting cavity-nesting birds. 92% of the available habitat for cavity nesting, snag foraging and early succession species would remain untreated.

Direct and Indirect Effects of Alternative 3

Alternative 3 would salvage dead and dying timber on approximately 1,129 acres. Dead and dying trees would be removed on 4.5% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 4.5%, snag guidelines as mentioned in Chapter 2 would be implemented. Snag and down dead wood habitat would be retained within harvest units as in Alternative 2. Effects to cavity nesting, snag foraging and early succession bird species would be similar to Alternative 2, with fewer overall acres being treated. Over 95% of the available habitat for cavity nesting, snag foraging and early succession species would remain untreated.

Direct and Indirect Effects of Alternative 4

Alternative 4 would salvage dead and dying timber on approximately 3,718 acres. Dead and dying trees would be removed on 12% of the 34,362 acres of FS land affected by the fire. All snags and down dead wood would not be removed from this 12%, snag guidelines as mentioned in Chapter 2 would be implemented. Effects to cavity-nesting, snag foraging and early succession bird species would be similar to Alternatives 2 and 3, with more overall acres being treated. 88% of the available habitat for cavity nesting, snag foraging and early succession species would remain untreated.

The approximately 930 acres of harvest within IRAs would increase the acres treated and would further reduce acres available to serve as high-quality snag and down dead wood habitat. Design criteria would remain the same for these acres (snag retention, etc.). The only effect of this harvest would be increasing the total acres treated by this alternative and human disturbance levels higher than the other alternatives.

Approximately 280 acres of potential beetle salvage units were identified and could be implemented under this alternative if the stands were to become infested. Harvesting at this small of a scale would produce insignificant beneficial effects pertaining to curtailing further outbreaks at large scales. However, at the stand level, if implementation of these units could remove infested trees from a stand in a timely manner; live trees remaining within the stand could potentially be retained. The direct effects of removing these dead and dying trees as a snag and down dead wood resource would be outweighed by the potential of retaining the remaining live trees within the stand.

Cumulative Effects Common to All Alternatives

Areas with a balance of habitat types would benefit NTM and Forest and Rangeland Song Birds. The reasonable and foreseeable actions of prescribed burning should benefit birds in Categories 2, 4, and 5, slightly reduce habitat for birds in category 3, while not affecting Category 1. This is a good mix of habitat conditions.

No irreversible and/or irretrievable effects would result under any alternative.

Forestry

The silviculture analysis is based on the third order watersheds affected by the Snow Talon fire. The fire most heavily affected the Copper Creek watershed; it is a major tributary of the Landers Fork drainage, which experienced a lesser degree of fire. Together these watersheds total 66,201 acres. The Snow Talon fire perimeter is approximately 37,700 acres, with 34,000 of that being NF land.

Affected Environment

Pre-Fire Forest Conditions

The majority of the NF that burned was in subalpine fir habitat types (Pfister, Kovalchik and Arno 1977). These cool and moist forests can support Douglas-fir, lodgepole pine, Engelmann spruce, and whitebark pine as successional species with subalpine fir eventually dominating the site barring disturbance. Drier forests tend to be populated by Douglas-fir. Conifer forests were generally continuous throughout the area, which assisted the spread of the fire and the fire intensity it supported.

General Forest Conditions

Except for harvested areas, most of the forests in the watershed were mature or older and consequently quite advanced in forest succession. In the Copper Creek drainage, lodgepole pine overstories generally had dead tops and were dying of old age. Dwarf mistletoe (a parasitic plant) was common in this species. Succession of forest understories was also advanced with dense understories of pole-sized subalpine fir being common. Downed woody fuel loading was heavy and increasing and was composed primarily of dead lodgepole pine. In upper Copper Creek, timberline forests composed of subalpine fir and whitebark pine were more common. In the Indian Meadows area, forests were younger and dominated by mature lodgepole pine. Understories were quite open and fuel loading was light to moderate. In upper Landers Fork, forests were also mature lodgepole pine and Douglas-fir. These forests were older than the Indian Meadows areas, and fuel loading was moderate.

Past Timber Management

Figure 12 shows the location of past timber harvests. Table 29 shows past timber harvests that occurred within the project area.

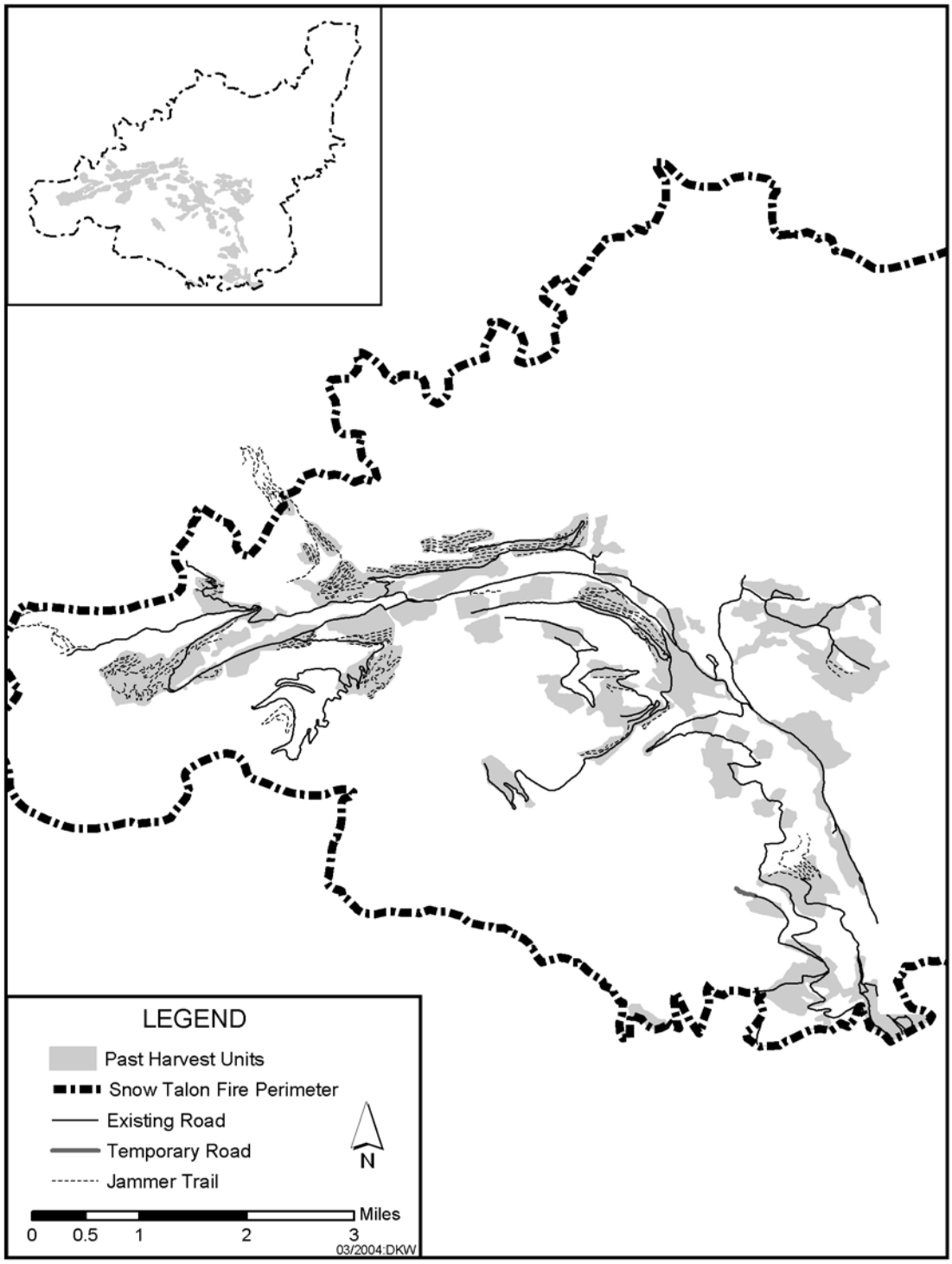

Figure 12. Locations of past harvests areas within the Snow Talon fire perimeter.

Table 29. Past timber management in the silviculture analysis area.

Decade of Harvest	Acres Harvested
1960	754
1970	588
1980	405
1990	430

Reforestation Success

The NFMA requires that forests that are harvested be reforested within 5 years of the harvest. A query was made of the Timber Stand Database to determine past reforestation success of stands harvested within the perimeter of the burn. This query demonstrated a 92% compliance with this requirement within 5 years, and 100% reforestation success at the time of the fire.

Forest Disturbance Ecology

Forests exist on the landscape due, not only to the site conditions that are present but also because of the disturbances they are exposed to. Disturbances come in many forms. Examples can include windstorms, flooding, insect and disease activity, and wildfire. In the western United States, wildfire has been a predominant shaper of our landscapes for millennia (Fischer and Clayton 1983).

The more cool and moist forests undergo periodic stand replacement fires. They tend to be affected by a variety of fire regimes depending on their seral stage and the weather they are exposed to. Early seral stages of these forests sometimes underburn, which thins the forest. As succession advances, these forests tend to become more flammable resulting from an increase of dead wood and the growth of understory trees that can carry a fire up into the main canopy, thus generating a crown fire. Eventually fuel loading and weather conditions combine and expose these forests to a stand replacing fire. The most influential disturbance process that these forests react to is infrequent, but high-intensity fire that kills most or all of the trees within a stand. These forests are generally resilient to this disturbance and regenerate with seral tree species following such events (Fischer and Clayton 1983).

The dry forest type has evolved with more frequent but lower intensity fire regimes. Trees in these forests tend to be thick barked with high crowns and are able to survive this intensity of fire (Fischer and Clayton 1983).

Current fire suppression technology is highly effective, with the result that fires are most likely to escape control during the most severe combinations of fuel and weather conditions. This can result in fires that are intense and often extensive on the landscape.

Post-Fire Conditions

The fire brought about a great deal of change to the forests of the area. After the fire, new aerial photography was taken. Then individual stands in the burn were mapped (using the photography) to determine the degree of damage that had occurred. This mapping became the base vegetation layer for the current forest conditions. Mapping criteria was as follows:

- High mortality—Over 50% of the green foliage is consumed (including overstory tree foliage and understory vegetation)

- Mixed mortality—Between 30–50% of the green foliage is not consumed
- Low mortality—Less than 30% of green foliage is consumed by the fire, but may have evidence of fire.

In the analysis area, forest vegetation experienced 60% high mortality, 29% moderate mortality, and 11% low mortality.

Post-Fire Forest Vegetation Prognosis

Fire Damaged Trees

The post-fire condition of the forests is still dynamic. Forests will continue to die from fire damage. In some instances the cambium (sapwood) of the tree may be damaged to the extent that the tree will die. The mortality of live trees can be estimated based on the species, degree of canopy consumption, and degree of bole char (Appendix B).

Post-fire Forest Age Class Structure

As seen in Table 30, the Snow Talon fire changed the age classes of the area's forests toward an earlier successional stage. Extensive mortality is present within the main Copper Creek drainage and at the headwaters of Landers Fork. Most of the forests that burned were advanced successionally with mixtures of older lodgepole pine and Douglas-fir overstories, and subalpine fir understories. Stands of large spruce trees were present along the Copper Creek riparian area.

Table 30. Dry and moist forests pre- and post-fire age classes.

	0 years (% of forest)	1–40 years (%)	40–80 years (%)	80–120 years (%)	120–160 years (%)	160+ years (%)
Dry Forests						
Pre-fire	NA	13	<1	7	30	50
Post-fire	54	4	0	3	19	20
Moist Forests						
Pre-fire	NA	18	1	16	21	43
Post-fire	68	3	<1	8	7	14

Old Growth Forest Resources

Old growth was analyzed according to *Forest Plan* standards that state,

> *"Five percent of each third order drainage should be managed for old growth. The priority for old growth acres within each drainage is: first, lands below 6000 feet in elevation; second, riparian zones and mesic drainage heads; and third, management areas emphasizing wildlife habitat…Management areas other than T-1 through T-5 will be the primary source for old growth. However, if adequate old growth cannot be achieved then the T management areas will be considered to meet old growth objectives."* (USDA 1986, II/20-21)

An old growth analysis had not been completed for the area prior to the fire, although old growth had been partially inventoried. Stand component data were analyzed following

the fire to determine old growth (including replacement old growth) validity for stands of trees that had survived the fire, by third-order watershed. (All discussions of old growth forests include "replacement old growth" implying the forest is on a strong trajectory to attain old growth conditions.)

The pre-fire old growth analysis indicates the extent of inventoried old growth forests prior to the fire. The post-fire analysis indicates the effect of the fire to inventoried old growth forests. Following the fire, stand data were analyzed and identified additional replacement old growth forests to attain *Forest Plan* standards. The results of this process are shown in Table 31. Old growth forests are defined by *Eastern Montana Zone Old Growth Definitions* (Green et al. 1992), and additional information on old growth may be found in the Snow Talon project analysis file.

Table 31. Results of Snow Talon old growth assessment process.

Watershed	Acres in Watershed	Pre-fire Inventoried Old Growth (%)	Post-fire Inventoried Old Growth (%)	Current Situation Inventoried Old Growth (%)
209 (Keep Cool)	3,538	22.5	11.8	11.8
501-4 (Look Out Creek)	4,067	3.0	3.0	6.1
501-5 (Baking Powder/Falls Creek)	9,686	5.7	4.7	5.4
502-1 (Upper Copper)	16,927	5.1	2.9	5.6
502-2 (Snowbank)	4,832	10.1	1.1	5.1
3CS (Lower Copper)	6,223	13.7	4.9	5.1
3LF-1 (Lower Landers)	14,696	2.4	1.7	5.1
3LF-2 (Tom's Gulch)	6,237	6.1	5.6	5.6

Insect Activity

Fire-damaged trees, especially Douglas-fir, are highly attractive to bark beetles, and insect activity can be expected to increase in damaged trees (USDA 1994). The infestation may spread beyond the burned area into undamaged forests. Monitoring of the fires of 2000 on the NF indicates increases in Douglas-fir beetle, and to a lesser extent mountain pine beetle (Kendley 2001). Both these insects can become aggressive tree killers.

The Douglas-fir beetle was observed attacking fire-charred, dead trees the first summer following the fires of 2000. In following seasons this insect began to attack trees that were still green but weakened by fire damage, and there is a concern that this insect may spread beyond the fire perimeter and attack unburned trees. The Douglas-fir beetle prefers, and will attack, the largest and generally oldest trees available.

There is a possibility mountain pine beetle will attack lodgepole pine and whitebark pine. These trees are thin barked and generally killed by direct-fire effects, so there are fewer weak trees available for the insect than Douglas-fir. Once more though, trees in a weakened condition are easy prey for opportunistic bark beetles.

Insect activity can be anticipated to increase in the Snow Talon fire area and may spread beyond the fire's perimeter (Sturdevant 2003).

A direct effect of the Snow Talon fire was the extensive mortality of the trees within the fire perimeter. An indirect effect of the fire is the weakening of trees damaged by the fire. The cumulative effect of the direct and indirect effects is that more trees will die within the area resulting from fire damage and attack by bark beetles.

Environmental Consequences

Effects Common to All Action Alternatives on Forestry Resource

The action alternatives would salvage harvest trees that were killed by the fire or that are anticipated to die from fire injury. Different alternatives address different issues and manipulate this final sort of harvest units.

The action alternatives are designed to salvage dying and fire-killed trees while leaving snags and woody debris sufficient to maintain ecological processes that protect ecosystem function. Minimal post-harvest slash treatments are anticipated. Snags are being managed utilizing the *Northern Region Snag Management Protocol* (USDA 2000b). With this protocol, different types of forests are managed for different densities of snags. The predominant resource for snags would be areas outside harvest units.

When seed sources are available, conifer regeneration has a high probability for success. Areas that would need planting to assist reforestation have been identified. The NFMA requires that areas that are harvested be reforested within 5 years of harvest. Therefore, different alternatives, depending on the units they harvest, reforest different acreages of land.

Natural tree regeneration is anticipated in many salvage harvest units and the salvage of trees from these areas would not prevent natural tree regeneration from occurring. Summer logging of ground-based units may reduce the number of seedlings that become established. Much less damage to seedlings would be expected with winter logging of these areas and in the helicopter and cable harvest areas.

Succession and Forest Structure

The Snow Talon fire killed many stands of trees and initiated a new pioneer stage of succession. The action alternatives affect succession to the extent that where planting is proposed. Succession will be hastened towards the establishment of a conifer forest and will generally increase the diversity of tree species on the site. The salvage harvests themselves do not change the successional stage because only dead and dying trees are proposed for harvest,

In forests with mixed mortality fire behavior, the distribution of mortality is often highly variable. Gaps and patches of openings would be interspersed with green trees. This mixture of green trees with interspersed opening would be the residual structure. As this type of forest continues to age and new seedlings grow, a two storied stand structure would develop. This type of forest structure could provide future potential old growth.

Landscape Level Effects

The alternatives that have been considered have direct and indirect effects on the stands proposed for salvage harvest. However, it is important to remember that this harvest fits into a much larger landscape.

The post-fire landscape can be understood as forests that

- Survived the fire to the degree they retain a mature forest function
- Were killed by the fire and would not be harvested
- Would be harvested.

Perhaps the most obvious difference the salvage harvest has on the post-fire forest is the removal of a portion of the snag component. Most of the Snow Talon fire area consisted of cool and moist forests that landscape ecology predicts to have infrequent and high-intensity fires. Snags are periodic on the landscape and are in abundance immediately after a fire. The effects of the salvage harvest would be to remove some of those snags. This removal should also be considered in the context of the total 38,000 acre fire area. The removal of some dead snags in the harvest units can be seen as creating diversity on the landscape through the generation of a different fuel load and downfall configuration.

An additional cumulative effect is the Canyon Creek fire, a 264,000-acre wildfire that burned in 1988 just north of the Snow Talon fire. Much of this fire burned in high elevation, cool and moist forests, with stand replacing intensity. The cumulative effect of these two fires is to reduce the mature forest component within the southern Bob Marshall wilderness complex and the Copper Creek/Landers Fork watershed.

Mitigations Included Under All Alternatives

Snag Management

The fire created extensive areas of snags (dead trees) and it is highly probable that many more trees will die resulting from fire damage or attack by insects.

Regional snag management protocol will be utilized to manage the snag resource. This protocol proposes snag management in clumps and linkages (USDA 2000b) with variable densities based on the type of forest affected.

Mitigations Included Under All Action Alternatives

All applicable federal, state, and local statues, standards, orders, permits, or other regulations will be applied to the action alternatives.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

With Alternative 1, no salvage timber harvest would occur and species and community biodiversity would return through succession, natural plant regeneration and recolonization. Germination can be expected from those plants whose seeds survived the fire or from seedfall of plants that survived the fire.

Areas would be left to naturally regenerate with conifers because no trees would be planted. Conifer regeneration is dependent on a seed source. There are some forests within the suitable timber base that are not expected to naturally regenerate. This would not be compliant within the expectations and outputs of the *Forest Plan*.

Forest Age Class Structure

A severe fire, with total consumption of all live vegetation will have the direct effect of returning a forest habitat back to the primary succession stage. If a conifer seed source is

present in these burned areas then tree regeneration will occur within a few years. If there is no conifer seed source, burned areas may remain in a grass/shrub phase for decades.

Old Growth Forests

The direct effect of the fire was to reduce the amount of inventoried old growth forest below *Forest Plan* standards; however, because the third order watersheds are much larger than the fire, the cumulative effect is there are still available forests that can be managed to contribute to the *Forest Plan* standards for old growth. Old growth forests would be unaffected by this alternative; some of these forests are high risk to insect attack, which could reduce their old growth character.

Cumulative Effects of Alternative 1

An indirect and cumulative effect of the fire is to change the distribution of forest succession on the landscape and change the habitats available for associated plants and animals.

The no action alternative would forgo the opportunity to implement the purpose and need of this project.

Short-term Uses vs. Long-term Productivity of Alternative 1

Some areas of the suitable timber base are not expected to naturally regenerate with trees. The *Forest Plan* emphasizes managing the suitable base for "healthy stands of timber to optimize the timber growing potential over the planning horizon" (USDA 1986, III-30.) Not planting deforested sites would not be within the expectations of the *Forest Plan* in the suitable base. An opportunity would be foregone to restore this forest landscape.

Irreversible/Irretrievable Commitments of Alternative 1

Trees killed by the fire are beginning the decomposition process and should remain commercially valuable for up to 3 years. Presently, there is a window of opportunity to salvage some of the fire-killed trees.

Snags in the fire-killed forest will fall for the next several decades. These falling trees will break or deform tree regeneration. Heavy fuel loading will make stocking control impossible should a need for precommercial thinning arise. These heavy fuel loads will also impede future commercial thinning opportunities.

Unavoidable Adverse Effects of Alternative 1

The no action alternative, through its very nature, has unavoidable adverse effects on active forest management.

Forest Plan Consistency of Alternative 1

The *Forest Plan* projects active forest management including the production of timber from some land use allocations and the active management of forests. The no action alternative is not consistent with these goals.

Effects of Action Alternatives

Direct and Indirect Effects of Alternative 2

This alternative identifies 969 acres of harvest units that are not expected to naturally regenerate. These stands would be planted. This would hasten these areas towards conifer based succession, and promote tree species diversity as a variety of tree species would be planted. Harvest on cable and tractor units would occur in the winter which would lessen damage to plants and conifer germinants.

Some stands of trees survived the fire but are high risk to insect attack. This alternative does not consider salvage harvest of these areas. Insect outbreaks in these stands would be left to run their course. In this respect, this reduces this alternatives compliance with the purpose and need for this project.

Direct and Indirect Effects of Alternative 3

This alternative identifies 118 acres of harvest units that are not expected to naturally regenerate. These stands would be planted. This would hasten these areas towards conifer-based succession, and promote tree species diversity as a variety of tree species would be planted. Harvest on cable and tractor units would occur in the winter, which would lessen damage to plants and conifer germinants.

Because helicopter units would not be harvested the NFMA requirement to regenerate these sites would not be triggered. Alternatives 2 and 4 prescribe planting 969 acres of land. This alternative plants about 10% of that acreage. The effects of not regenerating conifers on 851 acres of land would be they would remain in a grass and shrub phase until conifers naturally regenerated those sites. This could take several decades to occur. This would not be in compliance with *Forest Plan* expectations for the management of those lands.

The standing snag structure within the helicopter yarding units that exceed 1,300 acres in Alternatives 2 and 4 would not be harvested allowing for higher levels of natural downfall and the buildup of coarse woody debris in those areas.

Some stands of trees survived the fire but are high risk to insect attack. This alternative does not consider salvage harvest of these areas. Insect outbreaks in these stands would be left to run their course. In this respect, this reduces this alternatives compliance with the purpose and need for this project.

Direct and Indirect Effects of Alternative 4

This alternative identifies 969 acres of harvest units that are not expected to naturally regenerate. These stands would be planted. This would hasten these areas towards conifer-based succession, and promote tree species diversity as a variety of tree species would be planted.

Harvest on cable and tractor units could occur during any season which could cause some damage to plants and conifer germinants. Past experience and the compliance with regional soil disturbance requirements (of less that 15% detrimental disturbance) has show this damage to be limited in nature and not a significant management concern.

About 130 acres of old growth reside in four harvest units (94 acres in Lower Copper Creek watershed and 36 acres in Keep Cool watershed). These stands would be

considered for harvest if trees exceed the fire damage mortality indicators (indicating the tree will die) or if trees show evidence of insect attack.

Some stands of trees survived the fire but are high risk to insect attack. This alternative considers salvage harvest of these areas if insect activity is observed in the stand. The effects of harvest would be to harvest additional volume and further contribute to the purpose and need. Timely harvest and tree removal, while the insects are within the tree would reduce insect populations to some degree, but when considered in scale to the size of the fire this removal is not likely to make a great deal of difference in post-fire insect populations.

Cumulative Effects of Action Alternatives

The action alternatives harvest various acreages based on the issues that developed them. The cumulative effects of this harvest will be to remove some of the dead trees killed by the Snow Talon fire. This will reduce future fuel loading and snag availability in between 3–10% of the fire area. However, even within areas proposed for harvest, snags will be managed as per regional snag management protocol.

Short-Term Uses vs. Long-Term Productivity of Action Alternatives

The action alternatives meet the purpose and need of this analysis and harvest forest products from a portion of the fire area. They vary in scale and their ability to meet the purpose and need.

Some areas of the suitable timber base are not expected to naturally regenerate with trees. The action alternatives project tree planting in some of these areas. This reforestation effort is compliant with the expectations of the *Forest Plan* and assists in the restoration of the forested landscape.

Irreversible/Irretrievable Commitments of Action Alternatives

The salvage of trees killed by the fire is compliant with the purpose and need of this project and is supported by the *Forest Plan*.

Commercially viable dead trees will be removed from between 3–10% of the fire-killed forest. The removal of these dead trees will reduce future fuel loading in these areas and assist in proactive future forest management such as the promotion of new forest stands, and precommercial and commercial thinning opportunities.

Unavoidable Adverse Effects of Action Alternatives

The action alternatives promote proactive forest management and, as such, have no unavoidable adverse effects on the forestry resource.

Forest Plan Consistency of Alternative 2

No harvest would be conducted in inventoried old growth. The old growth resource is in compliance with *Forest Plan* management standards.

Forest Plan Consistency of Alternative 3

Because helicopter units would not be harvested, the NFMA requirement to regenerate these sites would not be triggered. Alternatives 2 and 4 prescribe planting 969 acres of land. This alternative plants about 10% of that acreage. The effects of not regenerating conifers on 851 acres of land would be they would remain in a grass and shrub phase

until conifers naturally regenerated those sites. This could take several decades to occur. This would not be in compliance with *Forest Plan* expectations for the management of those lands.

No harvest would be conducted in inventoried old growth. The old growth resource is in compliance with *Forest Plan* management standards.

Forest Plan Consistency of Alternative 4

The Keep Cool watershed exceeds *Forest Plan* standards for old growth by 238 acres and would remain within standards. Additional stands of replacement old growth were identified in lower Copper Creek to bring the old growth resource within *Forest Plan* standards.

Other Required Disclosures Under Action Alternatives

As per regional guides, FSM 2471.1 openings may not exceed 40 acres except, "Where natural catastrophic events such as fire, windstorm, or insect and disease attacks have occurred, 40 acres may be exceeded without 60-day public review and Regional Forester approval, provided that the public is notified in advance and the environmental analysis supports the decision." The Snow Talon fire was a natural catastrophic wildfire and some openings for the salvage harvest would exceed 40 acres (see Chapter 2 for the size of specific harvest units).

Fuels

Affected Environment

The NF system lands within the Snow Talon fire boundary served as the analysis area to disclose the effects of the proposed project. These lands are located within a much larger ecosystem, which expands across the Northern Rocky Mountains. In most years, fire commonly occurs throughout this area. Fires are occasionally large and have widespread influence on social and biological resources.

Background

Fire has been the dominant disturbance factor to the forest communities across the Northern Rocky Mountains. The mosaic patterns of the current forested communities are the result. The frequent occurrence of fire across the landscape can cause high mortality to all life forms found in these communities. However, due in part to frequent fire activity, many of the vegetation species are well adapted to this fire-dependent environment and display unique survival characteristics.

Fire often occurs in this area of the country during dry periods, typically July and August, and becomes a significant disturbance event. During severe drought periods fire activity would often last well into September.

Where fire has occurred in the most recent past, fuel loadings can be quite variable depending on the forest structure found before the fire. Prior to the Snow Talon fire, much of the surrounding area has not had a significant fire event for the last 80–120 years. Although fire starts occur frequently from lightning in summer storms, fires greater than 1 acre are rare because of fire-suppression efforts and *Forest Plan* direction. Most, if

not all, of the forested communities on the Helena NF have been disturbed by fire in the last 2–3 centuries.

The Helena Interagency Dispatch Center started tracking fire reports from 1937 to the present. Data from these records show that 67 fires have occurred throughout the analysis area, burning a total of 785 acres since 1937. The longest fire-free period was 12 years from 1945–1957. Forty of these fires were caused by lightning, while human activities caused 27 fires. There were two fires greater than 100 acres throughout the analysis area. Prior to the Snow Talon fire, the two largest fires burned 575 acres in 1978 and 100 acres in 1998.

When a large and unusually severe fire occurs, it ultimately creates a correspondingly large mass of heavy fuels, starting 12–15 years after the fire when much of the dead timber has fallen (Arno, Parsons, and Keane 1999). This becomes incorporated into a new dense fuel bed with small conifers and large shrubs, which can readily support another severe wildfire, often called a reburn or "double burn" (Arno, Parsons, and Keane 1999). Historically, reburns have occurred with some regularity in the Northern Rocky Mountains. In fact, the Moose-Wasson fire reburned portions of the Adair (1994) and Anaconda fires in GNP. The Biggs Flat fire (2001) on the Lewis and Clark NF reburned over 4,000 acres of the Gates Park fire (1988). The McDonald II fire (2000) and the Cabin Creek fire burned portions of the Canyon Creek fire (1988).

The size, spread, intensity, and severity of a reburn fire are affected by many factors. These factors include seasonal timing of the start, drought effects, weather, wind, appropriate management response, terrain, and fuels.

The change in policy and effectiveness of wildland fire suppression has contributed to the changing landscape and the influence of future fires on vegetative condition (structure, composition, and fuel loading) within the analysis area. Over time, the changes and consequences inherent in the continued active suppression of fire include:

- Vegetation conditions would continue to progress towards older, more dense stands dominated by shade-tolerant trees, with extensive "ladder fuels" to carry a fire to the treetops.
- Fuel loadings would increase.
- Suppression of wildfires would increase in risk, complexity, and cost and the probability of large lethal fires would increase.
- Increased intensity and severity exposes firefighters to greater risk and hazard during initial attack and extended attack.

The effects of suppression vary depending on site conditions, but in many cases, the changes in vegetative condition over time increase the likelihood of large lethal fires over what would have occurred historically.

Near the end of a natural fire cycle, increased fuel loading and greater continuity of fuels results in the increased probability that any fire could quickly develop into a mixed- to lethal-severity fire and involve burning large areas with uniform lethal severity.

Vegetative Types

The vegetative resources are lumped into five different groups inside the Snow Talon fire project area: moist forest, dry forest, whitebark pine forest, grassland, and rock. Moist

forests include those vegetative types that occur on north and east aspects and receive more moisture than the dry forests, which occur on the south and west aspects. The moist forests have stand conditions that are prone to stand replacing fires covering large areas if they are left undisturbed for relatively long periods of time. Dry forests are areas within which a typical fire would burn in the understory, rather than consuming the crowns of the trees over large acreages. The third vegetative type includes grasslands and shrublands. The fourth vegetative type includes whitebark pine areas. Areas dominated or heavily influenced by rock are included as the fifth type, primarily to separate these areas from nonrock types. Many times rock dominated areas will have an overstory of trees, but these areas are generally not actively managed and do not have desired conditions described. Disturbances such as fire are an important process in all of these areas. Many species have evolved with fire and are capable of quickly returning to normal life cycles following a wildfire.

The Snow Talon fire perimeter includes approximately 38,000 acres. Private land makes up approximately 4,000 acres of the fire area and is not addressed in this report, as little information is available for private land. Vegetation within the fire perimeter had been mapped prior to the fire and each area or "stand" had been assigned a habitat type (Pfister, Kovalchik and Arno 1977), fire group (Fisher and Clayton 1983) and general age based on the majority of trees (or other vegetation) within a given stand. Fire group and habitat type are useful classifications to help predict fire process and vegetative response to disturbances. Table 32 reflects the vegetative makeup of the forest lands within the analysis area based on vegetation type, which relates to response to fire effects.

Table 32. Vegetative composition of the Snow Talon fire salvage analysis area for the fuels resource.

Vegetation Type	Percent of Fire Area
Moist forest/Whitebark pine forest	81 (71 and 10, respectively)
Dry forest	13
Grassland	3
Rock	3

Environmental Consequences

Direct and Indirect Effects of Alternative 1

No acres are treated under this alternative and, thus, there are no direct or indirect effects to the vegetation. Existing conditions as described previously under "Affected Environment," would be maintained.

Under Alternative 1 there would be no fuels reduction and the probability of more severe fire behavior will increase as snags fall (Arno and Brown 1991). Currently, in areas within the Snow Talon fire that burned at high severity, most of the potential fuel has burned and is charred. As snags fall and fine fuels from grasses, shrubs and conifers develop, a fuel complex capable of carrying fire will exist. Fuel loads may exceed 70 tons per acre, and in many cases may surpass 100 tons per acre (Fischer 1981).

The greatest risk to fire fighters is snags that will have a higher probability of falling down during suppression efforts. The risk will be greater over the next 30–40 years as a majority of the snags will fall down during this period. Once the snags have fallen, the ability to construct fire line will decrease and, therefore, decrease the potential to keep

fires small. Production rates for line construction by an initial attack fire fighter in the current conditions, large downed fuels, are comparable to that of a fuel model 10 and 5, which would be less than one chain per hour (National Wildfire Coordinating Group 1998). A fuel model 10 contains large dead downed fuel loadings, and a fuel model 5 has a brush component such as ninebark.

In areas of light- to moderate-severity fire, the potential for difficulty in extinguishing future fires also exists; however, the fuel complex will be somewhat different. Although these areas did not experience a crown fire, charring all vegetation, high levels of subsequent mortality are expected. Ground fire effectively killed trees without consuming foliage. The result will be a greater accumulation of fine fuels than in areas that burned more intensely. This fuel complex includes dead needles, branches and stems, and large woody material. In the event of a fire, the fuels may burn hot enough to consume organic matter in the soil. When dead and live tree biomass increase, so does flame length and fire line intensity (Rothermel 1983).

Fire intensity is driven by the amount of fine fuel in the fuel complex and fuel moisture, both dead fuel and live fuel where it is a significant component of the fuels complex (Agee 1993; Rothermel 1983). The risk for future high intensity fire in the post-fire plant community is driven, in part, by the amount of fine fuels in the fuel bed and the extent and type of live fuels present that are also available for burning (live fuel moisture drops below a critical level).

Fire severity as it relates to soil damage is a function of fire duration. Fire duration, in turn, is a function of fuel loading, fuel moisture, particle size, and packing ratio. As well documented in smoke management literature, the more fuel available to burn (loading and moisture), the greater the consumption. The smaller the particle size, the quicker it would burn, hence the importance of fine fuels to fire intensity (Agee 1993; Rothermel 1983). The higher the packing ratio of the fuels, the longer such fuels can burn. Thus downed logs and duff are the main contributors to fire severity as defined above (Agee 1993). Burnout time for duff and downed logs can be days, as opposed to hours for finer fuels. Where large concentrations of downed logs may occur, the potential for fire severity increases due to the potential for long fire residence time. When large amounts of fuel are present, soil temperatures can remain high for several hours with large changes in soil properties; whereas the soil temperatures produced in low-severity fires may not result in any appreciable changes in soil properties (DeBano 1991).

Currently the *Helena Forest Fire Management Plan* (citation to be provided) and the *Review and Update of the 1995 Federal Wildland Fire Management Policy* (USDI et al. 2001) direct that the appropriate management response to a wildland fire would be suppression in the Snow Talon fire project area. Aggressive initial attack actions would be used to control the wildland fires outside the Scapegoat Wilderness. This would continue to be the case where human life, property and certain resource values are highest priority.

The large fuels remaining in the burned area would decay slowly, and likely remain on the landscape until it burns again. A reburn results when fall-down of the old burned forest contributes significantly to the fire behavior and fire effects of the next fire. The possibility of a reburn is small on any site, but it is high over the landscape. Accumulations of large woody fuels can hold a smoldering fire on a site for extended periods. Heat from the large fuels in direct contact with the ground could have severe

effects on soils. Potential for spotting and crown fires is greater where large woody fuels have accumulated (Brown, Reinhardt and Kramer 2001). A severe fire occurrence in the next several decades would depend on amount of fuels present, vegetation development, point of ignition, and weather. Based on Brown, Reinhardt and Kramer's (2001) results, potential spread of a future fire in the areas that burned in 2000 at a moderate to high severity are described as follows.

- 0 to 10 years after 2003 fires—Severe fire is unlikely because large woody fuels would still be accumulating and there would not be enough decay to support prolonged smoldering combustion.
- 10 to 30 years after 2003 fires—Most of the large woody fuels would have fallen down, with some decay to support prolonged burning. A duff layer would not be well established. High-severity burns would primarily occur where large woody material was lying on or close to the ground. High-severity burns could be substantial where a large portion of the soil surface was directly overlain by large woody pieces.
- 30 to 60 years after 2003 fires—Large woody fuels would have considerable rot; a duff layer may be well established depending on the amount of overstory conifer. More severe burning is possible, depending on extent of soil coverage by large woody pieces. If a conifer overstory is present, crowning and burnout of the duff could amplify the burn severity.

The Snow Talon fire area would resist fire growth and spread in the short term until there is enough vegetation to carry and sustain fire into the larger dead downed fuels that have and would continue to accumulate on the ground. It would take over 30 years for a duff layer to become established in areas that burned with moderate to high severity (Brown, Reinhardt and Kramer 2001). Fine fuels would increase as shrubs and grasses resprout and new seedlings become established. Snags would begin to fall, with the majority being on the ground in the next 10–30 years. Fire hazard and resistance to control reach high ratings when large woody fuels exceed 25–30 tons per acre, in combination with small, woody fuels of 5 tons/acre or more.

Fire behavior is the manner in which a fire reacts to the influences of fuel, weather, and topography. Forest fuel is combustible material or organic matter that could burn if ignited (Brown 1975). Fuels contribute to the rate of spread of a fire, the intensity of the fire, how long a fire is held over in an area, flame length, and the size of the burned area (Rothermel 1983). Removal of fuels helps to reduce or retard wildfire spread and severity (Pollet and Omi 1999). Fuels are broken into three categories: fine fuels (such as grass or forbs), small woody fuels less than 3 inches in diameter, and large woody fuels greater than 3 inches in diameter. Fine fuels carry the ignition. Small woody fuels can lose their moisture faster, start easier, and burn more readily (Agee 1993), influencing a fire's rate of spread and intensity. Large woody fuels contribute to development of large fires and high fire intensity (Brown, Reinhardt and Kramer 2001). Fire hazard and resistance to control are highest when large woody fuels exceed 25–30 tons per acre with small woody fuels of 5 tons per acre or more.

Fire behavior is affected by fuel characteristics such as forest density, species composition, amount of surface fuel, arrangement of fuels, and fuel moisture content (Rothermel 1983). Fuels are the only element affecting fire behavior that can be controlled. Fuel management can include reducing the loading of available fuel,

converting fuels to those with lower flammability, or isolating or breaking up large continuous bodies of fuels (DeBano, Neary, and Ffolliott 1998). Fuel management includes: reducing the loading of available fuels, converting fuels to those with a lower flammability, or isolating or breaking up large continuous bodies of fuels.

Cumulative Effects of Alternative 1

Change would occur as an inevitable and natural consequence of the working of ecosystem processes. The Snow Talon fire will begin immediately to revegetate, beginning a natural succession eventually creating a forest much like the one that burned in 2003. The naturally occurring longer fire intervals and fire exclusion in combination with natural processes such as insect, disease, and fire mortality, allow forests to grow and change through any existing stand structure diversity, typically leading to more uniform and more flammable conditions.

Over time, these natural increases in vegetation and downed woody debris increase the probability that any future fire would be a high intensity, lethal-severity fire and involve large areas. The risk of this kind of wildland fire in the Snow Talon fire project area increases substantially over time under all alternatives.

Fuel—Effects of Action Alternatives

Cumulative Effects of Action Alternatives

As with the no action alternative, change would occur as an inevitable and natural consequence of the working of ecosystem processes. Proposed treatments are of a scale that they would not substantially alter landscape level vegetation development over time, or the potential fire behavior when/if another fire occurs. Smoke from pile burning may affect air quality. Implementation of the pile burning will apply to the Montana/Idaho Airshed Group Operating Guide and will be documented within prescribed burn plan.

Nonconiferous Vegetation

This section addresses the nonconiferous vegetation within the project area. This includes understory vegetation in forested systems, grassland and meadow habitats, unique plant communities, and riparian habitats. Noxious weeds are addressed in detail in the noxious weed section. Sensitive plants are addressed in detail in the sensitive plant section. A detailed discussion of coniferous vegetation can be found in the forest resource section.

Affected Environment

Table 32 presented the vegetative makeup of the NF lands within the analysis area based on vegetation type. The types of forest relate to fire frequency and fire effects associated with those types (Fischer and Clayton 1983; USDA 1995a). Moist forests burn infrequently and generally with large areas of conifers killed by the fire. Dry forests naturally burned frequently with mixed fire effects that ranged from low conifer mortality to matches of complete mortality.

The effects of the Snow Talon fire on vegetation vary depending on the type of vegetation that was burned and fire characteristics at the time it burned. The understory vegetation associated with the different forests varies by habitat type. Habitat type is a vegetation classification developed by Pfister, Kovalchik and Arno (1977) for the

forested sites in Montana, and by Mueggler and Stewart (1980) for the grassland and shrubland habitat types of Western Montana. Hansen et al. (1995) describes riparian and wetland habitat types and community types for Montana. These classifications are useful for predicting the plant species present on such sites and predicting plant communities that develop following disturbance such as fire or logging. Table 33 shows the terrestrial habitat types present within the project area.

Subalpine fir (*Abies lasiocarpa*)/elksedge (*Carex geyeri*), Douglas-fir (*Pseudotsuga menziesii*)/elksedge (*Carex geyeri*), and Douglas-fir (*Pseudotsuga menziesii*)/ huckleberry (*Vaccinium globulare*) all occupy less than 1% of the project area.

Two habitat types, subalpine fir/menziesia and subalpine fir/beargrass, occupy almost half of the entire area. Neither of these habitat types have tremendous diversity (Pfister, Kovalchik and Arno 1977), although both of these types are much higher in diversity than Douglas-fir pinegrass, which occupies 10% of the area. Subalpine fir/huckleberry and subalpine fir/twinflower make up 7% and 6% of the area, respectively and both of these types are quite diverse. Subalpine fir/woodrush, 5% of the area, is a high-elevation habitat type that supports whitebark pine as do the whitebark pine habitats, so these are important to overall diversity, but these types are not extremely high in plant diversity. The most diverse habitat types are subalpine fir/bluejoint and subalpine fir/bedstraw, each occupying 1% of the drainage. These habitats are very moist, and particularly when they occur on landtype 12A, can have very high diversity.

There is a suite of fire tolerant or fire-adapted plants that occur in the various habitat types, which include shrubs, grasses, and forbs. Table 34 shows the fire effects of 11 important understory species that are found in the listed habitat types (Pfister, Kovalchik and Arno 1977). The fire response and recovery time are interpreted from the literature as

Table 33. Terrestrial habitat types present within the Snow Talon fire project area.

Habitat Type	Percent of Analysis Area
Subalpine fir (*Abies lasiocarpa*)/beargrass (*Xerophyllum tenax*)	30
Subalpine fir (*Abies lasiocarpa*)/menziesia (*Menziesia ferruginea*)	19
Douglas-fir (*Pseudotsuga menziesii*)/pinegrass (*Calamagrostis rubescens*)	10
Subalpine fir (*Abies lasiocarpa*)/huckleberry (*Vaccinium globulare*)	7
Subalpine fir (*Abies lasiocarpa*)/twinflower (*Linnea borealis*	6
Subalpine fir (*Abies lasiocarpa*)/woodrush (*Luzula hitchcockii*)	5
Subalpine fir (*Abies lasiocarpa*)-whitebark pine (*Pinus albicaulis*)	3
Subalpine fir (*Abies lasiocarpa*)/bedstraw (*Galium boreale*)	2
Subalpine fir (*Abies lasiocarpa*)/grouse whortleberry (*Vaccinium scoparium)*	2
Subalpine fir (*Abies lasiocarpa*)/pinegrass (*Calamagrostis rubescens*)	2
Subalpine fir (*Abies lasiocarpa*)/Sitka alder (*Alnus sitchensis*)	1
Subalpine fir (*Abies lasiocarpa*)/bluejoint (*Calamagrostis canadensis*)	1
Douglas-fir (*Pseudotsuga menziesii*)/snowberry (*Symphoricarpos albus*)	1
Douglas-fir (*Pseudotsuga menziesii*)/bunchgrass (*Festuca scabrella* or *Pseudoroegenaria spicata*)	1
Douglas-fir (*Pseudotsuga menziesii*)/common juniper (*Juniperus communis*)	1
Whitebark pine habitats (*Pinus albicaulis*)	1

Table 34. Effects of fire on 11 important understory species in the Snow Talon fire analysis area.

Species	Habitat Type	Growth form and Fire Response	Recovery Time
Huckleberry (*Vaccinium globulare* Syn. *V. caespitosum*) (FEIS 2004)	(Subalpine fir [SAF]/beargrass) SAF/menziesia SAF/huckleberry* SAF/twinflower SAF/woodrush SAF-Whitebark	Low growing shrub. Rhizomatous root. Survives light to moderate fire, killed by severe. Colonizes from offsite.	Rapid where rhizomes survived. Slow in large areas of severe fire.
Grouse whortleberry (*Vaccinium scoparium*) (FEIS 2004)	SAF/menziesia, (SAF/beargrass), SAF/huckleberry*, SAF/twinflower, SAF/woodrush SAF-Whitebark	Low growing shrub. Rhizomatous root. Survives light to moderate fire, killed by severe. Seedlings rare.	Rapid where rhizomes survived. Slow in large areas of severe fire.
Menziesia (*Menziesia ferruginea*) (FEIS 2004)	SAF/beargrass, SAF/menziesia*, SAF/twinflower	Sprouts from root crowns, adventitious stem buds. Not much information	Rapid in light to moderate fire. Slow where fire was severe.
Sitka alder (*Alnus sinuata* Syn. *A. viridis* ssp *sinuata*) Information is for *A. viridis* ssp *crista*. (FEIS 2004)	SAF/menziesia, SAF/beargrass, SAF/twinflower	Tall ascending shrub, shallow roots. Nitrogen fixer that sprouts from root crown and propagates from seed.	Rapid.
Twinflower *(Linnaea borealis*) (FEIS 2004)	SAF/menziesia, SAF/twinflower* (Douglas-fir [DF] /pinegrass)	Dwarf, stoloniferous evergreen shrub. Killed by even light fire. Colonizes from offsite seed.	Rapid in Cave Gulch and Maudlow fires.
Oregon grape (*Mahonia repens* Syn. *Berberis repens*) (FEIS 2004)	DF/pinegrass, SAF/twinflower, SAF-Whitebark	Short growthform, evergreen shrub. Rhizomatous. Fire adapted, sprouts from buds on rhizomes.	Rapid in Cave Gulch and Maudlow fires which had severe conditions. Slow in severe fires with extended heating.
Spiraea (*Spiraea betulifolia*) (FEIS 2004)	SAF/beargrass, DF/pinegrass*, SAF/huckleberry, SAF/twinflower	Low shrub, rhizomatous. Highly resistant to fire kill. Onsite survivor. Sprouts from rhizomes and root crown.	Rapid.
Snowberry (*Symphoricarpos albus*) (FEIS 2004)	DF/pinegrass, SAF/huckleberry, SAF/twinflower	Low shrub, rhizomatous. Highly resistant to fire kill. Onsite survivor. Sprouts from rhizomes and buried seed.	Rapid.
Kinnickinnick (*Arctstaphylos uva-ursi*) (FEIS 2004)	DF/pinegrass, SAF-Whitebark, SAF/twinflower	Prostrate evergreen shrub. Sprouts from root crown, adventitious buds and stored seeds.	Lit. variable response. Cave Gulch*
Beargrass (*Xerophyllum tenax*) (FEIS 2004)	SAF/beargrass*, SAF/menziesia, SAF/twinflower, SAF/woodrush, SAF-Whitebark	Rhizomatous forb. Abundant seedlings but slow growth. Survives light to moderate fires, killed by severe duff reducing fires.	Greenup of mature plants observed in some areas 9/03 post fire. In very severe areas plants were obviously dead.
Pinegrass (*Calamagrostis rubescens*) (FEIS 2004)	SAF/menziesia, SAF/beargrass, DF/pinegrass, SAF/huckleberry, SAF/twinflower, SAF-Whitebark	Rhizomatous grass. Vigorous sprouter following fire. Cover increases following fire.	Rapid.

well as experience and monitoring from past fires on the Helena NF (USDA 2004; Olsen 2001a, 2001b). Recovery for the purposes of this table is the time estimated for the species to produce a canopy cover of at least 5% following the fire. Rapid recovery is the first or second growing season, while slow recovery is 5–7 years.

Table 34 includes habitat indicator species to show the overlap between habitat types and the expected response of the habitat. Numerous additional species of shrubs, forbs, and grasses are expected to proliferate following the fire. Plant productivity is greatly affected by available nitrogen, which is generally much reduced in the soil following organic matter consumption by wildfire (DeBano et al. 1998). Some plants are adapted to taking nitrogen from the atmosphere and storing it in root nodules. As the plants die, the nitrogen becomes available in the soil for other species (Ditsch and Collins 2000). Two important nitrogen-fixing shrubs that should be present in especially the drier habitat types are shiny ceanothus (*Ceanothus velutinus*) and buffaloberry (*Sheperdia canadensis*) (USDA 2004). Both shrubs are adapted to fire and would be expected to have rapid recovery. Other nitrogen fixing plants are native forbs in the legume (Fabaceae) family, and include lupine (*Lupinus spp*.), sweetvetch (*Hedysarum spp*.), and locoweed (*Astragalus spp.*). Twelve nitrogen fixing species from the legume family were found in the Cave Gulch fire in the first growing season following fire (Olsen 2001a, 2001b). These genera would all be expected in this area following the fire. Numerous grasses including rough fescue (*Festuca scabrella*), western needlegrass (*Stipa occidentalis*), and bluebunch wheatgrass (*Pseudoroegenaria spicata*) are fire adapted and would be expected to have rapid recovery within the dry habitat types (USDA 2004). Two annual geraniums, *Geranium bicknellii* and *Geranium carolianum,* occurred the first growing season following the Warm Springs fire (*G. bicknellii* only), and Cave Gulch and Maudlow-Toston fires and provided soil stability and protection. Horseweed (*Conzya canadensis*), another annual native forb, was found at the Warm Springs fire (1989; Olsen personal observation) but did not establish on the Cave Gulch or Maudlow-Toston fires. These species, especially atleastone of the geraniums, would be expected to occur on the Snow Talon fire area as well.

All of the habitat types that occur in this area are adapted to fire (USDA 1995a; USDA 2004; Fischer and Clayton 1983). As discussed previously, post-fire nonconiferous plant response varies by individual species but, in general, ground level canopy cover will be at least 30% on the majority of the habitats at the end of the first growing season, with some areas much higher. By the end of the second growing season very few areas will have a ground level canopy cover less than 30% (Olsen 2001a, 2001b). Only the most harsh, dry rocky sites would fit that category. Riparian area shrubs will sprout from rootstocks in all but most severely burned areas, and sedge meadows and grasslands will show little effect other than stimulation by the fire (Dwire and Kauffman 2003; USDA 2004). The fire did not cause a reduction in native plant diversity, but on the contrary, will cause more species richness, at least for the short term as numerous shade intolerant species occupy the area previously shaded by the conifer canopy. The exceptions to this are areas that were infested with noxious weeds prior to the fire. Weed infestations are expected to greatly increase following the fire, and many studies have shown that a proliferation of exotic species results in an overall decrease in plant diversity and site productivity (McIver and Starr 2000; Noxious Weed Specialists' Report).

Table 34 does not reflect plant communities that are unique and occupy relatively small areas of land. That includes riparian corridors, aspen communities and small (less than 5-acre openings in the timber canopy. Copper Creek is a mosaic of habitat types, ranging from spruce dominated (*Picea engelmannii*/*Cornus stolonifera*), cottonwood community types (*Populus angustifolia*/*Cornus stolonifera*) and willow habitat types (*Salix geyeriana*/*Carex utriculata*). The side drainages are primarily dominated by with small openings of shrub dominated habitats. Small stands of quaking aspen (*Populus tremuloides*) occur scattered throughout the fire area, many times associated with riparian areas. Many of the aspen stands were decreasing in vigor and size, resulting from competition from conifers, lack of disturbance, and browsing by wildlife (Debyle and Winokur 1985). The effect of the fire on willow, dogwood and aspen would be sprouting from root crowns or from seed, depending on fire severity (USDA 2004).

Whitebark pine is considered a unique plant community within the Helena NF (USDA 1995a). Habitats that support whitebark pine occupy approximately 10% of the area. Prior to the fire, this species in general was in poor health. White pine blister rust has infected many trees throughout the west (USDA 2004), and the Snow Talon fire area was no different. The trees were also stressed prior to the fire from competition from subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*), which were present resulting from a lack of fire for many years in these ecosystems. Fire is a critical part of the life cycle of whitebark pine, as seeds cached by Clark's nutcracker require bare mineral soil to germinate. Blister rust and mountain pine beetle reduce viable seed for whitebark pine, and without fire the limited viable whitebark pine seed is not successful in surviving (USDA 2004). The effect of the Snow Talon fire on this species is to increase the survival of seedlings. This effect may be overcome by the effect of insects and disease, but fires such as Snow Talon are the only hope of the species thriving over time. 54% of the habitat types that support whitebark pine experienced stand-replacing fire. Long-term effects are hard to predict for this species but the fire provided suitable seedbed for seedlings to germinate, provided viable seed is available, as well as killing the competing lodgepole pine and subalpine fir that dominated these habitats.

It is evident from the above tables that the area is mostly timbered with small areas of grassland and rock interspersed. Many of the small features that are moist to wet habitats within the conifer forests would be associated with landtype 12A (USDA 2001a), which occupies approximately 10% of the project area. The most likely coniferous habitats within this landtype to have moist microsites are subalpine fir (*Abies lasiocarpa*)/ bluejoint (*Calamagrostis canadensis*) and subalpine fir (*Abies lasiocarpa*)/bedstraw (*Galium boreale*). These habitats support tremendous plant diversity (Pfister, Kovalchik and Arno 1977).

Grasslands and meadows occupy 3% of the project areas. The grasslands are a combination of rough fescue (*Festuca scabrella*)/Idaho fescue (*Festuca idahoensis*) and rough fescue (*Festuca scabrella*)/bluebunch wheatgrass (*Pseudoroegenaria spicata*) habitat types. The meadows are typically sedge-dominated meadows, beaked sedge (*Carex utriculata*), slender sedge (*Carex lasiocarpa*) with bluejoint reedgrass (Calamagrostis canadensis). The meadows include shrub-dominated inclusions of shrubby cinquefoil (*Potentilla fruticosa*)/tufted hairgrass (*Deschampsia cespitosa*) and Geyer willow (*Salix geyeri*)/beaked sedge (*Carex utriculata*) (USDA 1997b). The Indian

Meadows RNA (USDA 1997a) contains unique wetland habitat and a high diversity of vegetation associated with the meadows.

The concept of biodiversity has generally been interpreted as species richness (Simberloff 1999). The number of species present in the forested ecosystems in the Snow Talon area is largely a function of habitat type and in these fire-adapted ecosystems, disturbance within the ecosystem (Fischer and Clayton 1983; Pfister, Kovalchik and Arno 1977). Over 60% of the forests in the analysis area were over 120 years old prior to the fire. Following the fire, trees that are over 120 years old dominate 21% of the moist forests and 30% of the dry forests. While this is a large change in age structure because of the fire, there are still many areas with older forest conditions. The effect of the fire was to create a different mix of age classes, with the youngest age class now dominant on the landscape. Along with structural change, the mix of species would be expected to change as sun tolerant species would be favored over shade tolerant species.

Mosses and lichens are common components of most ecosystems, and their distributions are controlled by two main climatic factors, temperature and precipitation (Vitt, Marsh, and Bovey 1988). The Snow Talon fire area would be included in the dry coniferous forest, described by Vitt, Marsh, and Bovey (1988). Moss and lichen inventories have not been completed for this area, although several common mosses and lichens have been noted during other inventories and reconnaissance. *Hylocomnium splendens*, *Pohlia cruda*, *Pohlia nutans*, and *Polytrichum juniperinum* have been noted in adjacent areas and would be expected to be here as well (Olsen, personal observations). Following disturbance, the understory succession of mosses and lichens in boreal forests in British Columbia is initiated by acrocarpous mosses (*Polytrichum spp.*) and crustose lichens (*Trapeliopsis spp.*) that colonize bare ground. Over time establishment of *Cladonia spp*. and *Cladina lichens* occurs. Without disturbance, the feather mosses (*Hylocomnium splendens* and *Ptilium crista-castrensis*) dominate the community (Coxson and Marsh 2001). Personal observation of local fires indicates that some mosses recolonize burned sites fairly quickly following fire. Data collected in the Cave Gulch and Maudlow-Toston wildfires of 2000, post-fire monitoring showed *Pohlia nutans* beginning to occupy the soil within the first growing season following the fire (Olsen 2001, datafile). Ground reconnaissance immediately following the Snow Talon fire indicated that in low to moderate vegetation mortality areas lichen and moss species were present, presumably alive (Olsen, personal observations).

Environmental Consequences

Mitigations Included Under All Action Alternatives

Herbicides would be applied as discussed in the noxious weed section to limit infestations resulting from the activity associated with this alternative. Areas that have 30% or greater ground disturbance would be seeded with a native seed mix appropriate to the area.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

No actions and no mitigations would be proposed under Alternative 1. A direct effect of taking no action would occur in the jammer trail area. These trails and the surrounding

landscape are infested with noxious weeds, primarily spotted knapweed (*Centaurea maculosa*) and to a lesser extent yellow toadflax (*Linaria vulgaris*). Accelerated soil erosion would be expected to occur in this area (see "Soils"section of Chapter 3). Lack of plant cover, instability of burned soils, the amount of jammer trails crossing the slopes, and interfering with natural hydrology all contribute to the erosion. As areas erode, weed seeds would be spread and new infestations both from the existing plants plus the seeds scattered in the freshly created seedbeds would proliferate. The area would be unstable for many years. Over time, the area would not be accessible to vehicles for herbicide application. The native plant community would be less diverse than in areas that were more stable and/or had fewer weeds.

Since no harvest activities would occur with this alternative, there would be no increased probability of noxious weed infestations to increase resulting from those activities. There would also not be any loss of plant growth within units because of equipment impacts so recovery of native vegetation following the fire would not be impacted.

Indirect effects would include noxious weed infestations that spread beyond the jammer trail areas because of the instability of the area. Impacts to sensitive plant species from increased noxious weed infestations, adverse impacts to native plant populations within the RNAs from noxious weeds and damage to wildlife habitat could result. Since no harvest activities would be proposed with this alternative, increased potential for noxious weed spread from those activities would also not occur.

Cumulative Effects of Alternative 1

Cumulative effects that could affect understory plants, aspen and riparian communities, would be related to natural erosional processes caused by the loss of vegetative cover from the Snow Talon fire. Accelerated soil movement would be expected and could impact vegetation recovery. Water regimes could change, in most cases rising, and that could create wetlands that did not previously exist. This would result in distinct, relatively fast changes in plant communities. Because of natural erosion processes following the fire, adverse effects could occur in the meadows and fens of the Indian Meadows RNA. One of the most potentially adverse impacts to all plants in the fire area as well as the RNA is the spread of noxious weeds. The most susceptible habitat types for weed spread in the fire area include Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*), a total of approximately 3,890 acres. Spotted knapweed is closely associated with roadsides, but is also known to infest open grasslands and dry, open grown forests that have not been disturbed (USDA 2004). The remaining habitat types are moist forest, subalpine fir habitat types that would have had closed canopies and low probability of weed infestation prior to the fire, particularly spotted knapweed. There are known noxious weed populations within the RNA boundaries and 750 acres of infestation prior to the fire (Olsen, personal observations; weeds database). It is very important that noxious weed populations be controlled to avoid long-term loss of plant diversity in the area. The Red Mountain RNA (USDA 1997c) is mostly outside of the fire perimeter, but this area could be adversely affected

Recreation, including vehicular, pedestrian, and equestrian visitors, could have adverse impacts to all plant communities if this activity spreads noxious weeds. Recreation within the RNA area would be discouraged and limited to the mainline trail that passes the edge

of the area. Potential impacts to all plant communities related to mushroom picking could occur from trampling emerging vegetation and vehicular disturbance.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, but sheep have not historically grazed the northern portion of the area, which burned. No cumulative effects would be expected resulting from grazing on NF land.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, and decrease native plant diversity. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed above, particularly for dry habitat types. In addition, ground-disturbing activities associated with logging, road building or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing would be less likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. All of these activities could decrease native plant diversity and retard plant growth, depending on the ground disturbance of the activities. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 1

There are not specific goals or objectives in the *Forest Plan* for plant diversity. There are standards and goals for RNAs, noxious weeds, plant species of special concern, wildlife habitat, soil productivity, and water quality. All of these goals are better achieved with native plant diversity that is not adversely affected by our activities. This alternative would be consistent with the direction in the *Forest Plan*, as well as other federal legislation listed in this report, with the exception of the potential for this alternative to allow the spread of noxious weeds in the jammer trail areas.

Conclusions of Alternative 1

There would be no short-term adverse environmental consequences to nonconiferous native plant species associated with Alternative 1. Long-term impacts would likely occur from the erosion and instability related to jammer trail prisms remaining on the slopes. Over time these areas would continue to erode, weed infestations would increase as seeds were spread with the soil, and native plant communities would be unable to colonize unstable areas. Less ground cover would establish in those areas, plant diversity would be lessened, and overall productivity would be reduced over time. Impacts to sensitive plant species from increased noxious weed infestations, adverse impacts to native plant populations within the RNAs from noxious weeds, and damage to wildlife habitat could result. Since no harvest activities would be proposed with this alternative, increased potential for noxious weed spread from those activities would also not occur.

Effects of Alternative 2

Mitigations Included in Alternative 2

All landings, skid trails, or other areas of disturbance resulting from the logging activities that have over 1% soil disturbance would be monitored for weed infestations. If any of the species on the Montana noxious weed list or the species listed in this report is located within the disturbed areas, the infestations would be treated using appropriate herbicides for three seasons following the harvest activity. All landings, skid trails, or other activity areas that have over 30% ground cover removal/soil disturbance resulting from the activity would be seeded with a prescribed native seed mixture as soon as appropriate following the cessation of activities.

Jammer trail recontoured areas would be monitored for 3 years following the recontouring to ensure native plant were surviving and colonizing the area. Noxious weeds would be spot treated with herbicides to ensure control of infestations in these areas. Effective biological control agents of the various noxious weed species should be established for long-term control of weeds.

Direct and Indirect Effects of Alternative 2

Direct effects to understory plants within the log landings, the temporary road corridor or jammer trail recontouring areas include uprooting of plants that survived the fire, removal of plant regrowth of plants that survived the fire, and removal of plants that started growing from seed following the fire. These effects would be expected to occur on at least 50% of the surface of these areas, and up to 100% in many areas. Few plants would be expected to survive in these areas of heavy traffic. The landings that would be used primarily in the winter would have somewhat less soil disturbance than helicopter landings that are used without seasonal restrictions, but the difference would not be great. Indirect effects could occur if soil erosion from these areas caused significant soil movement that affected plants outside the areas. The landings would likely have 100% soil disturbance, removing any surface vegetation that had resprouted or colonized the area following the fire. The landings and road corridor would be constructed so as to minimize offsite effects.

The habitat types included in the units for Alternative 2 can be used to predict the response of understory plants following the fire, and the proposed activities. Table 35 shows the acres of habitat types that are included in Alternative 2, with the type of logging system proposed and jammer trail recontouring activities. The plant species discussed under the affected environment section would all be present within the units. The native vegetation in this area is adapted to fire, and the native species would all begin to regrow as discussed previously.

Jammer trail recontouring would be located on the five different habitat types (see Table 33) in areas that had been harvested in the past. These areas had ground cover from both native vegetation and noxious weeds (primarily spotted: knapweed [*Centaurea maculosa*] and yellow toadflax [*Linaria vulgaris*]) that had colonized the area following the logging. Stabilizing this area in addition to reducing the noxious weeds in the area would have long-term benefits to any plant populations present. The species proposed for planting as plugs as well as the native seed mix (see Appendix D) should survive and colonize the larger area of past harvest over time. The plants that were present prior to the Snow Talon

Table 35. Vegetative habitat types involved in Alternative 2.

Habitat Type	Helicopter Logging (acre)	Skyline Logging (acre)	Tractor Logging (acre)	Jammer Trail Rehabilitation (acre)
Subalpine fir (*Abies lasiocarpa*)/menziesia (*Menziesia ferruginea*)	479	121	179	44
Subalpine fir (*Abies lasiocarpa*)/beargrass (*Xerophyllum tenax*)	352	91	205	10
Subalpine fir (*Abies lasiocarpa*)/huckleberry (*Vaccinium globulare*)	58	–	162	–
Subalpine fir(*Abies lasiocarpa*)/pinegrass (*Calamagrostis rubescens*)	117	24	19	–
Subalpine fir(*Abies lasiocarpa*)/twinflower (*Linnea borealis*	41	6	69	–
Douglas-fir (*Pseudotsuga menziesii*)/snowberry (*Symphoricarpos albus*)	85	11	20	38
Douglas-fir (*Pseudotsuga menziesii*)/ pinegrass (*Calamagrostis rubescens*)	70	–	20	6
Subalpine fir(*Abies lasiocarpa*)/grouse whortleberry (*Vaccinium scoparium)*	2	–	85	–
Subalpine fir (*Abies lasiocarpa*)/elksedge (*Carex geyeri*)	–	14	51	–
Subalpine fir (*Abies lasiocarpa*)/woodrush (*Luzula hitchcockii*)	55	–	–	4
Subalpine fir(*Abies lasiocarpa*)/Sitka alder (*Alnus sitchensis*)	20	15	9	–
Subalpine fir(*Abies lasiocarpa*)/bluejoint (*Calamagrostis canadensis*)	32	–	4	–
Douglas-fir (*Pseudotsuga menziesii*)/bunchgrass (*Festuca scabrella* or *Pseudoroegenaria spicata*)	20	–	16	–
Subalpine fir(*Abies lasiocarpa*)/bedstraw (*Galium boreale*)	–	–	9	–

fire in those habitat types were adapted to fire (USDA 2004) and should begin actively growing in the first season following the fire, as long as the root crowns of the shrubs were not killed (Brown and Smith 2000). Native grasses and forbs would resprout the first growing season following the fire (Brown and Smith 2000; USDA 2004). The trail recontouring would require 100% disturbance of the soil in the area being recontoured. The recontoured area would be left rough with minimal straight slopes to provide microsites for seeds and rain/snow catchment. Woody debris and rock would be used to stabilize the recontoured areas. The primary species proposed for revegetation are shown in Appendix D. These species would be planted and seeded in the main corridor where recontouring was completed. The planting would speed up the recovery in the area by producing seed within a growing season that would be dispersed to the surrounding area and/or extend roots into the surrounding area, producing more plants to stabilize the site. Plant diversity would be increased over time as the planted species as well as offsite native plants colonize more of the recontoured area.

The effect of logging equipment on frozen ground and/or over snow would be minimized (McIver and Starr 2000). Plants that had resprouted or grown from seed following the fire would be protected with minimal soil disturbance within the units. Helicopter logging, even without seasonal restriction, has been shown to have little ground disturbance (McIver and Starr 2000). The plants in these areas would be well protected from disturbance, allowing the natural fire recovery process to continue with minimal disturbance. Risk of noxious weed infestation would be low for the harvest units under this alternative. Landings and road construction would be expected to cause 100% soil disturbance, removing any plants that had regrown or started from seed.

Cumulative Effects of Alternative 2

Cumulative effects that could affect understory plants from implementation of Alternative 2 are the same as those presented in the cumulative effects of Alternative 1. Cumulative effects that could affect understory plants, aspen and riparian communities, would be related to natural erosional processes caused by the loss of vegetative cover from the Snow Talon fire. Accelerated soil movement would be expected and could impact vegetation recovery. Water regimes could change, in most cases rising, and that could create wetlands that did not previously exist. This would result in distinct, relatively fast changes in plant communities. Because of natural erosion processes following the fire, adverse effects could occur in the meadows and fens of the Indian Meadows RNA. One of the most potentially adverse impacts to all plants in the fire area as well as the RNA is the spread of noxious weeds. The most susceptible habitat types for weed spread in the fire area include Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*), a total of approximately 3,890 acres. Spotted knapweed is closely associated with roadsides, but is also known to infest open grasslands and dry, open grown forests that have not been disturbed (USDA 2004). The remaining habitat types are moist forest, subalpine fir habitat types that would have had closed canopies and low probability of weed infestation prior to the fire, particularly spotted knapweed. There are known noxious weed populations within the RNA boundaries and 750 acres of infestation prior to the fire (Olsen, personal observations; weeds database). It is very important that noxious weed populations be controlled to avoid long-term loss of plant diversity in the area. The Red Mountain RNA (USDA 1997c) is mostly outside of the fire perimeter, but this area could be adversely affected

Recreation, including vehicular, pedestrian, and equestrian visitors, could have adverse impacts to all plant communities if this activity spreads noxious weeds. Recreation within the RNA area would be discouraged and limited to the mainline trail that passes the edge of the area. Potential impacts to all plant communities related to mushroom picking could occur from trampling emerging vegetation and vehicular disturbance.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, but sheep have not historically grazed the northern portion of the area, which burned. No cumulative effects would be expected resulting from grazing on NF land.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations,

and decrease native plant diversity. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed above, particularly for dry habitat types. In addition, ground-disturbing activities associated with logging, road building, or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing would be less likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. All of these activities could decrease native plant diversity and retard plant growth, depending on the ground disturbance of the activities. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 2

There are not specific goals or objectives in the *Forest Plan* for plant diversity. There are standards and goals for RNAs, noxious weeds, plant species of special concern, wildlife habitat, soil productivity, and water quality. This alternative would be consistent with the direction in the *Forest Plan*, as well as other federal legislation listed in this report, as long as effects to native plant populations are mitigated within the activity areas.

Conclusions of Alternative 2

The recontouring of the jammer trails in Alternative 2 would cause some loss of native plants within the 110 acres of recontouring activity. At least half of the area is trail prism with minimal plant cover however. The ground-based logging activity in Alternative 2 occurs on frozen ground and/or over snow. This restriction alone provides a great deal of protection for recovering native plant populations, as compared to ground-based logging without seasonal restrictions. Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). The landings and temporary road construction would disturb the majority of the area within them, removing any surface vegetation that had resprouted or colonized the area following the fire. These areas would be seeded with a native seed mix to speed the revegetation of these areas.

Effects of Alternative 3

Mitigations Included in Alternative 3

All landings, skid trails, or other areas of disturbance resulting from the logging activities that have over 1% soil disturbance would be monitored for weed infestations. If any of the species on the Montana noxious weed list or the species listed in this report is located within the disturbed areas, the infestations would be treated using appropriate herbicides for three seasons following the harvest activity. All landings, skid trails, or other activity areas that have over 30% ground cover removal/soil disturbance resulting from the activity would be seeded with a prescribed native seed mixture as soon as appropriate following the cessation of activities.

Jammer trail recontoured areas would be monitored for 3 years following the recontouring to ensure native plant were surviving and colonizing the area. Noxious weeds would be spot treated with herbicides to ensure control of infestations in these areas. Effective biological control agents of the various noxious weed species should be established for long-term control of weeds.

Direct and Indirect Effects of Alternative 3

Direct effects to understory plants within the log landings, the temporary road corridor or jammer trail recontouring areas include uprooting of plants that survived the fire, removal of plant regrowth of plants that survived the fire, and removal of plants that started growing from seed following the fire. These effects would be expected to occur on at least 50% of the surface of these areas, and up to 100% in many areas. Few plants would be expected to survive in these areas of heavy traffic. The landings would have 100% soil disturbance, removing any surface vegetation that had resprouted or colonized the area following the fire. Indirect effects could occur if soil erosion from these areas caused significant soil movement that affected plants outside the areas. The landings and road corridor would be constructed so as to minimize offsite effects.

The habitat types included in the units for Alternative 3 can be used to predict the response of understory plants following the fire, and the proposed activities. Table 36 shows the acres of habitat types that are included in Alternative 3, with the type of logging system proposed or jammer trail recontouring activities. The plant species discussed under the affected environment section would all be present within the units. The native vegetation in this area is adapted to fire, and the native species would all begin to regrow and colonize the area as discussed above.

Jammer trail recontouring would be located on five different habitat types in areas that had been harvested in the past and as presented in "Direct and Indirect Effects of Alternative 2" in the sensitive plants section.

Cumulative Effects of Alternative 3

Cumulative effects of Alternative 3 are the same as those presented in cumulative effects of Alternative 2 of the nonconiferous vegetation section.

Table 36. Vegetative habitat types involved in Alternative 3.

Habitat Type	Skyline Logging (acre)	Tractor Logging (acre)
Subalpine fir (*Abies lasiocarpa*)/menziesia (*Menziesia ferruginea*)	121	179
Subalpine fir (*Abies lasiocarpa*)/beargrass (*Xerophyllum tenax*)	118	232
Subalpine fir (*Abies lasiocarpa*)/huckleberry (*Vaccinium globulare*)	–	162
Subalpine fir(*Abies lasiocarpa*)/pinegrass (*Calamagrostis rubescens*)	24	19
Subalpine fir(*Abies lasiocarpa*)/twinflower (*Linnea borealis*	6	69
Douglas-fir (*Pseudotsuga menziesii*)/snowberry (*Symphoricarpos albus*)	11	20
Douglas-fir (*Pseudotsuga menziesii*)/ pinegrass (*Calamagrostis rubescens*)	–	20
Subalpine fir(*Abies lasiocarpa*)/grouse whortleberry (*Vaccinium scoparium)*	–	85
Subalpine fir (*Abies lasiocarpa*)/elksedge (*Carex geyeri*)	14	51
Subalpine fir (*Abies lasiocarpa*)/woodrush (*Luzula hitchcockii*)	–	–
Subalpine fir(*Abies lasiocarpa*)/Sitka alder (*Alnus sitchensis*)	15	9
Subalpine fir(*Abies lasiocarpa*)/bluejoint (*Calamagrostis canadensis*)	–	4
Douglas-fir (*Pseudotsuga menziesii*)/bunchgrass (*Festuca scabrella* or *Pseudoroegenaria spicata*)	–	16
Subalpine fir(*Abies lasiocarpa*)/bedstraw (*Galium boreale*)	–	9

Forest Plan Consistency of Alternative 3

There are not specific goals or objectives in the *Forest Plan* for plant diversity. There are standards and goals for RNAs, noxious weeds, plant species of special concern, wildlife habitat, soil productivity, and water quality. This alternative would be consistent with the direction in the *Forest Plan*, as well as other federal legislation listed in this report, as long as effects to native plant populations are mitigated within the activity areas.

Conclusions for Alternative 3

The recontouring of the jammer trails in Alternative 3 would cause some loss of native plants within the 110 acres of recontouring activity. However, at least half of the area is trail prism with minimal plant cover. The ground-based logging activity in Alternative 3 occurs on frozen ground and/or over snow. This restriction alone provides a great deal of protection for recovering native plant populations, as compared to ground-based logging without seasonal restrictions (McIver and Starr 2000). The landings and temporary road construction would disturb the majority of the area within them, removing any surface vegetation that had resprouted or colonized the area following the fire. These areas would be seeded with a native seed mix to speed the revegetation of these areas.

This alternative disturbs fewer acres than Alternatives 2 or 4 and, therefore, has less impact on native plant populations. There would also be a lower risk of noxious weed infestation spread, which indirectly benefits native species.

Effects of Alternative 4

Mitigations Included in Alternative 4

All landings, skid trails, or other areas of disturbance resulting from the logging activities that have over 1% soil disturbance would be monitored for weed infestations. If any of the species on the Montana noxious weed list or the species listed in this report is located within the disturbed areas, the infestations would be treated using appropriate herbicides for three seasons following the harvest activity. All landings, skid trails, or other activity areas that have over 30% ground cover removal/soil disturbance resulting from the activity would be seeded with a prescribed native seed mixture as soon as appropriate following the cessation of activities.

Jammer trail recontoured areas would be monitored for 3 years following the recontouring to ensure native plant were surviving and colonizing the area. Noxious weeds would be spot treated with herbicides to ensure control of infestations in these areas. Effective biological control agents of the various noxious weed species should be established for long-term control of weeds.

Direct and Indirect Effects of Alternative 4

Direct effects to understory plants within the log landings, the temporary road corridor, or jammer trail recontouring areas include uprooting of plants that survived the fire, removal of plant regrowth of plants that survived the fire and removal of plants that started growing from seed following the fire. These effects would be expected to occur on at least 50% of the surface of these areas, and up to 100% in many areas. Few plants would be expected to survive in these areas of heavy traffic. The landings that would be used primarily in the winter would have somewhat less soil disturbance than helicopter landings that are used without seasonal restrictions, but the difference would not be great.

Indirect effects could occur if soil erosion from these areas caused significant soil movement that affected plants outside the areas. The landings would likely have 100% soil disturbance, removing any surface vegetation that had resprouted or colonized the area following the fire. The landings and road corridor would be constructed so as to minimize offsite effects.

The habitat types included in the units for Alternative 4 can be used to predict the response of understory plants following the fire, and the proposed activities. Table 37 shows the acres of habitat types that are included in Alternative 4, with the type of logging system proposed or jammer trail recontouring activities. The plant species discussed under the affected environment section would all be present within the units. The native vegetation in this area is adapted to fire, and the native species would all begin to regrow as discussed previously.

Jammer trail recontouring would be located on the five different habitat types in areas that had been harvested in the past and as presented in "Direct and Indirect Effects of Alternative 2" in the nonconiferous vegetation section.

Table 37. Vegetative habitat types for Alternative 4.

Habitat Type	Helicopter Logging (acre)	Skyline Logging (acre)	Tractor Logging (acre)	Jammer Trails (acre)
Subalpine fir (*Abies lasiocarpa*)/menziesia (*Menziesia ferruginea*)	507	121	194	44
Subalpine fir (*Abies lasiocarpa*)/beargrass (*Xerophyllum tenax*)	606	91	281	10
Subalpine fir (*Abies lasiocarpa*)/huckleberry (*Vaccinium globulare*)	152	—	223	—
Subalpine fir (*Abies lasiocarpa*)/pinegrass (*Calamagrostis rubescens*)	117	24	19	—
Subalpine fir(*Abies lasiocarpa*)/twinflower (*Linnea borealis*)	322	6	123	—
Douglas-fir (*Pseudotsuga menziesii*)/snowberry (*Symphoricarpos albus*)	123	11	20	38
Douglas-fir (*Pseudotsuga menziesii*)/ pinegrass (*Calamagrostis rubescens*)	276	—	60	6
Subalpine fir (*Abies lasiocarpa*)/grouse whortleberry (*Vaccinium scoparium*)	3	—	85	—
Subalpine fir (*Abies lasiocarpa*)/elksedge (*Carex geyeri*)	5	14	51	—
Subalpine fir (*Abies lasiocarpa*)/woodrush (*Luzula hitchcockii*)	55	—		4
Subalpine fir(*Abies lasiocarpa*)/Sitka alder (*Alnus sitchensis*)	20	15	27	—
Subalpine fir(*Abies lasiocarpa*)/bluejoint (*Calamagrostis canadensis*)	32	—	4	—
Douglas-fir (*Pseudotsuga menziesii*)/bunchgrass (*Festuca scabrella* or *Pseudoroegenaria spicata*)	101	—	16	—
Subalpine fir(*Abies lasiocarpa*)/bedstraw (*Galium boreale*)	4	—	9	—

alternative, but moderate for the ground-based units. Landings and road construction would be expected to cause 100% soil disturbance, removing any plants that had regrown or started from seed.

Cumulative Effects of Alternative 4

Cumulative effects of Alternative 4 are the same as those presented in cumulative effects of Alternative 2 of the nonconiferous vegetation section.

Forest Plan Consistency of Alternative 4

Alternative 4 would be consistent with the *Forest Plan* and the federal legislation referenced in this report as long as native plant populations are protected should populations be found within the activity areas.

Conclusions for Alternative 4

The recontouring of the jammer trails in Alternative 4 would cause some loss of native plants within the 110 acres of recontouring activity. At least half of the area is trail prism with minimal plant cover however. Almost half of the ground-based logging activity in Alternative 4 occurs on unfrozen ground. This activity would be expected to cause far more ground disturbance than Alternatives 2 or 3, which occur only on frozen ground. Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). The recontouring of the jammer trails occurs on habitat types that have low potential to support sensitive plant populations. The landings and temporary road construction would disturb the majority of the area within them, removing any surface vegetation that had resprouted or colonized the area following the fire. These areas would be seeded with a native seed mix to speed the revegetation of these areas.

Sensitive Plants

Sensitive species in the Northern Region of the FS are those plant and animal species identified by the Regional Forester for which population viability is a concern. Viability concern is evidenced by significant current or predicted downward trends in population numbers or density and significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (Reel, Schassberger, and Ruediger 1989). The Helena NF has known or suspected occurrences of 25 species of sensitive plants. A complete list of the species and a description of habitat associated with those species can be found in Appendix E.

Affected Environment

Four sensitive plant species have been found within the perimeter of the Snow Talon fire. The plants were all found within the Indian Meadows RNA. The unique riparian plant communities and pristine condition of the Indian Meadows RNA were the primary reasons for designating the RNA. The four species that were found were pale sedge (*Carex livida*), English sundew (*Drosera anglica*), linear-leaved sundew (*Drosera linearis*), and water bulrush (*Scirpus subterminalis*). It is unlikely that additional sensitive plant species would be found within the RNA, as numerous botanists have examined the vegetation in the area (Montana Natural Heritage Program database records; USDA 1997b).

The Montana Natural Heritage Program was contracted by the Helena NF in 2002 to survey potential sensitive plant populations associated with noxious weed populations. No populations were found in the Blackfoot landscape area, which includes the area of the Snow Talon fire. The species of primary interest in that study included long-styled thistle (*Cirsium longistylum*) (not expected in the Blackfoot area), Howell's gumweed (*Grindelia howellii*), Missoula phlox (*Phlox kelseyi* var. *missoulensis*), and Austin's knotweed (*Polygonum douglasii var austinae*). Wavy moonwort (*Botrychium crenulatum*) and peculiar moonwort (*B. paradoxum*) were subsequently added to the study, but the Blackfoot area had already been completed. These species all occur in open, mostly dry and/or open grassland habitats. As these species were not located during this study and little such habitat occurs within the areas proposed for activity, these species are considered not likely to occur within the activity area.

Table 38 shows the species that could potentially occur within the Snow Talon analysis area, as well as the type of habitat the species requires.

Although the species listed in this table have the potential to occur in the analysis area, only those species associated with conifer forest, *Aquilegia brevistyla*, *Cypripedium parviflorum, Cypripedium passerinum,* and *Viola renifolia,* would have potential to occur within or adjacent to the proposed activity areas. None of those species have been found on the Helena NF to date, although *Cypripedium parviflorum* has been found in a low elevation area just outside the Forest Boundary near Helena. These four species are generally associated with Engelmann spruce (*Picea engelmannii*).

Landtype 12A and habitat types subalpine fir (*Abies lasiocarpa*)/bluejoint (*Calamagrostis canadensis*) and subalpine fir (*Abies lasiocarpa*)/bedstraw (*Galium boreale)* would have the highest probability of supporting sensitive species habitat.

Table 38. Sensitive plant species that could occur in the Snow Talon fire salvage project analysis area.

Plant Species of Concern	Habitat	Potential Occurrence
Aquilegia brevistyla	Coniferous wet meadows/ecotones	P
Botrychium crenulatum	Streambottoms and edges of marshes	P
Botrychium paradoxum	Open moist meadows	P
Carex livida	Wet, organic soils	K
Cypripedium parviflorum	Coniferous wet meadows/ecotones	P
Cypripedium passerinum	Coniferous wet meadows/ecotones	P
Drosera anglica	Peatlands, floating organic mats	K
Drosera linearis	Peatlands, floating organic mats	K
Juncus hallii	Moist to wet meadows	P
Scirpus subterminalis	Open water and boggy ponds	K
Viola renifolia	Swampy spruce woods	P

P: possible, K: known

Environmental Consequences

Mitigations Included Under All Action Alternatives

Microsites that have saturated soils would be excluded from harvest activity if the logging operation would disturb the soil of that area. Such microsites would be identified and searched for sensitive plant populations. Specifically, ground reconnaissance of landtype 12A would occur prior to logging.

The two habitat types referenced in this report would be inventoried as to the presence of sensitive plant species prior to logging to ensure no impact to plant populations would occur.

Herbicides would be applied as discussed in the noxious weed report to limit infestations resulting from the activity associated with this alternative. Areas that have 30% or greater ground disturbance would be seeded with a native seed mix appropriate to the area.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

As no actions would be undertaken in this alternative, no impacts or potential impacts would occur to sensitive plants. An indirect effect of taking no action would occur in the jammer trail area. These trails and the surrounding landscape are infested with noxious weeds, primarily spotted knapweed (*Centaurea maculosa*) and to a lesser extent yellow toadflax (*Linaria vulgaris*). Accelerated soil erosion would be expected to occur in this area (see Soils Specialist Report). Lack of plant cover, instability of burned soils, the amount of jammer trails crossing the slopes, and interfering with natural hydrology all contribute to the erosion. As areas erode, weed seeds would be spread and new infestations, both from the existing plants and the seeds scattered in the freshly created seedbeds, would proliferate. The area would be unstable for many years. Over time, the area would not be accessible to vehicles for herbicide application. The native plant community would be less diverse than in areas that were more stable and/or had fewer weeds.

Since no harvest activities would occur with this alternative, there would be no increased probability of noxious weed infestations resulting from those activities.

Cumulative Effects of Alternative 1

Cumulative effects that could affect sensitive plant populations would be related to natural erosional processes caused by the loss of vegetative cover from the Snow Talon fire. Water regimes could change, in most cases rising, and that could create wetlands that did not previously exist. Most of the sensitive plants that are likely or known to occur in this area are wetland species. This could be a benefit, if the plant could be dispersed to the area. As these are not common or numerous species, there is not much likelihood that sensitive plant populations would be increased by changes in the water table. Because of natural erosion processes following the fire, adverse effects could occur in the meadows and fens of the Indian Meadows RNA. One of the most potentially adverse impacts to sensitive plants in the RNA is the spread of noxious weeds. There are known noxious weed populations within the RNA boundaries (Olsen, personal observations). It is very

important that those populations be controlled to avoid long-term loss of plant diversity in the area.

Recreation, including vehicular, pedestrian, and equestrian visitors, could have adverse impacts to sensitive plants if this activity spreads noxious weeds. Recreation within the RNA area would be discouraged and limited to the mainline trail that passes the edge of the area. Potential impacts to sensitive plants from plant collectors could have very adverse effects.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, but sheep have not historically grazed the northern portion of the area, which burned. No known sensitive plant populations have been found within the allotment boundary and no cumulative effects would be expected resulting from grazing on NF land.

Private land activities such as post-fire logging, livestock grazing and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, although no known populations occur. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed under Alternative 1. In addition, ground-disturbing activities associated with logging, road building, or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing is less likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 1

This alternative would be consistent with the direction in the *Forest Plan*, as well as other federal legislation listed in this report.

Conclusions for Alternative 1

There would be no adverse environmental consequences to sensitive plant species associated with Alternative 1.

Effects of Alternative 2

Mitigations Included in Alternative 2

Microsites that have saturated soils would be excluded from harvest activity if the logging operation would disturb the soil of that area. Such microsites would be identified and searched for sensitive plant populations. Specifically, ground reconnaissance of landtype 12A would occur prior to logging.

The two habitat types referenced in this report would be inventoried for sensitive plant species prior to logging to ensure no impact to plant populations would occur.

Herbicides would be applied as discussed in the noxious weed report to limit infestations resulting from the activity associated with this alternative. Areas that have 30% or greater ground disturbance would be seeded with a native seed mix appropriate to the area.

Direct and Indirect Effects of Alternative 2

Direct effects would be caused if sensitive plant populations occurred in the units, log landings, temporary road corridor or jammer trail recontouring areas. Indirect effects could occur if activities affected hydrology related to an area with sensitive plant populations, or caused significant erosion that affected plants outside the units.

Approximately 60% of the jammer trail recontouring is located on dry, southerly facing slopes that had been harvested in the past and is it unlikely that sensitive plant populations occur in that area. The remaining habitat types do not have high potential to support sensitive species, particularly following road construction, logging, and noxious weed infestations.

The habitat types that are included in the units for Alternative 2 can be used to predict the potential for sensitive plant habitat to be present. Table 35 (see nonconiferous vegetation section) shows the acres of habitat types that are included in Alternative 2, with the type of logging system proposed as well as the jammer trail activities.

Only subalpine fir/bluejoint and subalpine fir/bedstraw habitat types have the potential to support sensitive plant species, if there are very moist to wet pockets located in those areas. Those pockets would likely coincide with landtype 12A. The sensitive plant species associated with conifer forest and/or ecotones, *Aquilegia brevistyla*, *Cypripedium parviflorum*, *Cypripedium passerinum,* and *Viola renifolia*, could potentially occur within very wet zones within those habitat types. None of these species have been found on the Helena NF to date.

Subalpine fir/bluejoint occupies a total of 36 acres within the units. Twenty acres are included in helicopter units, and 4 acres are in tractor units. Helicopter logging causes low amounts of ground disturbance (McIver and Starr 2000). It is unlikely that if any plant were present that any impact to a population would occur. The 4 acres included in the tractor unit could have ground disturbance that could affect a population, if one were present. The tractor logging would occur in the winter on frozen ground and/or snow, and it is unlikely that a plant population would be affected but this is an area that requires ground reconnaissance prior to logging. The other habitat type that could be moist enough to support sensitive plant populations is subalpine fir/bedstraw. A total of 9 acres of this habitat type occur in the units and the proposed logging system is tractor. This habitat type tends to be drier than subalpine fir/bluejoint, but field reconnaissance should occur in this area prior to logging to ensure no populations are present.

Cumulative Effects of Alternative 2

The cumulative effects shown in Alternative 1 are common to Alternative 2. In addition, ground disturbance related to the logging and jammer trail recontouring would likely cause an increase in noxious weed infestations. Areas that are disturbed would be expected to retard native vegetation recovery following the fire in the short term (McIver and Starr 2000).

Forest Plan Consistency of Alternative 2

Alternative 2 would be consistent with the *Forest Plan* and the federal legislation referenced in this report as long as sensitive plant populations are protected should populations be found within the activity areas.

Conclusions for Alternative 2

The ground-based logging activity in Alternative 2 occurs on frozen ground and/or over snow. This restriction along provides a great deal of protection for any potential plants populations, as compared to ground-based logging without seasonal restrictions. Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). The recontouring of the jammer trails occurs on habitat types that have low potential to support sensitive plant populations. The environmental consequences of Alternative 2 would not be likely to adversely affect any plant populations. No known populations would be impacted by the activities associated with Alternative 2. In terms of potential for indirect effects, this alternative would have less impact than Alternative 4 because of less equipment being used and fewer acres of harvest occurring. More acres of harvest occur in this alternative than in Alternative 3, which means more overall potential for spread of noxious weed infestations that would occur with this alternative.

Effects of Alternative 3

Mitigations Included in Alternative 3

Microsites that have saturated soils would be excluded from harvest activity if the logging operation would disturb the soil of that area. Such microsites would be identified and searched for sensitive plant populations. Specifically, ground reconnaissance of landtype 12A would occur prior to logging.

The two habitat types referenced in this report would be cleared prior to logging to ensure no impact to plant populations would occur.

Herbicides would be applied as discussed in the noxious weed report to limit infestations resulting from the activity associated with this alternative. Areas that have 30% or greater ground disturbance would be seeded with a native seed mix appropriate to the area.

Direct and Indirect Effects of Alternative 3

Direct effects would be caused if sensitive plant populations occurred in the units, log landings, temporary road corridor, or jammer trail recontouring areas. Indirect effects could occur if activities affected hydrology related to an area with sensitive plant populations, or caused significant erosion that affected plants outside the units.

The jammer trail recontouring effects are the same in all action alternatives

The habitat types that are included in the units for Alternative 3 can be used to predict the potential for sensitive plant habitat to be present. Table 36 (see nonconiferous vegetation section) shows the acres of habitat types that are included in Alternative 3, with the type of logging system proposed and jammer trail reclamation proposed.

Only subalpine fir/bluejoint and subalpine fir/bedstraw habitat types have the potential to support sensitive plant species, if there are very moist to wet pockets located in those areas. Those pockets would likely coincide with landtype 12A. The sensitive plant species associated with conifer forest, *Aquilegia brevistyla*, *Cypripedium parviflorum, Cypripedium passerinum,* and *Viola renifolia*, could potentially occur within very wet zones within those habitat types. None of these species have been found on the Helena NF to date.

Subalpine fir/bluejoint occupies a total of 4 acres in tractor units. The area included in the tractor unit could have ground disturbance that could affect a population, if one were present. The tractor logging would occur in the winter on frozen ground and/or snow, and it would be unlikely that a plant population would be affected but this is an area that requires ground reconnaissance prior to logging. The other habitat type that could be moist enough to support sensitive plant populations is subalpine fir/bedstraw. A total of 9 acres of this habitat type occur in the units and the proposed logging system is tractor. This habitat type tends to be drier than subalpine fir/bluejoint, but field reconnaissance should occur in this area prior to logging to ensure no populations are present.

Cumulative Effects of Alternative 3

The cumulative effects shown in Alternative 1 are common to Alternative 3. In addition, ground disturbance related to the logging and jammer trail recontouring would likely cause an increase in noxious weed infestations. Areas that are disturbed would be expected to retard native vegetation recovery following the fire in the short term. Alternative 3 would have the lowest impact of any of the action alternatives as fewer acres would be harvested. All logging would be seasonally restricted also causing fewer disturbances.

Forest Plan Consistency of Alternative 3

Alternative 3 would be consistent with the *Forest Plan* and the federal legislation referenced in this report as long as sensitive plant populations are protected should populations be found within the activity areas.

Conclusions for Alternative 3

The ground-based logging activity in Alternative 3 occurs on frozen ground and/or over snow. This restriction along provides a great deal of protection for any potential plants populations, as compared to ground-based logging without seasonal restrictions (McIver and Starr 2000). The recontouring of the jammer trails occurs on habitat types that have low potential to support sensitive plant populations. The environmental consequences of Alternative 3 would not be likely to adversely affect any plant populations. No known populations would be impacted by the activities associated with Alternative 3. This alternative has slightly less impact overall because of less equipment being used and fewer acres of harvest occurring. A lower overall potential for spread of noxious weed infestations would occur with this alternative.

Effects of Alternative 4

Microsites that have saturated soils would be excluded from harvest activity if the logging operation would disturb the soil of that area. Such microsites would be identified and searched for sensitive plant populations. Specifically, ground reconnaissance of landtype 12A would occur prior to logging.

The two habitat types referenced in this report would be inventoried for sensitive plant species prior to logging to ensure no impact to plant populations would occur.

Herbicides would be applied as discussed in the noxious weed report to limit infestations resulting from the activity associated with this alternative. Areas that have 30% or greater ground disturbance would be seeded with a native seed mix appropriate to the area.

Direct and Indirect Effects of Alternative 4

Direct effects would be caused if sensitive plant populations occurred in the units, log landings, temporary road corridor, or jammer trail recontouring areas. Indirect effects could occur if activities affected hydrology related to an area with sensitive plant populations, or caused significant erosion that affected plants outside the units. Increasing noxious weed infestations in the area would also cause indirect effects.

The jammer trail recontouring effects are the same in all action alternatives

The habitat types that are included in the units for Alternative 4 can be used to predict the potential for sensitive plant habitat to be present. Table 37 (see nonconiferous vegetation section) shows the acres of habitat types that are included in Alternative 4, with the type of logging system proposed.

Only subalpine fir/bluejoint and subalpine fir/bedstraw habitat types have the potential to support sensitive plant species, if there are very moist to wet pockets located in those areas. Those pockets would likely coincide with landtype 12A. The sensitive plant species associated with conifer forest, *Aquilegia brevistyla*, *Cypripedium parviflorum*, *Cypripedium passerinum,* and *Viola renifolia*, could potentially occur within very wet zones within those habitat types. None of these species have been found on the Helena NF to date.

Subalpine fir/bluejoint occupies a total of 36 acres within the units. Twenty acres are included in helicopter units, and 4 acres are in tractor units. Helicopter logging causes low amounts of ground disturbance. It is unlikely that if any plant were present that any impact to a population would occur. The 4 acres included in the tractor unit would likely have ground disturbance that could affect a population, if one were present. With the tractor logging that would occur in the winter on frozen ground and/or snow, is unlikely that a plant population would be affected but this is an area that requires ground reconnaissance prior to logging. Tractor logging on unfrozen ground that has been burned has been shown to cause a large amount of ground disturbance (McIver and Starr 2000). The other habitat type that could be moist enough to support sensitive plant populations is subalpine fir/bedstraw. A total of 9 acres of this habitat type occur in the units and the proposed logging system is tractor with the same potential effects stated above. This habitat type tends to be drier than subalpine fir/bluejoint, but field reconnaissance should occur in this area prior to logging to ensure no populations are present.

Cumulative Effects of Alternative 4

The cumulative effects shown in Alternative 1 are common to Alternative 4. Overall effects are greater with this alternative than any other alternative as this alternative has much more ground disturbance from ground-based logging activities. The higher disturbance is primarily caused by the ground-based logging without seasonal restrictions. Ground disturbance related to the logging and jammer trail recontouring would likely cause an increase in noxious weed infestations grater than the other action alternatives resulting from the activity that occurs without seasonal restrictions. Areas of ground disturbance within the logging units that are disturbed would be expected to retard native vegetation recovery following the fire in the short term. Helicopter logging would be expected to cause low levels of ground disturbance.

Forest Plan Consistency of Alternative 4

Alternative 4 would be consistent with the *Forest Plan* and the federal legislation referenced in this report as long as sensitive plant populations are protected should populations be found within the activity areas.

Conclusions for Alternative 4

Almost half of the ground-based logging activity in Alternative 4 occurs on unfrozen ground. This activity would be expected to cause far more ground disturbance than Alternatives 2 or 3, which occur only on frozen ground. Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). The recontouring of the jammer trails occurs on habitat types that have low potential to support sensitive plant populations. The environmental consequences of Alternative 4 would not be likely to adversely affect any plant populations. No known populations would be impacted by the activities associated with Alternative 4. This alternative has the greatest overall potential for the spread of noxious weed infestations because of more acres of harvest and more equipment being used. A higher overall potential for spread of noxious weed infestations would occur with this alternative, which could have an indirect effect on sensitive plants.

Noxious Weeds

Affected Environment

The *Federal Noxious Weed Act of 1974* (7 U.S.C. 61 §§ 2801 to 2813, 1990), as amended, defines a noxious weed as "any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind which is of foreign origin, is new to or not widely prevalent in the U.S., and can directly or indirectly injure crops, other useful plants, livestock, poultry or other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or the public health." Montana also has a *Weed Control Act* (7 *Montana Code* 22 §§ 2101 et seq., 2003), and while Montana laws do not apply to federal lands, the *Federal Noxious Weed Act of 1974* requires that federal land management agencies implement cooperative agreements and management plans in states with active weed management programs. It allows for federal agencies to adopt state noxious weed lists in the management of weeds on their lands. All entities are required to control these plants and limit the spread of these species. Montana currently has 24 species on the statewide noxious weed list (Grubb, Sheley, and Stivers 2003). Within the analysis area, the Snow Talon fire, approximately 750 acres were infested with noxious weeds prior to the fire. These areas were infested to various levels, from low (less than 10%) to high (greater than 50% canopy of weeds). The effect of wildfire on noxious weeds has been shown to greatly increase the area infested as well as the level of infestation (USDA 2004).

Noxious weeds are aggressive plants and especially when competition from other plants is reduced as the first season following a wildfire. There are three noxious weed species of primary concern in this area: spotted knapweed (*Centaurea maculosa*), yellow toadflax (*Linaria vulgaris*), and Canada thistle (Cirsium arvense). Two other noxious weeds, Dalmation toadflax (*Linaria dalmatica*) and houndstongue (*Cynoglossum officinale*) are also found within the project area, currently at low infestation levels. Figure 13 shows the location of Spotted knapweed and Yellow toadflax within the fire perimeter.

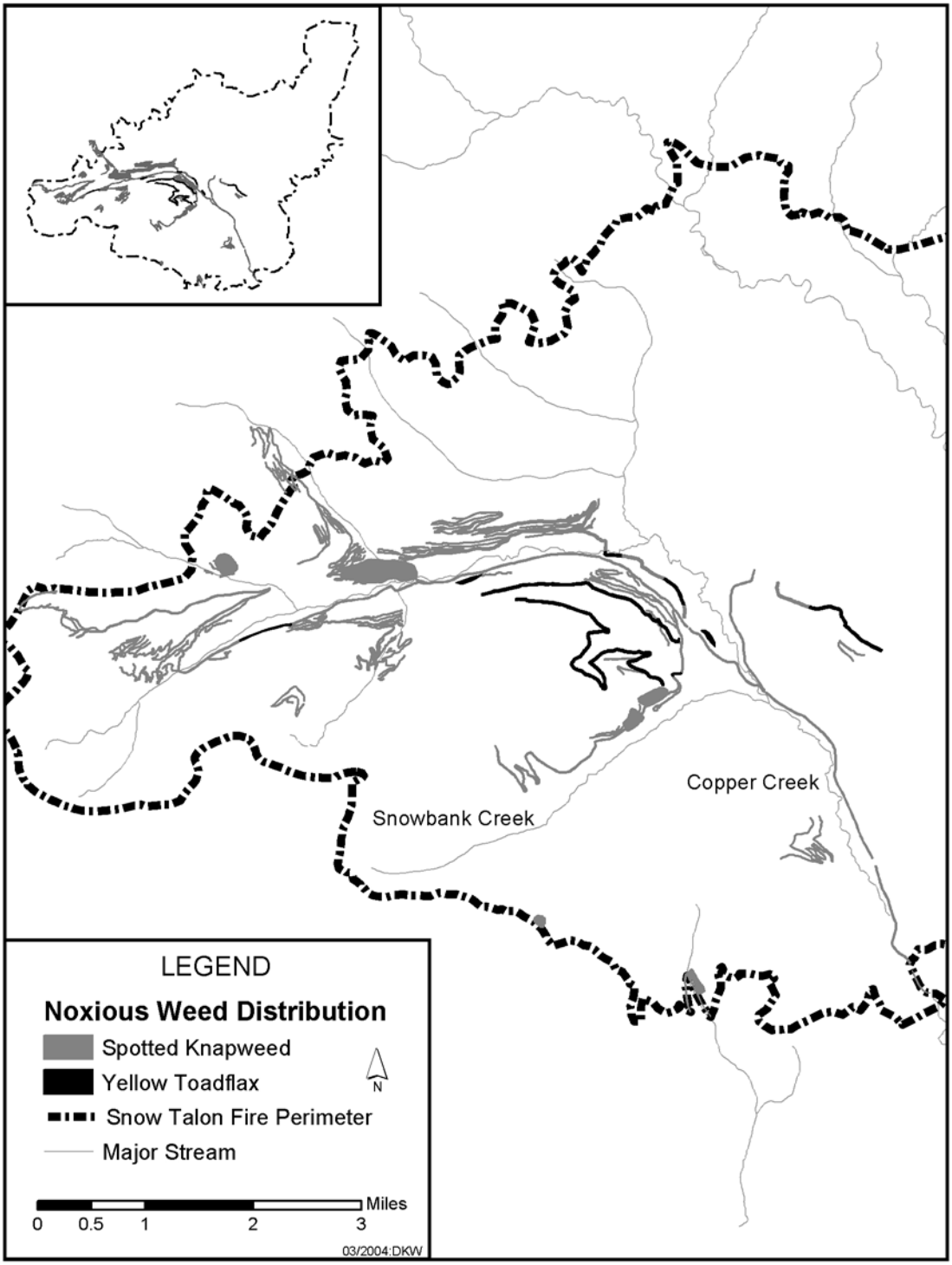

Figure 13. Noxious weed distribution within and proximal to the Snow Talon fire perimeter.

Yellow toadflax (*Linaria vulgaris*) was found along several roadsides within the fire perimeter prior to the fire. Dalmation toadflax (*Linaria dalmatica*) was only known from a small infestation in the Indian Meadows RNA. Toadflax has been shown to readily establish on open and disturbed sites where competition from other plants is reduced (USDA 2004). This species can survive even the most severe fires. Yellow toadflax (*Linaria vulgaris*) seeds may be dispersed by water, ants, birds, and rodents, but existing infestations of yellow toadflax appear to expand mainly by vegetative reproduction rather than by seed (USDA 2004; Pauchard, Alaback, and Edlund 2003). Dalmatian toadflax (*Linaria dalmatica)* seeds may also be dispersed by cattle, deer and other browsing animals, and the seeds can remain viable after passing through the gastrointestinal tracts of cattle, and possibly deer. Dalmation toadflax (*Linaria dalmatica)* can also expand vegetatively by the formation of adventitious shoots from both the tap and lateral roots (USDA 2004). There is serious risk of infestation from Dalmation toadflax (*Linaria dalmatica*), even though current infestation levels are thought to be very low. Weeds are expected to increase in level of infestation and acres infested overall in the fire area in spite of the efforts of herbicide application for control. This is due to a large amount of surface soil movement related to removal of surface duff, litter, and plant cover. Weed seeds are stored in the upper soil layers, and would move as the soil moves.

Spotted knapweed (*Centaurea maculosa*) had the largest extent of infestation within the fire perimeter, prior to Snow Talon. The species occurred along roadsides and throughout southfacing areas of harvest, as well as in the area of many of the jammer trails. Spotted knapweed thrives in open areas, with forest canopies of less than 20% closure. Research has shown that fires create the type of disturbance that promotes the colonization of knapweeds by creating areas of bare soil and increasing the amount of sunlight that reaches the ground surface. Fire will top-kill spotted knapweed and stress the plant, but the taproot can generally survive and resprout. Spotted knapweed (*Centaurea maculosa*) spreads almost entirely by prolific seed production. This species has also been shown to have allelopathic properties, secreting toxins that suppress the growth of other plants, although resource competition is just as effective in its ability to dominate areas. Canada thistle (*Cirsium arvense*) spreads primarily by adventitious root buds that may form new adventitious shoots can develop along the root at any location, and houndstongue, (*Cynoglossum officinale*), is spread by large seeds that attach to animals, humans, as well as dispersed by wind (USDA 2004).

Canada thistle (*Cirsium arvense*) was present in relatively low levels within the fire perimeter prior to the Snow Talon fire, generally associated with roadside disturbance or harvest disturbance. However, this species was also found in the Indian Meadows RNA prior to the fire. Its habitat was restricted to open areas of less than 10% canopy closure.

Fire effects on this species are variable, ranging from reducing populations to increasing (USDA 2004). This species is adapted to both survive fire on site, and to colonize recently burned sites with exposed bare soil. This species would be expected to expand infestation level and extent resulting from the effects of the fire.

Houndstongue (*Cynoglossum officinale*) was present in low levels prior to the Snow Talon fire. The effects of fire on this species are relatively unknown (USDA 2004). The species is generally top-killed by fire, and severe fire may kill the deep taproot. The species reproduces by seed, which is dispersed by wind and the fur or hair of mammals. Houndtongue is relatively shade tolerant, although it thrives in full sunlight. There is

potential for this species to spread dramatically in the fire area and it must be carefully monitored. Table 39 shows the species and acres of known infestation, prior to the Snow Talon fire.

Table 39. Known noxious weed infestation prior to the Snow Talon fire.

Noxious Weed Species	Acres of Known Infestation	Risk of Spread Following Wildfire
Spotted knapweed (*Centaurea maculosa*)	Approximately 700	High
Canada thistle (*Cirsium arvense*)	<1	Moderate
Yellow toadflax (*Linaria vulgaris*)	Approximately 54	Moderate
Houndstongue (*Cynoglossum officinale*)	9	Moderate
Dalmation toadflax (*Linaria dalmatica*)	<1	High

Grasslands and dry forests habitat types are most susceptible over time to weed infestation (USDA 2004). In the Snow Talon fire area, the most susceptible habitat types include Douglas-fir (*Pseudotsuga menziesii*)/snowberry (*Symphoricarpos alba*), Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*) and Douglas-fir/pinegrass (*Calamagrostis rubescens*), which occupy 3,890 acres within the fire perimeter.

Noxious weeds can create monocultures if uncontrolled with herbicides or effective biocontrol. The loss of plant biodiversity, soil productivity and foraging values are great (USDA 2004; Pauchard, Alaback, and Edlund 2003). Low levels of grazing have been shown for toadflax and spotted knapweed, but forage values are lower than the native flora, primarily grasses, that are replaced. The effects of noxious weed infestations are adverse to native fauna and flora and present the greatest large-scale threat to native ecosystems that exist in the nation's wild lands today (Mack et al. 2000; Pauchard, Alaback, and Edlund 2003).

Environmental Consequences

Mitigations Included Under All Action Alternatives

All landings, skid trails, or other areas of disturbance resulting from the logging activities that have over 1% soil disturbance would be monitored for weed infestations. If any of the species on the Montana noxious weed list or the species listed in this report is located within the disturbed areas, the infestations would be treated using appropriate herbicides for three seasons following the harvest activity. All landings, skid trails, or other activity areas that have over 30% ground cover removal/soil disturbance resulting from the activity would be seeded with a prescribed native seed mixture as soon as appropriate following the cessation of activities. A 30-foot buffer would be applied for herbicide application related to log hauling activities as well as road BMP work.

Only herbicides approved for use under the Helena NF Noxious Weed EIS (USDA 1987) will be used. All herbicides will be used in accordance with label restrictions. Tordon 22K label precautions that will specifically be applied here include:

- Do not apply to any water bodies or in areas where the runoff from treated areas will reach fish-bearing waters

- Do not contaminate water through spray drift, by cleaning of equipment or disposal of wastes
- Do not apply to soils that are very permeable (textures of sandy load to sand) throughout the entire profile and which also have an underlying shallow aquifer
- Do not apply to soils whose surfaces are composed of severely fractured rock or unconsolidated gravel and underlain with an aquifer.

All weed treatment activities must be closely coordinated with fishery experts to ensure bull trout are not adversely affected. Specifically, activities such as crossing Copper Creek to access weed infestations, water use for chemical mixing, and amount of chemical applied within a given drainage as well as RHCA buffer areas would be done in close coordination with fishery experts.

The recontoured jammer trails would be spot treated for noxious weeds using appropriate herbicides for three seasons following the recontouring activity.

The portions of the haul route that require reconditioning prior to haul should be treated with herbicides prior to the reconditioning early in the growing season to prevent seed set, and again in the fall following reconditioning to limit the effect of the ground disturbance. There are no additional mitigations being considered.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

No actions would be proposed under Alternative 1. Weed treatment would continue throughout the fire perimeter, as prescribed in the Snow Talon BAER report (USDA 2003a). No additional ground disturbance related to logging activities would occur under this alternative. Areas that are treated with herbicides would not be expected to increase in infestation level, and spread form these areas would be limited. Weeds would be expected to increase in level of infestation and acres infested overall in the fire area in spite of the efforts of herbicide application for control. This is because of a large amount of surface soil movement related to removal of surface duff, litter, and plant cover. Noxious weeds are aggressive plants, especially when competition from other plants is reduced as in the first season following a wildfire.

One specific area that would be expected to increase in the infestation level of spotted knapweed is the area around the jammer trails. This would be because of limited access with ground-based equipment, limited herbicides, and new infestations that were unknown prior to the fire. These areas were scheduled for treatment with herbicides through the BAER process for three successive growing seasons. Tordon and 2,4-D were to be used, depending on the location of the infestation. The Helena Forest Noxious Weed EIS (USDA 1987) limits herbicides for weed control to Tordon (active ingredient picloram), Banvel (active ingredient dicamba), Roundup (active ingredient glyphosate), and 2,4-D. Erosion from the fire would likely limit access using the old jammer systems over time, so weed treatment would be very difficult and expensive as the infestations would only be accessible using backpack sprayers. New infestations that occurred post-fire would spread prior to detection and follow-up treatment. Once BAER funding was expended, the normal weed control program would continue to treat the weeds within the fire area. This area would be prioritized with the remainder of the Forest so treatment of

all the weeds would most likely not occur annually. Research has shown that treatments every 3 or 4 years for 12 years are necessary to control infestations of toadflax. Complete control of spotted knapweed is considered no longer an option by numerous researchers (USDA 2004) and no specific estimate for control was given. Repeated applications of chemicals or mechanical treatment are required to control infestation levels, as well as a healthy, diverse native plant community to provide competition (USDA 2004). The best long-term treatment for the fire area would involve an integrated pest management program that includes using biological control agents for the major noxious weed species of concern.

Indirect effects would include noxious weed infestations that spread beyond the jammer trail areas resulting from the instability of the area. Impacts to sensitive plant species from increased noxious weed infestations, adverse impacts to native plant populations within the RNAs from noxious weeds and damage to wildlife habitat could result. Since not harvest activities would be proposed with this alternative, increased potential for noxious weed spread from those activities would also not occur. The most susceptible habitat types for weed spread in the fire area include Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*), a total of approximately 3,890 acres. Spotted knapweed is closely associated with roadsides, but is also known to infest open grasslands and dry, open grown forests that have not been disturbed (USDA 2004). The remaining habitat types are moist forest, subalpine fir habitat types that would have had closed canopies and low probability of weed infestation prior to the fire, particularly spotted knapweed. This species does not tolerate shading (USDA 2004). Canada thistle tolerates more shade than spotted knapweed, but it is closely associated with ground disturbing activities (USDA 2004). Since these areas were not disturbed prior to the fire, there is low probability that Canada thistle persisted there. Yellow toadflax was limited to a few roadsides prior to the fire. Yellow toadflax can produce a large number of seeds, but low viability and strong seed dormancy result in poor yellow toadflax seedling establishment, especially with competition. Yellow toadflax seedlings, once established, have a rapid rate of growth and vegetative spread, enabling them to colonize a suitable niche quickly when competitive stresses are low (USDA 2004). Spread is likely to be primarily from the existing populations as vegetative spread is a primary spread mechanism for this species. Dalmation toadflax was only known from one infestation in the Indian Meadows RNA, but this species could spread exponentially following the fire. Dalmation toadflax has been found under low to moderate tree canopies, although it is more common in open areas (USDA 2004).

Alternative 1 would have the least adverse impact on the spread of noxious weeds resulting from the lack of logging activity than any of the action alternatives. The long-term effect of not recontouring the jammer trails in this alternative would have more adverse long-term effects in the spread of spotted knapweed as compared to the action alternatives.

As no harvest activities would occur with this alternative, there would be no increased probability of noxious weed infestations to increase, resulting from those activities.

Cumulative Effects of Alternative 1

Cumulative effects that could affect noxious weed infestation levels, understory plants growth, aspen and riparian community recovery, would be related to natural erosional

processes caused by the loss of vegetative cover from the Snow Talon fire. Accelerated soil movement would be expected and could impact vegetation recovery. One of the most potentially adverse impacts to all plants in the fire area as well as the RNA is the spread of noxious weeds. The most susceptible habitat types for weed spread in the fire area include Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*), a total of approximately 3,890 acres. Spotted knapweed is closely associated with roadsides, but is also known to infest open grasslands and dry, open grown forests that have not been disturbed as well as areas of disturbance such as harvest units (USDA 2004). The remaining habitat types are moist forest, subalpine fir habitat types that would have had closed canopies and low probability of weed infestation prior to the fire, particularly spotted knapweed. There are known noxious weed populations within the RNA boundaries and 750 acres of infestation prior to the fire (Olsen, personal observations; weeds database). It is very important that noxious weed populations be controlled to avoid long-term loss of plant diversity in the area. The Red Mountain RNA (USDA 1997c) is mostly outside of the fire perimeter, but this area could be adversely affected by noxious weed infestations as well.

Recreation, including vehicular, pedestrian, and equestrian visitors, could have adverse impacts to all plant communities if this activity spreads noxious weeds. Potential impacts to all plant communities related to mushroom picking could occur from trampling emerging vegetation, noxious weed spread and vehicular disturbance.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, but sheep have not historically grazed the northern portion of the area, which burned. No cumulative effects would be expected resulting from grazing on NF land.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, and decrease native plant diversity. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed above, particularly for dry habitat types. In addition, ground-disturbing activities associated with logging, road building or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing would be less likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. All of these activities could decrease native plant diversity and retard plant growth, depending on the ground disturbance of the activities. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 1

This alternative would be consistent with the direction for noxious weeds in the *Forest Plan*, as well as other federal legislation listed in this report with the exception of the potential for this alternative to allow the spread of noxious weeds in the jammer trail areas.

Conclusions for Alternative 1

There would be no short-term adverse environmental consequences related to noxious weed infestation spread associated with Alternative 1. Long-term impacts would likely occur from the erosion and instability related to jammer trail prisms remaining on the slopes. Over time these areas would continue to erode, weed infestations would increase as seeds were spread with the soil, and native plant communities would be unable to colonize unstable areas. Less ground cover would establish in those areas, plant diversity would be lessened and overall productivity reduced over time. Impacts to sensitive plant species from increased noxious weed infestations, adverse impacts to native plant populations within the RNAs from noxious weeds and damage to wildlife habitat could result. Since no harvest activities would be proposed with this alternative, increased potential for noxious weed spread from those activities would not occur.

Effects of Alternative 2

Mitigations Included in Alternative 2

See “Mitigations Included under Action Alternatives” in the noxious weed resource section.

Direct and Indirect Effects of Alternative 2

Under this alternative, 2,461 acres of timber harvest would occur. One-half mile of temporary road, 30 miles of haul route, 30 acres helicopter landings, and 56 acres of log landings would be used. Ground-based logging systems (847 acres of tractor and 308 acres of skyline) would occur over snow and on frozen ground. Ground disturbance would be minimized in these areas and noxious weed spread would also be minimized. Limiting this activity to the dormant season on a frozen surface would greatly decrease the chance for weeds to be spread, either from plants within the logged area or from earth on the machinery. Past studies have shown a significant decrease in soil disturbance resulting from logging when the activity occurs on frozen ground (McIver and Starr 2000). Limited ground disturbance would result in lower risk of increased weed infestations.

Approximately 1,303 acres of helicopter logging would occur under this alternative. Areas of helicopter logging would not be expected to significantly impact noxious weed infestation level even though these activities occur during the growing season. Minimal ground disturbance would occur in the helicopter units (McIver and Starr 2000). Some soil disturbance would occur due to tree falling, and some soil disturbance could occur. If weeds are present in these areas, the logging activity could increase the acres of infestation. This impact would be fairly minimal. The most susceptible habitat types within the helicopter units would be dry habitat types that may have had low infestations of spotted knapweed prior to the fire because of the natural openness of such forest types. These habitat types include Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*), a total of approximately 165 acres. Spotted knapweed is closely associated with roadsides, but is also known to infest open grasslands and dry, open grown forests that have not been disturbed (USDA 2004). The remaining habitat types are moist forest, subalpine fir habitat types that would have had closed canopies and low probability of weed infestation prior to the fire, particularly spotted knapweed. This species does not

tolerate shading (USDA 2004). Canada thistle tolerates more shade than spotted knapweed, but it is closely associated with ground disturbing activities (USDA 2004). Since these areas were not disturbed prior to the fire, there is low probability that Canada thistle persisted there. Yellow toadflax was limited to a few roadsides prior to the fire. Any additional ground disturbance could result in increased infestation of this species, if any plants are in the vicinity of the disturbance (USDA 2004).

In this alternative, approximately 30 miles of old jammer trails would be recontoured, seeded, and planted with shrubs and trees. The habitat types associated with these sites are very dry—Douglas-fir (*Pseudostuga menziesii*)/pinegrass (*Calamagrostis rubescens*) and Douglas-fir/bluebunch wheatgrass (*Pseudoroegenaria spicata*). The old harvest units associated with the jammer system were infested with spotted knapweed prior to the fire, as were the areas adjacent to the jammer trails. These areas were scheduled for treatment with herbicides through the BAER process, for three successive treatments. Tordon and 2,4-D were to be used, depending on the location of the infestation. The recontouring of these roads may cause some initial spread of noxious species. Pre- and post-treatment of the infestations is essential in controlling the spread of weeds. These treatments, prior to recontouring, would limit the increase in infestation. Over the long term, as grass seed, planted shrubs and trees get established, the area would be less susceptible to weed invasion and dominance. Studies have shown that a combination of herbicides and seeding has successfully limited infestation levels of spotted knapweed (USDA 2004). Recontouring these old transportation systems would improve soil stability over a shorter period of time than if the transportation systems were not recontoured, resulting in more ground cover in a shorter period of time.

Many of the effects shown under Alternative 1 would occur under this alternative, as a result of the fire and not related to the logging activities. Alternative 2 has the potential for somewhat higher adverse impacts in terms of noxious weed spread and infestation level as compared to alternative because there are more acres of disturbance. Because of the fact that the additional acres of disturbance are helicopter logging, the risk of increased weed infestation is low on the additional acres. This alternative would have less adverse impact long-term in the spread of spotted knapweed in the area of the jammer trails than Alternative 1.

Table 40 shows the individual activity proposed in the alternative, the risk of infestation for each activity (based on ground disturbance associated with the activity) and the estimated acres of potential weed infestation.

Approximately 2.5 miles of the haul route in the Red Creek drainage will require road reconditioning prior to haul, and there are known weed infestations in this area. This is common to all alternatives.

For the purposes of calculating the potential amount of herbicide applied to the treatment areas, a low risk is equated to soil disturbance of approximately 1–5% (midpoint of 3%) of the potential acres affected. Moderate risk is equated to approximately 5–15% soil disturbance (midpoint of 10%) of the potential acres affected. High risk is equated to approximately 15% or greater soil disturbance of the acres affected. When a high risk is assigned, the type of activity is assessed. Generally, 100% soil disturbance is assumed in the case of landings or road recontouring/reconstruction activities. Estimate of herbicide application needed is 50% of the total acres of disturbance.

Table 40. Effects of Alternative 2 on noxious weeds.

Activity	Risk of Infestation	Potential Acres of Activity[a]	Estimated Acres of Weed Infestation
Acres of jammer trail treatment	High	101	0.50×101 = 51
Acres of haul road/temp. road (30-ft buffer) used in winter	Low	20	0.03×22 = 1
Acres of haul road/temp. road (30-ft buffer) not limited seasonally	Moderate	86	0.10×86 = 9
Temporary road construction (30-ft disturbance)	High	2	0.50×2 = 1
Acres of helicopter harvest	Low	1303	0.03×1303 = 39
Acres of helicopter landings	High	30	0.50×30 = 15
Acres of ground-based harvest (winter only)	Low	1155	0.03×1155 = 35
Acres of ground-based log Landings (winter only)	High	56	0.50×56 = 28
Total acres of potential weed infestation			179

a. This column represents total acres. None of the listed activities are expected to cause infestations on all of the acres affected, but all acres affected would be monitored and spot treated with herbicides.

Cumulative Effects of Alternative 2

Herbicide applications will occur within the Snow Talon fire area through the BAER project. Approximately 640 acres per treatment would have herbicides applied, using appropriate chemicals within label restrictions. Biological control efforts are currently being explored to provide long-term integrated pest management within the area. Additional BAER projects include road improvements such as culvert replace and routine maintenance. Any ground disturbing activities have the potential to increase noxious weed infestations. Many of the existing weed populations are included in the areas proposed for activities, such as the jammer trails. Table 41 shows the additional acres of potential herbicide application, above the BAER project level.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, and the northern portion of the area which burned has not historically been grazed by the sheep.

Recreation activities within the fire perimeter, including vehicular, pedestrian, and equestrian traffic, have the potential to spread noxious weeds. Weed seeds or parts of plants can become attached to humans, animals, and vehicles, and get wide distribution.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, although no known populations occur. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed under Alternative 1. In addition, ground-disturbing activities associated with logging, road building or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing is not likely to affect the noxious weed species addressed

Table 41. Potential herbicide application in the Snow Talon project area.

Type of Activity	Alternative 2 (acre)	Alternative 3 (acre)	Alternative 4 (acre)
BAER treatment acres	640	640	640
Total acres potential infestation resulting from proposed activities	179	117	263
Weed infestations within activity areas prior to treatment (duplicated in BAER)	131	86	137
Potential infestations resulting from activity acres above BAER treatments (row 2 minus row 3)	48	31	126
Total acres of herbicide treatment (BAER and New Activity)	688	671	766

in this document, although continuous heavy grazing could increase noxious weed populations. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 2

This alternative would be consistent with the direction for noxious weeds in the *Forest Plan*, as well as other federal legislation listed in this report as long as the recommended mitigation practices are observed.

Conclusions for Alternative 2

The ground-based logging activity in Alternative 2 occurs on frozen ground and/or over snow. This restriction alone reduces the risk of spreading noxious weeds, resulting from the limited ground disturbance as compared to ground-based logging without seasonal restrictions (McIver and Starr 2000). Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). The recontouring of the jammer trails has high risk of increasing noxious weed infestations because this activity would occur in an area that is already infested and disturbs 100% of the 30-foot recontoured area. This would be common to all action alternatives. Alternative 2 has more potential adverse impact in terms of potential for noxious weed infestation spread than Alternative 3 as there would be additional acres of disturbance. The additional disturbance would be helicopter logging with low risk of infestation, and the helicopter landings (high risk). Alternative 2 would have a much lower potential risk of noxious weed spread than Alternative 4 because of the seasonal restrictions on the ground-based logging activities.

Effects of Alternative 3

Mitigations Included in Alternative 3

See “Mitigations Included under Action Alternatives” in the noxious weed resource section.

Direct and Indirect Effects of Alternative 3

Under this alternative, 1,129 acres of timber harvest would occur. One-half mile of temporary road, 21 miles of haul route, and 56 log landings would be constructed.

Ground-based logging systems (847 acres of tractor and 282 acres of skyline) would occur over snow and on frozen ground. Ground disturbance would be minimized in these areas and noxious weed spread would also be minimized. Limiting this activity to the dormant season on a frozen surface would greatly decrease the chance for weeds to be spread, either from plants within the logged area or from earth on the machinery. Past studies have shown a significant decrease in weed infestation resulting from logging when the activity occurs on frozen ground (McIver and Starr 2000). Limited ground disturbance at the landings would have the same effect, of limiting weed spread. No helicopter logging would occur under this alternative.

The effects of this alternative would be the same as those of Alternative 2 for the ground-based logging activities. There is less potential for ground disturbance under this alternative as compared to Alternative 2, as no helicopter logging would occur. Little impact in terms of weed infestation spread would occur under this alternative. Jammer trail recontouring would have the same effects as those under Alternative 2.

Alternative 3 has the potential for the least adverse impacts in terms of noxious weed spread and infestation level of any of the action alternatives in terms of timber harvest activity. This alternative would have less adverse impact long term in the spread of spotted knapweed in the area of the jammer trails than Alternative 1.

Table 42 shows the individual activity proposed in the alternative, the risk of infestation for each activity (based on ground disturbance associated with the activity) and the estimated acres of potential weed infestation.

For the purposes of calculating the potential amount of herbicide applied to the treatment areas, a low risk is equated to soil disturbance of approximately 1–5% (midpoint of 3%) of the potential acres affected. Moderate risk is equated to approximately 5–15% soil disturbance (midpoint of 10%) of the potential acres affected. High risk is equated to approximately 15% or greater soil disturbance of the acres affected. When a high risk is assigned, the type of activity is assessed. Generally, 100% soil disturbance is assumed in the case of landings or road recontouring/reconstruction activities. Estimate of herbicide application needed is 50% of the total acres of disturbance.

Alternative 3 has less potential adverse impact in terms of effects to noxious weed infestation spread than Alternative 2, and far lower impact than Alternative 4.

Table 42. Effects of Alternative 3 on noxious weeds.

Activity	Risk of Infestation	Potential Acres of Activity[a]	Estimated Acres of Weed Infestation
Acres of jammer trail treatment	High	101	0.50×101 = 51
Acres of haul road/temp. road (30-ft buffer)	Low	76	0.03×76 = 3
Acres of temporary road construction (30-ft disturbance)	High	2	0.50×2 = 1
Acres of ground-based harvest	Low	1129	0.03×1129 = 34
Acres of ground-based log landings	High	56	0.50*56 = 28
Total acres of potential weed infestation			117

a. This column represents total acres. None of the listed activities are expected to cause infestations on all of the acres affected, but all acres affected would be monitored and spot treated with herbicides.

Cumulative Effects of Alternative 3

Herbicide applications will occur within the Snow Talon fire area through the BAER project. Approximately 640 acres per treatment would have herbicides applied, using appropriate chemicals within label restrictions. Biological control efforts are currently being explored to provide long-term integrated pest management within the area. Additional BAER projects include road improvements such as culvert replace and routine maintenance. Any ground disturbing activities have the potential to increase noxious weed infestations. Many of the existing weed populations are included in the areas proposed for activities, such as the jammer trails. Table 41 shows the additional acres of potential herbicide application, above the BAER project level.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, and the northern portion of the area which burned has not historically been grazed by the sheep.

Recreation activities within the fire perimeter, including vehicular, pedestrian, and equestrian traffic, have the potential to spread noxious weeds. Weed seeds or parts of plants can become attached to humans, animals, and vehicles and get wide distribution.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, although no known populations occur. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed under Alternative 1. In addition, ground-disturbing activities associated with logging, road building, or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing is not likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Forest Plan Consistency of Alternative 3

This alternative would be consistent with the direction for noxious weeds in the *Forest Plan*, as well as other federal legislation listed in this report as long as the recommended mitigation practices are observed.

Conclusions for Alternative 3

The ground-based logging activity in Alternative 3 occurs on frozen ground and/or over snow. This restriction alone reduces the risk of spreading noxious weeds, resulting from the limited ground disturbance as compared to ground-based logging without seasonal restrictions (McIver and Starr 2000). The recontouring of the jammer trails has high risk of increasing noxious weed infestations because this activity would occur in an area that is already infested and disturbs 100% of the 30-foot recontoured area. This would be common to all action alternatives. Alternative 3 has less potential adverse impact in terms of potential for noxious weed infestation spread than Alternative 2 as there would be fewer acres of disturbance overall. Alternative 3 would have a much lower potential risk

of noxious weed spread than Alternative 4 resulting from the seasonal restrictions on the ground-based logging activities, and the lowest overall risk of all alternatives.

Effects of Alternative 4

Mitigations Included in Alternative 4

See “Mitigations Included under Action Alternatives” in the noxious weed resource section.

Direct and Indirect Effects of Alternative 4

Under this alternative, 3,715 acres of timber harvest would occur. One-half mile of temporary road, 30 miles of haul route, 30 helicopter landings, and 74 log landings (35 associated with no seasonal restrictions and 39 associated with winter logging) would be used. Ground-based logging systems (531 acres of tractor any season and 282 acres of skyline) would occur without seasonal restrictions. Ground disturbance would be extensive in these areas and the potential for noxious weed spread would also be extensive. Allowing machinery access to the recently burned soil and little plant cover greatly increases the potential for weeds to be spread, either from plants within the logged area or from earth on the machinery. Past studies have shown an increase in weed infestation resulting from logging when the activity occurs in burned areas (McIver and Starr 2000). Extensive ground disturbance at the landings would have the same effect, which greatly increases the potential for weed spread. 582 of tractor winter logging only would occur, with 39 associated log landings. The risk of weed infestation on these areas would be low.

Helicopter logging would occur on 2,323 acres. The effects of helicopter logging would be the same in this alternative as those listed under Alternative 2, with more acres potentially affected. The effects of recontouring the jammer trails would be the same as those listed under Alternative 2.

Table 43 shows the individual activity proposed in the alternative, the risk of infestation for each activity (based on ground disturbance associated with the activity) and the estimated acres of potential weed infestation.

For the purposes of calculating the potential amount of herbicide applied to the treatment areas, a low risk is equated to soil disturbance of approximately 1–5% (midpoint of 3%) of the potential acres affected. Moderate risk is equated to approximately 5–15% soil disturbance (midpoint of 10%) of the potential acres affected. High risk is equated to approximately 15% or greater soil disturbance of the acres affected. When a high risk is assigned, the type of activity is assessed. Generally, 100% soil disturbance is assumed in the case of landings or road recontouring/reconstruction activities. Estimate of herbicide application needed is 50% of the total acres of disturbance.

Tractor logging without seasonal restrictions was rated as moderate disturbance. It is not clear in reviewing current literature (McIver and Starr 2000) and in consultation with Forest Soil Scientist that soil disturbance would be in the moderate range. These sources agree that past logging has shown 30–40% exposed, bare ground following logging operations on burned areas. There would be potential for high disturbance on the tractor logged areas with no seasonal restrictions.

Table 43. Effects of Alternative 4 on noxious weeds.

Activity	Risk of Infestation	Potential Acres of Activity[a]	Estimated Acres of Weed Infestation
Jammer trail treatment	High	101	0.50×101 = 51
Acres of haul road (30-ft buffer) used in winter	Low	20	0.03×20 = 1
Acres of haul road (30-ft buffer) not limited seasonally	Moderate	86	0.10×86 = 9
Temporary road construction (30-ft disturbance)	High	2	0.50×2 = 1
Helicopter harvest	Low	2332	0.03×2332 = 70
Helicopter landings	High	30	0.50×30 = 15
Acres of ground-based harvest, winter only	Low	582	0.03×582 = 17
Ground-based log landings, winter only	High	39	0.50×39 = 20
Tractor harvest, no seasonal restrictions	Moderate (see discussion below)	531	0.10×531 = 53
Skyline harvest, no seasonal restrictions	Low	282	0.03×282 = 8
Ground-based log landings, no seasonal restrictions	High	35	0.50×35 = 18
Total acres of potential weed infestation			263

a. This column represents total acres. None of the listed activities are expected to cause infestations on all of the acres affected, but all acres affected would be monitored and spot treated with herbicides.

Cumulative Effects of Alternative 4

Herbicide applications will occur within the Snow Talon fire area through the BAER project. Approximately 640 acres per treatment would have herbicides applied, using appropriate chemicals within label restrictions. Biological control efforts are currently being explored to provide long-term integrated pest management within the area. Additional BAER projects include road improvements such as culvert replace and routine maintenance. Any ground disturbing activities have the potential to increase noxious weed infestations. Many of the existing weed populations are included in the areas proposed for activities, such as the jammer trails. Table 41 shows the additional acres of potential herbicide application, above the BAER project level.

The Helena NF does not permit any livestock grazing within the area of the proposed timber harvest or the jammer trail recontouring. The closest grazing allotment, called Keep Cool-Liverpool, is located partially within the fire area but outside of any activities. This is a sheep grazing allotment, and the northern portion of the area, which burned, has not historically been grazed by the sheep.

Recreation activities within the fire perimeter, including vehicular, pedestrian, and equestrian traffic, have the potential to spread noxious weeds. Weed seeds or parts of plants can become attached to humans, animals and vehicles and get wide distribution.

Private land activities such as post-fire logging, livestock grazing, and recreation within the Snow Talon fire perimeter have the potential to increase noxious weed infestations, although no known populations occur. Noxious weeds occur on private land adjacent to the NF and effects from the Snow Talon fire would be similar to those discussed under Alternative 1. In addition, ground-disturbing activities associated with logging, road building, or subdivision development would increase noxious weed infestation level and extent. Cattle or sheep grazing is not likely to affect the noxious weed species addressed in this document, although continuous heavy grazing could increase noxious weed populations. Recreation activities such as off road motorized use and mountain biking could also cause the spread of noxious weeds. Herbicides maybe used by private landowners to control noxious weeds.

Unavoidable Adverse Effects of Alternative 4

This alternative would be consistent with the direction for noxious weeds in the *Forest Plan*, as well as other federal legislation listed in this report, as long as the recommended mitigation practices are observed.

Conclusions for Alternative 4

Almost half of the ground-based logging activity in Alternative 4 could occur on unfrozen ground, as there are not seasonal restrictions with this alternative. This activity would be expected to cause far more ground disturbance than Alternatives 2 or 3, which occur only on frozen ground. Helicopter logging has been shown to create little ground disturbance (McIver and Starr 2000). There are more acres of helicopter logging in this alternative and even though the risk of infestation is low, there is a higher risk than the other alternatives resulting from the greater acreage being disturbed. Alternative 4 has the potential for the most adverse impacts in terms of noxious weed spread and infestation level than any other alternative overall.

Summary

Alternative 1 would have the least adverse impact on the spread of noxious weeds resulting from the lack of logging activity than any of the action alternatives. The long-term effect of not recontouring the jammer trails in this alternative would have more adverse long-term effects in the spread of spotted knapweed as compared to the action alternatives.

Alternative 2 would have more potential adverse impact in terms of effects to noxious weed infestation spread than Alternative 3, but much lower impact than Alternative 4. There are a total of 179 acres of potential weed infestation in Alternative 2.

Alternative 3 would have less potential adverse impact in terms of effects to noxious weed infestation spread than Alternative 2, and far lower impact than Alternative 4. There are a total of 117 acres of potential weed infestation in Alternative 3.

Alternative 4 would have the potential for the most adverse impacts in terms of noxious weed spread and infestation level than any other alternative. There are a total of 263 acres of potential weed infestation in Alternative 4. Table 44 compares the relative risk for increased noxious weed infestations among alternatives.

Table 44. Comparison of alternatives and alternative features and noxious weed infestation risk.

Activity	Alt 1	Alt 2	Alt 3	Alt 4
Jammer trail treatment	Highest	No difference	No difference	No difference
Haul road/temp road (30-foot buffer)	None	Moderate	Lowest	Highest
Helicopter harvest	None	Low	None	Low
Helicopter landings	None	High	None	High
Acres of ground-based harvest, winter only	None	Low	None	Low
Ground-based log landings, winter only	None	Low	Low	Low
Ground-based harvest, no seasonal restrictions	None	None	None	Highest
Ground-based log landings, no seasonal restrictions	None	None	None	Highest

Recreation

The Copper Creek drainage within the Snow Talon fire salvage project area is the most heavily used area for recreation purposes on the Lincoln RD. This area is an easy drive from the communities of Lincoln, Helena, Missoula, and Great Falls. Recreational opportunities include developed, dispersed, and backcountry camping, stock use, backpacking, fishing, hunting, picnicking, hiking, swimming, mountain biking, OHV use, snowmobiling, cross-country skiing, and outfitter-served trips.

Developed recreation facilities on NF lands within the project area include Indian Meadows Trailhead, Copper Creek Campground and facilities at Snowbank Lake.

Indian Meadows Trailhead provides access into the Scapegoat Wilderness, which is part of the Bob Marshall Wilderness Complex. The majority of use occurring from the trailhead is livestock related. Heaviest use period occurs during the fall hunting season. The trailhead consists of a native surface parking area, a stock unloading ramp, feeding mangers, an information board, signs, and a restroom.

OHV use in the Copper Creek area is occurring, but opportunities are quite limited. The entire area is closed to motorized travel with the exception of designated roads. ATVs do occasionally travel on the main Copper Creek Road and the adjacent Indian Meadows Road. Illegal OHV use has been noted in some locations.

A variety of wildlife species occupy or pass through the project area and provide opportunities for wildlife viewing and hunting. The area is especially popular for big game hunting during rifle season.

There are four outfitter services that are authorized under a special use permit to provide commercially guided trips into the Scapegoat Wilderness. Current outfitter guide use allows for 178 service days during the summer months and 1,165 user days during the fall.

Affected Environment—Summer/Fall Recreation Use

During the summer and fall seasons, the Copper Creek area is visited frequently by forest users. Activities range from camping at the Copper Creek Campground to visiting the Scapegoat Wilderness by either horseback or on foot. Many users enjoy Snowbank Lake during the hot summer days to swim or fish, and the majority of the use in this area occurs on weekends. Table 45 displays the number of vehicles that traveled on the Copper Creek Road during the summer and fall of 1999 and during the months of July and August 2003.

Table 45. Vehicle use on Copper Creek Road.

Year	Weekday Totals	Weekend Totals
1999	6,299	8,062
2003	2,126	649

Developed recreation facilities on NF lands within the project area include Indian Meadows Trailhead, Copper Creek Campground, and facilities at Snowbank Lake.

The Snow Talon fire burned about one-third of Indian Meadows Trailhead. The natural integrity of the area surrounding the trailhead was heavily impacted by the fire; however, most of the trailhead facilities remain intact.

Copper Creek Campground consists of 21 sites with each site having a designated parking spur, picnic table and fire ring. There are four restrooms in the campground and two information boards. The campsites located in the northern most portion (about 50% of the sites) of Copper Creek Campground were the most impacted by the fire. These sites were completely burned; however, the facilities remain intact. Snowbank Lake facilities consist of a restroom and designated parking area. Fire burned all around the lake but the facilities were untouched. Table 46 shows the amount of use Copper Creek Campground has received from 1998–2003.

Several system trails are located in the project area. The Mainline Trail (#481) is the most heavily used as it leads into the Scapegoat Wilderness and provides for an easy day hike to Heart Lake. Table 47 describes the trails that can be found in the area.

Table 46. Copper Creek Campground annual use from 1998 to 2003.

Year	Total Nights Used
1998	787
1999	872
2000[a]	769
2001	901
2002	908
2003[a]	683

a. During the summer of 2000, NF lands were closed due to extreme fire conditions. In 2003, the campground was closed from August 13 until the end of the season.

Table 47. Trails accessed via Copper Creek Campground area.

Trail Number	Trail Access
481	101 miles, leads into the Scapegoat Wilderness
438	6.5 miles from Indian Meadows Trailhead to Silver King Lookout. Also provides access in Scapegoat Wilderness
418, 417	6 miles from Snowbank Lake to Stonewall Mountain
418	8.5 miles from Snowbank Lake to the Sucker Creek area
485	6.5 miles from Copper Camp to Stonewall Creek; 4.5 miles from Copper Camp to Lower Copper Lake

Environmental Consequences—Summer/Fall Recreation Use

This section discloses the environmental consequences of implementing Alternative 2 and its alternatives on summer/fall recreation use.

Effects Common to All Alternatives

The following effects have been determined to be common to all alternatives:

- Copper Creek Road will remain open for public use
- System trails will remain open
- Developed recreation sites will be available for use
- Access into the Scapegoat Wilderness from Indian Meadows Trailhead will continue.

Effects Common to All Action Alternatives

None of the action alternatives directly affect recreational use at Copper Creek Campground. All existing system roads and trails would remain in place. All action alternatives may limit recreational access to popular dispersed sites. Some delays on the Copper Creek Road and the road to Indian Meadows Trailhead may occur.

Mitigations Included under All Alternatives

Recreational sites and trails will continue to be monitored for public safety reasons. It may be determined to close some of the sites due to post-fire effects from flooding, landslides, and other natural processes.

Mitigations Included under Action Alternatives

Contractors will be required to post signs along FS haul roads warning the public of truck traffic and other logging activities. Public announcements and warning signs will be used to notify users of logging activities in the Copper Creek area. On roads closed to motorized use that are needed to access salvage units, public access will remain restricted.

Effects of Alternative 1—Summer/Fall Recreation Use

Direct and Indirect Effects of Alternative 1

Selection of the no action alternative would result in no changes in regards to recreation resources or activities involved with summer/fall recreation use.

Cumulative Effects of Alternative 1

Fire-related road and trail repairs would continue. Over time, dead trees would continue to fall, as well as additional trees dying due to bark beetle infestations along roads and trails. Mushroom and forest products gathering may increase in the burned area. Outfitters may experience an increase in conflicts resulting from multiple-use activities in the Snow Talon fire project area.

Unavoidable Adverse Effects of Alternative 1

Blown down trees, post-fire flooding, debris flow, and channel cutting could restrict use in developed and dispersed sites within the project area.

Forest Plan Consistency of Alternative 1

Meets *Forest Plan* direction.

Conclusions

Under Alternative 1, summer/fall recreation use should continue at the same level the area is experiencing now. Post-fire natural processes may restrict use in the area temporarily.

Effects of Action Alternatives—Summer/Fall Recreation Use

Direct and Indirect Effects of Action Alternatives

Some users may feel they are being displaced from recreational sites in the project area while logging activities are occurring. For the most part, the area will remain open for public use; however, delays may occur on roads and trails and/or areas may be temporarily closed until logging operations have been completed.

Cumulative Effects of Action Alternatives

Fire-related road and trail repairs would continue. Over time, dead trees would continue to fall, as well as additional trees dying due to bark beetle infestations along roads and trails. Mushroom and forest products gathering may increase in the burned area. Outfitters may experience an increase in conflicts resulting from multiple-use activities in the Snow Talon fire project area.

If visitors do not wish to wait for the delays that may occur during the summer/fall season, sites in the lower portion of Copper Creek could see an increase in use. Visitors also may wish to do their recreation activities in other locations on the RD and this could create additional resource impacts in those locations.

Unavoidable Adverse Effects of Action Alternatives

Same as those disclosed under Alternative 1.

Forest Plan Consistency of Action Alternatives

Meets *Forest Plan* direction.

Conclusions

Under Alternatives 2, 3, and 4, forest users may feel they are being displaced from summer/fall recreation use in the Copper Creek area during harvesting operations. This could cause an increase in use on other portions of the Lincoln RD.

Affected Environment—Winter Recreation

The Snow Talon fire project area is the most popular winter recreation area on the Lincoln RD. It is not uncommon to have significant snowfall amounts in the area and for snow to remain in the upper reaches of Copper Creek well into July.

During the winter months, the Copper Creek drainage is inundated with snowmobilers. Some of the best snowmobiling conditions in the state can be found here. There are approximately 120 miles of groomed trails and 65 miles of ungroomed trails available for snowmobilers. Grooming is done by the Ponderosa Snow Warriors, a snowmobile club located in Lincoln. The Copper Bowls are very popular with those who wish to do some extreme snowmobiling. As a result of the Snow Talon fire, snowmobile access has improved; however, grooming new routes for snowmobiling has been prohibited. Table 48 shows snowmobile use in the area over the past ten years.

Environmental Consequences—Winter Recreation

Effects Common to All Alternatives

The following effects have been determined to be common to all alternatives:

- The area will remain open for winter recreation use.

Table 48. Project area snowmobile use from 1992 to 2003.

Year	Sucker Creek Road	Snowbank Lake
1992–1993	5383	2110
1993–1994	1933	1895
1994–1995	4230	3476
1995–1996	4826	2865
1996–1997	4561	4025
1997–1998	6597	4041
1998–1999	10469	5184
1999–2000	11914	5834
2000–2001	7624	3496
2001–2002	9958	7064
2002–2003	3304	2995
Total	70799	42,985

Statistics provided by Ponderosa Snow Warriors. The numbers reflect each time a snowmobile crossed the counter at each site.

Effects Common to All Action Alternatives

All existing system roads and trails that are open during the winter months would remain in place. All action alternatives may limit recreational access to popular snowmobile areas. Some delays on snowmobile routes may occur. No new routes would be available for grooming.

Mitigations Included under All Alternatives

Snowmobile trails will continue to be monitored for public safety reasons. It may be determined to close some of the trail due to post-fire effects from natural processes.

Mitigations Included under Action Alternatives

Contractors will be required to post signs along FS haul roads warning the public of truck traffic and other logging activities. Public announcements and warning signs will be used to notify users of logging activities in the Copper Creek area. On roads closed to motorized use that are needed to access salvage units, public access will remain restricted.

Effects of Alternative 1—Winter Recreation

Direct and Indirect Effects of Alternative 1

Selection of the no action alternative would result in no changes in regards to winter recreation resources or activities.

Cumulative Effects of Alternative 1

There is a potential for snowmobile play areas to develop in the burned area.

Unavoidable Adverse Effects of Alternative 1

Blown down trees and post-fire natural processes could restrict winter use in the project area.

Forest Plan Consistency of Alternative 1

Meets *Forest Plan* direction.

Conclusions

Under Alternative 1, winter recreation activities would continue to occur similarly to what the area is currently experiencing. Post-fire natural processes may hamper some winter activities.

Effects of Action Alternatives—Winter Recreation

Direct and Indirect Effects of Action Alternatives

Under Alternatives 2, 3, and 4, some users may feel they are being displaced from snowmobiling in the project area while logging activities are occurring. For the most part, the area will remain open for public use; however, delays may occur on trails and/or areas may be temporarily closed until logging operations have been completed.

Cumulative Effects of Action Alternatives

There is a potential for snowmobile play areas to develop in the harvest units after they have been logged. Some snowmobilers may choose to recreate in different areas on the Lincoln RD while harvesting is occurring in Copper Creek. This could create play areas where they currently do not exist, which may result in additional resource impacts.

Unavoidable Adverse Effects of Action Alternatives

Blown down trees and post-fire natural processes could restrict winter use in the project area.

Forest Plan Consistency of Action Alternatives

Meets *Forest Plan* direction.

Conclusions

Under Alternatives 2, 3, and 4, some winter recreation users may feel like they are being displaced from the Copper Creek area during winter logging operations. This could cause an increase in snowmobile use on other areas of the RD. New cross-country routes to the Copper Bowls could develop. Play areas in harvested units may be developed by snowmobile users.

Roadless Area

In 1972, the FS began identifying roadless areas for wilderness consideration through the Roadless Area Review and Evaluation (RARE) I. In 1979, the agency completed RARE II, a more extensive national inventory of roadless areas. The Helena NF incorporated RARE II data to develop inventories of roadless areas into the *Forest Plan*.

Affected Environment

Much of the following information is summarized from pages C-1 through C-53 in Appendix C of the *Forest Plan* (USDA 1986).

The entire Bear-Marshall-Scapegoat-Swan (BMSS) roadless area encompasses a gross acreage of 866,330, with 58,752 acres located on the Helena NF, Lincoln RD. The Stonewall Mountain subunit totals 51,485 acres and includes the Indian Meadows, Copper Creek, and Stonewall Mountain areas. Most of the area west of Stonewall Mountain and Copper Creek is very steep and rocky. The area east of Stonewall Mountain to Copper Creek is steep and well timbered on north facing slopes. It contains open growing stands of timber with small grassland parks on south and west facing slopes. Elevations range from 4,900 feet in the Blackfoot Valley to 9,411 feet on Red Mountain. Following are descriptions of the features for roadless areas that can be found in the project area:

- Apparent Naturalness and Natural Integrity—The area is large enough contiguous with the Scapegoat Wilderness and the topography is such that any person visiting the area would gain the feeling that they are in a natural area free from human activities and development. The high peaks within the area afford the viewer with vistas of part of the Scapegoat Wilderness, mountain ranges to the south and many of the major drainages on the Lincoln RD.

- Manageability and boundaries—The entire BMSS roadless area encompasses a gross acreage of 866,330 acres; 58,752 acres are located on the Lincoln RD. The Stonewall subunit totals 51,485 acres and includes the Alice Creek (both east and west of the divide), Indian Meadows, Copper Creek, and Stonewall Mountain areas.
- Primitive Recreation Opportunities—In this portion of the Stonewall subunit, there are limited primitive recreation opportunities except as one ventures closer to the Scapegoat Wilderness Area. Most of the area provides semi-primitive recreation opportunities with roaded natural opportunities occurring
- Opportunities for Solitude—This area provides a moderate to high opportunities for solitude. The topography lends itself to being natural and solitude values are considered to be high.
- Unique Features—Red Mountain is located within this subunit and is the highest peak from Lincoln to GNP, rising from 9,411 ft above sea level. This is also one of the few sites in the United States where limber pine and white bark pine grow together. Big game is prevalent in the area and hunting is a popular activity. The area supports a small herd of goats near Red Mountain.

Environmental Consequences

This section discloses the environmental consequences of implementing Alternative 2 and its alternatives to roadless areas.

Effects Common to All Alternatives

The following effects have been determined to be common to all project alternatives:

- System trails will remain open.

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

Selection of the no action alternative would result in no changes in regards to recreation resources or activities.

Unavoidable Adverse Effects of Alternative 1

Blown down trees, post-fire flooding, debris flow, and channel cutting could restrict use in developed and dispersed sites within the project area.

Forest Plan Consistency of Alternative 1

Meets *Forest Plan* direction.

Effects of Alternatives 2 and 3

Direct and Indirect Effects of Alternatives 2 and 3

No management activities are proposed in IRAs; therefore, there are no direct or indirect effects from any activities.

Cumulative Effects of Alternatives 2 and 3

The proposed management activities would slightly reduce the natural integrity and apparent naturalness of the subunit. Otherwise there would be no long-term effects to other roadless characteristics.

Unavoidable Adverse Effects of Alternatives 2 and 3

Same as those disclosed under Alternative 1.

Forest Plan Consistency of Alternatives 2 and 3

Meets *Forest Plan* direction.

Conclusions

As there are no management activities proposed in the roadless area under Alternatives 2 and 3, there should be minimal effects on the roadless characteristics for the Stonewall Mountain subunit of the BMSS roadless area.

Effects of Alternative 4

Direct and Indirect Effects of Alternative 4

Alternative 4 proposes harvest on approximately 800 acres in the roadless area. No new roads would be constructed within the designated roadless area and harvest would be conducted by helicopter only. Chapter 2, Alternative 4 description, provides details of the proposed harvest in the roadless area.

Harvest activities would change the natural integrity and apparent naturalness of the area; however, most of these characteristics have been altered through management activities on adjoining private lands. There would be short-term loss of solitude during the actual harvest activities, but there should be no long-term change in solitude for the area. As the proposed harvest units are located on the edge of the roadless area, there would be no appreciable effect on the overall characteristic of remoteness. Opportunities for primitive recreation would not change substantially. Harvest activities would not significantly change overall manageability of the area or the characteristics of its boundaries. There are no other prominent features that would be affected by the proposed harvest units.

Cumulative Effects of Alternative 4

The proposed management activities under this alternative would slightly reduce the natural integrity and apparent naturalness of the roadless area. Otherwise, there would be no long-term effects to other roadless characteristics.

Irreversible/Irretrievable Commitments of Alternative 4

Potential for a reduction in the natural integrity and apparent naturalness of the Stonewall Mountain subunit of the BMSS roadless area.

Unavoidable Adverse Effects of Alternative 4

Same as those disclosed under Alternative 1.

Forest Plan Consistency of Alternative 4

Meets *Forest Plan* direction.

Direct and Indirect Effects of Alternative 4

Under Alternative 4, proposed management activities could slightly reduce the natural integrity and apparent naturalness of the Stonewall Mountain roadless area; however, these two characteristics have been altered through management practices on adjoining private lands.

Unroaded Area

Concerns were expressed about the impacts of activities proposed in the Snow Talon fire salvage project to unroaded lands in the context of roadless characteristics, future wilderness eligibility, and future IRA eligibility.

This unroaded analysis is not intended to be an allocation process. A determination of the eligibility of an unroaded area for wilderness or inventoried roadless is beyond the scope of this project and would be more appropriately handled during *Forest Plan* revision.

For this analysis, unroaded landscapes are considered to be a resource area. As such, all alternatives were evaluated to determine their effects on unroaded resources. This analysis identifies "areas without the presence of classified roads, of a size and configuration sufficient to protect the inherent characteristics associated with its unroaded condition" (36 CFR 219.36 [2003]). The existing condition of those areas are described in terms of the roadless area characteristics listed in the Roadless Rule (36 CFR 294.11 [2003]) and in terms of unroaded resource values. Table 49 describes the link between inventoried roadless characteristics and unroaded resource values. Unroaded characteristics of unroaded areas were described accordingly.

Three blocks of unroaded areas were identified within the Snow Talon fire perimeter. Salvage harvest is proposed in all three of these unroaded areas (Figure 14). These three unroaded areas were not identified as inventoried roadless land in the roadless area reviews. These unroaded areas may contain roadless characteristics such as high quality soil, water, and air, or diversity of plant and animal communities.

Affected Environment

Unroaded Area 1 was identified in Sections 15 and 22 in the lower portions of the Copper Creek drainage between Roads #330 and #1881, consisting of approximately 1,255 acres. Unroaded Area 1 is also adjacent to private land along Copper Creek. A very small portion of Unroaded Area 1 (in the southwest corner) is adjacent to the Stonewall Mountain IRA subunit boundary. Fireline was constructed by bulldozers across approximately 375 meters of the southernmost tip of Unroaded Area 1 near Road #1881-B1 and Road #1881-C1. This fireline was reclaimed and seeded with a native seed mix in fall 2004.

Unroaded Area 2, approximately 2,104 acres in size, was identified in an area between Copper Creek and Stonewall Mountain IRA subunit. The boundaries of Unroaded Area 2 are formed by Copper Creek Road #330, Cotter Mine Road #330-B1, Snowbank Creek Road #1832, and the Stonewall Mountain IRA subunit boundary. Unroaded Area 3, approximately 1,250 acres in size, was identified in the headwaters of the Copper Creek drainage and extends into the Red Creek drainage. This area is bounded by the Copper Creek Road #330, Road #771-A2, and the Stonewall Mountain IRA subunit boundary.

Unroaded Areas 1, 2, and 3 were not identified as inventoried roadless land in roadless area reviews. Salvage harvest is proposed in all three of these unroaded areas.

The existing condition of wilderness characteristics and related roadless characteristics considered for this analysis of these unroaded areas are: apparent naturalness and natural integrity, remoteness and solitude/primitive recreation opportunities, special features and special places, and manageability and boundaries.

Apparent Naturalness and Natural Integrity

Apparent naturalness and natural integrity of Unroaded Areas 1, 2, and 3 are low. As a result of the fire, existing offsite intrusions, in the form of roads and harvest areas, are much more visible, both looking into these unroaded areas and looking outward from within these unroaded areas. Unroaded Areas 1, 2, and 3 are generally surrounded by FS system roads. Several FS system roads extend into the middle of Unroaded Areas 1, 2, and 3. Extensive networks of non-system jammer trails used for timber harvest in the 1960s are also present in these unroaded areas. Between 1961 and 1998, extensive timber harvest and construction of system roads has occurred in these unroaded areas. Analysis indicates that timber harvest has occurred across a total of approximately 35% of these

Table 49. Unroaded resource values and roadless characteristics.

Unroaded Resource Values	Inventoried Roadless Characteristics (36 CFR 294.11)
Natural Integrity (is the extent to which long-term ecological processes are intact and operating)	High quality or undisturbed soil, water, and air Sources of public drinking water Diversity of plant and animal communities Habitat for threatened, endangered, candidate, proposed, and sensitive species dependent on large areas Reference landscapes
Apparent Naturalness (means the environment looks natural to most people)	Natural-appearing landscapes with high scenic quality
Remoteness (perceived condition of being secluded, inaccessible, and out of the way) and **Solitude** (personal, subjective value defined as the isolation from the sights, sounds, and presence of others and the development of man)	Primitive, semi-primitive nonmotorized, and semi-primitive motorized classes of dispersed recreation
Special Features (unique geological, biological, ecological, and cultural or scenic features) and **Special Places** (what is it about the area that causes one to visit for pleasure or their livelihood)	Other locally identified unique characteristics Traditional cultural properties and sacred sites
Manageability and Boundaries (ability to manage as an unroaded area)	No criteria

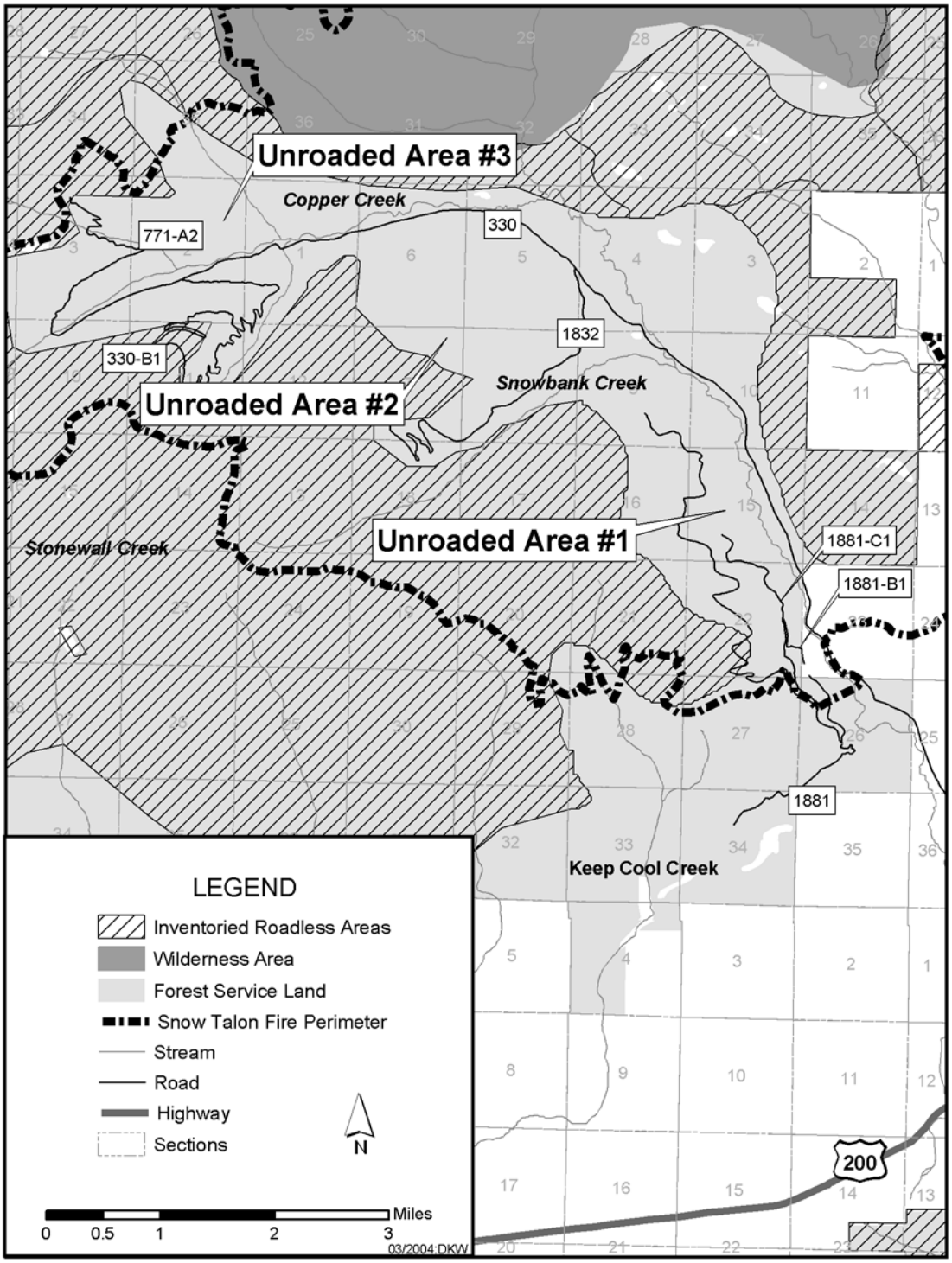

Figure 14. Salvage harvest proposed in unroaded areas.

unroaded areas. The majority of this previous timber harvest was clear-cutting with some sanitation salvage cutting, mainly along Copper Creek, also occurring. Much of this harvest and roadbuilding activity is visible within Unroaded Areas 1, 2, and 3 from Copper Creek Road #330.

Unroaded Areas 1, 2, and 3 may contain areas with roadless characteristics such as high quality soil, water, and air or diversity of plant and animal communities. Within these unroaded areas, previous timber harvest, roadbuilding, and the Snow Talon fire have resulted in alteration and disturbance to soil resources, water resources, plant and animal community diversity, and habitat for threatened, endangered, candidate, proposed, and sensitive species dependent on large areas. The type and levels of alteration and disturbance are disclosed in other resource-specific sections of Chapter 3 of this document.

The 375 meters of reclaimed fireline in the Unroaded Area 1 has further reduced the low levels of apparent naturalness and natural integrity of this area.

The largest contiguous portion of one of these unroaded areas that lacks disturbance due to previous timber harvest and roadbuilding is in Unroaded Area 2 and is about 400 acres in size. This area of higher natural integrity/apparent naturalness lies between the Stonewall Mountain IRA subunit and Road #1883, in the south one-half of Section 6 and in Section 7. Natural integrity and apparent naturalness of this area has, however, been affected by the burn intensity of the Snow Talon fire. Disturbance due to the Snow Talon fire in most of this area has been mapped as a medium to high burn severity. Severity transitions to low with increasing elevation and proximity to the Stonewall Mountain IRA subunit.

No developed sources of public drinking water or reference landscapes exist within these unroaded areas. No reference landscapes exist within these unroaded areas.

Remoteness and Solitude/Primitive Recreation Opportunities

Overall remoteness and solitude are low in Unroaded Areas 1, 2, and 3, because of the close proximity of roads. The Snow Talon fire removed a substantial amount of vegetation from the entire area. There are few opportunities for solitude in the areas resulting from the short distances to roads and the generally poor vegetative and topographic screening. Analysis indicates that over 90% these unroaded areas are within 0.25 mile of FS system roads. Few opportunities exist for a truly primitive recreation experience due to the shape and small size of these unroaded areas. Opportunities for semi-primitive nonmotorized and semi-primitive motorized classes of dispersed recreation exist within these unroaded areas. However, the steep nature of the terrain has resulted in little of this activity occurring historically in these unroaded areas. Several groomed snowmobile routes exist on the road systems that form the borders of these unroaded areas. Moderate to heavy snowmobile use of these groomed trails occurs throughout the winter. Off-trail snowmobile use is mainly concentrated in the Copper Bowls in the headwaters of Copper Creek, with main access routes to the Copper Bowls crossing through the Unroaded Area 3.

Special Features and Special Places

In general, the Copper Creek drainage is a special place, in that it is the most heavily used area for recreation on the Lincoln RD. Several popular dispersed roadside campsites

adjacent to Copper Creek within these unroaded areas were identified prior to the Snow Talon Fire. Following the fire, hazard trees were removed at these campsites, with the trees felled within the RHCAs being left on the ground. The effects of the fire may deter use and concentrations of downed hazard trees may impede access for recreationalists at dispersed campsites within RHCAs. Burned, down trees may also deter off-trail snowmobile and other recreational access in these unroaded areas. At this point, it is unknown to what degree primitive, semi-primitive nonmotorized, and semi-primitive motorized recreational use in these unroaded areas will be affected by vegetation burned in the Snow Talon fire and hazard tree removal efforts. One special feature is that these unroaded areas provide good scenic views into the Scapegoat Wilderness.

Manageability and Boundaries

Roads and adjacent IRAs form easily identified map boundaries. These unroaded areas may contain roadless characteristics such as high quality soil, water, and air or diversity of plant and animal communities. However, due to the effects of past disturbances such as timber harvest and roadbuilding, Unroaded Areas 1, 2, and 3 do not provide wilderness attributes of apparent naturalness, remoteness, or solitude and may present problems related to manageability and boundaries.

Environmental Consequences

No significant issues related to other unroaded areas were identified. The following effects indicators were used to focus the unroaded analysis and disclose relevant environmental effects:

- Effects of the alternatives to apparent naturalness and natural integrity, remoteness and solitude, primitive recreation opportunities, manageability and boundaries in unroaded areas.

Effects Common to All Alternatives

No direct or indirect effects common to all alternatives on Unroaded Areas 1, 2, and 3 were identified in this analysis.

The cumulative effects common to all alternatives to unroaded resource values and related inventoried roadless characteristics of Unroaded Areas 1, 2, and 3 are included the following paragraphs.

Cumulative Effects to Apparent Naturalness and Natural Integrity Common to All Alternatives

Natural integrity and apparent naturalness would be reduced regardless of the alternative selected.

Fire suppression would have a long-term negative effect on natural integrity in Unroaded Areas 1, 2, and 3.

Herbicide spray for noxious weed control would result in an improvement to natural integrity. Herbicide treatment would decrease establishment and expansion of aggressive species in unroaded areas and reduce weed-related impacts.

Special-use permits would have long- and short-term effects on apparent naturalness.

Indirect cumulative effects associated with recreational use, including noxious weed spread, soil compaction and erosion, litter, evidence of fire rings, etc., are minor but long term.

Cumulative Effects to Remoteness and Solitude/Primitive Recreation Opportunities Common to All Alternatives

Motorized and nonmotorized recreation is expected to increase within these unroaded areas. Remoteness and solitude of Unroaded Areas 1, 2, and 3 would likely be affected by anticipated increases in recreation use due to increases in regional population. The location, magnitude, and duration of this change are very difficult to predict or quantify. Recreational hunting and fishing will have very minor and short-term effects on solitude. Indirect effects associated with recreational use, including noxious weed spread, soil compaction and erosion, litter, evidence of fire rings, etc., are minor but long term. Recreational use might cause a short-term reduction in solitude as it occurs individually, but repeated activities will make the effects long term.

Mushrooms grow very well in moist recently burned over areas; thus, there has been a large influx of people harvesting mushrooms in mapped unroaded areas that burned on NFs in 2000 and 2001. Mushroom harvesting in the Snow Talon fire area is likely to occur over for the next year or two. People harvesting mushrooms would decrease solitude in these unroaded areas.

Fire suppression would have a short-term negative effect on solitude in Unroaded Areas 1, 2, and 3 while suppression activities are occurring.

Any aerial or ground-based spraying of herbicides for weed control would reduce feelings of remoteness and solitude during the time periods in which spraying would actually be occurring. Recreational opportunities may also be affected by weed treatment as some treatments in unroaded areas may require temporary closures or signing to indicate where treatments occurred.

Special-use permits would have long- and short-term effects on solitude in Unroaded Areas 1, 2, and 3.

In conclusion, Alternatives 1–4, together with reasonably foreseeable and ongoing activities, would reduce solitude within Unroaded Areas 1, 2, and 3 while these activities occur. Solitude is likely to be reduced in Alternative 1 as well, although not to the degree of the action alternatives in the short-term (2–5 years).

Cumulative Effects to Special Features and Special Places Common to All Alternatives

Traditional cultural properties and sacred sites would be protected everywhere, including unroaded areas, in all alternatives.

No cumulative effects to special features and special places common to all alternatives on Unroaded Areas 1, 2, and 3 were identified in this analysis.

Cumulative Effects to Manageability and Boundaries Common to All Alternatives

No cumulative effects to manageability and boundaries common to all alternatives on Unroaded Areas 1, 2, and 3 were identified in this analysis.

Effects Common to All Action Alternatives

The direct and indirect effects to wilderness characteristics and related roadless characteristics of these unroaded areas are covered in the following paragraphs.

Apparent Naturalness and Natural Integrity

In the short-term, timber harvest would have the effect of further detracting from the apparent naturalness and natural integrity of these unroaded areas. Stumps would be visible in the foreground. The results of harvest would be most apparent adjacent to existing roads and system trails where ground and skyline logging systems are used. In areas where tractor skidding and skyline yarding are proposed, corridors might be visible, although the effects would largely diminish over time as trees grow back in the skid trails and skyline corridors. Changes in helicopter units would be less apparent. Tree stumps and skid trails/skyline corridors could exclude the unroaded areas from roadless area inventory of potential wilderness until the stumps have deteriorated and skid trails/skyline corridors have regenerated to the degree of surrounding canopy closure (FSH 1909.12). Jammer trail area reclamation would further cause short-term disturbance to the soil and any remaining or newly grown post-fire vegetation.

In the long-term, removing some of these trees through timber harvest would, from a distance, have the same basic visual effect as Alternative 1, since fire-killed trees generally fall down within 25–50 years. Tree planting would occur in mapped unroaded areas under these alternatives. Planting will not affect the apparent naturalness because tree species composition and patterns are the same as would occur naturally.

The apparent naturalness and natural integrity of the area that lies between the Stonewall Mountain IRA subunit and Road #1883 in Unroaded Area 2 would be most affected by Alternatives 2 and 4. Under Alternatives 2 and 4, 189 acres of helicopter harvest would occur within in this portion of the 2104 acre unroaded area, with the same general effects of helicopter harvest to apparent naturalness and natural integrity as occur under all helicopter harvest. Under Alternative 3, helicopter harvest would not occur in this area. Approximately 83 acres of tractor harvest is proposed in this portion of the unroaded area under Alternatives 2, 3, and 4.

Remoteness and Solitude/Primitive Recreation Opportunities

Opportunities for solitude would be reduced during active logging operations, BMP work, jammer trail area rehabilitation, and road use associated with Alternatives 2, 3, and 4. In the long term, opportunities for solitude would remain unchanged. Opportunities for primitive recreation experiences would not change. The feeling of remoteness may be slightly reduced while activities such as harvest and jammer trail area reclamation are occurring.

Special Features and Special Places

Traditional cultural properties and sacred sites would be protected everywhere, including unroaded areas, in all alternatives.

Manageability and Boundaries

Following harvest, boundaries of the remaining unroaded area would be more difficult to manage.

Cumulative Effects Common to All Action Alternatives

In addition to the cumulative effects common to all alternatives to unroaded areas, the following cumulative effects common to Alternatives 2, 3, and 4 would occur:

All action alternatives reduce the total amount of unroaded areas available on the forest.

Jammer trail reclamation would result in minor long-term enhancement of roadless/wilderness characteristics. Jammer trail reclamation activities, such as recontouring, planting of trees and other vegetation, and noxious weed treatments would restore the apparent naturalness and natural integrity (and corresponding roadless characteristics) in portions of Unroaded Areas 1, 2, and 3.

At the scale of the cumulative effects analysis (the approximately 51,000-acre Stonewall Mountain IRA subunit), any effects of the Snow Talon fire salvage project action alternatives to overall unroaded characteristics of the cumulative effects analysis area would, overall, be very small (a maximum area equivalent to approximately 2.5% of the Stonewall Mountain IRA subunit would be affected).

Economics

This section presents a description of the economic environment that could be potentially affected by Alternative 2 and its alternatives, along with an estimate of what those effects might be. The focus is on the economic relationship of the Helena NF to the economy within and around the NF and the economic influence of goods and services the forest provides. Emphasis would be placed on those components of the economy identified during the public scoping process, mainly through public comments regarding employment and income in the local area, the loss of raw materials to the wood products industry and federal funds to communities.

Affected Environment

Economic issues identified during scoping included local support of timely timber salvage logging to obtain value from burned trees, concerns that the harvest would not provide opportunities to local communities, that helicopter logging is a high-cost logging method, and concerns over just how the timber sale is packaged and could preclude local mills or small operators from participating in the harvest.

The following effects indicators were used in focusing the economic analysis and to disclose relevant environmental effects. The economic environment is also described in terms of these indicators:

- Effects on job growth and rate of growth
- Effects on unemployment rate

- Effects on income and wages
- Effects on cost of living
- Effects on economic dependency and diversity
- Effects on economic trends
- Effects on revenue sharing.

The Economic Community

The Helena NF includes parts of five Montana counties: Lewis and Clark, Jefferson, Broadwater, Meagher, and Powell. Most of the effects of the Snow Talon fire salvage project and associated projects would occur in Lewis and Clark, Broadwater, and Powell counties, with lesser effects in the other two counties. However, the economic impact area can vary and is systematically determined for each proposed project or program.

The economic setting in the area of influence is described in terms of industry composition, economic diversity, economic dependence, employment and income, and other trends affecting the economy. As Alternative 2 features the management of the timber resource, an emphasis is placed on describing both the existing timber industry and the past and present role of the Helena NF in that industry.

The Helena NF is an important part of the NCDE, which covers most of northwest-central Montana. This area has significant economic value on a regional, national, and international scale when recreation and tourism, wildlife, and aesthetic values are considered along with a significant timber management program. However, it is beyond the scope of this analysis to evaluate markets for all these resources because they have not been identified as significant economic issues in respect to Alternative 2. The emphasis is on the economic effects that Alternative 2 and its alternatives would have on the timber industry and economic communities that would be primarily affected.

The Economic Impact Area

The designation of Lewis and Clark, Broadwater, and Powell counties as the affected area was based on the multiple criteria suggested in the FS Economic and Social Analysis Handbook (FSH 1909.17) (USDA 1988). Criteria include the location of the economic center, wood processing facilities, residences of the forest products industry workforce, and the center of spending for retail and wholesale goods and services. A discussion of the reasoning used in selecting the economic impact area is included in the project record.

The Economy

Industry Profile—When looking at the entire economy (all industries) as sectored by the U.S. Department of Commerce (USDC) and summarized in Table 50, the following picture develops (USDC 2004). The services industry is the largest industry followed by government, trade, construction, and manufacturing (the latter includes the wood products industry). Agriculture is fairly insignificant at about 1.0% of the total economy. In this type of sectoring, tourism, which is deemed important to the Helena area, is not considered an industry by itself, and tourism spending is primarily in the services and trade industries. Future expectations of these industries are discussed in the economic trends section of this resource discussion.

Table 50. Total industry sector profile—Lewis and Clark County and Montana.

Percent of Total Labor Income—2001		
Industry	Lewis and Clark County	Montana
Agriculture	0.3	1.7
Mining	0.1	1.8
Construction	5.0	5.0
Manufacturing	2.0	4.0
Transportation and Utilities	2.3	4.0
Trade	7.8	8.6
F.I.R.E.[a]	6.0	3.5
Services	25.2	21.5
Government	26.8	14.5

a. Finance, insurance and real estate, including rental and leasing

Lewis and Clark County is used to display the total sector profile for the affected area. Data are limited for Broadwater and Powell counties; available data will be displayed.

The economic profile for Lewis and Clark County is similar to the state of Montana for most industries (Table 50). However, there are a few exceptions. The government industry is almost twice that of the state percentage. Finance and insurance, real estate, including rental and leasing, are significantly greater in Lewis and Clark County than it is in Montana in general. Agriculture and mining are insignificant parts of the total income generated in both Lewis and Clark County and the State of Montana. All other industries are very similar (USDC 2004).

However, when looking at the economic base (i.e., that portion of the economy that involves the importing of dollars and is the source of the derivative part of the economy), a different picture presents itself. Manufacturing (including wood products and other manufacturing) accounts for only about 6% of the economic base. As shown in Table 51, the largest single component in 2003 was state and federal government at 62%. Other basic industries of significance include trade center (18%), transportation (7%), and manufacturing (6%). Agriculture and other related industries amount to only 5% of the basic economy (Polzin 2004).

Table 51. Basic industry sector profile—Lewis and Clark County.

Industry	Percent of Total Labor Income—2002
Agriculture	5.0
Trade Center	18.0
Manufacturing	6.0
Education	2.0
Federal Government	21.0
State Government	41.0
Transportation & Comm.	7.0

Industry Trends

Employment

Job Growth Rate

Although wage and income growth in Lewis and Clark County and Montana have been lagging, job growth has been significant. Positive job growth has occurred in every year from 1991 through 2001 in Lewis and Clark County. During this period, over 8,000 jobs have been created in Lewis and Clark County for an increase of 26%, or an average of more than 740 jobs per year. This is just below the average Montana job growth.

Job growth, on average, has increased in Powell and Broadwater counties between 1991 and 2001; however, not as steady as in Lewis and Clark, with even a few years of job growth decline (USDC 2004).

Unemployment

Related to job growth is the unemployment rate. The annual unemployment rate for Lewis and Clark County for the year 2003 was 3.7%. This is below the overall Montana rate of 4.4%. In general, the unemployment rate for Lewis and Clark County has been slowly decreasing since 1991. Along with a lower annual average rate, the monthly rates have shown much more stability. In 2003, the highest monthly rate was 4.7% in January, and the lowest was 2.9% in October.

The annual unemployment rate for Broadwater and Powell counties is above the state average and these counties exhibit greater fluctuations throughout the year. The annual unemployment rate for Broadwater County is 4.7% in 2003, the highest monthly rate was 5.9% in January and the lowest rate was 3.6% in August. While the annual unemployment rate for Powell County was 5.4% in 2003, the highest monthly rate was 6.5% in December and the lowest rate was 3.6% in August. The unemployment rates for Lewis and Clark, Broadwater, and Powell counties vary quite closely with the State of Montana, but rates in the winter months are relatively higher; therefore, suggesting a higher percentage of seasonal employment (Montana Department of Labor and Industry 2004).

Income

Components of Total Personal Income and Trends

Total personal income (TPI) includes the earnings (wages and salaries, other labor income, and proprietor's income); dividends, interest, and rent; and transfer payments[3] received by the residents of a county. Counties impacted economically by the Snow Talon fire salvage project and their respective TPI and trends are presented in the following paragraphs.

Lewis and Clark County—In 2001, earnings were 64.0% of TPI (compared with 63.7% in 1991); dividends, interest, and rent were 22.3% (compared with 21.9% in 1991); and transfer payments were 13.7% (compared with 14.3% in 1991). From 1991 to 2001, net

[3] Transfer payments are income payments to persons for which no current services are performed. They are payments by government and business to individuals. Examples are social security, Medicare, government retirement, worker's compensation, and income maintenance (e.g., Aid to Families with Dependent Children and food stamps).

earnings increased on an average 5.6% each year; dividends, interest, and rent increased on average 5.7%; and transfer payments increased on an average of 5.1% (USDC 2004).

Broadwater County—In 2001, earnings were 53.2% of TPI (compared with 56.6% in 1991); dividends, interest, and rent were 24.7% (compared with 25.4% in 1991); and transfer payments were 22.1% (compared with 18.1% in 1991). From 1991 to 2001, net earnings increased on an average of 4.6% each year; dividends, interest, and rent increased on an average of 5.0%; and transfer payments increased on average 7.4% (USDC 2004).

Powell County—In 2001, earnings were 56.8% of TPI (compared with 59.7% in 1991); dividends, interest, and rent were 23.5% (compared with 22.3% in 1991); and transfer payments were 19.7% (compared with 17.9% in 1991). From 1991 to 2001, net earnings increased on an average of 3.0% each year; dividends, interest, and rent increased on an average of 4.0%; and transfer payments increased on average 4.5% (USDC 2004).

Per Capita Personal Income

Lewis and Clark County—In 2001, the per capita personal income (PCPI) was $26,230. This PCPI ranked 5th in the state, and was 109% of the state average of $24,044, and 86% of the national average, $30,413. This is a slight improvement from the recent past when it was the lowest it has been as a percentage of the national PCPI since 1969. In 1991, the PCPI was $17,804 and ranked 9th in the state. The 1991–2001 of average annual growth rate for Lewis and Clark PCPI was 4.0%. The average annual growth rate for the state was 3.9% and for the nation was 4.3% (USDC 2004).

Broadwater County—In 2001, PCPI was $18,955. This PCPI ranked 40th in the state, and was 79% of the state average of $24,044, and 62% of the national average of $30,413. This reflects a slight decrease from the recent past. In 1991, the PCPI was $14,753 and was ranked 36th in the state. The 1991–2001 of average annual growth rate for Broadwater County PCPI was 2.5%. The average annual growth rate for the state was 3.9% and for the nation was 4.3% (USDC 2004).

Powell County—In 2001, PCPI was $19,119. This PCPI ranked 38th in the state, and was 80% of the state average of $24,044, and 63% of the national average of $30,413. This is a slight improvement from the recent past. In 1991, the PCPI was $14,293 and ranked 42nd in the state. The 1991–2001 average annual growth rate for Powell County PCPI was 3.0%. The average annual growth rate for the state was 3.9% and for the nation was 4.3% (USDC 2004).

TPI

Lewis and Clark County—In 2001, TPI was $1.5 billion and ranked 6th in the state, accounting for 6.8% of the state total. In 1991, the TPI was $0.9 billion and ranked 6th in the state. The average annual growth rate of TPI over the past ten years was 5.5%. The average annual growth rate for the state was 5.0% and for the nation was 5.5% (USDC 2004).

Broadwater County—In 2001, TPI was $83.3 million and ranked 37th in the state, accounting for 0.4% of the state total. In 1991, the TPI was $49.8 million and ranked 39th in the state. The average annual growth rate of TPI over the past ten years was 5.3%. The average annual growth rate for the state was 5.0% and for the nation was 5.5% (USDC 2004).

Powell County—In 2001, TPI was $135.2 million and ranked 29th in the state, accounting for 0.6% of the state total. In 1991, the TPI was $95.9 million and ranked 32nd in the state. The average annual growth rate of TPI over the past ten years was 5.5%. The average annual growth rate for the state was 5.0% and for the nation was 3.5% (USDC 2004).

Wages—Annual wages of employees are another indicator of the economic well being of a region. Year 1999 and 2000 data show that Montana has the lowest average annual pay of any state in the U.S. In the year 2000, wages in Montana were only 67% of the U.S. average. From 1999 to 2000 Montana wages increased by 4.4%, which was higher than approximately one-third of the states in the U.S. but was still below the U.S. average increase of 5.9% (USDL 2002a). U.S. wage growth averages exceeded Montana averages in every industry category except mining and government. Montana wage rates for the top employing industries in Lewis and Clark, Broadwater, and Powell counties (services, trade, and manufacturing) significantly lagged behind U.S. growth rates for wages (USDL 2002b).

Cost of Living—Per Capita income alone is not an adequate measure of economic well-being. The cost of living in an area must also be considered (Power 1990). Cost of living indices provided by the American Chamber of Commerce Researchers Association indicate the cost of living in the Helena area in the third quarter of 2003 is approximately 98% of the national average. Utilities are the highest component at 105% and housing the lowest at 87%. Groceries, transportation, and miscellaneous goods and services all exceed the national average. Health care is slightly less than the national average (American Chamber of Commerce 2002).

Diversity/Dependency

It is generally believed that economic diversity is a positive attribute of a regional economy. A diverse economy is economically resilient which means it has the ability to adapt to change (Haynes et al. 1999). Dependency refers to a community's dependence on a single or small group of industries for its survival. Communities that are highly dependent are not usually diverse and are frequently vulnerable to changes occurring in its major industries. Lewis and Clark County is thought to have a diverse economy. A recent analysis (2000) of Montana counties using the Shannon-Weaver entropy indices found Lewis and Clark County to be a relatively diverse county in Montana (USDA 2004). Diversity also usually increases with population and Lewis and Clark County is the sixth most populous county in Montana and is continuing to increase. All of the above indicators suggest that the economy of Lewis and Clark County is very diverse and likely not relatively vulnerable to external forces. The Shannon–Weaver entropy indices for Broadwater and Powell counties display a higher dependency on fewer industries, including woods products, but still diverse and not likely to be vulnerable to external forces.

Economic Trends

Federal and state governments have traditionally been the largest components of Lewis and Clark County's economic base (trend data unavailable for Broadwater and Powell counties). Together they were primarily responsible for the growth in the 1970s and contributed to steady growth through the 1990s.

Communication and the trade center have generally been Helena's most rapidly growing basic industry in the 1980s and 1990s and continue to grow.

As elsewhere, construction, health care, and business services accounted for much of the income growth for the past decade. The following synopsis of the recent past and predictions for the future of Lewis and Clark County has been provided by The University of Montana's Bureau of Business and Economic Research (BBER) as follows:

> *"Helena is certainly a government town. Federal and state governments together represent more than 60% of the economic base. The Lewis and Clark County economy is a bit more stable due to the buffering provided by state and federal government. Nevertheless, there are distinct long-term trends in the Helena area economy, with fast growth in the 1970s, little overall growth in the 1980s, and moderate growth in the 1990s. Helena's base industries easily explain these long-term trends, as well as year-to-year short-term peaks and valleys in the overall economy. Not only are state and federal governments the largest components in the basic sector, but they also supplied the largest increases in basic labor income between 1995 and 2000. Unfortunately, this does not include the closure of the East Helena refinery, which occurred in 2001."*

The BBER goes on to predict growth rates in nonfarm labor income from 2001 to 2006 varying from a low of 1.6% in 2006 and 2007 to a high of 2.4% in 2004. This is very similar to the prediction for the State of Montana as a whole.

The Timber Industry

Historical Production and Capacity—Historically, timber harvest from NF system land in Montana peaked at greater than 800 MMBF at the end of the 1960s. In the period of 2000–2001, the timber harvest had dropped to the general vicinity of 100 MMBF or slightly greater than 10% of the past peak level (USDA 2004).

The percentage of milling capacity that is actually used or remains available for use affects the demand for logs and is a variable effecting log prices, which in turn, affects the quantity of logs supplied to mills.

Timber Industry Outlook—After exhibiting very low levels during the first six months of 2003, wood products prices increased substantially in the last half of 2003. Plywood prices reached all-time highs, and lumber prices reached their highest level since early 2000. The upward surge in prices was attributed to a number of factors including, high domestic lumber consumption, a weaker U.S. dollar with less imports, and increased foreign demand.

Montana mills did not benefit fully from the high prices, with forest closures due to wildfires and court decisions creating log shortages and curtailments at numerous mills. Two major mills have closed since 2002—Stimson's plywood plant in Libby closed in December 2002, citing poor markets, and Louisiana Pacific's Belgrade sawmill was shut down in August 2003 as part of a company-wide restructuring plan.

The estimated total sales value of the state's primary wood and paper products in 2003 was $970 million, nearly the same as in 2002. Despite the high prices in the second half of the year, the mill closures mentioned above as well as other production cut backs led to reduced production, employment and wages for the year.

While lumber prices dropped in late December 2003, a number of factors point to moderately good prices well into 2004. Interest rates should remain low and domestic wood products consumption is expected to remain high. Also, the U.S. dollar should weaken somewhat more in 2004, and a potential agreement with Canada setting quotas on softwood lumber imports is possible. Both events could positively impact lumber prices. On the negative side, uncertainty over log supply remains a major and perhaps growing issue. Most of the major processors expect overall operating conditions to be the same as, or better than 2001.

Recent trends in employment in the Montana wood products industry have shown a gradual and steady decline. For example, from January 2000 to December 2001, employment went from 4,556 workers to 4,027 workers, a 12% reduction. This includes production workers at all timber processing and wood residue processing facilities. Production workers account for 40–50% of the total workers in Montana's forest products industry (Keegan et al. 2002). Therefore, it could be reasonably assumed that the total reduction in workers in the total forest products industry, which also includes logging, transportation, reforestation, etc., is more than twice the loss shown for just the wood products industry.

At the end of 2003, estimated total employment in the wood products industry was about 9,000 workers, down nearly 4.5% from the previous year, and worker earnings were also down about 5%. Lumber production in the state was slightly more than 1.11 billion board feet, down from 1.14 billion board feet in 2002. Contrary to conditions in the housing industry, the log home industry experienced its third straight year of weaker sales. Before this time, this industry had been growing consistently since the early 1970s.

Because of a decade-long decrease in federal timber harvest, timber availability remains a major issue for Montana's forest products industry even as wood products markets improve in the longer-term. Salvaged timber from burned areas could increase the volume of available timber. The FS has proposed substantial salvage operations. Recent work done by University of Montana researchers indicates that millions of acres of timberlands in the state are in need of ecosystem and fire hazard treatment and could provide—as a profitable byproduct—a sustainable flow of timber considerably above current harvest levels (Keegan et al. 2002)

Helena NF Timber Sale Program

Alternative 2 or its alternatives would offer for sale approximately 11–35 MMBF of timber; perhaps in several separate timber sales to be sold in fiscal year 2004.

Table 52 shows the proposed project in perspective with recent timber sale program history. The table shows that since 1995, the Helena NF has offered for sale a high of 18 MMBF of timber in 1996, and a low of 1 MMBF in 2000 with a mean of 6.7 MMBF from 1995 through 2003. The timber harvested from the Helena NF has followed the same general pattern. The timber under contract for the Helena NF reached a high of 24 MMBF in 1996 and a low of 7 MMBF in 2001 (USDA 2004).

Aside from the fires in 2003, the forecast for the near future was for the Helena NF to sell from 10–12 MMBF per year. An important question in estimating the economic effects of the proposed project on the local timber industry and economy in general, is what the timber harvest would be if the proposed project was not implemented. It is obvious that the timber to be offered under Alternative 2 could not be made up with other sales. It is

Table 52. Helena NF timber sale program information.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	Mean
Timber Offered (MMBF)	3	18	10	3	9	1	3	9	4	6.7
Timber Harvested (MMBF)	8	5	9	13	6	2	6	4	10	7.0
Timber under Contract (MMBF)	11	24	19	8	11	11	7	13	7	12.3

also assumed that the planned sales of 10–12 MMBF per year will be deferred for a few years if Alternative 2 is implemented.

Revenue Sharing from Helena NF Programs

Revenues from NF programs are distributed to counties annually in accordance with several federal acts. Historically, the *Twenty-Five Percent Fund Act of May 1908* (Public Law 60-135) has been the greatest source of funds. However, the recent enactment of an amendment to the 1908 Act, the *Secure Rural Schools and Community Self-Determination Act of 2000* (Public Law 106-393; 16 U.S.C. 2, 2000), has significantly changed the revenue distribution. The *Payment in Lieu of Taxes Act* (PILT) (31 U.S.C. 69 §§ 6901-6907. 1976) also distributes funds to counties based on the amount of federal land in each county. This amount is normally reduced by other certain payments (including 25% funds) paid in the prior year. The PILT fund program is administered by the BLM.

Under the Twenty-five Percent Fund Program, 25% of all funds generated from certain NF programs are paid to the state in which NF system lands are located. The funds generated by each forest are distributed to each county in which the forest is located in proportion to the amount of forest land in each county. The location of the project within a particular forest generating the revenue does not matter.

The amount distributed from the Twenty-five Percent Fund is based on certain receipts, including special use fees, recreation fees, minerals returns, grazing fees, and timber sales. In Montana two-thirds of the dollars received go to the counties' general fund for road maintenance, while the remaining one-third is allocated to public schools. For the Helena NF, timber sale receipts have historically composed approximately 85% of the Twenty-five Percent Fund payments returned to counties. Table 53 shows how the payments have been distributed to Helena NF counties (arising from all NF within those counties) in the past 5 years, with fixed payment projection from 2001–2006.

PILT payments are made to local governments to supplement other receipt-sharing programs such as the Twenty-five Percent Fund. PILT payments may be used for any government purpose; they are not limited for use in roads and schools. Generally, the more 25% funds received, the less would be the PILT payments. However, the formula is complex, and varies from county to county, and will not be explained in the document. A

Table 53. Distribution of twenty-five percent fund payments to affected area counties.

Year	Lewis and Clark (thousand $)	Broadwater (thousand $)	Powell (thousand $)	Total (thousand $)
1997	380	95	318	793
1998	566	105	394	1,065
1999	216	48	186	450
2000	211	42	155	408
2001–2006	417	82	450	949

complete explanation of the PILT provisions and revenue sharing can be found in Schuster (1995 and 1996).

Due to declining FS timber revenues in the west, Congress enacted the *Secure Rural Schools and Community Self-Determination Act of 2000* (Public Law 106-393) to supplement the *Twenty-five Percent Fund Act*. This allowed electing counties to base their Twenty-five Percent Fund payments on an average of the highest three years of payments from 1986 to 1999. If elected, counties would receive the newly calculated payment instead of what would have been normally received under the *Twenty-five Percent Fund Act*. This would provide level payments over the election period regardless of what the forest revenues were for the present period. All counties receiving payments based on Helena NF programs have elected the new option. This election will remain in effect through 2006. As can be seen in Table 53, this election will make a substantial difference in payments.

Economic Efficiency Analysis

Economic efficiency of each alternative has been analyzed to display the differences between alternatives in terms of the present net value (PNV) of anticipated costs and revenues. Although NEPA does not consider economic efficiency an environmental effect, it is a factor that is considered when comparing alternatives. PNV can be viewed as the lump sum of money the decision-maker would have in hand as a result of committing forest resources to a particular alternative. This analysis was conducted for revenues and costs associated with the 3-year term of the timber sale contracts. Assumptions used in this analysis include:

- This analysis determines the net economic returns of various alternatives based on those amenity resource costs and benefits, which can be objectively measured in dollar terms. Other resources are more subjective in nature when applying dollar values (e.g., wildlife, water, and air) were not considered.
- Net values were determined for the year 2004.
- The only revenue and costs considered are those related to timber sale analysis, preparation, implementation, administration, and post-sale treatments.
- Economic analysis was conducted with the most recent FS economic analysis computer model, Project-Level Analysis of Treatment Alternatives (Jones 2002), with timber prices calculated by transaction evidence appraisal and local cost adjustments included in this program.

Table 54 displays a summary of the estimated timber volume that may be offered, total PNV cost, total PNV revenue, and revenue/cost ratio. Costs and revenues were discounted to present value at the rate of 4%.

Table 54. Summary of discounted costs and revenues for the project period.

	Snow Talon Fire Salvage Project Alternative			
Timber Sale Analysis	1	2	3	4
Timber Volume (CCF)	0	55460	18885	81628
Total Present Value Cost ($)	500,000	1,712,080	1,022,820	2,283,590
Total Present Value Revenue ($)	0	1,730,050	1,130,960	2,049,060
Present Net Value (PNV)	500,000	17,970	108,140	-234,530
Revenue /Cost Ratio	0	1.01	1.11	0.90
% Helicopter	–	54	0	62

Salvage of burned timber from portions of the Maudlow-Toston and Cave Gulch fires has been ongoing since the winter of 2001–2002. Two sales have been offered and sold. The first sale, Maudlow-Toston, comprised a combination of helicopter, tractor and skyline harvest units; however, 60% of the harvest area was designated as helicopter yarding. The second sale, Cave Gulch, comprised a combination of tractor and skyline yarding. These sales sold for $30.34 and $35.27 per CCF, respectively, and will be completed the summer of 2004. Comparisons with these FS timber sales was conducted and indicate the combinations of logging methods proposed in each of the Snow Talon fire salvage project alternatives are currently economically viable. It is anticipated that the combination of tractor, skyline, and helicopter yarding in each alternative will offset the higher helicopter yarding costs on the portions of the sale where proposed.

Delay in timber harvest beyond the first year will result in a decrease in timber value and volume. Dead wood deteriorates and loses value over time. Deteriorization happens especially fast in fire-affected areas. Recoverable (merchantable) product value is a significant factor that determines potential bid values, and ultimately revenues to the government. Factors that affect this include product defect amount and piece size. Defect (decay/rot and cracks) reduces volume quantities, and increases the minimum piece size needed to obtain recoverable products. Dead tree defect and minimum piece sizes needed to obtain recoverable products both increase with time from the date trees are fire killed. Thus, volume is reduced and the costs of removing it increase over time.

This reduction in overall timber value may create conditions for all alternatives to fall below a favorable benefit/cost ratio.

Environmental Consequences

Effects of Alternative 1

Direct and Indirect Effects of Alternative 1

The effect of this alternative is that the potential commercial timber product recovery value within the Snow Talon fire project area would be “foregone.” No dead tree salvage

volume would be harvested, and no revenues to the government would be generated. A benefit/cost ratio could not be determined for this reason. The PNV for Alternative 1 is negative (-) $500,000. This PRV reflects the cost of NFMA/NEPA data gathering, analysis, and planning efforts. This cost applies to all alternatives.

Potential revenues generated from the sale of salvage volume would not be available to be returned to the U.S. Treasury, for deposit in the salvage sale trust fund, or for fire-associated restoration activities. Restoration activities would be dependent solely upon regular Congressional appropriations, if available.

Cumulative Effects of Alternative 1

Diminished salvage sale trust fund balances, used to fund the Snow Talon planning and restoration effort, would not be replenished. Future efforts may require appropriated funding sources.

Effects Common to All Action Alternatives

Effects on Industry Profile

All of the action alternatives would likely increase the wood products industry and manufacturing sector more than other sectors; therefore, increasing their percentage of the total economy. The increase would depend largely on how much substitute timber volume would be milled if the action alternatives were not implemented. Depending upon which alternative is implemented, the change could vary from insignificant to somewhat measurable, if the local timber industry is able to absorb the additional timber volume. See the employment and income sections for actual estimates of changes in employment and income.

Effects on Job Growth Rate

Up to 602 total jobs years (see timber harvesting section) could be created from timber harvesting and processing, reforestation, and jammer trail rehabilitation from the action alternatives. However, the short-term effects on the job growth rate could be reduced if: there is a labor shortage and labor is drawn from one industry to another and the project is spread out over the entire contract period, or if all of the timber that would normally have been sold as part of the regular NF program was not sold.

Effects on Unemployment Rate

An addition of approximately 602 jobs could have a measurable effect on the unemployment rate. History shows that the unemployed workforce in Lewis and Clark County maintains a relatively constant percentage of the total workforce compared to surrounding counties. New jobs tend to be filled from new arrivals, or by people with different jobs who are eventually replaced by recent immigrants. If all the new jobs were filled from the present workforce, which is highly unlikely, and the new jobs (ranges between 194–602) are spread over 4 years (ranges between 48–150 jobs per year), the unemployment rate would decline by a maximum of 1%. However, the most likely effect would be much smaller.

Effects on Personal Income and Wages

Personal income or wage income effects would be similar to the changes in job growth rate previously explained. The effects can be extremely variable depending on the

outcomes, but not significant. Per capita income would increase only if the incomes from the new jobs created were higher than the average incomes of the existing jobs in the county. This should be the case as wages in the wood products industry are usually higher than most other wages in the county. However, even in the most favorable event, the increase would be minimal because the wage rates are not significantly higher and the total numbers of new jobs are a small percentage of the workforce. However, at the household and individual level, income could increase substantially.

Effects on Cost of Living

There should be no measurable effects to the cost of living resulting from the proposed project. An increase in wood products manufacturing would not affect the price of wood products whose prices are determined in a regional or national market. The maximum increase in wood products from the proposed project is insignificant when compared to the regional or national market. Additional jobs and income should not have a measurable effect on consumer goods as they are also priced in a regional market and the increase in jobs and wages is insignificant. However, if a significant number of the new jobs are filled by people from outside the region, and create a rapid corresponding increase in population, there could be an additional increase in housing costs.

Effects on Economic Dependency and Diversity

If we consider the local economy to be “dependent” upon the wood products industry, the proposed project has the potential to make the local economy even more dependent—it would not make it less dependent. The same should hold true for diversity. However, the maximum potential increase is relatively small and should not have any negative effects on the overall health of the economy in terms of both dependency and diversity.

Effects on Economic Trends

The proposed project has the potential to have a measurable effect on economic trends depending on how regional processing facilities elect how to program their future harvesting. However, there are so many other economic factors effecting the local economy that potential changes in timber harvest would probably be masked by these other changes and probably be difficult to measure. The proposed project should not cause any adverse pressure on present trends.

Effects of Timber Harvesting on Employment and Income

The activity of timber harvesting, as proposed, has the potential to create a substantial amount of employment and income. These effects are both direct—workers employed in the forest products industry and government, and indirect—jobs and income created from the local spending of the forest products industry and government, and the spending of industry and government employees. The effects on employment and income have the potential to affect the other economic variables such as economic structure, unemployment, and wages.

These effects could be minimal in the short-run as it is possible that alternative sources of FS or other timber could find its way to processing facilities and not disrupt planned production. However, there is a possibility that this would not happen, in which case there could be more than an incidental effect on local employment and income.

Although the proposed activities could have slight economic effects on adjacent counties, as previously explained, it is assumed that most of the effects would occur in Lewis and Clark, Broadwater, and Powell counties. This would depend on who purchases the timber sales. There are major processors in Broadwater, Powell, and Missoula counties that are potential purchasers. Whichever processor purchases any of the sales the effects would tend to flow in that direction.

Recent analysis in northwest Montana (USDA 2001d) shows that the harvesting and processing of one MMBF of timber generates a total of approximately 15 job years.[4] This includes both direct and indirect jobs[5] and employee compensation. These jobs and income include direct jobs and income in logging, wood processing, transportation, and the FS; jobs supporting these industries; and jobs and income generated from the spending of the workers in the preceding industries. Table 55 provides a summary of the maximum potential effects to total employment and employee compensation in Lewis and Clark County from the harvest and processing of timber from the proposed project assuming there is no substitute timber to the proposed project. Table 55 shows that Alternative 4, which harvests the most timber, generates the most job years (567) and employee compensation ($13,869,000). Alternative 1, which harvests no timber, generates no jobs or income from the harvest and processing of timber.

Table 55. Employment and income from timber harvest and processing.

Alternative	Jobs/Year	Employee Compensation (M$)
2	403	9,838
3	175	4,218
4	567	13,869

It is proposed that from no acres (Alternative 1) to 969 acres (Alternatives 2 and 4) may be artificially regenerated, primarily through planting tree seedlings (Table 56). Alternatives 2 and 4 each would generate approximately 29 total jobs while Alternative 3 would generate approximately 13 jobs.

Table 56. Employment and income from reforestation proposal.

Alternative	Acres to be Planted	Total Cost of Planting (M$)	Total Jobs from Planting	Total Income from Planting (M$)
2	969	534	29	177
3	448	246	13	82
4	969	534	29	177

[4] A job year is a job that lasts the equivalent of one year. For example 10 job years could be 10 jobs for one year or one job for 10 years or any combination thereof.

[5] A job can be categorized as full-time, part-time, seasonal, or permanent but not as a "full-time equivalent."

In addition to the jobs and income generated by timber harvesting and planting, there would be jobs and income also generated by associated timber management activities. These include slash disposal, site preparation, and subsequent surveys, monitoring and analysis. History shows that there is a good chance that a significant amount of the economic effects of reforestation activities could occur outside of the Lewis and Clark County area, depending on the origin of planting contractors and crews.

The potential jobs and income previously described are assumed to be spread over approximately a 4-year period, from 2005–2009.

Jammer Trail Rehabilitation

The jammer trail rehabilitation project is the same in all alternatives. As shown in Table 57, road decommissioning is not a very labor-intensive activity producing only five total jobs with the action alternatives. This estimate is based on analysis done on other projects in northwest Montana (USDA 2001d).

Table 57. Employment and income from jammer trail rehabilitation.

Alternative	Acres to be Decommissioned	Total Cost of Decom. (M$)	Total Jobs from Decom.	Total Income from Decom. (M$)
2	110	320	5	93
3	110	320	5	93
4	110	320	5	93

Effects on Revenue Sharing—As all counties have made the election for even-payments under Public Law 106-393, changes in FS revenues would have no effect through 2006 on payments-to-counties. Although, FS revenues change from alternative to alternative in this proposal, payments to counties, including PILT payments, would not change. It is assumed the revenue generating portions of the proposed project would be completed by the end of 2006. Therefore, the proposed project would have no effect on payments to counties.

Effects on Economic Efficiency

The effect is that the potential commercial timber product recovery value within the Snow Talon fire project area would be “realized,” varying by alternative.

Depending on alternative, potential revenues generated from the sale of salvage volume would be available to be returned to the U.S. Treasury, for deposit in the salvage sale trust fund, or for fire-associated restoration activities. Restoration activities would not be dependent solely on regular Congressional appropriations.

Cumulative Effects of Action Alternatives

Diminished salvage sale trust fund balances, used to fund the Snow Talon planning and restoration effort, would not be replenished. This may affect the NF’s ability to finance similar activities in the future using salvage sale trust funds. Or future restoration efforts would require higher reliance on Congressional appropriated funding sources

Heritage

People have inhabited the upper Blackfoot River valley for millennia. American Indian groups once occupied, seasonally used or traveled through this large river valley and the adjacent foothills and mountain ranges. Today, the Salish (Flathead) in particular attach great cultural significance to the ancient campsites, hunting and plant food gathering places, tool stone quarries, paint pigment sources, vision questing sites, and old trails found throughout the upper Blackfoot River valley.

The Euroamerican settlement of the upper Blackfoot River valley mirrors that of Montana in general. The Lewis and Clark Expedition of 1804–1806 gave way to fur trapping and trading, then early military expeditions and railroad route explorations. A gold strike in Abe Lincoln Gulch near present day Lincoln brought permanent settlement. Nearby placer mining in Jefferson, Nevada, and Washington Creeks attracted more people who eventually established small communities that were supported by mining, farming, ranching and logging. Early in the 20th Century, federal (FS and BLM) administration of mountain forests and surrounding lands, and increased public participation in outdoor recreation, added other dimensions to this rural lifeway. This natural resource- and tourist-oriented economy still characterizes the sparsely populated upper Blackfoot River valley.

The physical remnants of the river valley's long human history are considered to be heritage resources in federal historic preservation jargon. The bulk of these are historic in origin—old homesteads, ranches, mining ruins, and wagon roads. Due to their antiquity, coupled with the effects of geological processes over time, and historic and recent mining, logging, road construction and urban encroachment, fewer prehistoric (American Indian archaeological) sites have survived.

A heritage resource inventory has not been completed for the Snow Talon fire salvage project. The DEIS analysis occurred during the late fall and early winter of 2003–2004, which precluded fieldwork. However, portions of each alternative have been inventoried for earlier timber sales and other projects in the Copper Creek drainage. These past inventory and heritage site distribution data form the basis of this NEPA analysis.

A heritage resource inventory would be completed of the selected NEPA alternative, in accordance with the *National Historic Preservation Act* (NHPA) and its implementing regulations (16 U.S.C. 1A §§ 470 et seq.). This inventory could occur in spring/summer of 2004. Due to project time constraints, NHPA site significance evaluations may not be completed prior to project implementation. Without the benefit of these formal evaluations, all newly discovered sites would be treated as potentially significant and worthy of protection during project activities. Mitigation measures for affected heritage sites, such as harvest unit redesign or logging over snow, would be developed and implemented, following consultation with the State and tribal historic preservation officers.

Affected Environment

The project area encompasses the Copper Creek drainage on the western front of the Lewis and Clark (Continental Divide) Range in western Montana. This scenically appealing but harsh landscape has attracted people for thousands of years because of its varied natural resources. Early Holocene evidence is scarce but the Steinbach Ranch site

(24LC1306) and Alice Creek (24LC1015) located on the east and west sides of Lewis and Clark Pass, respectively, and the Willow Creek Site (24LC1023), located near Lincoln, document Archaic period habitations dating from approximately 5,500 to 200 years before present (Ferguson 2002; Scott 2001). These and other prehistoric sites reflect American Indian habitation and seasonal use of the river valley and adjacent mountains, as well as prehistoric foot and horse (after 1700 AD) travel through the upper Blackfoot River drainage and over various passes atop the Continental Divide Range (Cadotte, Lewis and Clark, Rogers) to access the bison hunting country of west-central Montana (Scott 2001).

Historically, the upper Blackfoot drainage was inhabited or used by the Salish, Pend d'Oreille, Nez Perce, Blackfeet, Crow, and Shoshone tribes (Brumley et al. 1998; Knight 1989; Scott 2001). Tribal oral tradition and archaeological research indicates that this American Indian occupation has substantial antiquity. Relevant to this project, American Indian peoples were likely responsible for (and vulnerable to) past wildfires in the river valley and adjacent mountain ranges. These wildfires were due to both runaway campfires and deliberate burning to improve game forage, horse pasturage, and plant food gathering areas. These human-caused fires, coupled with lightning strikes, undoubtedly constrained the type of forest fuels build-up in some areas that spurred the Snow Talon fire in 2003. Still, it is likely that the Lewis and Clark Range experienced any number of severe wildfires in the distant past that shaped (by way of post-fire landslides, flooding, and scouring) today's landscape. Tree ring analyses, pollen cores, and other environmental data would help build an accurate picture of the drainage's "historic" vegetative condition.

Meriwether Lewis crossed Lewis and Clark Pass on this ancient Indian road to the buffalo on July 7, 1806. Fur traders and trappers and then, in the 1840s, missionaries soon followed in the familiar pattern of Western history. Father Nicolas Point, who traveled frequently with the Salish, may have planted a stone Celtic cross atop Lewis and Clark Pass (Scott 2001). Various military expeditions, including those sent by Governor Isaac Stevens, searched the upper Blackfoot River drainage for suitable overland routes in the early 1850s. The importance of the upper Blackfoot River as a travel corridor of long-standing is reflected in local Government Land Office maps, produced in the early 1870s, showing old "Indian trails" through major drainages (including Copper Creek), over the Continental Divide and into central Montana.

Miners poured into the upper Blackfoot River Valley mountain range in the mid-1860s from other western gold strikes. A mining camp in Abe Lincoln Gulch became the namesake of the current community of Lincoln, although it was located about 4 miles to the northwest (Upper Blackfoot Historical Society [UBHS] 2004). It, and other placer camps in various gulches in the mountains to the east and west (i.e., Jefferson, McClellan, Nevada, and Washington), had lively existences through the late 1870s when the placer gold played out. Quartz lode (underground) mines sprung up around Lincoln, which brought some measure of community stability. By the turn of the Century, lode mines, such as the Big Blackfoot, Fool Hen, Jay Gould, Mike Horse, and Swansea, produced precious and base metals. With important exceptions such as the Mike Horse, few mines survived as substantial operations into the 1950s. However, prospecting and minerals exploration is still on going, as exemplified by the MacDonald Gold Mine proposal in the mid-1990s and various minerals exploration permits processed by the FS.

Produce and livestock from local homesteads and ranches helped to support all of the placer and then lode mining activity (although wagon freight trains from Fort Benton and Corrine, Utah, and after 1880, railroads, kept the mining frontier well-supplied). By the late 1880s, homesteads were claimed in the Lander's Fork, Keep Cool Creek, Alice Creek and other mountain drainages, as well as in the valley bottom surrounding the Blackfoot River. A maze of rails and wagon roads, frequently located atop old Indian trails, connected homesteads and small communities with larger urban entities such as Helena and Missoula. Logging and sawmill operations also became an economic mainstay of Lincoln, and throughout the Blackfoot River valley (UBHS 2004). They supplied wood for construction as well as fuel for boilers in mining and milling operations.

Incorporated into the NF system early in the 20th century, the Lewis and Clark Range became the scene of federal land management, and with its inclusion in the NF system came roads, recreation facilities and trails, livestock allotments, timber sales, and tree plantations. Fire lookouts were established atop prominent peaks in the Continental Divide, including Green and Stonewall Mountains. (The cupola-style lookout atop Stonewall Mountain burned down in the Snow Talon fire).

During the Great Depression of the 1930s, Civilian Conservation Corps crews were instrumental in developing many of the FS's early trails, recreation structures, and administrative facilities. By this time, recreation was becoming more important to the area's economy. Old mining and homestead cabins became popular hunting camps and summer recreational residences; those on public lands were used under a Special Use Permit administered by the FS. Hunting, fishing and touring were important visitor attractions. Considered a "gateway" to Glacier Park, Lincoln businessmen such as L. J. Lambkin catered to the dude ranch and tourist trade (UBHS 1994).

Accelerated timber harvest during and after World War II gave Lincoln its distinctive timber town character but summer and winter tourism (beginning in the 1960s with the advent of snowmobiles) became critical to the area's economic survival. The creation of the Scapegoat Wilderness Area in the Lewis and Clark Range (as an expansion of the larger Bob-Marshall Wilderness Complex) in 1964 expanded recreation-related business opportunities, particularly outfitting and guiding during the fall hunting season. In the context of this salvage project, Copper Creek became a popular destination recreation area, and today the drainage provides outdoor opportunities for campers, hikers, fishermen, hunters, horse riders, and snowmobile enthusiasts.

Although mining, logging, ranching, agriculture, and tourism have intermittently flourished in the Blackfoot River valley for some 140 years, these have not led to a substantial population increase or significant industrial or commercial development. The project area and its surrounds are still thinly populated and seem relatively remote, although Helena, Great Falls, and Missoula are located only 1–2 hours away. From the viewpoint of historic preservation, this has resulted in the conservation of relatively pristine cultural landscapes, such as in Alice Creek and atop Lewis and Clark Pass, and various heritage sites.

An abundance of heritage sites have been identified in the upper Blackfoot River valley proper, and some of its major tributary drainages, especially where historic mining occurred. However, the upper Copper Creek is somewhat "off the beaten" path and, to date, heritage inventories have turned up only ten sites within 2 miles of the Snow Talon

fire project area. Of this total, three sites (Items 2, 3, and 4 in Table 58) lie within the boundaries of Snow Talon fire salvage units. With the possible exception of the Mainline trail site (Item 3), none of the sites are particularly valuable. Intensive survey of the selected project alternative may yield a few more sites whose significance may now be compromised by the Snow Talon fire.

Table 58. Heritage sites located within Snow Talon proposed salvage units.

Item	Site Number	Type-Origin	Integrity & National Register Status	Proposed S-T Unit
1	24LC931, Indian Meadows GS	FS guard station	Excellent—modern GS, NR ineligible	0
2	24LC1018, Indian Meadows Site	Prehistoric lithic scatter	Poor—very disperse, probably NR eligible	T47
3	24LC1272, Helena Mainline Trail #481	Prehistoric-Historic trail	Good—existing FS trail system, NR eligible	H49, S48
4	24LC1859	Historic can dumps	Fair-burnt by fire, NR ineligible	T57
5	24LC1865	Historic can dumps	Fair-burnt by fire, NR ineligible	0

Environmental Consequences

This section discloses the environmental consequences of implementing Alternative 2 or any of its alternatives. These effects analysis form the scientific and analytical basis for comparing Alternative 2 and its alternatives.

Effects Common to All Alternatives

Under all project alternatives, the effects of the Snow Talon fire salvage project have been evaluated using the following criteria:

- Number, distribution, and types of currently identified heritage sites located within proposed salvage harvest unit boundaries, temporary roads, helicopter landings, and log decking areas
- Amount of area within each project alternative that has been subject to previous heritage resource inventory and number of sites found
- Amount of high site probability ground in harvest units, temporary roads, and decking areas, and the potential for the discovery of additional sites
- Short- and long-term risk to identified heritage sites resulting from implementing Alternative 2 or its alternatives (i.e., increased access and consequent vandalism).

Effects Common to All Action Alternatives

A variety of heritage surveys have been completed in the upper Copper Creek drainage since the early 1980s. The surveys have mostly been done for timber sale projects and have yielded very little cultural evidence. Still, the entire Copper Creek drainage has never been thoroughly investigated so the current site distribution, as based on past compliance inventories, may present a somewhat skewed picture of heritage site distribution.

The Snow Talon fire severely scorched much of the Copper Creek drainage bottom and surrounding mountain slopes so previously undiscovered sites that are found during compliance survey for this project are likely burnt (historic log structures) or burnt over (prehistoric lithic scatters). However, some of these sites may still warrant protection and active management from post-fire flooding, landslides, and other natural processes.

Mitigations Included under All Alternatives

Whether or not this salvage project is implemented, heritage sites within the Snow Talon wildfire boundaries will be periodically monitored to determine post-fire effects from flooding, landslides, and other natural processes, and human activity (i.e., recreation). Additionally, because of enhanced ground exposure caused by the fire, Helena NF heritage staff will be opportunistic in surveying and/or resurveying areas within the burn to identify new sites. Due to the large scale of the fire, timing, and lack of post-fire funding, a comprehensive inventory of the burn area has not been completed. Contingent on the results of these surveys and site condition checks, some management measures may be implemented to abate further site damage, such a closing recreational access to areas within exposed heritage sites along Copper Creek or limiting recreation around the Indian Meadows trailhead.

Mitigations Included under All Action Alternatives

A full NHPA (Section 106) compliance inventory would precede implementation of any action alternative. The inventory would designed and implemented in accordance with the NF's Site Identification Strategy, and focus on harvest units, temporary roads, helicopter landings, log decks, and old jammer spurs proposed for reclamation. State and tribal historic preservation staff would be given the opportunity to review and comment on the inventory results and any site treatments that are proposed, following standard compliance protocols.

To reiterate: Heritage site treatment and/or mitigation may be a moot point for sites that were badly damaged or destroyed during the Snow Talon fire. However, intact and significant heritage sites would be protected and/or treated in several ways. Time permitting, identified sites potentially in harm's way as a result of this project would be evaluated for National Register significance or eligibility. Without the benefit of these formal evaluations (and concurrent State Historic Preservation Officer tribal review and comment), all sites would be necessarily treated as potentially significant and worth of protection during project activities.

Heritage sites in project impact areas could be protected through project redesign and site avoidance. That is, the unit (or temporary road, helicopter landing, or log deck) would be relocated or reconfigured so that the affected site(s) lies outside the boundaries of the impact areas. An alternative approach would be to conduct logging operations over frozen ground and snow. The critical factors are the degree to which the ground is frozen, snow depth, and site condition and integrity. For example, lithic scatters—prehistoric camps evidenced by stone tools and chipping waste slightly buried in the ground—may be easier to protect during snow logging than historic mining ruins that, while dilapidated, may have aboveground ruins (collapsed cabins) that are not completely buried in snow. A case-by-case review would be necessary.

Most jammer spurs in old harvest units are located on steep ground where heritage resources are unlikely to be found. But in the event that some are, such as a prehistoric

camp or stopover, reclamation work—ripping and contouring—would not occur atop these sites.

Effects of Alternative 1

Alternative 1 is the no action alternative and, thus, salvage logging and related activities will not have a direct or indirect effect on identified heritage sites. Burnt and/or dead timber that blows down during high winds or as a result of natural decay over time may fall atop identified heritage sites or expose them, and particularly artifacts and other cultural evidence, in tree wells and upturned root wads. This situation, in turn, could invite deliberate artifact collection and vandalism, or inadvertent destruction if trees are salvaged for firewood or are moved to access dispersed recreation sites. Post-fire flooding and landslides could alternatively scour and sweep away, or bury, identified heritage sites, similar to what occurred to historic placer mining ruins in the 2000 Cave Gulch fire area in the north Big Belt Mountains, also on the Helena NF.

Direct and Indirect Effects of Alternative 1

The no action alternative will result in neither direct nor direct effects on identified or yet to be discovered heritage resources in the Snow Talon fire salvage project. However, opportunities to locate, record, and study prehistoric and historic sites would be foreclosed if the project was not implemented. Opportunities to assess the post-fire condition of identified and as-yet-undiscovered sites would be foreclosed, as well as the option of implementing measures to protect them given the strong potential for post-fire flooding, channel scouring, and landslides.

Cumulative Effects of Alternative 1

The upper Copper Creek drainage has primarily been the scene of timber harvest and recreational development and use since the turn of the Century. The drainage's upper reaches do not have significant mining or homesteading histories, which might have altered or destroyed existing prehistoric sites but in the process created new historic ones (i.e., old mines). Modern "infrastructure" in the drainage includes the main Copper Creek road system, FS trails, campgrounds (Copper Creek and Snowbank Lake), and administrative facilities (Indian Meadows Cabin). Because much of this infrastructure was built prior to the 1960s (and thus prior to the NHPA), its piece-meal construction was not preceded by heritage inventories or related work. These various activities may have damaged or destroyed an unknown number of heritage sites. However, in view of drainage's harsh environment, these sites likely were the result of short-term, seasonal (prehistoric and historic period) human activities and would have left scant traces on the ground.

Protecting scenic values, producing commodities (timber and livestock grazing), and accommodating wilderness and nonwilderness recreation have been the Helena NF's principle management objectives in the Copper Creek drainage over the last several decades. Since the late 1970s, projects associated with these management activities have been preceded by heritage resource inventories. These inventories have tended to focus on steep mountain slope where timber units are located. The resultant surveys have led the discovery of only a small number of heritage resources, bearing out the assumption that the upper Copper Creek drainage was never a Mecca of cultural activity.

It is important to note that the situation in upper Copper Creek contrasts with that in lower Copper Creek, particularly near its junction with the Blackfoot River. This part of the drainage lies near an important prehistoric-early historic travel route connecting western and central Montana, and saw extensive prehistoric and early historic use and settlement. However, much of the area encompasses private and State land.

Past and reasonably foreseeable projects/developments on lands in the lower Copper Creek project area include logging on State (DNRC) and private (Seiban and Solvie) property, livestock grazing and rural development and subdivision. DNRC activities in the lower Copper Creek drainage have been preceded by heritage resource inventories and sites (i.e., rock cairns) are identified (and protected) in timber sale areas. Activities on private land have likely affected an unknown number of heritage resources, including old trails, Indian campsites, and homesteads.

The Snow Talon fire has precipitated a variety of emergency fire restoration work, including resizing road culverts, removal of burnt hazard trees, and weed spraying. This work promises to continue as the FS deals with the first round of post-fire flooding resulting from spring (2004) melt-off and summer thunderstorms. Fire restoration work, and relocation of recreation and other facilities, in the bottom of Copper Creek could present a significant heritage challenge to Helena NF heritage staff because it could be invoked both by emergency issues (flooding) and pressure to provide recreational access (and facilities) in the burn area again.

Mushroom collecting and firewood gathering in the Snow Talon burn area will not necessarily require heritage inventory because of there broad-scale nature of these activities throughout the burn area. However, mushroom collection could invite vandalism (artifact collecting) at exposed sites and firewood gathering could encourage the same, along with ground disturbance caused by pickups and tree felling. Opportunistic heritage resource inventory and post-fire monitoring may help abate this potential problem.

Alternative 1 would not result in another FS timber management activity in the upper Copper Creek drainage. Thus it would not add to the cumulative effect of agency projects and public activities on the heritage resource base in the drainage, as they are presently known. In the longer view, known and undiscovered heritage sites in the Snow Talon fire perimeter would be potentially threatened by post-fire flooding, channel scouring and other natural processes, as well as by public use of the area once fire rehabilitation is complete. Inventory in advance of timber harvest would provide an opportunity to identify some of these heritage sites of concern and to develop protection-management measures. So, in this sense, the no action alternative could add to the cumulative effect of FS management on heritage resources in Copper Creek.

Irreversible/Irretrievable Commitments of Alternative 1

The opportunity to inventory parts of the Snow Talon fire area would be foreclosed under this alternative. Therefore, opportunities to identify and document the fire's effect on known and as-yet-undiscovered heritage sites would also be foreclosed. This, in turn, would limit options to implement protection measures for sites now threatened by post-fire flooding, wind-thrown burnt timber, dispersed recreation, and other natural processes and human activities.

Unavoidable Adverse Effects of Alternative 1

Blown-down trees, post-fire flooding, scouring and channel-cutting, land slides, and recreational activity could damage or destroy currently identified and any number of undiscovered sites in the Copper Creek drainage.

Forest Plan Consistency of Alternative 1

The *Forest Plan* requires the integration of heritage resources in project planning and forest management. Periodic monitoring of known sites in the wildfire area would occur under Alternative 1, following BMPs.

Conclusions

This alternative proposes no new ground disturbance that could adversely affect heritage resources. As stated above, post-fire natural processes and human activity, coupled with fire restoration emergency measures, could disturb and/or destroy currently known and undiscovered heritage sites within the fire perimeter.

Effects of Alternative 2

Alternative 2 would use both helicopter and ground-based (tractor) logging systems to salvage burnt timber. This activity has the potential to affect three identified heritage sites (Table 58). Two sites are of marginal value because little evidence has survived and/or they lack context and associated ruins. One is a historic Mainline trail whose current condition in the proposed harvest unit is unknown.

Alternative 2 harvest units encompass about 2,461 acres. Another 87 acres are included in helicopter and unit landings, and temporary roads. During the past several decades Helena NF archaeologists have inventoried approximately 720 acres within Alternative 2 harvest units, which equates to 28% of the project impact area under this alternative. This coverage includes the 110 acres of old jammer trails that are proposed for reclamation in this alternative.

Approximately 338 (14%) of all of the harvest area encompassed by Alternative 2 units falls within the high-probability zone in the Helena NF SIS. These are relatively flat areas along Copper Creek and around Indian Meadows that are accessible to water. There is a strong likelihood that compliance inventory in these fire-burned areas would turn up a heritage site or two, although their post-fire preservation value could be questionable.

Of the total impact acres this alternative, 1,486 acres (60%) would fall in the medium site probability zone. This zone encompasses forest terrain with 15–45% slopes that may or may not lie near water or other attractive natural features. The number of sites that typically occur in the medium probability zone varies by mountain range on the Helena. Past inventories in or near the project area, on the Lincoln RD, and on the west slope of the Continental Divide have not been very productive except where historic mining has been extensive. Copper Creek does not have an extensive history of mining. It is likely that few, if any, heritage sites will be discovered during compliance inventory within this probability zone.

Terrain of more than 45% slope is considered to have low potential for heritage sites; humans tend not to spend much time on steep mountain slopes, although historic prospecting and (lode) mining are exceptions to this general rule. In Alternative 2,

approximately 643 acres (26%) of the impact areas meet low site probability criteria. Timber harvest, construction of temporary roads and helicopter landings, or jammer trail reclamation in this terrain is unlikely to affect any heritage resources.

Direct and Indirect Effects of Alternative 2

Timber harvest, and the associated construction of temporary roads, log deck areas, and helicopter landings, create ground disturbances that may adversely affect heritage resources. Rubber-tired logging equipment can reduce but not eliminate soil disturbance so heritage sites could still be adversely affected by tractor-based logging. The overall amount of surface disturbance caused by a skyline cable operation is less than for tractor logging but felled timber dragged repeatedly to decking areas creates deep ruts. Helicopter logging causes the least ground disturbance but still requires the construction of log decking areas and helicopter landing areas within or near the harvest units. Logging when the soil is frozen and atop deep snow would abate ground disturbance (and heritage resource concerns) with tractor, skyline cable, or helicopter logging systems.

Reclamation of old jammer trails could adversely affect heritage resources. However, these trails primarily lie on mountain slopes where heritage resources are unlikely to be located.

Increased public access into the project area created by timber harvesting may invite inadvertent and deliberate ground disturbance, vandalism, and artifact collecting.

Cumulative Effects of Alternative 2

Cumulative effects background context is provided in the Alternative 1 description above. This alternative would invoke more timber management activity in the drainage concurrent with wildfire hazard tree removal and related fire restoration work. This would add to the cumulative effect of FS management activities on heritage resources in the upper Copper Creek drainage since the turn of the century. This effect could be abated if the identified heritage sites were protected through unit redesign and avoidance.

Unavoidable Adverse Effects of Alternative 2

Salvage timber harvest may increase public access and, as a consequence, enhance opportunities for artifact collecting in the vegetation-denuded landscape.

Forest Plan Consistency of Alternative 2

The *Forest Plan* requires the integration of heritage resources in project planning and forest management. Compliance inventory, evaluation of project effect, and implementation of mitigation-treatment plans for project-threatened sites would comply with Section 6 regulations of the NHPA and *Forest Plan* (USDA 1986a) standards and guidelines. Monitoring of known sites in the wildfire area would occur under Alternative 2 following BMPs.

Conclusions

This alternative has the potential to adversely affect three identified heritage sites, and potentially several as-yet-undiscovered sites in high probability terrain in tractor, skyline, and helicopter harvest units.

Effects of Alternative 3

Alternative 3 is similar to Alternative 2, but Alternative 3 excludes all helicopter units. Therefore, the amount of potential ground disturbance is reduced by half. This alternative has the potential to affect three identified heritage sites (Table 58). Two sites are of marginal value because there is little surviving evidence and/or cultural associations, and one is a historic trail whose current, post-fire condition in the proposed harvest unit is unknown.

Alternative 3 harvest units encompass approximately 1,129 acres. Of this total, 561 acres were examined during previous heritage surveys in the Copper Creek drainage. Thus, approximately 49% of this alternative's acreage, including the old jammer trails, has already been inventoried.

About 275 acres (24%) of the harvest area encompassed by Alternative 3 lie within the high site probability zone. These are the same areas described in Alternative 2, with the exclusion of helicopter units. There is strong possibility of discovering a few new sites "in the black," which may in turn require unit boundary adjustments or other mitigation measures.

Approximately 800 acres (69%) can be assigned to the medium site probability zone, encompassing the same areas as Alternative 2 again with the exception of helicopter units. Compliance inventory could yield a few new sites. Approximately 80 acres in proposed harvest units lie on steep (>45%) mountain slopes where heritage sites are unlikely to be found.

Direct and Indirect Effects of Alternative 3

This alternative relies on tractor and skyline cable logging systems. Similar to Alternative 2, timber harvest will create ground disturbance that may adversely affect heritage resources. Logging when the ground is frozen and atop deep snow would abate ground disturbance and heritage resource concerns with either the tractor or skyline cable systems.

Increased public access into the project area created by timber harvesting may invite inadvertent and deliberate ground disturbance, vandalism, and artifact collecting.

Cumulative Effects of Alternative 3

The cumulative effect is similar to Alternative 2 although the overall effect is less because of amount of ground affected by logging is reduced by half.

Unavoidable Adverse Effects of Alternative 3

Same as those disclosed under Alternative 2.

Forest Plan Consistency of Alternative 3

Same as that disclosed under Alternative 2.

Conclusions

This alternative has the potential to adversely affect three identified heritage sites, and potentially several as-yet-undiscovered sites in high probability terrain in tractor and skyline harvest units.

Effects of Alternative 4

Alternative 4 uses both helicopter and ground-based logging systems to maximize timber harvest. It includes all harvest units proposed in Alternative 1 and another 1,257 harvest acres. Tractor and skyline landings, helicopter landings, and temporary roads would encompass another 88 acres. This alternative has the potential to affect the same three identified heritage sites described in Alternatives 2 and 3.

Alternative 4 would affect approximately 3,718 acres. Of this total, 839 acres (22% of the Alternative 4 total) were inventoried during previous compliance surveys in the Copper Creek drainage. This coverage also takes into account the jammer trails in old harvest units that are proposed for reclamation.

Some 744 acres (20%) of the harvest units encompassed by this alternative fall within the high site probability zone. A few sites could be discovered if heritage inventory is pursued in these areas. The presence of these sites may affect the location and/or configuration of some harvest units and/or temporary roads and helicopter landings.

About 1,300 acres (60%) occurs in the medium site probability zone. This zone includes the large, relatively gentle divide separating Copper Creek from Indian Meadows Creek-Landers Fork. Heritage sites found in these and adjacent drainage, and the low divides between them, relate to seasonal American Indian travel over the Continental Divide to hunt bison in the distant past, as well as more recent homesteading and ranching. If this pattern holds true, this contiguous block of country could yield a slightly larger number (i.e., 2–4) of sites than would be typical of the medium probability zone elsewhere in the project area.

About 640 acres (20%) in proposed harvest units lie on steep (>45%) mountain slope and are unlikely to contain heritage sites.

Direct and Indirect Effects of Alternative 4

This alternative would harvest an additional 1,257 acres of timber over Alternative 2 and 2,589 acres over Alternative 3. There would be a proportional increase in the amount of ground disturbance that could affect heritage resources. As with the other two action alternatives, logging when the ground is frozen and atop deep snow could abate soil and site disturbance.

Increased public access into the project area created by timber harvesting may invite inadvertent and deliberate ground disturbance, vandalism, and artifact collecting.

Cumulative Effects of Alternative 4

The cumulative effect of Alternative 4 is potentially greater than for either Alternative 2 or 3 because considerably more logging would be done. This would equate to more ground disturbance and potentially, more public access to vulnerable sites.

Unavoidable Adverse Effects of Alternative 4

Same as those disclosed under Alternatives 2 and 3.

Forest Plan Consistency of Alternative 4

Same as that disclosed under Alternatives 2 and 3.

Conclusions

This alternative has the potential to adversely affect three identified heritage sites, and potentially several as-yet-undiscovered sites in high probability terrain in tractor, skyline and helicopter harvest units.

Landscape Aesthetics

This section addresses the effects of the Snow Talon fire on the visual/aesthetic environment of the Copper Creek and Landers Creek viewsheds. This section also describes the probable effects of alternative recovery strategies on the Snow Talon burn area's aesthetic environment and how these alternatives are likely to move or allow the present landscape conditions of the Snow Talon fire recovery area to generate the desired landscape character and VQOs as defined in the *Forest Plan*.

This analysis used the FS scenery management system (SMS) in combination with the visual management system (VMS), which was the guidance used in developing the VQOs for the *Forest Plan*.

The *Forest Plan* established the following VQOs, which are used for each MA of the Forest including the Snow Talon fire project area:

- Preservation. This visual quality object allows ecological changes only. Management activities except for very low visual impact recreation facilities, are prohibited.
- Retention. This visual quality object provides for management activities, which are not visually evident. Under retention, activities may only repeat form, line, color, and texture, which are frequently found in the characteristic landscape.
- Partial Retention. Within this VQO, management activities remain visually subordinate to the characteristic landscape. Management activities borrow and repeat natural line, form, color, common in the characteristic landscape but changes in their qualities, size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape.
- Modification. Under the modification VQO, management activities may visually dominate the original characteristic landscape. However, activities vegetative and landform alteration must borrow from naturally established form, line, color, or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type.
- Maximum Modification. Under this VQO, management activities may dominate the landscape. However, when viewed as background, the visual characteristic landscape must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail, which is incongruent with natural occurrences as seen in the foreground or middle ground.

Affected Environment

Social and Economic Values Affecting Landscape Aesthetics

Chapter 1, of the 1995 Landscape Aesthetics, USDA Handbook 701, defines landscape character as: "…a combination of the objective information contained within ecological unit description and the cultural values that people assign to landscapes. Together they help define the meaning of 'place,' and its scenic expression."

Montana's scenery is one of the State's prime economic resources. These aesthetic resources combined with the history of Lewis and Clark's epoch journey through Montana—including the heavily burned Landers Fork of the Blackfoot River—make the scenery of the Snow Talon area a prime economic resource.

Montana's forest users have, over many years, clearly defined their aesthetic values for the areas now engulfed by the Snow Talon fire. They have done so in tourism ads, news reports, movie productions, and on the Internet. A July 29, 2003, report by the Helena-based *Independent Record* newspaper described the views from the vintage Silver King Lookout Tower as "…endless views of the Blackfoot Valley and the Bob Marshall Wilderness…." The same report documented the impact of the Snow Talon fire on that very historic viewpoint: "On July 29, 2003, the Snow Talon fire rolled over Silver King Mountain 20 miles northeast of Lincoln, reducing the lookout to ashes and charring 37,000 acres of surrounding Helena National Forest Land" (*Independent Record* 2003).

Montana's scenery, including wildlife viewing, is big business. Norma Nickerson, director of the Tourism and Economic Research Department in the University of Montana's School of Forestry, reported the State received approximately $1.8 billion in tourist dollars in 2003 (Mendenhal 2004).

Description of the Landscape Character Region

Measuring and understanding the desired long-term landscape character management goals of the Snow Talon burn requires a review of the regional landscape character attributes. From 1972 through 1975, Timothy G. Love under the guidance of Dr. John M. Crowley, professor of geography, University of Montana, identified, classified, mapped, and described the landscape types and regions of the FS Region 1 – Northern Region. Region 1 encompasses four broad-scale landscape regions, the North American Prairie, the Great Plains, the Rocky Mountains, and the Intermountain regions.

Extrapolating from Love and Crowley's work, we find that the Snow Talon burn lies within a landscape character type known as the Broad Valley Rockies Subregion. The Broad Valley Rockies region was further mapped and classified into seven bio-climatic/altitudinal/plant association zones:

- Floodplain—Black cottonwood-Ponderosa pine floodplain forest
- Steppe—Big sagebrush, bunch wheatgrass, bluebunch wheatgrass (Montana State Grass), bunchgrass
- Prairie—Ponderosa pine-bluebunch wheatgrass parkland, fescue-bluebunch wheatgrass
- Montane—Ponderosa pine forest, Douglas fir forest
- Subalpine—Subalpine fir forest, Whitebark pine parkland

- Alpine—Alpine tundra
- Subnival—Bare rock outcrop and talus.

Aesthetic/Visual Environment of the Snow Talon Burn Area

The primary aesthetic Snow Talon fire was immediate and obvious. Where the fire burned intensely, hillsides are covered with black, limbless spikes where once grew stands of green canopies (Figure 15). The gray-black ashes are all that remain of pine grass, huckleberry, and myriads of other shrubs and forbs that blanketed the forest floor before the fire. Where the fire burned less intensely, conifer needles still remain on the branches but have turned yellow, brown, and black from the heat or from tree damage.

Post-fire views from the Copper Creek road offer graphic, close-up views of bare ground, a mosaic of green, yellow, brown and black. Views of dead, blackened, limbless trees extend from road edges to the tops of distant ridges (Figure 16).

The Snow Talon fire engulfed NF lands heavily used for recreation. Copper Creek and the entire watershed area is a well known, high sensitivity, destination locale for both summer and winter recreation (USDA 2003a). The fire opened up more viewing opportunities from the Copper Creek Road and Road #1882, which is the primary route to the Scapegoat Wilderness. In addition, the primary Scapegoat Wilderness jump-off site, Indian Meadows, was also burned (Schramm 2003). In addition, the fire engulfed the Copper Creek Campground, numerous popular, undeveloped camping sites, undeveloped trailheads, snowmobile play areas, and designated trails and undeveloped travel-ways leaving hazardous, dead and dying trees in these high-use areas. The potential for injury or a fatality is high in these areas—both in the short and long term unless mitigated by hazard tree removal (USDA 2003a).

In FS SMS terms, the pre-fire landscapes of the Snow Talon fire area can be described, at least in the short term, as having unacceptably low scenic integrity (USDA 1995a, E 1–3). Under both the FS's VMS and a more recent SMS, the most severely burned areas would be classed as a rehabilitation management goal (Table 59).

Post-fire photography shows at least three, very square shaped, pre-fire, clear-cut units with associated road construction clearly visible on the steep slopes above Copper Creek road (Figure 17). The subsurface soils exposed by the steep slope road construction are very light-colored and offer a high, unnatural contrast to both the original and burned ground colors. Because of their location in the foreground and middle-ground view of a level one travel route these square-shaped harvest units would be described as having unacceptably low scenic integrity, they are extremely dominant and borrow little if any line, form, color, texture, pattern, or scale from natural landscape character. Landscape alterations created at this level of integrity need rehabilitation (USDA 1995, 2–4).

Environmental Consequences

The Snow Talon fire burned in a natural appearing mosaic and will in the long-term enhance the aesthetics of the area. Part of this enhancement may come as a result of the burn covering over some pre-fire harvest units that were square-shaped creating an unacceptable, unnatural landscape character.

Landscape recovery to an acceptable level of scenic integrity in every alternative is dependent upon and affected by the following factors:

Figure 15. Intensely burned landscape from the Snow Talon fire.
(Photo—Helena National Forest)

Figure 16. View overlooking Copper Creek Area and clearcuts.
(Photo—Helena National Forest)

Figure 17. Pre-fire, clear-cut units are visible on slopes above Copper Creek.
(Photo—Helena National Forest)

Table 59. Comparison of SMS scenic integrity ratings and VQO ratings by burn severity levels within the Snow Talon fire analysis area.

Severity Class	SMS—Scenic Integrity	VQO
Unburned	High to Moderate	Retention to Partial Retention
Low	Moderate to High	Partial Retention to Retention
Moderate to High	Low to Very Low	Modification to Maximum Modification

- Extent of soil damage and exposure by fire suppression and salvage operations
- Areas covered by characteristic light-colored, subsurface soils
- Extent of exposure to the viewing public by fire suppression activities and salvage operations
- Timing and extent of renewed livestock grazing
- Soil productivity
- Natural vegetative recovery capability
- Fire severity
- Timing of post-fire livestock grazing.

Effects Common to All Alternatives

The loss—even the temporary loss—of viable, native, ground cover in the large-scale Snow Talon fire area is an open door to invasive, noxious weeds. In addition to the destruction of wildlife habitat, displacement of many native plant and animal species, and reduction in recreation opportunities (USDI 2004), weeds are blight on aesthetic resources anywhere (Central Park Conservancy 2004). A potential for a noxious weed invasion exists under all the action salvage alternatives as well as the no action alternative (USDA 2003a).

Under all alternatives, large acreages and wide vistas of dead and dying trees will, remain and be part of a burned-over landscape character for many years. In the very long-term, however, the forest landscape character will change to a more open, pastoral character, to which many people is a familiar and enjoyable landscape (Shepard and Foreman 1972, 48).

Estimating the time needed for full recovery to the *Forest Plan* VQOs under any alternative would require a level of research beyond the scope of this analysis.

A literature review of several completed fire recovery reports on the effects of wildfire on forest aesthetics show wide variations in estimated recovery times ranging from 20–30 years (Thomas 2002) to 180 years (Larson 2003).

Mitigations Included under All Alternatives

- Implement early weed control programs (BLM 2004; Bryon 2003).
- Delay and limit livestock grazing until indigenous plants are fully reestablished (Beschta 2002).

Mitigations Included under All Action Alternatives

- Conduct computer based mapping of harvest areas to identify best and most efficient opportunities to minimize exposure of the characteristic light-colored soil types in the Snow Talon burn area.
- Conduct on-the-ground visual observations and mapping to supplement computer-based seen area mapping.
- Restrict logging to winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow.
- Reclaim all new roads and helicopter landings after tree harvest and burn rehabilitation work is completed.
- Abandon existing jammer roads.
- Rehabilitate and reclaim 110 acres of existing jammer trails.
- Implement early weed control programs (BLM 2004; Bryon 2003).
- Delay and limit livestock grazing until indigenous plants are fully reestablished (Beschta 2002).
- Favor leaving trees that have a reasonable chance of surviving.

Effects of Alternative 1

Mitigations Included in Alternative 1

- Implement early weed control programs (BLM 2004; Bryon 2003)
- Delay and limit livestock grazing until indigenous plants are fully reestablished (Beschta 2002).

Direct and Indirect Effects of Alternative 1

As this is a no action management alternative, the existing unacceptable visual situation in the foreground and near middle-ground areas would continue. This would be especially true for the pre-fire, foreground and middle-ground areas logged in an aesthetically unacceptable manner adjacent to Copper Creek road. Alternative 1 would probably result in a less visually diverse landscape than under alternatives proposed for dead and dying tree removal. The Snow Talon landscape would recover in the long run. However, visible fire suppression impacts on the landscape and some emergency treatments would be evident for many years.

Weed invasions will likely occur in response to fire salvage activities. In addition, if grazing activities begin before indigenous plants become well established (Beschta 2002), weed infestations are likely to be compounded. Weeds are easily spread by vehicles, heavy equipment like bulldozers, and graders. In addition, they are carried and spread by hikers, bicyclists, ATV users, pack and saddle stock, livestock, and pets (California Department of Food and Agriculture [CDFA] 2003).

Cumulative Effects of Alternative 1

The foreground and middle-ground landscapes of Alternative 1 would be one of weathering snags emanating from a diverse carpet of grasses and shrubs. Those areas burned at low intensity would support islands of green trees adding focal points and needed landscape variety. The accumulation of heavy, woody litter and competition from grasses and shrubs would slow the establishment and growth of new trees.

A potential for a noxious weed invasions and increased numbers of beetle-killed trees exists under all the salvage alternatives considered (USDA 2003a). However, under Alternative 1, noxious weed populations and the numbers of beetle-killed trees would probably be the greatest. These changes in vegetation, color, and texture would likely affect landscape aesthetics.

Short-term Uses vs. Long-term Productivity of Alternative 1

Foreground and near middle-ground scenic quality would not be enhanced in the short term by the implementation of Alternative 1. *Forest Plan* retention and partial retention VQOs would likely be achieved in the long term. However, estimating the time needed for full recovery to the NF VQO goals under any alternative would require a level of research beyond the scope of this analysis. Because of the high volume of dead trees that eventually fall to the forest floor, some fuel reduction projects may be required in the future.

Irreversible/Irretrievable Commitments of Alternative 1

Without any management intervention, weed invasions would continue because of the fire resistance of most species of weeds (Bushey 1995). In addition, some experts believe

that when weed/alien plant invasions are "already well established there must be some acceptance that biological invasions are often irreversible" (Wooten and Morrison 1995). Weed invasions into a natural forest landscape ultimately affect the quality of recreation experiences and associated forest aesthetics.

Unavoidable Adverse Effects of Alternative 1

It would likely take several generations if not hundreds of years for the burned Snow Talon landscape to return to its full ecologic potential. Under the no action alternative, weed invasions would continue because of the fire resistance of most species of weeds (Bushey 1995). Weed invasions into a natural forest landscape ultimately affect the quality of recreation experiences and associated forest aesthetics (USDI 2004).

Forest Plan Consistency of Alternative 1

Alternative 1 would delay achieving *Forest Plan* VQOs in some foreground and middle-ground zones in of sensitive travel routes of the Snow Talon area, including a primary access to the Scapegoat Wilderness.

Conclusions

Alternative 1 would probably result in a less visually diverse landscape than under alternatives proposed for dead and dying tree removal. It would likely take several generations if not hundreds of years for the burned Snow Talon landscape to return to its full ecologic potential. The Snow Talon landscape would recover in the long run; however, visible fire suppression impacts on the landscape and some emergency treatments would be evident for many years.

Effects of Alternative 2

Alternative 2 proposes to remove dead and dying trees from about 2,461 acres within the burned area. Alternative 2 would remove about 1,300 acres or over half by helicopter logging. Tractor logging would encompass about 850 acres and skyline logging would be used on about 300 acres. Under Alternative 2, approximately 740 acres of *Forest Plan*-designated retention and partial retention VQO areas would be logged. About 500 of those acres would be logged by helicopter while approximately 200 would be logged by tractor (Table 60).

To aid in the tree removal, 0.5 mile of new, short, temporary spur roads and 27 helicopter landing sites are proposed. Under this proposal, the new roads and helicopter landings would be reclaimed after tree harvest and burn rehabilitation work is completed. Both new and existing, jammer roads would be reclaimed. In addition, 110 acres of jammer trails would be rehabilitated.

Because of the extensive tree kill and ground cover and forest litter removal in highly sensitive recreation travel routes, fishing streams, and camping areas, the landscape character and scenic integrity of most of the Snow Talon fire is considered, at least in the short term, to be very low to unacceptable. The *Forest Plan* VQOs for the foreground and middle-ground areas seen from Copper Creek road are retention and partial retention.

Helicopter salvage logging results in minimal impact to aesthetic resources (USDA 2002). This aerial salvage provides for the removal of dense stands of snags and

Table 60. Alternative 2 logging systems and affected Helena *Forest Plan* VQO acres.

Logging System	VQO				
	Retention (Acre)	Partial Retention (Acre)	Modification (Acre)	Maximum Modification (Acre)	Total by Logging System (Acre)
Helicopter Logging	452.7	49.0	548.4	251.7	1301.8
Skyline Logging	5.6	29.7	183.4	88.8	307.5
Tractor Logging	81.3	123.5	520.0	122.0	846.8
Total Logged by VQO (Acre)	539.6	202.2	1251.8	462.5	2456.1

the conversion of the unacceptably altered landscape to a more open, diverse, natural appearing landscape with fewer trees in the short term.

Mitigations Included in Alternative 2

- Conduct computer-based mapping of harvest areas to identify best and most efficient opportunities to minimize exposure of the characteristic light-colored soil types in the Snow Talon burn area
- Conduct on-the-ground visual observations and mapping to supplement computer-based seen area mapping
- Restrict logging to winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow
- Reclaim all new roads and helicopter landings after tree harvest and burn rehabilitation work is completed
- Abandon existing jammer roads
- Rehabilitate and reclaim 110 acres of existing jammer trails
- Implement early weed control programs (BLM 2004; Bryon 2003)
- Delay and limit livestock grazing until indigenous plants are fully reestablished (Beschta 2002)
- Favor leaving trees that have a reasonable chance of surviving.

Direct and Indirect Effects of Alternative 2 on Landscape Aesthetics

The Alternative 2 proposed harvest area encompasses about 2,461 acres. The scenic integrity of the burn area is now considered very low to unacceptable. The Helena *Forest Plan* management direction generally prescribes retention and partial retention VQOs for all forest landscapes viewed from high-sensitivity travel routes and recreation use sites.

Helicopter salvage logging, and related yarding methods would remove commercial-sized dead trees except those retained to meet wildlife and other needs. Helicopter logging and related yarding activities minimize ground disturbances (no roads or skid trails) and has a minimal impact on aesthetic resources. Helicopter logging activities generally have only short-term impacts on the landscape and meet retention and/or partial retention VQO standards. Helicopter landings would be rehabilitated after use (USDA 2002).

Cumulative Effects of Alternative 2

Road construction, helicopter landing creation activities that expose post-burn, light-colored soils have high probability of cumulatively altering the landscape character. However, the FS requirement for winter logging under this alternative would likely keep soil disturbance to a minimum.

Short-term Uses vs. Long-term Productivity of Alternative 2

In the short term, some of the disturbed soils created by helicopter landings and temporary logging roads may be noticeable from sensitive viewpoints. In the long term, the removal of dead trees would increase landscape diversity.

Under this alternative, achievement of *Forest Plan* retention and partial retention VQOs would probably be realized sooner than under the no action alternative because of the removal of many of the dead and dying trees in foreground and middle-ground areas. However, estimating the time needed for full recovery to the *Forest Plan* VQO goals under any alternative would require a level of research beyond the scope of this analysis.

Irreversible/Irretrievable Commitments of Alternative 2

Under this alterative, no irreversible/irretrievable commitments of aesthetic/scenic resources have been identified.

Unavoidable Adverse Effects of Alternative 2

In the short term, soil disturbances resulting from the harvesting/removal of dead trees in the foreground and near middle-ground view areas of high sensitivity roads and high-use recreation sites may be very noticeable. In the long term, these soil-disturbing activities will heal as the result of new ground cover, shrub, and tree growth.

Weed infestations in Montana NFs are well established (Bryon 2003). A potential for a noxious weed invasion exists under all the salvage alternatives considered (USDA 2003a). In addition, some experts believe that when weed/alien plant invasions are "already well established there must be some acceptance that biological invasions are often irreversible" (Wooten and Morrison 1995). Any activities that propagate alien plant growth in a natural forest landscape ultimately affect the quality of recreation and associated forest aesthetics (USDI 2004).

Forest Plan Consistency of Alternative 2

This action alternative is responsive to the *Forest Plan* direction by its proposal to implement landscape rehabilitation strategies-including the removal of dead trees-within the high visitor use, high sensitivity viewsheds.

Conclusions

In the short term, soil disturbances resulting from the harvesting/removal of dead trees in the foreground and near middle-ground view areas of high sensitivity roads and high-use recreation sites may be very noticeable. In the long term, and under BMPs, these soil-disturbing activities will heal as the result of new ground cover, shrub, and tree growth.

Weed control will likely be a long-term challenge and could affect aesthetic resources within foreground and middle-ground view areas.

Effects of Alternative 3

Alternative 3 proposes to remove dead and dying trees from about 1,129 acres within the burned area. Tractor logging would encompass about 824 acres and skyline logging would be used on about 305 acres. Under Alternative 3, a total of about 276 acres of designated *Forest Plan* retention and partial retention VQO areas would be logged. Approximately 241 acres of retention and partial retention would be logged by tractor. Alternative 2 would not include any helicopter logging (Table 61).

About 0.5 miles of short, temporary spur are proposed. Under this proposal, the new roads would be reclaimed after tree harvest and burn rehabilitation work is completed. As in Alternative2, 110 acres of jammer trails would be rehabilitated.

As in Alternative 2, the extensive wildfire-related tree kill, ground cover, and forest litter removal in highly sensitive recreation travel routes, fishing streams, and camping areas, has changed the landscape character and scenic integrity of most of the Snow Talon burn to a very low and unacceptable classifications in the eyes of many viewers. The *Forest Plan* VQO for the foreground and middle-ground areas seen from Copper Creek Road and Road #1882 are retention and partial retention.

Because helicopter logging is not included in this alternative, tractor and skyline logging is programmed for the most visually sensitive areas. Both tractor and skyline salvage logging often creates the greatest impact to aesthetic resources (USDA 2002).

Table 61. Alternative 3 logging systems and affected Helena *Forest Plan* VQO acres.

	VQO				
Logging System	Retention (Acre)	Partial Retention (Acre)	Modification (Acre)	Maximum Modification (Acre)	Total by Logging System (Acre)
Skyline Logging	5.6	29.7	183.4	88.8	305
Tractor Logging	80.5	120.5	505.0	118.0	824
Total Logged by VQO (Acre)	86.1	148.2	688.4	206.8	1,129

Mitigations Included in Alternative 3

- Conduct computer-based mapping of harvest areas to identify best and most efficient opportunities to minimize exposure of the characteristic light-colored soil types in the Snow Talon burn area
- Conduct on-the-ground visual observations and mapping to supplement computer-based seen area mapping
- Restrict logging to winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow.
- Reclaim all new roads and helicopter landings after tree harvest and burn rehabilitation work is completed
- Abandon existing jammer roads
- Rehabilitate and reclaim 110 acres of existing jammer trails
- Implement early weed control programs (BLM 2004; Bryon 2003)
- Delay and limit livestock grazing until indigenous plants are fully reestablished (Beschta 2002).
- Favor leaving trees that have a reasonable chance of surviving.

Direct and Indirect Effects of Alternative 3

Under Alternative 3, about 240 acres of *Forest Plan*-designated retention and partial retention VQO areas would be logged. Alternative 3 would log about 305 acres with skyline systems and about 824 acres with tractor logging. This alternative would log about 1,300 less acres than Alternative 2. However, the proposed tractor logging for both Alternatives 2 and 3 is about the same, 824 acres.

A major aesthetic effect would be the exposure of the light-colored soils found in the area by tractor and yarding operations. However the restriction of logging operations winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow would minimize these effects.

Cumulative Effects of Alternative 3

Without the winter logging provisions, the aesthetic effects created by the extensive use of tractor and skyline logging activities of Alternative 3 on highly visible, sensitive viewing areas would likely result in a longer-term, unacceptable landscape character caused by the highly contrasting light-colored character of exposed soils of the Snow Talon area (Figure 18).

Short-term Uses vs. Long-term Productivity of Alternative 3

In the short term, some of the disturbed soils created by log landings and temporary logging roads may be noticeable from sensitive viewpoints. In the long-term, the removal of dead trees would increase landscape diversity.

Under this alternative, achievement of *Forest Plan* retention and partial retention VQOs would probably be realized sooner than under the no action alternative because of the removal of many of the dead and dying trees in foreground and middle-ground areas.

Figure 18. View from Copper Creek road showing light colored soils of exposed jammer trails.
(Photo—George Parisot)

However, estimating the time needed for full recovery to the *Forest Plan* VQO goals under any alternative would require a level of research beyond the scope of this analysis.

Irreversible/Irretrievable Commitments of Alternative 3

Under this alterative, no irreversible/irretrievable commitments of aesthetic/scenic resources have been identified.

Unavoidable Adverse Effects of Alternative 3

In the short term, soil disturbances resulting from the harvesting/removal of dead trees in the foreground and near middle-ground view areas of high-sensitivity roads and high-use recreation sites may be very noticeable. In the long term, these soil-disturbing activities will heal as the result of new ground cover, shrub, and tree growth.

Weed invasions will likely occur in response to fire salvage activities. In addition, if grazing activities begin before indigenous plants become well established (Beschta 2002), weed infestations are likely to be compounded. Weeds are easily spread by vehicles, heavy equipment like bulldozers, and graders. In addition they are carried and spread by hikers, bicyclists, ATV users, pack and saddle stock, livestock, and pets (CDFA 2003)

Forest Plan Consistency of Alternative 3

The *Forest Plan* requires the application of the FS VMS and therefore the updated SMS. Alternative 3 is responsive to *Forest Plan* direction by its proposal to implement

landscape rehabilitation strategies-including the removal of dead trees within the high-visitor use, high-sensitivity viewsheds.

Conclusions

Alternative 3 proposes to remove dead and dying trees from about 1,129 acres within the 37,000 acre burned area. Logging systems include the use of skyline and tractor systems.

Logging-related construction activities would expose some light-colored soils, which would be visible from sensitive roads, trails, and recreation use areas. In addition, exposed soils would also be fertile ground for noxious weeds that negatively affect aesthetic resources (Wooten and Morrison 1995).

Effects of Alternative 4

Alternative 4 proposes to remove dead and dying trees from about 37,000 acres within the burned area. Tractor logging would encompass about 1,115 acres and skyline logging would be used on about 305 acres. Computer-based viewshed/seen area mapping (Map 4) shows the degree of visibility (times seen) for Alternative 4 proposed harvest units.

Under Alternative 4, about 1,172 acres of *Forest Plan*-designated retention and partial retention VQO areas would be logged. However, about 931 acres of these retention and partial retention areas would be logged by helicopter. Alternative 4 would log about 2,305 acres by helicopter, 305 acres with skyline systems, and about 1,115 acres with tractor logging (Table 62). This alternative would log about 1,000 more acres by helicopter than Alternative 2.

About 0.5 mile of short, temporary spur roads are proposed. In addition, about 30 helicopter landing areas are proposed. Tractor and yarding operations on ashcap soils would be restricted to winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow.

Table 62. Alternative 4 logging systems and affected Helena *Forest Plan* VQO acres.

Logging System	VQO				
	Retention (Acre)	Partial Retention (Acre)	Modification (Acre)	Maximum Modification (Acre)	Total by Logging System (Acre)
Helicopter Logging	861	75.4	1069.0	298	2305.0
Skyline Logging	5.6	28.7	177.0	85.9	297.2
Tractor Logging	83.0	124.0	710.0	198.1	1115.1
Total Logged by VQO (Acre)	949.6	228.1	1956.0	581.8	3717.3

Under this alternative, new roads would be reclaimed after tree harvest and burn rehabilitation work is completed. Existing jammer roads would be abandoned and reclaimed. In addition, 110 acres of jammer trails would be rehabilitated.

Harvest is not proposed within IRAs, RHCAs, or RNAs. All old growth and surviving designated old growth stands and trees have been identified, mapped, and scheduled for protection under this alternative. In addition, forest-marking crews would be using a mortality estimator to determine whether fire impacted trees would survive the effects of fire and insects. In recognition of the value of living trees, the estimator guidelines are conservative and favor leaving trees that might die rather than harvesting those trees that have a reasonable chance of surviving.

The extensive tree kill, ground cover, and forest litter removal in highly sensitive recreation travel routes, fishing streams, and camping areas, has changed the landscape character and scenic integrity of most of the Snow Talon burn to a very low level. The *Forest Plan* VQO for the foreground and middle-ground areas seen from Copper Creek Road and Road #1882 are retention and partial retention. Alternative 4 would probably have the greatest, long-term impact on aesthetic resources because of the high probability of greater soil disturbance.

Mitigations Included in Alternative 4

- Conduct computer-based mapping of harvest areas to identify best and most efficient opportunities to minimize exposure of the characteristic light-colored soil types in the Snow Talon burn area
- Conduct on-the-ground visual observations and mapping to supplement computer-based seen area mapping
- Restrict logging to winter conditions with 4 inches of frozen ground and/or 6 inches of packed snow
- Reclaim all new roads and helicopter landings after tree harvest and burn rehabilitation work is completed
- Abandon existing jammer roads
- Rehabilitate and reclaim1110 acres of existing jammer trails
- Implement early weed control programs (BLM 2004; Bryon 2003)
- Delay and limit livestock grazing until indigenous plants are fully reestablished (This mitigation may need to be considered as part of a separate EIS)
- Favor leaving trees that have a reasonable chance of surviving.

Direct and Indirect Effects of Alternative 4

The scenic integrity of the burn area is now considered very low to unacceptable. The *Forest Plan* management direction generally prescribes retention and partial retention VQOs for all forest landscapes viewed from high sensitivity travel routes and recreation use sites. In addition, the *Forest Plan* directs that portions of most MAs, including those with an overall VQO of modification and maximum modification (if any) that are within the sensitive viewing areas of the roads, trails, and areas be managed to meet more restrictive VQOs (USDA 1995e).

Helicopter salvage logging and related yarding methods would remove commercial-sized dead and dying trees except those retained to meet wildlife and other needs. Helicopter logging and related yarding activities minimize ground disturbances (no roads or skid trails) and, therefore, has a minimal impact on aesthetic resources (USDA 2002). Helicopter logging activities generally have only short-term impacts on the landscape and meet retention and/or partial retention VQO standards. Helicopter landings would be rehabilitated after use.

Cumulative Effects of Alternative 4

The aesthetic effects created by the extensive use of tractor and skyline logging activities of Alternative 4 in highly visible, sensitive viewing areas could result in a longer-term, unacceptable landscape character caused by the highly contrasting light-colored character of exposed soils of the Snow Talon area (Figure 18). Carefully managed winter logging operation may minimize this potential effect.

Short-term Uses vs. Long-term Productivity of Alternative 4

In the short term, some of the disturbed soils created by helicopter landings and temporary logging roads may be noticeable from sensitive viewpoints. In the long-term, the removal of dead trees would increase landscape diversity.

Under this alternative, achievement of *Forest Plan* retention and partial retention VQOs would probably be realized sooner than under the no action alternative because of the removal of many of the dead and dying trees in foreground and middle-ground areas. However, estimating the time needed for full recovery to the *Forest Plan* VQO goals under any alternative would require a level of research beyond the scope of this analysis.

Irreversible/Irretrievable Commitments of Alternative 4

The length of time needed to restore or replace topsoil, especially topsoil recently scorched by a wildfire, removed for logging construction activities is very difficult to predict. One recent court case on this subject argues that logging related activities can create an irreversible/irretrievable commitment of aesthetic resources (*CW v. SJNF* 2003).

In addition, some experts believe that when weed/alien plant invasions are “already well established there must be some acceptance that biological invasions are often irreversible” (Wooten and Morrison 1995). Any activities that propagate alien plant growth in a natural forest landscape ultimately affect the quality of recreation/forest aesthetics (USDI 2004).

Unavoidable Adverse Effects of Alternative 4

Alternative 4 proposes about 1,250 more acres of logging activity that Alternative 2, the preferred alternative. In the short term, soil disturbances resulting from the harvesting/removal of dead trees in the foreground and near middle-ground view areas of high-sensitivity roads and high-use recreation sites may be very noticeable. In the long term, these scarred and exposed soils would normally heal if not disturbed by other soil disturbing activities.

Weed invasions will likely occur in response to fire salvage activities. In addition, if grazing activities begin before indigenous plants become well established (Beschta 2002), weed infestations are likely to be compounded. Weeds are easily spread

by vehicles, heavy equipment like bulldozers, and graders. In addition they are carried and spread by hikers, bicyclists, ATV users, pack and saddle stock, livestock, and pets (CDFA 2003).

Forest Plan Consistency of Alternative 4

The *Forest Plan* requires the application of the FS VMS and the updated SMS. Alternative 4 is not as responsive the *Forest Plan* direction because of the exposure of considerably more, about 1,250 acres more, light-colored soil in an area already exposed by a massive removal of all vegetation.

Conclusions

Alternative 4 proposes to remove dead and dying trees from about 3,718 acres within the 37,000-acre burned area. Logging systems include the use of helicopters, skyline, and tractors. Alternative 4 proposes about 1,250 more acres of logging activity that Alternative 2.

Logging-related construction activities would expose some light-colored soils, which would be visible from sensitive roads, trails, and recreation use areas (Figure 18). In addition, exposed soils would also be fertile ground for noxious weeds that negatively affect aesthetic resources (Wooten and Morrison 1995).

CHAPTER 4. CONSULTATION AND COORDINATION

Preparers and Contributors

The FS consulted the following individuals, federal, state, and local agencies, tribes and non-FS persons during the development of this environmental impact statement:

IDT Members

AmberDawn Kamps	Lincoln District Ranger	USDA-FS, Helena NF, Lincoln RD
Dan Seifert	Team Leader, NEPA Coordinator	USDA-FS, Helena NF, Lincoln RD
Sharon Scott	Team Leader, Logging Systems, Economics	USDA-FS, Helena NF, Lincoln RD
Martie Schramm	Resource Specialist	USDA-FS, Helena NF, Lincoln RD
Laura Burns	Fisheries Biologist	USDA-FS, Helena NF, Lincoln RD
Scott Schrenk	Wildlife Biologist	USDA-FS, Helena NF, Lincoln RD
Jay Lindgren	Assist. Fire Management Officer, Fuels	USDA-FS, Helena NF, Lincoln RD
Debbie Cuyle	Recorder/Database Manager	USDA-FS, Helena NF, Lincoln RD
Jack Kendley	Silviculturist	USDA-FS, Helena NF, Lincoln RD
Lois Olsen	Ecologist	USDA FS, Helena NF
Sue Farley	Soil Scientist	USDA FS, Helena NF
Chip Fisher	GIS Specialist	USDA FS, Helena NF
Dennis Heffner	Planning Forester, GIS	USDA FS, Helena NF
Jan FauntleRoy	NEPA Coordinator	USDA FS, Helena NF

Bo Stuart	Hydrologist	USDA FS, Helena NF
Rudy Tantare	Contracting Officer's Representative	USDA FS, Helena NF
Mike Blinn	Contracting Officer	USDA FS, B.D. NF
Jeanne Plummer	Contracting Officer	USDA FS, B.D. NF
Michael J. Spry	President/Project Manager	Portage Environmental
John Beller	Project Manager	Portage Environmental
Margo Lynn Lasky	Public Scoping Analysis	Portage Environmental
Diane Wheeler	GIS Specialist	Portage Environmental
Ginger Gillin	Fisheries Biologist	Portage Environmental
Eric Tomasik	Wildlife/Fisheries Biologist	Portage Environmental
Pat Shanley	Wildlife Biologist	USDA FS, Helena NF, Lincoln RD
Ann Sullivan	GIS Specialist	USDA FS, Helena NF
Gary Hathaway	Landscape Architect	Portage Environmental
Carl Davis	Heritage, Wilderness Program	USDA FS, Helena NF
Paul Callahan	Hydrologist	Portage Environmental
Paul Beckley, Ph.D.	Economist	Region 1 FS, Regional Office Missoula
Lisa Aldrich	Document Production	Portage Environmental
Jennifer Hancock	Document Production	Portage Environmental

Federal, State, and Local Agencies

Mark Baumler, Ph.D.	Montana State Historic Preservation Officer	Montana Historical Society, Helena, MT
Ron Pierce	Fisheries Biologist	Montana Department of Fish, Wildlife and Parks, Missoula, MT

Beth Dickerson	Fish and Wildlife Biologist	US Fish and Wildlife Service Helena, MT
Jay Frederick	Fish and Wildlife Biologist	US Fish and Wildlife Service Helena, MT
Pat Thomas	Landscape Architect	USDA FS, Flathead and Kootenai NFs, Kalispell, MT

Tribes

Fred Matt	Tribal Chairman	Confederated Salish and Kootenai Tribes Pablo, MT
Marlene Bear Walter	Blackfoot Tribal Council	Browning, MT

Distribution of the Environmental Impact Statement

This EIS has been distributed to individuals who specifically requested a copy of the document ([for final environmental impact statements only] and those who submitted substantive comments on the draft EIS).

Bonnie Miller	Joe Marino	Gary Duffey
Sierra Club, Missoula, MT	Mona Ehnes, GFTBRA	Jim Freeman, Cascade County
Ted & Elizabeth Snow	Ronald Zarr	Max Barker, JJJ Wilderness Ranch
James Hannah	Jerry Mauer	Lincoln Unit, Montana Department of Natural Resources and Conservation
Ronald & Douglas Johnson	Cedron Jones	Jim McGrane
Paul Spengler, Tri County Fire Working Group	Jack & Vicki Thomas	Contrad Burns, U.S. Senator
J. Clark Pinkerton II	Donald Kern	Tim Speyer
R.J. Berger	Aaron Shewman	Jim Vonada
James Nettleton	Ralph Visconti	Ellen Engstedt, Montana Wood Products Assoc.

David Russoff	John Wardell, Montana Office Director US EPA	Patricia Shaw
Bill Hammer	Randall & Sherry Reynolds, FAA	Charles & Maureen Redfield
Garett Bacon, Prickly Pear Sportman's Assoc.	Jim Haslip	Dale & Martha Baker
Jerry Burns	Tom Wolf, Continental Divide Trail Society	Mike Hoffman, Lincoln Trail Riders
Steve Horner, Blackfoot Logging	Wendell Weaver	Jim & Maida Paris
Adrian Reichenburg	Jim Suek	Bob Bushnell, Montana Snowmobile Assoc.
Marvin Love	Jack Mahon	Ed Regan, RY Timber, Inc.
Jerry & Ruth Massee	Ruth Miller	Marty & Kris Peters
Gloria B. Stiner	Deborah Kmon Davidson, American Wildlands	Dave White, Natural Resource Conservation Svc.
Steve Flynn, Louisiana Pacific Corp	Guy & Mary Jo. Stoner	Sara Johnson, Native Ecosystems Council
Shawn Regnerus, American Wildlands	Carolyn Laws	John Gilliam
Larry Anderson, U.S. Senator Conrad Burns	Bruce Farling, Trout Unlimited	Land Tawney, Theodore Roosevelt Conservation Alliance
Jim French	Dick Mackey	Paul Roos
Ben Thompson		

In addition, copies have been sent to the following Federal agencies, federally recognized tribes, State and local governments, and organizations representing a wide range of views regarding the Snow Talon fire salvage project.

US Environmental Protection Agency, Washington, DC	Helena Office EPA Steve Potts Helena, MT	Ecosystem Management Coordinator USDA–FS Washington, DC
Gail Kimball Region 1 Regional Forester Missoula, MT	Office of Environmental Affairs, Department of the Interior Washington, D.C.	Manager, Intergovernmental Review State Clearinghouse Helena, MT
Jim Bauermeister, Montana Dept. of Environmental Quality Helena, MT	Honorable Dennis Rehberg Helena, MT 59601	Honorable Max Baucus US Senate Helena, MT 59601
Honorable Conrad Burns U.S. Senate Helena, MT	Jeff Hagener, Director Montana Dept. of Fish, Wildlife & Parks Helena, MT	Montana Dept. of Fish, Wildlife and Parks Bozeman, MT
Lewis and Clark County Library Helena, MT	Lincoln Community Library Lincoln, MT	Broadwater Community Library Townsend, MT
Boulder Community Library Boulder, MT	Policy & Planning Division Office of Civil Rights USDA FS Washington, D.C.	Helena Office, EPA Attn: John Wardell Helena, MT
USDA—National Agricultural Library Beltsville, MD	Montana Dept of Fish, Wildlife & Parks Great Falls, MT	Montana Dept. of Fish, Wildlife & Parks Region 2 Missoula, MT

CHAPTER 5. LITERATURE CITED

40 CFR 28 §§ 1500 et seq. 2002. "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act." Council on Environmental Quality, Executive Office of the President. Code of Federal Regulations. Office of the Federal Register. National Archives and Records Administration. July 1. Online via http://www.gpoaccess.gov/cfr/retrieve.html.

40 CFR 29 § 1503.3. 2002. "Specificity of Comments." Council on Environmental Quality. *Code of Federal Regulations.* Office of the Federal Register. National Archives and Records Administration. July 1. Online via http://www.gpoaccess.gov/cfr/retrieve.html.

68 FR 231. 2003. "Helena National Forest, Montana, Snow Talon Fire Salvage." *Federal Register.* Office of the Federal Register. National Archives and Records Administration. Notice of Intent to Prepare Environmental Impact Statement. December 2. pp. 67397-67399. Online via http://frwebgate2.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=849602117701+0+2+0&WAISaction=retrieve.

69 FR 50. 2004. "Notice of Cancellation for the Copper Creek Road Improvement Project." *Federal Register.* Office of the Federal Register. National Archives and Records Administration. March 15. p. 12115.

7 Montana Code Annotated 22 §§ 2101 et seq. 2003. "County Weed Control." *Montana Code Annotated 2001*. Montana Legislative Council. Montana State Legislature. Helena, Montana. Online via http://data.opi.state.mt.us/bills/mca_toc/7_22_21.htm.

7 U.S.C. 61 §§ 2801 to 2813, 1990, "Federal Noxious Weed Act of 1974," as amended by Sec. 2814, "Management of Undesirable Plants on Federal Lands," *United States Code*, Legal Information Institute, Cornell Law School, online via: http://www4.law.cornell.edu/U.S.C.ode/7/2814.html, November 28.

16 U.S.C. 1A §§ 470 et seq. 2003. "National Historic Preservation Act," as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/16/470.html

16 U.S.C. 23 §§ 1131 et seq. 1964. "Wilderness Act of 1964," as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/16/1131.html.

16 U.S.C. 35 §§ 1531 et seq. 1988. "Endangered Species Act of 1973," as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/16/1531.html.

16 U.S.C. 36 §§ 1600 et seq. 1988. "National Forest Management Act of 1976," as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/16/1600.html.

31 U.S.C. 69 §§ 6901–6907. 1976. "Payment for Entitlement Land." *United States Code*. Legal Information Institute, Cornell Law School. Online via: http://www4.law.cornell.edu/uscode/31/6901.notes.html.

33 U.S.C. 26 §§ 1251 et seq. 2000. "Federal Water Pollution Control Act," commonly referred to as the Clean Water Act, as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/33/1251.html.

42 U.S.C. 55 §§ 4321 et seq. 1990. "National Environmental Policy Act of 1969," as amended. *United States Code*. Legal Information Institute, Cornell Law School. Online via http://www4.law.cornell.edu/uscode/42/4321.html.

Administrative Rules of Montana 17.30.623, 2002. "Water-Use Classifications—Clark Fork Columbia River Drainage Except the Flathead and Kootenai River Drainages." Montana Department of Environmental Quality. March 31. Online via http://www.deq.state.mt.us/dir/legal/Chapters/CH30-06.pdf.

Agee, J. K. 1993. *Fire Ecology of PNW Forests*. Washington D.C.: Island Press, pp. 33–52.

Alexander, E. B. 1988. Strategies for determining soil-loss tolerance. In: *Environmental Management* 12:6:791–796.

American Chamber of Commerce. 2003. ACCRA cost of living index. American Chamber of Commerce Research Association. Louisville, Kentucky. Available from Montana Dept. of Commerce, Census and Economic Information Center, Helena, Montana.

Arno, S. F., and J. K. Brown. 1991. Overcoming the Paradox in Managing Wildland Fire. Western Wildlands. Spring 1991.

Arno, S. F., D. J. Parsons, and R. E. Keane. 1999. Mixed-severity fire regimes in the Northern Rocky Mountains: Consequences of fire exclusion and options for the Ayres, Survey of 1889.

Aune, K and W. Kasworm. 1989. Final Report: East Front Grizzly Studies. MDFWP. pp. 73–80.

Beeson, P. C., S. N. Martens, and D. D. Breshears. 2001. Simulating overland flow following wildfire: mapping vulnerability to landscape disturbance. *Hydrol. Process* 15:2917–2930.

Belt, G. H., J. O. Laughlin, and T. Merrill. 1992. Design of forest riparian buffer strips for the protection of water quality: analysis of scientific literature. Idaho Forest, Wildlife, and Range Policy Group. Report No. 8 University of Idaho, Moscow.

Benavides-Solorio, J., and L. H. MacDonald. 2001. Post-fire runoff and erosion from simulated rainfall on small plots, Colorado Front Range. *Hydrol. Process* 15:2931–2952.

Benda, L., D. Miller, J. Sias, D. Martin, R. Bilby, C. Veldhuisen, and T. Dunne. 2003. Wood recruitment processes and wood budgeting. S. V. Gregory, K.L. Boyer, and A.M. Gurnell, editors. The Ecology and Management of Wood in World Rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland. pp. 49-75.

Beschta, R. L., C. A. Frissell, R. Gresswell, R. Hauer, J. R. Karr, G. W. Minshall, D. A. Perry, and J. J. Rhodes, 1995. Wildfire and salvage logging: recommendations for ecologically-sound post-fire salvage management and other post-fire treatments on federal lands in the west. Oregon State University. Corvallis, Oregon.

Beschta, R. L. and B. Kauffman. 2002. "Expect fire of words once flames die down." Web Site: Save America's Forests. Posted/Updated: 08/15/02. Save America's Forest/The Oregonian, Portland, OR. Retrieved 02/20/04 from: http://www.saveamericasforests.org/congress/Fire/Oregonian-beschtaoped.htm.

Blanchard and Knight, 1993. Effects of Wildfire on Grizzly Bear Movements and Foraging Strategies. In- Proceedings of the Second Bienneal Scientific Conference on the Greater Yellowstone Ecosystem. International Association of Wildland Fire. Fairfiel, WA. J.M. Greenlee, editor. pp. 117-122.

Bosch, J. M., and J. D. Hewlett. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. *J. Hydrol.* 55:3–23.

Brown, J. K. 1975. Fire cycles and dynamics in lodgepole pine forests. Edited by D. M. Baumgartner. *Management of Lodgepole Pine Ecosystems Symposium Proceedings*. Pullman, Washington: Washington State University Cooperative Extension Service. p. 443.

Brown, J. K., E. D. Reinhart, and K. A. Kramer. 2003. Coarse woody debris: managing benefits and fire hazard in the recovering forest. General Technical Report RMRS-GTR-105. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Ogden, Utah.

Brown, J. K, E. D. Reinhardt, and K. Kramer. 2001. Coarse woody debris and succession in the recovering forest. Unpublished Report. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Missoula, Montana.

Brumley, J. H., C. Nemeth, A. Weiser, and S. Jung, 1998. *Synopsis of Cultural Resource Studies Conducted to Date in Response to the Proposed McDonald Mine, Lewis and Clark Co., MT*. Report submitted to Seven-Up Pete Joint Venture. Ethos Consultants. Havre, Montana. CRABS # LC-6-20294. T14N R8W Sections 1, 12; T15N R8W Sections 25, 36.

Bull, E. L.; C. G. Parks; and T. R. Torgersen. 1997. Trees and Logs Important to Wildlife in the Interior Columbia River Basin. Gen. Tech. Rep. PNW-GTR-391. USFS, Pacific Northwest Research Station. Pages 21-39.

Bull, E. L.; R. S. Holthausen and M.G. Henjum. 1990. Techniques for Monitoring Pileated Woodpeckers. Gen. Tech. Rep. PNW-GTR-269. Portland, Or: USDA, Forest Service, Pacific Northwest Research Station. 13pp.

Burns, L. 2003. Personal communications from 1999 to 2003 with L. Burns, fisheries biologist, Helena National Forest, and G. Gillin, aquatic resources consultant, GEI Consultants, Inc.

Burton, T. A. 1997. Effects of basin-scale timber harvest on water yield and peak streamflow. *J. Am. Wat. Res. Assoc.* 33(6):1187–1196.

Bryon, E., 2004. "System faulted for letting fires get out control." Web site: Lee Enterprises. Posted: 01/22/04. Helena Independent Record/Lee Enterprises - Editorial Matters. Retrieved 02/19/04 from http://editorialmatters.lee.net/articles/2004/01/22/stories/top_stories/9znews070.txt

Bryon, E., 2003. "Forest Service proposes aerial spraying for weeds." Web site: Montana Forum. Posted: 10/30/03. Helenair.com/Independent Record. Retrieved 02/24/04 from: http://www.montanaforum.com/rednews/2003/10/30/build/forests/aerialspray.php?nnn=3.

Bushey, C. L., 1995. "Fire Effect on Noxious Weeds Within the Columbia River Basin." Web site: Interior Columbia Basin Ecosystem Management Project. Posted: 03/10/95. Montana Prescribed Fire Services, Inc. Retrieved 02/24/04 from: http://www.icbemp.gov/science/bushey.pdf

California Department of Food and Agriculture. 2003. "How do weeds spread?" Web site: California Department of Food and Agriculture. Posted: 12/13/03. Retrieved 02/24/04 from: http://www.cdfa.ca.gov/phpps/ipc/weedmgtareas/MariposaMF/howdoweedspread.htm

Callahan, C. P., D. F. Potts, and R. Pfister. In press (2003). Hydrologic recovery in the northern Rockies. *Environmental Management*. December.

Cannon, S. H., R. M. Kirkham, and M. Parise. 2001. Wildfire-related debris flow initiation processes, Storm King Mountain, Colorado. *Geomorphology* 39:171–188.

Central Park Conservancy. 2004. "Central Park Then & Now 1878-1960." Web site: Central Park Conservancy. Posted/Updated: Unkown. Central Park Conservancy. New York, NY. Retrieved 02/22/04 from http://www.centralparknyc.org/thenandnow/cp-history/cphistory1878-1960/

Chamberlin, T. W., R. D. Harr, and F. H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. American Fisheries Society Special Publication 6:181–205.

Cherry, M.B. 1997. The Black-backed and Three-toed Woodpeckers: Life History, Habitat Use, and Monitoring Plan. U.S. Department of Agriculture, Forest Service, Gallatin NF.

Clayton, J. L., and W. F. Megahan. 1997. Natural erosion rates and their predition in the Idaho batholith. *J. Am. Water Resour. Assoc*. 33:689–703.

Cline, R., G. Cole, W. Megahan, R. Patten, and J. Potyondy. 1981. Guide for predicting sediment yields from forested watersheds. U.S. Department of Agriculture. Forest Service. Northern and Intermountain Regions.

Copeland, J. P. 1996. Biology of the Wolverine in Central Idaho. M.S. Thesis. The University of Idaho. Pages 92–100 and 128–130.

Coxson, D. S., and J. Marsh. 2001. Lichen chronosequences (postfire and postharvest) in lodgepole pine (*Pinus contorta*) forests of northern interior British Columbia. *Can. J. Bot.* 79:1449–1464.

DeBano, L. F. 1991. The effect of fire on soil properties. *Proceedings, Symposium on management and productivity of western-montane forest soils*. April 10–12, 1990. Boise, Idaho [Gen. Tech. Rep, INT-280]. Ogden, Utah. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. pp. 151–156.

DeBano, L. F., D. G. Neary, and P. F. Ffolliott. 1998. *Fire's effects on ecosystems*. New York: John Wiley & Sons, Inc. pp. 55–63, 80, 88, 97, 103–114, 131, 133, 136–137, 148–158, 167, 172, 180, and 182–183.

Debyle, N. V., and R. P. Winokur. 1985. Aspen: Ecology and Management in the Western United States. GTR RM-119. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

DellaSala, D. A., A. Martin, R. Spivak, T. Schulke, B. Bird, M. Criley, C. van Daalen, J. Kreilick, R. Brown, and G. Aplet. 2003. A citizens' call for ecological restoration: forest restoration principles and criteria. *Ecological Restoration* 21(1):14–23.

Ditsch, D. C., and M. Collins, 2000. "Reclamation considerations for pasture and hay lands receiving sity-six centimeters or more precipitation annually." In: Reclamation of drastically disturbed lands. R. L. Barnhisel, R. G. Darmody and W. L. Daniels (Eds.), ASA, CSSA, SSSA. *Agronomy* No. 41. Madison, Wisconsin. pp. 241–322.

Dixon, R. D., and V. A. Saab. 2000. Black-backed Woodpecker (*Picoides arcticus*). As cited in The Birds of North America, No 509. Philadelphia, PA.

Dollof, C. A. 1994. Large woody debris—the common denominator for integrated environmental management of forest streams. In: Cairns, J. Jr., T. V. Crawford, H. Salwasser. Eds. Implementing integrated Environmental Management. Blacksburg,

VA: Center for Environmental and Hazardous Materials Studies, Virginia Polytechnic Institute and State University. pp. 93–108.

Dolloff, C. A. and M. L. Warren Jr. 2003. Fish relationships with large wood in small streams. Pages179-193 in S. V. Gregory, K. L. Boyer, and A. M. Gurnell, editors. The ecology and management of wood in world rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland.

Dwire K. A., and J. B. Kaufmann. 2003. Fire and riparian ecosystems in landscapes of the western USA. *Forest and Ecology Management* 178:61–74.

Eaglin, G. S., and W. A. Hubert. 1993. Effects of logging and roads on substrate and trout in streams of the Medicine Bow National Forest, Wyoming. *North American Journal of Fisheries Management*. 13:844-846.

Elliot, W. J., D. E. Hall, and D. L. Scheele. 2000. WEPP interface for disturbed forest and range runoff, erosion and sediment delivery model—Technical documentation. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station and San Dimas Technology and Development Center. pp. 2, 10, and 14.

Environmental Protection Agency. 1980. "An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources (A Procedural Handbook)." EPA-600/8-80-012. Environmental Research Laboratory, Athens, Georgia, 30605. pp. V.26–V.29.

Everett, R. 1995. Letter dated August 16 to J. Lowe. Review of Beschta document. On file with: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1133 N. Western Ave., Wenatchee, Washington, 98801.

Ferguson, D. 2002. *Archaeological Testing and Evaluation of Alice Creek Site, 24LC1015, and Willow Creek Site, 24LC1023, in Lewis and Clark County, Montana*. Report submitted to the Helena National Forest. GCM Services, Inc. Butte, Montana.

Fischer, W. C. 1981. Photo guide for appraising downed woody fuels in Montana Forests. GTR-INT-223. U.S. Department of Agriculture, Forest Service. Ogden, Utah. p. 141.

Fischer, W. C., and B. D. Clayton. 1983. *Fire Ecology of Montana Forest Habitat Types East of the Continental Divide*. GTR- INT-151. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Research Station, Ogden, Utah. pp. 83.

Forest Ecosystem Management Assessment Team. 1993. Forest Ecosystem Management: an Ecological, Economic, and Social Assessment. Washington, D.C. U.S. Forest Service and Collaborating Agencies.

Galbraith, A. F. 1975. Method for predicting increases in water yield related to timber harvesting and site conditions. *Proceedings: Watershed Management Symposium*.

Irrigation and Drainage Division. American Society of Civil Engineers. Logan, Utah.

Graham, R. T., A. E. Harvey, M. F. Jurgensen, T. B. Jain, J. R. Tonn and D. S. Page-Dumroese. 1994. *Managing coarse woody debris in forests of the Rocky Mountains*. Research Paper INT-RP-477. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah.

Green, P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Nauman. 1992. *Old-growth forest types of the Northern Region*. Unpublished report, U.S. Department of Agriculture, Forest Service, Northern Region. Missoula, Montana.

Gresswell, R. E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society. 129(2) 193-221.

Grubb, R. T., R. L. Sheley, and J. Stivers. 2003. Understanding Montana's Noxious Weed Laws. Montana State University Extension Service, Report No. MT199605AG, revised 6/03. 4 pp.

Hansen, P. L., R. D. Pfister, K. Boggs, B. J. Cook, J. Joy, and D. K. Hinckley. 1995. Classification and Management of Montana's Riparian and Wetland Sites. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana. Misc Pub. No. 54.

Hatler, D.F. 1989. A Wolverine Management Strategy for British Columbia. Wildlife Bulletin No. B-60. Victoria B.C, Ministry of Environment.

Haynes, R. W. 1999. Developing measures of socioeconomic resiliency in the Interior Columbia Basin. General Technical Report PNW-GTR-453. USDA Forest Service, Pacific Northwest Research Station. Seattle, Washington.

Hayward, G.D. 1983. Goshawk Nest Habitat Selection in Region 1. Unpublished Report. USDA Forest Service Northern Region, Missoula, Montana. 21pp.

Heede, B. H., M. D. Harvey, and J. R. Laird. 1988. Sediment Delivery Linkages in a Chaparral Watershed Following a Wildfire. *Environmental Management* 12:349–358.

Heinemeyer, K. S.; B.C. Aber and D. F. Doak. 2001. Aerial Surveys for Wolverine Presence and Potential Winter Recreation Impacts to Predicted Wolverine Denning Habitats in the Southwestern Yellowstone Ecosystem. Unpubl. Report. University of California, Santa Cruz Department of Environmental Studies.

Helvey. J. D. 1980. "Effects of a north central Washington wildfire on runoff and sediment production. *Water Resources Bulletin* 16(4):627–634.

Hillis, J. M.; M. J. Thompson; J. E. Canfield; L. J. Lyon; C. L. Marcum; P. M. Dolan and D. W. McCleerey. 1991. Defining Elk Security: The Hillis Paradigm. Elk Vulnerability Symposium, Bozeman, Montana.

Hillman, T. W., and D. W. Chapman. 1996. *Assessment of Fish Populations in the Upper Blackfoot River Basin*. A report to the Seven-Up Pete Joint Venture. BioAnalysts, Inc. Boise, Idaho. November.

Hutto, R. L. 1995. The Composition of Bird Communities Following Stand-replacement Fires in Northern Rocky Mountain (U.S.A.) conifer forests. Conservation Biology 9:1041-1058.

Independent Record. 2003. "Silver King Lookout: Gone but not forgotten." Kidston, Martin J. 2003. Web site: Independent Record. Posted: 11/09/03. Independent Record. Helena, Montana. Retrieved 02/23/04 from: www.helenair.com/ articles/2003/11/09/top/a01110903_01.txt

Interagency Grizzly Bear Committee. 1987. *Grizzly Bear Compendium*. Interagency Grizzly Bear Committee. U.S. Fish and Wildlife Service. Missoula, Montana.

Johansen, M. P., T. E. Hakonson, and D. D. Breshears. 2001. Post-fire runoff and erosion from rainfall simulation: contrasting forest with shrublands and grasslands. *Hydrol. Process* 15:2953–2965.

Johansen, M. P., T. E. Hadonson, F. W. Whicker, J. R. Simanton, and J. J. Stone. 2001. Hydrologic response and radionuclide transport following fire at semiarid sites. *J. Environ. Qual.* 30:2010–2017.

Jones, A. 2003. There's Value In Burned Trees." Web site: Saskatchewan Environment – Environment Newsline. Posted: 09/11/03. Retrieved 02/23/04 from: http://www.se.gov.sk.ca/media/Saskatchewan%20Environmentnewsline/Burned_Trees_Value.htm.

Keegan, C. E., III, T. A. Morgan, S. R. Shook, F. G. Wagner, and K. A. Blatner. 2004. Montana's forest products industry-current conditions and forecast, 2004. The University of Montana, Bureau of Business and Economic Research. Missoula, Montana.

Keller, E. A., A. MacDonald, T. Tally, and N. J. Merrit. 1985. Effects of large organic debris on channel morphology and sediment storage in selected tributaries of Redwood Creek northwestern California. In: Geomorphic Processes and Aquatic Habitat in the Redwood Creek Basin, Northewestern California. Nolan, K. M., H. M. Kelsey, and D. C. Maron. Eds. Vicksburg, MS, U.S. Geological Survey.

Kendley, J. 2001. Personal observations by J. Kendley, Silviculturist, U.S. Department of Agriculture, Forest Service, Helena National Forest.

Kershaw, G. P. 2001. Snowpack characteristics following wildfire on a simulated transport corridor and adjacent subarctic forest, Tulita, N.W.T. Canada. *Actic, Antarctic, and Alpine Res.* 33(2):131–139.

Kershner, J. L., L. MacDonald, L. M. Decker, D. Winters, and Z. Libohova. 2003. Fire-induced changes in aquatic ecosystems. Hayman Fire Case Study. USDA Forest Service Technical Report RMRS-GTR-114. Russel T. Graham Technical Editor.

Knight, G. C. 1989. *Overview: Ecological and Cultural Prehistory of the Helena and Deerlodge National Forests, Montana*. U.S. Department of Agriculture, Helena and Deerlodge National Forests. Helena, Montana.

Kohm, K. A. and J. F. Franklin, eds. 1997. *Creating a forestry for the 21st century, the science of ecosystem management*. Washington D.C.: Island Press. pp. 3, 112, and 118–119.

Laflen, J. M. W. J. Elliot, D. C. Flanagan, C. R. Meyer, and M.A. Nearing. 1997. WEPP: predicting water erosion using a process-based model. *Journal of Soil and Water Conservation*, March–April 1997, pp. 96–102.

Lemke, P.L. 1994. Northern Goshawk (Accipiter gentillis) Habitat Study. Beaverhead NF, Wisdom and Wise River RDs. Unpublished Report.

Leopold, L. B., M. G. Wolman, and J. P. Miller. 1992. *Fluvial processes in geomorphology*. New York: Dover Publications, Inc. pp. 337–344.

Lotspeich, F. B., and F. H. Everest. 1981. *A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel*. U.S. Forest Service Research Note PNW-369. U.S. Department of Agriculture, Forest Service. Pacific Northwest Forest and Range Experiment Station. Portland, Oregon. January.

Lynx Biology Team. 1999. Ecology of Canada Lynx in Southern Boreal Forests. Chapter 13, Page 20. U.S. Department of Agriculture, Forest Service. Gen Tech. Rep. RMRS-GTR-30.

Mace, R. D. and J. S. Waller. 1997. Final Report: Grizzly Bear Ecology in the Swan Mountains. MDFWP. Helena, Montana. pp. 36–41 and 64–73.

Mack, R. N., D. Simberloff, W. M. Lonsdale, H. Evans, M. Clout, and F.A. Bazzazz. 2000. Biotic invasions causes, epidemiology, global consequences, and control. *Ecological Application* 10:689–710.

Maloney, P C., J. L. Thorton and E. Lesch. 1995. Implementation and effectiveness monitoring of best management practices and soil and water conservation measures within the foothills fire salvage logging area 1992–1995. On file with: Boise National Forest, Supervisor's Office, Boise, Idaho.

Marcos, E., R. Tarrega, and E. Luis-Calabuig. 2000. Comparative analysis of runoff and sediment yield with a rainfall simulator after experimental fire. *Arid Soil Research and Rehabilitation* 14:293–307.

McAllister, K. A. 2003. Official USFS Memorandum. File Code: 2670. Subject: Lynx Linkage Areas. To: Marc Bosch, Forest Supervisors (1, 2, 4, 6, 9), BLM State

Offices and Districts (CO, ID, MT, UT, WA, WY), USFWS (Regions 1, 3, 5, 6), Directors of Fish and Wildlife Agencies: MT, ID, WY, UT, OR, WA, CO, MN, MI, WI, NH and VE.

McIver, J. D. and L. Starr, technical eds., 2000. Environmental effects of postfire logging: literature review and annotated bibliography. General Technical Report PNW-GTR- 486. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, Oregon.

Meehan, W. R. 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19: 1-15.

Mendenhall, K., 2004. "Valley's economy grew at 4 percent." Web site: Bozeman Daily Chronicle. Posted: 02/05/04. Bozeman Daily Chronicle. Retrieved 02/18/04 from: http://dailychronicle.com/articles/2004/02/05/news/economybzbigs.txt

Meyer, G. A. and J. L. Pierce. 2003. Climatic controls on fire-induced sediment pulses in Yellowstone National Park and central Idaho: a long-term perspective. *Ecol. Manage.* 178:89–104.

Meyer, G. A., J. L. Pierce, S. H. Wood, and A. J. T. Tull. 2001. Fire, storms, and erosional events in the Idaho batholith. *Hydrol. Process.* 15:3025–3038.

Meyer, G. A., S. G. Wells, and A. J. T. Jull. 1995. Fire and alluvial chronology in Yellowstone National Park: climatic and intrinsic controls on Holocene geomorphic processes. *Gol. Soc. Am. Bull.* 107:1211–1230.

Minshall, G. W., and J. T. Brock. 1991. Observed and anticipated effects of forest fire on Yellowstone stream ecosystems. In: Kriter, B., and M. Boyce. Eds. Greater Yellowstone's Future: Man and Nature in Conflict?. Tucson, AZ. University of Arizona press.

Minshall, G. W., C. T. Robinson, and D. E. Lawrence. 1997. Postfire response of lotic ecosystems in Yellowstone National Park, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 54:2509-2525.

Montana Bull Trout Scientific Group. 1995. *Bull Trout Status in the Blackfoot River Drainage, Montana*. Prepared for the Montana Bull Trout Restoration Team. c/o Montana Fish, Wildlife and Parks. Helena, Montana.

Montana Bureau of Mines and Geology. 2003. *Ground-Water Information Center, Wells Report for T15N, R08W.* Montana Bureau of Mines and Geology, Montana Tech of the University of Montana. Butte, Montana.

Montana Department of Environmental Quality. 2003a. *Montana Source Water Protection Program Query System*. Montana Natural Resource Information System, Water Information System. Helena, Montana. Online via http://nris.state.mt.us/ wis/swap/swapquery.asp.

Montana Department of Environmental Quality. 2003b. *2002 Montana 303(d) Impaired Waters Database*. Montana Natural Resource Information System, Water Information System. Helena, Montana. Online via http://nris.state.mt.us/scripts/esrimap.dll?name=TMDL2002&Cmd=INST.

Montana Department of Environmental Quality. 2002. *Geomorphic Assessment of the Landers Fork*. Appendix 1-Upper Blackfoot TMDL, Helena, Montana.

Montana Department of Fish, Wildlife & Parks. 1992. Montana Elk Management Plan. pp. 26–32.

Montana Department of Labor and Industry. 2004. Labor force monthly information for Flathead County. Research and Analysis Bureau, Workforce Services Division. Available in Statewide Area Research and Analysis System (MtSaras). Helena, Montana.

Montana Department of Natural Resources and Conservation. 2002. *Best Management Practices (BMPs) for Forestry in Montana.* Forestry Division. Missoula, Montana. January.

Montana Department of Natural Resources and Conservation, 2000. Montana forestry best management practices monitoring, the 2000 forestry BMP audits report. Forestry Division. Missoula, Montana, 59804. pp. 1–2 and 61–68.

Montana Natural Heritage Program. 2003. *Montana Natural Heritage Database for Element Occurrences.* Montana Natural Heritage Program. Helena, Montana. Online via http://nhp.nris.state.mt.us.

Montana State University. 2001. Capstone Class Report on Wildfire effects to soil resources within the Cave Gulch burn area, Helena National Forest. Bozeman, Montana.

Moody, J. A. and D. A. Martin. 2001a. Post-fire, rainfall intensity-peak discharge relations for three mountainous watersheds in the western USA. *Hydrol. Process.* 15:2981–2993.

Moody, J. A. and D. A. Martin. 2001b. Initial hydrologic and geomophric response following a wildfire in the Colorado Front Range. *Earth Surf. Process. Landforms* 26:1049–1070.

Morales, A. H., J. Navar, and P. A. Dominguez. 2000. The effect of prescribed burning on surface runoff in a pine forest stand of Chihuahua, Mexico. *Ecol. Manage.* 137:199–207.

Mueggler, W. F., and W. L. Stewart. 1980. Grassland and shrubland habitat types of Western Montana. GTR-INT-66. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. Ogden, Utah.

Muhlfeld, C. C., S. Glutting, R. Hunt, D. Daniels, and B. Marotz. 2003, Winter diel habitat use and movement by subadult bull trout in the upper Flathead River, Montana. North American Journal of Fisheries Management. 23: 163-171.

Nakamura, F., F. J. Swanson, and S. M. Wondzell. 2000. Disturbance regimes of stream and riparian systems-a disturbance-cascade perspective. *Hydrol. Process.* 14:2849–2860.

National Wildfire Coordinating Group. 1998. Fireline Handbook, NWCG Handbook 3, PMS 410-1, NFES 0065, January.

Neary, D. G., C. C. Klopatek, L. F. DeBano, and P. F. Ffolliott. 1999. Fire effects on belowground sustainability: a review and synthesis. *Forest Ecology and Management.* 122 (1999) 51–71. Elsevier Science, B.V.

Nesser, J. 2001. Personal e-mail communication, dated July 13, 2001, to S. Farley, Helena National Forest soil scientist. On file: Helena National Forest Supervisor's Office, 2880 Skyway Drive, Helena Montana.

Newcombe, C. P., and D. D. MacDonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. *North American Journal of Fisheries Management* 11:72–82.

North Continental Divide Ecosystem. 2002. North Continental Divide Ecosystem Grizzly Bear Access Management Protocol.

Olsen, L. J. 2001a. Vegetation Monitoring Report for the Cave Gulch Fire. U.S. Department of Agriculture, Forest Service. Unpublished report available at the Helena Forest Supervisor's Office, 2880 Skyway Drive, Helena, Montana.

Olsen, L. J. 2001b. Maudlow fire vegetation monitoring report. U.S. Department of Agriculture, Forest Service. Unpublished report available at the Helena Forest Supervisor's Office, 2880 Skyway Drive, Helena, Montana.

Palta, S. 1990. Northern Goshawk Monitoring Project Report. Final Report. P.O. 43-02S2-8-1931. 53pp.

Pauchard, A., P. B. Alaback, and E. G. Edlund. 2003. Plant invasions in protected areas at multiple scales: *Linaria Vulgais* (*Scrophulariaceae*) in the West Yellowstone area. *Western North American Naturalist* 63(4), pp. 416–428.

Peters, D. J. 1990. *Inventory of Fishery Resources in the Blackfoot River and Major Tributaries*. Montana Fish, Wildlife and Parks. Missoula, Montana. August.

Pfister, R. D., B. L. Kovalchik, and S. F Arno. 1977. Forest Habitat Types of Montana. GTR-INT-34. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station.

Pierce, R. 2003. Personal communications from 1999 to 2003 with R. Pierce, fisheries biologist, Montana Fish, Wildlife and Parks, and G. Gillin, aquatic resources consultant, GEI Consultants, Inc.

Pierce, R., and C. Podner. 2000. *Blackfoot River Fisheries Inventory, Monitoring, and Restoration Report 2000*. Montana Fish, Wildlife and Parks. Missoula, Montana.

Pierce, R., C. Podner, and J. McFee. 2002. *Blackfoot River Fisheries Inventory, Restoration and Monitoring Report for 2001*. Montana Fish, Wildlife and Parks. Missoula, Montana.

Pierce, R., D. Peters, and T. Swanberg. 1997. *Blackfoot River Restoration Project Progress Report*. Montana Fish, Wildlife and Parks. Missoula, Montana. June.

Pierce, R., and D. A. Schmetterling. 1999. *Blackfoot River Restoration Project: Monitoring and Progress Report 1997–1998*. Montana Fish Wildlife and Parks, Region 2 Headquarters. Missoula, Montana. March.

Pollet, J., and P. Omi, 1999. Effect of thinning and prescribed burning on severity in ponderosa pine forests. In: *Proceedings from: The Joint Fire Science Conference and Workshop*. Boise, Idaho. University of Idaho and the International Assoc. of Wildland Fire. pp. 137–141.

Polzin, P. E. 2004. Street Smart Economics: Know When to Hold 'Em and When to Fold 'Em. Outlook 2004-29th Annual Montana Economic Outlook Seminar-Investing in Montana. The University of Montana, Bureau of Business and Economic Research. Missoula, Montana.

Powell. 2000. The Influence of Prey Density on Post-fire Habitat use of the Black-backed Woodpecker. M.S. Thesis. The University of Montana.

Reel, S., L. Schassberger, and W. Ruediger. 1989. *Caring for Our Natural Community: Region 1—Threatened, Endangered & Sensitive Species Program*. U.S. Department of Agriculture, Forest Service, Northern Region, Wildlife and Fisheries.

Reichel, J. D. 1996. Preliminary Amphibian and Reptile Survey of the Helena NF: 1995. Montana Natural Heritage Program. pp. 10 and 60–65.

Reinhart, K. G., A. R. Eschner, and G. R. Trimble, Jr. 1963. Effect on streamflow of four forest practices in the mountains of West Virginia. U.S. Department of Agriculture, Forest Service. Res. Pap. NE-1. Northeast Forest Exp. Sta., Upper Darby, Pennsylvania.

Rieman, B., D. Lee, G. Chandler, and D. Myers. 1997. Does wildfire threaten extinction for salmonids? Responses of redband trout and bull trout following recent large fires on the Boise National Forest. Proceedings – Fire Effects on Rare and Endangered Species and Habitats Conference, Nov 14- 16, 1995, Coeur d' Alene, Idaho.

Robichaud, P. R. 2000. Fire effects on infiltration rates after prescribed fire in Northern Rocky Mountain forests, USA. In: *Journal of Hydrology* 231-232 (2000) 220–229. Elsevier Science, B.V.

Rosgen, D. 1996. Applied River Morphology. *Wildland Hydrology*. Pagosa Springs, Colorado.

Rothacher, J. 1970. Increases in water yield following clear-cut logging in the Pacific Northwest. *Water Resour. Res*. 6(2):653–658.

Rothermel, R. C. 1983. How to Predict Fire Spread and Intensity of Forest and Range Fires. Gen. Tech. Rep. INT-143. U.S. Department of Agriculture, Forest Service. pp. 2–5, 9–12, 46–47.

Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williamson. 2000. *Canada Lynx Conservation Assessment and Strategy*. 2nd edition. U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Fish and Wildlife Service, U.S. Department of Interiour, Bureau of Land Management, and U.S. Department of Interior, National Park Service. Missoula, Montana. August.

Ruggerio, L., B. Keith, S. W. Bushkirk, W. Steven, L. J. Lyon, and W. J. Zielinski. 1994. *The Scientific Basis for Conserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States*. Gen. Tech. Report RM-254. U.S. Department of Agriculture, Forest Service. Rocky Mountain Forest and Range Experiment Station. Ft. Collins, Colorado. September.

Saab, V. A., and J. G. Dudley. 1998. Responses of Cavity-nesting Birds to Stand-replacement Fire and Salvage Logging in Ponderosa Pine/Douglas-fir Forests of Southwestern Idaho. Res. Pap. RMRS-RP-11. Ogden, Utah, Forest Service, Rocky Mountain Research Station.

Schramm, M. 2002. Personal communication with M. Schramm, recreations staff officer, U.S. Department of Agriculture, Forest Service. Lincoln Ranger District, Lincoln, Montana.

Schultz, S., R. Lincoln, J. Cauhorn, and C. Montagne. 1986. North Hills fire erosion may explain formation of Montana landscape. *Montana Ag Research*, Autumn 1986. pp. 9–13.

Scott, S. 2001. *Historic Preservation Plan for the Lewis and Clark Trail on the Helena National Forest*. U.S. Department of Agriculture, Forest Service. Helena National Forest. Helena, Montana. November.

Servheen, C. 1981. Grizzly Bear Ecology and Management in the Mission Mountains, Montana. University of Montana. pp. 5–24.

Servheen, C., J. S. Waller, and P. Sandstrom. 2001. Identification and Management of Linkage Zones for Grizzly Bears Between the Large Block of Public Land in the Northern Rocky Mountains. USFWS. P. 9–30 and 74–82.

Shepard. P., and D. Foreman. 1972. Man in the Landscape—A Historic View of the Esthetics of Nature. Ballantine Books, Inc. New York, New York. 296 p.

Spencer, C. N., and F. R. Hauer. 1991. Phosphorus and nitrogen dynamics in streams during a wildfire" *J. N. Amer. Benthol. Soc.* 10(1):24–30.

Spina, A. P., and D. R. Tormey. 2000. Postfire sediment deposition in geographically restricted steelhead habitat. *N. Am. J. Fisheries Manage*. 20:562–569.

Sturdevant, N. K. 2003. Personal communication, J. Kendley , Silviculturist, and N. K. Sturdevant, Regional Entomologist. U.S. Department of Agriculture, Forest Service, Helena National Forest.

Swanberg, T., and L. Burns. 1997. *Movement and Habitat Use of Radio-tagged Bull Trout in the Upper Blackfoot River Drainage*. Montana Fish, Wildlife and Parks, Missoula, Montana, and Helena National Forest, Helena, Montana. February.

Swanston, D. N. 1991. "Natural processes." In: Meehan, W. R. (Ed.), Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. *Am. Fish. Soc. Special Pub*. 19, Bethesda, Maryland.

The Wildlife Society. 1996. Northern Goshawk and Forest Management in the Southwestern United States. Technical Review.

Thomas, J. W., ed. 1979. Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington. USDA Forest Service Handbook No. 553. Chapter 5, pp. 60–77.

Thomas, P., 2002. "Moose Final Environmental Impact Statement (FEIS)." Web site: USDA, Forest Service, Flathead National Forest. Posted: 11/27/02. USDA, Forest Service, Flathead National Forest. Retrieved 02/23/04 from: http://www.fs.fed.us/r1/flathead/nepa/moose/ch3/visual.pdf.

Trimble, S. W., and P. Crosson. 2000. U.S. soil erosion rates-myths and reality. *Science* 289:248–250.

Upper Blackfoot Historical Society, 1994. Gold Pans and Singletrees. Anderson Publications. Fairfield, MT.

USDA. 2004. Fire Effects Information System, Plants Database. Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available via. http://www.fs.fed.us/database/feis.

———. 2003a. Snow-Talon Fire Burned Area Emergency Response Report. U.S. Department of Agriculture, Forest Service, Helena National Forest, Lincoln Ranger District, Lincoln Montana. 65 pp. August 12.

———. 2003b. *Draft Environmental Impact Statement, Helena National Forest Weed Treatment*. U.S. Department of Agriculture, Forest Service, Helena National Forest, Lewis and Clark, Powell, Jefferson, Broadwater, and Meagher Counties. September.

———. 2003c. Maudlow Toston Salvage Sale Unit Log documenting a Jan. 8, 2003, field review of BMP and mitigation implementation and effectiveness in helicopter units and sale area haul roads, completed by S. Farley and V. Archer, soil scientists, with R. Fiegley and A. Kitto, biologists. U.S. Department of Agriculture, Forest Service. On file at Helena National Forest, Supervisor's Office, 2880 Skyway Drive, Helena, Montana. 2 pp.

———. 2003d. Maudlow Toston Salvage Sale, Photos from BMP Effectiveness Monitoring documenting an Oct. 16, 2003, field review of BMP and mitigation implementation and effectiveness in skyline units (both summer and winter logging) and tractor units that were winter logged, completed by S. Farley and V. Archer, soil scientists. U.S. Department of Agriculture, Forest Service. On file at Helena National Forest, Supervisor's Office, 2880 Skyway Drive, Helena, Montana. 3 pp.

———. 2003e. Maudlow Toston Salvage Sale Unit Log documenting an Oct. 16, 2003, field review of BMP and mitigation implementation and effectiveness in skyline units (both summer and winter logging) and tractor units that were winter logged, completed by S. Farley and V. Archer, soil scientists. U.S. Department of Agriculture, Forest Service. On file at Helena National Forest, Supervisor's Office, 2880 Skyway Drive, Helena, Montana. 5 pp.

———. 2003f. Maudlow Toston Salvage Sale Unit Log documenting an Oct. 29, 2003, field review of BMP and mitigation implementation and effectiveness in a winter tractor logging unit, completed by S. Farley and V. Archer, soil scientists. U.S. Department of Agriculture, Forest Service. On file at Helena National Forest, Supervisor's Office, 2880 Skyway Drive, Helena, Montana. 3 pp.

———. 2003g. 2003 Black-backed Woodpecker Surveys. Townsend Ranger District. Helena NF. Unpublished Report.

———. 2002. "Cascading Effects of Fire Exclusion in Rocky Mountain Ecosystems: A Literature Review General Technical Report, RMRS-GTR-91." Web site: USDA, Forest Service, Rocky Mountain Research Station (RMRS). Posted: May 2002. USDA, Forest Service, (RMRS). Retrieved 02/22/04 from: http://www.fs.fed.us/rm/pubs/rmrs_gtr091.pdf.

———. 2001a. *Soil Survey of Helena National Forest Area, Montana*. Soil survey of Helena National Forest Area, Montana. U.S. Department of Agriculture, Forest

Service and Natural Resources Conservation Service in cooperation with Montana Agricultural Experiment Station.

———. 2001b. *Off-Highway Vehicle Record of Decision and Plan Amendment for Montana, North Dakota, and Portions of South Dakota.* U.S. Department of Agriculture, Forest Service. Northern Region. January.

———. 2001c. "Erosion and flood event, Cave Gulch burned area, May 27, 2001." Internal report, by B. Stuart, hydrologist, and S. Farley, soil scientist. U.S. Department of Agriculture, Forest Service. On file at Helena National Forest, Supervisor's Office, 2880 Skyway Drive, Helena, Montana.

———. 2001d. Database of Economic Diversity Indices for U.S. Areas. Inventory and Monitoring Institute. Ft. Collins, Colorado. Available at www.fs.fed.us/institute/ economic_center/spaticaldata3.html.

———. 2000a. *Forest Service Roadless Area Conservation: Final Environmental Impact Statement*. Volume 1. U.S. Department of Agriculture, Forest Service. November.

———. 2000b. Northern Region Snag Management Protocol. USDA Forest Service, Northern Region. January. pp. 13-34.

———. 1999a. Forest Service Manual, FSM 2500—Watershed and air management, R-1 Supplement No. 2500-99-1. Effective November 12, 1999. Chapter 2550—Soil Management, Section 2554—Soil quality monitoring.

———. 1999b. Updated Region 1 Proposed, Threatened, Endangered and Sensitive Plant and Animal Species List. Unpublished Report.

———. 1997a. 1996 Terrestrial Protocols. U.S. Department of Agriculture, Forest Service. Northern Region. Pp. 51–57.

———. 1997b. *Establishment Record for Indian Meadows Research Natural Area within Helena National Forest Lewis and Clark County, Montana*. Unpublished report. Available at the Helena Forest Supervisor's Office, 2880 Skyway Drive, Helena Montana.

———. 1997c. *Establishment Record for Red Mountain Research Natural Area within Helena National Forest Lewis and Clark County, Montana*. Unpublished report. Available at the Helena Forest Supervisor's Office, 2880 Skyway Drive, Helena Montana.

———. 1995a. "Blackfoot Landscape Analysis." Unpublished Report. Available at the Helena National Forest Supervisor's Office.

———. 1995b. *Inland Native Fish Strategy Environmental Assessment (INFISH), Decision Notice and Finding of No Significant Impact, 1995, Intermountain, Northern, and Pacific Northwest Regions.* U.S. Department of Agriculture, Forest Service. Intermountain, Northern, and Pacific Northwest Regions. July 28.

———. 1995c. Forest Service Handbook, FSH 2509.13—Burned-area emergency rehabilitation handbook, Amendment No. 2509.13-95-7. Effective January 12. Chapter 20—Burned-area survey and emergency treatment strategy. Section 23.32a, Site indicators for fire intensity.

———. 1995d. Save our Birds-Save our Forests. U.S. Department of Agriculture, Forest Service. Forest Service. Pacific Northwest Research Station.

———. 1995e. Landscape Aesthetiscs: A Handbook for Scenery Management. Agriculture Handbook No. 701. U.S. Department of Agriculture, Forest Service. Washington D.C. 257 pp.

———. 1994. "Douglas-fir Beetle." Regional office entomology department. U.S. Department of Agriculture, Forest Service, Missoula, Montana.

———. 1988. Defining the Relevant Impact Area. (Forest Service Handbook 1909.17). Washington D.C.

———. 1987a. *Noxious weed control program; Final environmental impact statement*. U.S. Department of Agriculture, Forest Service, Helena National Forest. Helena, Montana. Report available in the Helena National Forest Supervisor's Office, 2880 Skyway Drive, Helena Montana. 165 pp.

———. 1986. *Helena National Forest Land and Resource Management Plan* (*Forest Plan*) and *Helena National Forest Land and Resource Plan Environmental Impact Statement* in appendices A, B, and C. U.S. Department of Agriculture, Forest Service. Helena National Forest. Helena, Montana. April.

———. 1980. "Land System Inventory of the Scapegoat and Danaher Portion of the Bob Marshall Wilderness." U.S. Department of Agriculture, Forest Service. On file at Helena National Forest Supervisor's Office, 2880 Skyway Drive, Helena, Montana.

———. 1964. *Keep Cool-Liverpool Sheep and Goat Allotment Management Plan.* U.S. Department of Agriculture, Forest Service. Helena National Forest. Helena, Montana.

USDA and USDI. 2001. *Biological Assessment of Road Related Actions on Western Montana's Federal Lands that are Likely to Adversely Affect Bull Trout*. U.S. Department of Agriculture, Forest Service, and U.S. Department of Interior, Bureau of Land Management. Submitted to the U.S. Fish and Wildlife Service, Montana Field Office. Helena, Montana. April 13.

USDC. 2004. Regional Economic Information System (REIS)-Regional Accounts Data. U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, Regional Economic Measurement Division. Washington D.C.

USDI. 2004. "National Invasive Weed Awareness Week February 22-27" Web site: Bureau of Land Management's Weeds Website. Posted/Updated: 2004. Bureau of

Land Management Washington, DC. Retrieved 02/21/04 from http://www.blm.gov/weeds/#What%20is%20a%20noxious%20weed

USDI. 1994. Montana Bald Eagle Recovery Plan. U.S. Department of Interior, Bureau of Reclamation. 104pp.

USDI, USDA, USDOE, USDOD, USDC, USEPA, Federal Emergency Management Agency, National Association of State Foresters, 2001, *Review and Update of the 1995 Federal Wildland Fire Management Policy*, U.S. Departments of Agriculture, Energy, Defense, Commerce; U.S. Environmental Protection Agency, USDI Bureau of Land Management Office of Fire and Aviation at the National Interagency Fire Center, Boise, Idaho, January.

USDL. 2002a. Table 1. State average annual pay for 1999 and 2000 and percent change in pay for all covered workers. U.S. Department of Labor, Bureau of Labor Statistics. Washington D.C.

———. 2002b. Table 4. State and industry average annual pay for 1999 and 2000 and percent change in pay for all covered workers. U.S. Department of Labor, Bureau of Labor Statistics, Washington D.C.

USFWS. 2002. *Bull Trout (Salvelinus confluentus) Draft Recovery Plan*. U.S. Fish and Wildlife Service. Portland, Oregon.

———. 1993. Grizzly Bear Recovery Plan. Missoula, Montana. 181pp.

———. 1987. Northern Rocky Mountain Gray Wolf Recovery Plan. Denver, CO. 119pp.

Vitt, D. H., J. E. Marsh, and R. B. Bovey. 1988. *Mosses, lichens and ferns of northwest North America*. Lone Pine Publishing, Edmonton, Alberta.

Walsh, L. 2003. Personal communications from 1999 to 2003 with L. Walsh, Fisheries Biologist, Helena National Forest, and G. Gillin, Aquatic Resources Consultant, GEI Consultants, Inc.

Warren, N. M. 1990. *Old-Growth Habitats and Associated Wildlife Species in the Northern Rocky Mountains.* U.S. Department of Agriculture, Forest Service, Northern Region. Wildlife Habitat Relationships Program.

Waters, T. F. 1995. *Sediment in Streams: Sources, Biological Effects and Control.* American Fisheries Society Monograph 7. Bethesda, Maryland.

Whitaker, J. 1996. National Audubon Society Field Guide to North American Mammals. Pages 839-842.

Wooten, G., and P. Morrison, 1995. "Biological Invasions of Alien Plants in the Interior Columbia River Basin." Web site: Sierra Biodiversity Institute. Posted: 05/19/1995. Methow Research Station, Sierra Biodiversity Institute. Retrieved 02/24/04 from: http://www.pacificbio.org/pubs/alienplants_ICRB.pdf.