United States
Department of
Agriculture

Forest
Service

January 2009

Environmental Assessment

Pinyon Osborn Vegetation Treatments

Pinedale Ranger District, Bridger-Teton National Forest
Sublette County, Wyoming

Portions of T38N, R110W; T39N, R108/109/110W; T40N, R109/110W

For Information Contact: Mark Randall, Asst. Fire Management Officer
P.O. Box 220, Pinedale, WY 82941
(307) 367-4326

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individuals income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Table of Contents

Chapter 1 Purpose and Need
Background 1-1
Purpose and Need for Action 1-1
Proposed Action 1-2
Decision Framework 1-3
Public Involvement 1-3
Issues 1-3

Chapter 2 Alternatives Considered
Alternatives, Including the Proposed Action ....……...2-1
Mitigations Common to Alternative 2……..2-3
Comparison of Alternatives……..2-4

Chapter 3 Environmental Consequences
Introduction……...……3-1
Fire and Vegetation Management and Ecosystem Sustainability…….3-3
Air Quality……...3-14
Range Resources and Rangeland and Shrubland Vegetation……..3-18
Noxious Weeds……....3-23
Soils…….…3-25
Fisheries and Watershed……..3-35
Wilderness and Inventoried Roadless Analysis……...3-42
Heritage Resources……..3-52
Wildlife……3-54

Appendices
Appendix A - List of Preparers…….....A-1
Appendix B - References……..A-2

Chapter 1 Purpose and Need

Background

Portions of this project were first identified through a proposal from Wyoming Game and Fish Department in the late 1990's. The Pinedale Ranger District completed a mid level assessment of the Upper Green River Area called the *Upper Green Landscape Assessment* (LSA), (USDA-FS, 1999). The primary purpose for conducting the LSA was: (1) to present a general overview of past and existing landscape-level resource conditions in the assessment area, (2) to validate or amend existing *Bridger-Teton National Forest Land and Resource Management Plan* (Forest Plan), (USDA-FS, 1990) direction pertaining to the assessment area, (3) to develop management direction and projects that would integrate the physical, biological, and social concerns identified in the Upper Green River area of the Pinedale Ranger District. In conjunction with the Forest Plan, the LSA provides a basis for much of the analysis in this Environmental Assessment (EA). This proposed action was also a part of the proposed action and analysis found in the *Moose Gypsum Final Environmental Impact Statement* and associated project file (Moose Gyp FEIS), (USDA-FS, 2006). The Moose Gyp FEIS also provides a basis and a reference for much of the analysis in this EA.

Authorization for the actions proposed in the Pinyon Osborn Vegetation Treatments project is found in the Forest Plan. Activities are proposed in one Management Area (MA) and in the Bridger Wilderness, each of which have documented Desired Future Conditions (DFCs). The management stratagies, or prescriptions, to attain the DFCs are stated for each management area in Chapter 4 of the Forest Plan, (pages 146-249) along with standards and guidelines specific to each MA. General standards and guidelines are listed on Forest Plan pages 93-144, and usually apply to practices called for, or allowed, in more than one management prescription. This section also describes how the various management practices can be applied. The *Bridger Wilderness Action Plan,* (USDA-FS, 1995) and *Forest Service Manual* (FSM) 2324.21 and 2324.22, (USDA-FS, 2007) also support authorization for some of the actions proposed in this project area that fall within the Bridger Wilderness.

Purpose and Need for Action

The purpose of this project is to move toward the Desired Future Conditions (DFCs) stated in the Forest Plan and the LSA. Moreover, reducing vegetation (fuel) accumulations that have built up due to lack of disturbance over the last 100 plus years and creating a mosaic of early, mid, and late seral stages in the shrub, aspen, and conifer vegetation types over a large landscape will move toward the DFCs for the project area. The purpose of human-ignited prescribed fire within the Bridger Wilderness is to meet the DFCs identified in the 1995 Bridger Wilderness Action Plan that specifies the following, "Fire management emphasizes preservation of wilderness values and allows natural processes of ecological change to operate freely." The actions proposed in this project are needed for the following reasons:

1. Improve Fire Regime Condition Class and DFCs over the entire landscape located within the project area.
2. Re-introduce fire into the project area as a natural disturbance tool.
3. Reduce the buildup of fuels in the project area to break up the continuity of ground and above ground vegetation which will also reduce the risk of future potential catastrophic wildfire near private property and structures.
4. Modify the composition of some vegetative species through a variety of vegetation treatments.
5. Improve wildlife habitat and rangeland conditions to increase availability of forage.
6. Improve the overall health of the watersheds within the project area.

Proposed Action

The actions proposed by the Forest Service to meet the purpose and need are to implement mechanical and prescribed fire treatments to reduce and restore shrub, aspen, and conifer fuels along the Upper Green River Corridor on the Pinedale Ranger District of the Bridger-Teton National Forest. These actions include:

1. Prescribed Burning of sagebrush, grass, aspen, and conifer vegetation types on 18,754 acres on the south facing slope of Pinyon Ridge and 2,466 acres in a portion of the Bridger Wilderness on the south facing slope of Osborn Mountain. Where understory fuels are not continuous enough to regenerate declining aspen stands with prescribed fire, mechanical treatments will be conducted (up to 3,461 acres of aspen within the burn units on Pinyon Ridge). No mechanical treatments will occur in the Bridger Wilderness.
   Project Design: Attain mortality in 40-60% of the sagebrush and grass vegetation by burning in a mosaic pattern; attain mortality in 60-100% of the aspen vegetation utilizing prescribed fire and or mechanical treatment (mechanical treatments consisting of cutting with chainsaw and/or machinery); attain mortality in 30-70% of the conifer vegetation utilizing prescribed fire. Drip torches, terra torch, fusees, helitorch, and aerial Plastic Sphere Dispenser (PSD) machine are ignition devices that could be utilized to carry out the prescribed burning.
2. Mechanically treat conifer and conifer encroached aspen stands on 3,069 acres on the east side of Forest Roads 600 and 650 between Dollar Lake and the Forest Boundary in the Upper Green River Area. No commercial forest products will be removed. Prescribed burning will be utilized to clean up slash after mechanical treatments.
   Project Design: a.) Mechanically treat by cutting with chainsaw and/or machinery within the solid conifer stands (where no remnant aspen are present) to reduce ladder fuels and dead, down, dying, diseased, and some mature green trees to a minimum bowl spacing of 25 feet (on the average) with lop and scatter or hand and/or machine piling of slash techniques; remove/reduce created slash utilizing prescribed fire after mechanical treatment; b.) mechanically treat by cutting with chainsaw and/or machinery the conifer encroached aspen stands to fall 70-90% of the conifers to the ground, and remove/reduce created slash and

regenerate aspen utilizing prescribed fire after mechanical treatment. Drip torches, terra torch, fusees, helitorch, and aerial Plastic Sphere Dispenser (PSD) machine are ignition devices that may be utilized to carry out the prescribed burning.

Decision Framework

Given the purpose and need, the deciding official reviews the proposed action and the other alternatives. The Decision Maker will decide whether or not to implement all or part of the proposed activities within the project area. The Decision Maker will also decide what mitigation measurers are appropriate, and under what conditions. The decision may include minor modifications (if any) and the time frames in which this project will occur.

Public Involvement

The proposal was listed in the Schedule of Proposed Actions on January 1, 2008. The proposal was provided to the public and other agencies in a formal scoping letter dated January 25, 2008. The formal 30 day Request for Comments was published in the paper of record, 'Casper Star Tribune' on January 30, 2008 and the Comment Period ended on February 29, 2008. Using the comments from the public and other agencies, the interdisciplinary team developed a list of issues to address.

Issues

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant 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 (CEQ) NEPA regulations require 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 (Sec. 1506.3)…" A list of non-significant issues and reasons regarding their categorization as non-significant may be found at Pinedale Ranger District in the project record.

The Forest Service identified 4 preliminary issues that were developed internally prior to scoping. Topics raised during scoping confirmed them. These significant issues include:

Watershed Health
This issue addresses internal and public concerns regarding:

- The contribution of sediment to the Green River and its tributaries
- Water quality
- Fisheries
- Potential impacts to wetlands and riparian areas

Vegetation Management

This issue addresses internal and public concerns regarding:

- Vegetation recovery after treatments
- Effects of livestock and wildlife on treatment areas

Threatened Endangered Species, Sensitive Species and Wildlife Habitat

This issue addresses internal and public concerns regarding:

- Changed wildlife patterns as a result of treatments
- Habitat management opportunities for all wildlife species
- Impacts to threatened, endangered, and sensitive species from this project
- Support for objectives expressed by wildlife management agencies

Fire Management and Ecosystem Sustainability

This issue addresses internal and public concerns regarding:

- Reducing the risk of catastrophic wildfire
- Reintroducing fire into the project area as a natural disturbance tool (enhancing spatial-temporal heterogeneity)
- Moving the project area vegetation towards a more natural range of variability
- Timing of proposed treatments

Chapter 2 Alternatives Considered

Alternatives, Including the Proposed Action

This chapter describes and compares the alternatives considered for the Pinyon Osborn Vegetation Treatments project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. The Pinedale Ranger District did not believe that the issues raised during the scoping phase of the NEPA process drove the creation of any alternatives other than the No Action Alternative. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social and economic effects of implementing or not implementing each alternative.

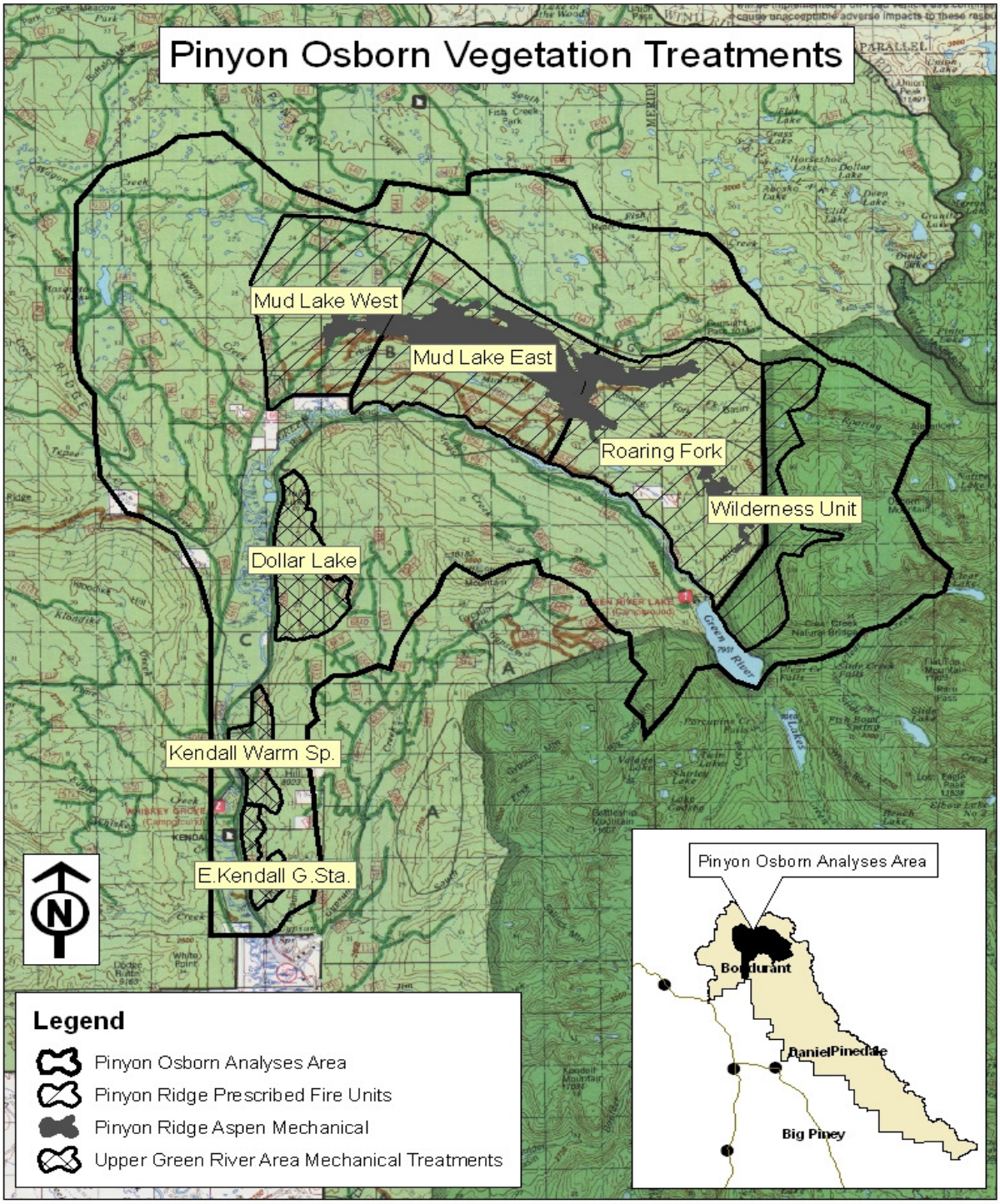
Alternative 1 (No Action)

Under the No Action alternative, current management plans would continue to guide management of the project area. No prescribed fire or mechanical treatments would be implemented to accomplish project goals. Wildland Fire would be the only approved tool to accomplish project goals, in part, or possibly in entirety depending on future conditions, timeframes of potential future fire starts, and location of fire starts.

Alternative 2 (Proposed Action)

The Proposed Action which was described early in this document would include all treatments in entirety. See Figure 1.

Figure 1. Pinyon Osborn Proposed Action Map



Mitigations Common to All Alternatives

In response to public comments on the proposal and as a result of internal analysis, mitigation measures were developed to ease or eliminate some of the potential impacts the various alternatives may cause. These mitigation measures will be applied to any action alternatives. If any of the following mitigations address identified issues, they will not be analyzed further in this document.

- Spill control materials for oil and fuel will be on-site for rapid response. Equipment should be inspected regularly and maintained periodically to minimize leakage of oil, fuel, and grease.
- No proposed activities will occur within the enclosure fence at Kendall Warm Springs to protect the Kendall Warm Springs Dace population.
- All vegetation treatments will have at least a 100 foot buffer strip from the shores of lakes, ponds, and wetlands, and from the outer edges of riparian vegetation of perennial and intermittent streams to minimize or avoid direct impacts to riparian habitat.
    - Where riparian buffers cannot be protected from prescribed fire within a reasonable cost constraint, or the Forest defines a vegetation prescription that recommends lightly burning within riparian areas, additional mitigations may apply. These mitigation measures will be developed by the fisheries biologist. Their purpose is to minimize soil loss and deterioration to water quality. Measures could include seeding and planting disturbed areas, installing water bars, or spreading slash.
- Prohibit prescribed fire ignition, camps, cleared fire lines, storage of hazardous substances (lubricants, gas, retardant, etc.) within 150 feet of the streamside.
- Disconnect run-off paths to streams and rivers by dispersing flow from road run-off into upland areas, such as vegetated meadows or low slope hillsides, before it reaches the stream.
- Stream habitat, fish passage, slope, bank full flow, and flood stage flow must be taken into consideration when designing any crossings, in order to best imitate the natural condition of the stream.
- The use of rubber tired or tracked equipment used to pile slash shall be restricted during wet periods.
- Restrict grazing on recently completed treatments until adequate (60%) ground cover is established.
- All project contractors will be required to store their food according to Forest Plan Standards for food storage and sanitation (Order Number 04-00-14, December 2004) during project implementation to minimize adverse interaction between bears and humans.
- Management direction from the National Bald Eagle Management Guidelines (USFWS 2007) will be followed to protect known bald eagle territories in the project area.
    1. Avoid vegetation treatment during the breeding season within 660 feet of the nest. If the nest site is occupied, vegetation treatment can only occur between

September 1 and January 31. A survey will be conducted beforehand by the District Biologist to determine occupancy.

2. Avoid removal of overstory trees within 330 feet of a nest tree, but selective removal can occur within this area (see Bald Eagle Mitigation #4). The District Biologist will be consulted to assist with the development of a prescription in this area.
3. Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree.

- Mitigations for Trumpeter Swans
  1. Data from WGFD surveys will be used to determine the presence of nesting swans near Mud Lake. Coordination with WGFD will occur as needed prior to treating sagebrush in this area.
  2. Treatment of vegetation will not occur during the nesting season.
  3. A vegetative buffer will be maintained around nesting habitat.
- If treatments in the Pinyon-Osborn Rx Fire Treatment Area are planned between the second week of April and the end of June, then site-specific surveys for denning gray wolf individuals, in coordination with the WGFD, would occur prior to project implementation. If denning wolves are located, then treatments will be postponed until July 1.
- In most cases vegetation treatments will not be conducted in elk/moose calving areas from May 15 through June 30. WGFD would be consulted if project activities (e.g. prescribed fire) would need to be completed in the spring in these areas.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 1. Effects on Alternatives.

Affected Resource	**Alternative 1** **(No Action)**	**Alternative 2** **(Proposed Action)**
Fire and Fuels Management	There would be no vegetation treatments under the no-action alternative. There would be no planned benefits to FRCC for the foreseeable future. Fire risks would continue to increase as stand and landscape vegetation grow older and away from the Potential Natural Vegetation.	The Fire Regime Condition Class (FRCC) would improve the most as the proposed actions move stand and landscape vegetation condition towards Potential Natural Vegetation.

Forested Management	Would not move the area toward DFC in a planned, predictable manner. Hazardous fuels along the Green River Corridor would still exist and increase when standing bug killed trees fell to the ground in the future.	Dead standing conifer along the Green River Corridor would be removed reducing the fuels hazard. Treatment in the Wilderness and Roaring Fork units on Pinyon Ridge would move the area toward DFC in age class diversity and species composition.
Aspen Management	There would be no vegetation treatments under the no-action alternative, thus aspen would not see any planned benefits for the foreseeable future. Aspen would continue to lose valuable wildlife, watershed, and scenic acres to conifer encroachment.	The aspen treatments would start to: (1) stem the loss of aspen stands to conversion to conifer stands, and (2) provide the desired future conditions for a more even distribution of age class diversity.
Range Management	There would be no vegetation treatments under the no-action alternative, thus over-mature sagebrush stands would continue to dominate the landscape.	The Pinyon Ridge projects would treat sagebrush, grass, aspen and conifers. Impacts to aspen and conifers are addressed under their respective resource. This alternative would do the most for sagebrush/grasslands to meet its desired future condition.
Noxious Weeds	There would be no risk of the establishment or spread of noxious weeds in the project area due to project-related activities since no ground-disturbing activities are proposed.	Vegetation treatments have the potential for the establishment and spread of noxious weeds.
Recreation -Wilderness	No effects to recreationists due to project implementation. Greater effects to recreation opportunities in Wilderness if potential future wildfire occurs. No change to vegetation with continued old age classes.	Prescribed fire treatments in wilderness would achieve wilderness objectives. Minimal effects to wilderness recreationists would be present during implementation. Future wilderness management in the project area would improve where potential threats to human safety from catastrophic wildfire would be reduced.
Visual Quality	No increased effect to visual resources over existing condition from vegetative or fuels treatments.	Overall Visual Quality Objectives (VQOs) would be met.
Soils		
–Conifer Forest Mgmnt.	No new soil disturbance activities in the watershed. The watershed would remain stable in its present condition.	The majority of soils impacted are rated slight to moderate for soil erosion and/or compaction.
–Sagebrush, Grass, and Aspen	The watershed condition would remain nearly stable. The primary management impact would continue to be grazing.	The sagebrush and grasses would be removed by fire while the aspen would remain standing. With the exclusion of grazing until treated areas achieve 60% ground cover, new aspen seedlings and grasses would protect the soil from erosion and roots would have time to develop to support the plants.

Water Resources **–Surface Water**	Little or no risk of impacts to surface waters from erosion and sedimentation associated with disturbing soils. However, a greater potential for a stand replacing fire would be possible and thus surface waters from erosion and sedimentation associated with disturbing soils would be greater.	The risk of adverse impacts to surface waters from erosion and sedimentation associated with soil disturbance due to mechanical treatments and prescribed fire activities is expected to be minor. Impacts to surface water quality from actions under this alternative are measured after the implementation of mitigation measures.
–Wetlands and Riparian Areas	Little or no risk of adverse effects to wetlands and riparian areas. There may be continued adverse impacts from existing activities.	The risk of adverse effects to wetlands and riparian areas due to mechanical treatments and prescribed burning is expected to be minor. These areas would be specifically protected by 100-200 foot buffers. Impacts to wetlands and riparian areas from actions under this alternative are measured after the implementation of mitigation measures.
–Water Quality of Lakes, Streams, And Rivers	Little or no risk of adverse effects from turbidity, suspended sediments or toxic contaminants to Green River Lakes or streams in the project area.	The risk of adverse effects from turbidity and suspended sediments to Green River Lakes and streams in the project area due to mechanical treatments and prescribed burning is expected to be minor. Impacts to water quality from actions in this alternative are measured after the implementation of mitigation measures.
Fisheries	No new impacts to fisheries would result as no new activities are proposed.	Vegetation treatments could impact fisheries habitat through sedimentation. The risk of erosion-induced sediment is generally low - moderate.
Wildlife	No new management activities would occur. Therefore, the potential beneficial and/or negative impacts from vegetative treatments would not occur. Existing conditions would be maintained and associated impacts to wildlife would continue.	Both negative and positive impacts to habitat of most harvested, ecological indicator MIS, and neotropical birds. Vegetation treatments have the greatest impact potential. Type and degree of impact depends on the species. The primary negative impacts for most species include habitat removal, disturbance to individuals, and the potential for vehicle-related mortality. The specific positive impacts for big game species includes an increase in forage, browse, and cover, particularly where sagebrush and aspen are treated.

Threatened, Endangered, and Sensitive Species (TES)	No new management activities would occur. Therefore, the potential beneficial and/or negative impacts to TES fish, wildlife, and plants would not occur. Existing conditions would be maintained and associated impacts to wildlife would continue.	Potential for both negative and positive impacts to habitat of most TES fish, wildlife, and plant species. Vegetation treatments pose the greatest potential impacts. Type and degree of impact depends on the species. The primary negative impacts for most species include habitat removal and disturbance to individuals. The specific positive impacts for some species includes an increase in early seral stage vegetation.
Air Quality	Current air quality would remain unchanged.	Temporary reductions in air quality from smoke production from prescribed burns. Long-term air quality would remain unchanged.
Heritage Resources	Historic properties would continue to be monitored and protected.	All historic properties would be avoided by the project. No historic properties would be affected.
Economic Benefits	No net loss or gain of economic benefits; however resource benefits would not exist.	Although it is hard to measure benefits of completed project related to dollars; resource benefits would be high.
Environmental Justice	The proposed action and the no action alternatives do not pose a disproportionately high and adverse environmental, human health, or social effect on the counties impacted, and there are no known community-identified environmental justice-related issues.	

Chapter 3 Environmental Consequences

Introduction

This chapter provides information about the existing environment of the Pinyon Osborn Vegetation Treatments Project Area, and the potential consequences of proposed management actions to that environment. It also presents the summary of scientific data and the analytical basis for the comparison of the Proposed Action and the No Action alternative. Each resource potentially affected by the Proposed Action or No Action alternative is described by its current condition and uses.

Environmental consequences are the effects of implementation on the physical, biological, social and economic environment. Following each resource description is a discussion of the potential effects (environmental consequences) to the resource associated with the implementation of each alternative, including the Proposed Action. All significant or potentially significant effects, including direct, indirect, and cumulative effects, are disclosed.

Direct, Indirect and Cumulative Effects. Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity, but would be significant in the foreseeable future. Cumulative effects result from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time. The scope by which effects are measured is not necessarily limited to the project area. The geographical area within which effects of activity are analyzed is identified within the applicable resource section.

Past and Present Actions. Except for routine maintenance of roads, trails, campgrounds, and grazing allotment facilities, there have been few activities requiring NEPA documentation within the Project Area in the recent past. Timber harvest since 1993 has been limited to small sales of personal use products, predominantly firewood. Timber sales and other projects currently in progress are the:

- Green River Lakes Campground/Administrative Site Salvage Timber Sale – It has been completed and focused on removing lodgepole pine infested with Mountain Pine beetle on approximately 40 acres.
- Bend in the River Timber Sale – It is in progress and is a salvage sale to remove dead and diseased trees from the effects of the Mountain Pine beetle.
- Battle Mountain Timber Sale – It is in progress and is a salvage sale to remove dead and diseased trees that resulted from a wildfire.
- Red Cliff Wildland Urban Interface Vegetation Treatments – Is a fuels reduction project in progress around private structures to reduce and remove timber.

Vegetation management and other activities impacting grazing and range resources will be consistent with range management direction found within allotment management plans

applicable to the Pinyon Osborn project area.

Decisions on oil and gas leasing have been deferred to the Forest Plan Revision scheduled to be completed in May 2009. For the purposes of this EA, except for air quality, they are not considered in cumulative effects analyses.

Effects are quantified where possible, and qualitative discussions are also included. Understanding the environmental consequences of the Proposed Action and its alternatives provides the decision-maker and public with site-specific information for the selection of actions to implement and the understanding of the environmental tradeoffs involved.

Additional analyses related to this section can also be found in the Pinyon Osborn EA project record, the Upper Green River Landscape Assessment, the Moose Gypsum Environmental Impact Statement, and the references noted in Appendix B of this document.

Fire and Vegetation Management and Ecosystem Sustainability

A. Issue Statement or Issue to be Addressed

Vegetation Management

This issue addresses internal and public concerns regarding:

- Vegetation recovery after treatments

Fire Management and Ecosystem Sustainability

This issue addresses internal and public concerns regarding:

- Reducing the risk of catastrophic wildfire
- Reintroducing fire into the project area as a natural disturbance tool (enhancing spatial-temporal heterogeneity)
- Moving the project area vegetation towards a more natural range of variability
- Timing of proposed treatments

B. Existing Conditions

The Bridger-Teton National Forest's Land and Resource Management Plan (Forest Plan), (USDA-FS, 1990), the Bridger-Teton National Forest PFC Assessment (PFC Assessment) (USDA-FS, 1997a), the Upper Green Landscape Assessment (LSA), (USDA-FS, 1999), the Upper Green River Area Rangeland Project (USDA-FS, 2004b), Interagency Fire Regime Condition Class – Methods – Great Basin Geographic Area (Spring 2004), and The Gypsum Creek Watershed Assessment (USDA-FS, 2004a), including all references and GIS data, form the basis for this vegetation assessment.

Modern human influences, several decades of fire suppression, and the absence of natural and aboriginal fire, in recent history, has allowed conifer and aspen overstory to grow toward mature and over mature conditions within the District and the Pinyon Osborn project area. Implementation of the proposed action is expected to occur over a ten to fifteen year period.

Fire Regime Condition Class, an illustration of current vegetation conditions:

Prior to the arrival of European man, a natural fire regime existed across the landscape. These landscapes contained vegetation and fuel characteristics much different from that which exists today. Fire Regime Condition Class (FRCC) was developed in order to inventory and display these divergent characteristics and to guide management decisions and actions in order to move closer to a natural fire regime.

Characteristic vegetation and fuel conditions are considered to be those occurring within the natural/historical fire regime. Uncharacteristic conditions are considered to be those that did not occur within the natural/historical fire regime, such as invasive species (e.g. weeds, insects, and diseases), the historical "high-graded" forest composition and

structure (i.e. "high-grading" was the historical harvest method of taking of large, fire-tolerant trees and the leaving of small fire-intolerant trees), or where repeated annual grazing reduced grassy fuels across relatively large areas to levels that will not carry a surface fire. Determination of the amount of departure is based on the comparison of a composite measure of fire regime attributes (vegetation-fuel composition, fire frequency, and fire severity) with the central tendency of the natural/historical fire regime. The resultant amount of departure from the natural/historical regime is then classified to determine the FRCC (Interagency Fire Regime Condition Class, 2004).

Data collected for determination of FRCC characterize the size of the area, geographic location, biophysical conditions, and fire regime characteristics. This method provides the ecological information used to classify the landscape fire regime and to determine similarity, departure, ecological sustainability risks, abundance of vegetation-fuel classes, and the FRCC. These variables can be determined at several scales: landscape, project, stands, or stratifications (Interagency Fire Regime Condition Class, 2004**). Table 1.** displays FRCC data from the project area.

The field procedures for Fire Regime and FRCC describe general characteristics of a landscape to calculate and classify the Fire Regime and FRCC when combined with estimates of the natural/historical fire regime reference values. A landscape is considered to be the contiguous area within a delineation that encompasses the variation of the national fire regimes. Typically this area is within a sub-watershed, but other types of landscape delineations can be used. The landscape can be stratified into biophysical and project or treatment strata. The landscape FRCC methods are used for large projects containing multiple stands, while the stand FRCC method is used for small areas, typically containing only one stand.

There are three FRCC classes. The three classes are based on low (FRCC1), moderate (FRCC2), and high (FRCC3) departure from the central tendency of the natural/historical regime (Hann, 2001, Hardy et al., 2001, and Schmidt et al., 2002). The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern), fuel composition, fire frequency, severity, and pattern, and other associated natural disturbances. Low departure is considered to be within the natural and historical range of variability, while moderate and high departures are outside of it.

Fire Regime Condition Class (FRCC) is a classification of the amount of departure from the natural regime (Hann and Burnell 2001). Course-scale FRCC classes have been defined and mapped by Hardy et al. (2001) and Schmidt et al. (2002). They define course-scale fire regime current condition classes as "the degree of departure from historical fire regimes, possibly resulting in alterations of key ecosystem components such as species composition, structural stage, stand stage, canopy closure, and fuel loadings." These alterations are the result of direct or indirect management activities and can be placed in one of three condition classes for each fire regime.

Table 1. contains the current FRCC of landscapes within and adjacent to the Pinyon Osborn analysis area, and **Figure 1. from Moose Gypsum Environmental Impact Statement** depicts the potential natural vegetation used to determine the current FRCC. The FRCC3 is "high" for "Interior West Lower Subalpine Forest" in all seven sub-watersheds. This means there is a high departure from the central tendency of the natural (historic) regime. The forest vegetation and fuel conditions are mature and old age due to suppression of fire and natural (historic) disturbances. At present, landscape vegetation and fuel conditions tend to be mature with high fuel loading. These conditions influence the management strategies that are to be applied in order to move the vegetation and fuel compositions toward characteristic FRCC within the subalpine forest types.

Table 1. Current Fire Regime Condition Class of Landscapes within and adjacent to the Pinyon Osborn Analysis Area by 6th Order Hydrological Unit

HUC 6 Name	PNVG Strata	% Composition	Strata FRCC Departure	PNVG FRCC	Landscape Departure	Landscape FRCC
Green River Mill Creek	SPFI1	47	74	3	70	High 3
	ASPN3	12	59	2		
	CSAG1	33	74	3		
	SAGE1	8	74	3		
Roaring Fork	SPFI1	71	70	3	69	High 3
	CSAG1	15	84	3		
	ASPN3	14	59	2		
Wagon Creek	SPFI1	28	74	3	73	High 3
	SAGE1	45	75	3		
	ASPN3	8	60	2		
	CSAG1	19	85	3		
Tosi Creek	SPFI1	52	70	3	57	Medium 2
	ASPN3	4	59	2		
	AMDW	20	15	1		
	CSAG1	22	85	3		
	SAGE1	2	75	3		
Gypsum Creek	SPFI1	75	68	3	70	High 3
	ASPN3	7	60	2		
	CSAG1	18	85	3		
Green River Lime Creek	SPFI1	48	70	3	70	High 3
	SAGE1	5	75	3		
	CSAG1	39	85	3		
	AMDW	5	80	1		
	ASPN3	3	80	2		
Green River Boulder Creek	SPFI1	79	75	3	72	High 3
	ASPN3	17	60	2		
	CSAG1	4	85	3		

Potential Natural Vegetation Group (PNVG), 6th Order Hydrological Unit Code (HUC6), Landscape = HUC6
PNVG's:
SPFI1=Interior West Lower Subalpine Forest #1 SAGE1=Sagebrush-Other (e.g., Silver Sagebrush)
ASPN3=Aspen (with High Elevation Conifers) AMDW=Alpine Meadows
CSAG1=Sagebrush-Cool (Mountain Big Sagebrush)

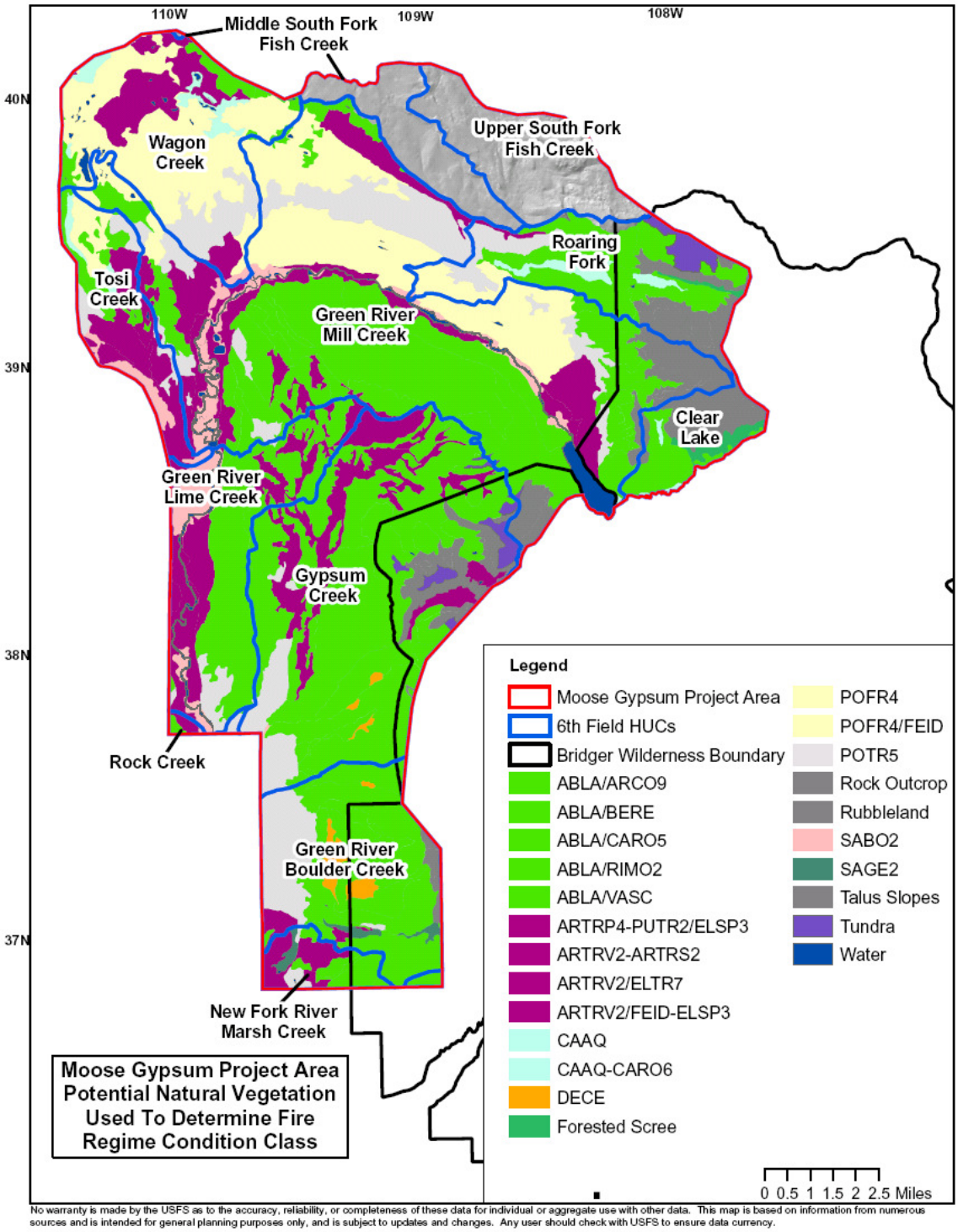


Figure 1. Moose-Gypsum EIS Potential Natural Vegetation used to determine Fire Regime Condition Class within and adjacent to the Pinyon Osborn Analysis Area.

Existing Conifer and Aspen Forest Conditions

Conifer forest comprises approximately 40 percent of the Upper Green LSA area (USDA-FS, 1999) as a whole. The major conifer forest habitat type series found within the LSA are: the Engelman spruce *(Picea engelmannii)* series, Douglas-fir (*Pseudotsuga menziesii*) series, subalpine fir (*Abies lasiocarpa*) series, and whitebark pine (*Pinus albicaulis*). Lodgepole pine (*Pinus contorta*) is found within most series as successional species. The dominant conifer species within the project area itself are spruce/fir and lodgepole pine which are approximately 32 percent of the project area.

Aspen (*Populus tremuloides)* as deciduous woodland comprises approximately 6 percent of the LSA and approximately 8 percent of the project area. The aspen community types are important providers of habitat components for a variety of wildlife species; important providers of forage for permitted livestock; ground water release into the hydrological cycle; and visual relief and enjoyment for human beings.At present, significant acreage of the aspen type has been lost through natural vegetation succession. This loss will continue unless interruption to the process occurs or new early succession stage aspen is created. Physiological age varies with approximately 25 percent of the current aspen stands being old (100 to 120years old), 15 percent seedlings, and the remaining 60 percent falling in the mature stage (50 to 100 years old) (USDA-FS, 1997a, USDA-FS, 1999).

Aspen occupies millions of acres in the West, occurs in a wide variety of environmental settings, and exhibits a diversity of successional dynamics. Community types where successional aspen occur as a component include Engleman spruce, subalpine fir, Douglas fir, lodgepole pine, and sagebrush. Here, conifers can replace aspen in the cooler, wetter sites as part of plant succession. The continued loss of successional aspen throughout its range due to conifer encroachment is of particular concern to resource managers (Romme, 2004). Conifer encroachment in this type is more likely to occur on north, east, and west aspects than on south-facing slopes. The likelihood of conifer encroachment increases with increased elevation on all aspects. In the project area, conifers occur more frequently in aspen stands with a mountain snowberry shrub layer than in other types. Fuel ladders created by conifer encroachment within aspen stands make these areas much more susceptible to stand-replacing fires (USDA-FS, 1997a).

At the landscape level, the composition of aspen stands is outside the natural (historic) range for the seven sub-watersheds within or adjacent to the project area. The FRCC2 rates moderate for aspen in all seven watersheds. Both vegetation and fuel conditions are mature, old age vegetation due to departure of fire and natural (historical) disturbances. In addition, conifers are invading some stands while most stands are deficient of fine fuels that would carry a ground fire.

Insects and Disease – The over-mature stands of spruce, fir, and lodgepole pine within the District and project area are especially susceptible to disease and to attack by insects. These two factors cause 82 percent of the total tree mortality in the project area. Mountain pine beetle, Douglas-fir beetle, spruce budworm, and Dwarf mistletoe are common pests in the forest, causing loss of wood fiber through endemic and occasionally epidemic infestations. Mountain pine beetle has historically been the most destructive

forest insect, and has inflicted extensive damage in mature and over-mature stands of lodgepole and whitebark pine.

In addition, there is currently an infestation of mountain pine beetle that is increasing and killing lodgepole and whitebark pine. There has been a significant increase in the past five years of mortality in subalpine fir caused by a complex of insects and disease outbreaks. Currently the project area is experiencing an epidemic outbreak of mountain pine beetle affecting mature lodgepole pine >8inches dbh.

While usually less dramatic in their effects than insects, diseases and decay take a bigger toll in the form of reduced growth rates. Dwarf mistletoe, one of the most serious disease problems in the District, is particularly common in lodgepole pine. About 30 percent of the stands are infected to some degree. (Hawksworth, 1984). Although many of the clearcuts created since the 1950s have now regenerated, the developing seedlings and saplings are also vulnerable, or are already infected by Dwarf mistletoe from adjacent older stands. In addition to reduced growth, infected stands suffer from increased mortality, loss in wood quality, reduced seed crops with less viable seeds per cone, and higher susceptibility to rot and wind-throw.

Fire Risks – The predominance of over-mature stands, fuel ladders, down woody fuels, and insect and disease outbreaks have increased the risk of stand-replacing fires for the conifer forest communities within the project area.

Fire and Fuel Management

Fire has played an important historic role in the formation of the project area's vegetation. The periodic occurrence of fire has prepared seedbeds, cycled nutrients, maintained various stages of vegetation, provided favorable habitat for wildlife species, maintained a diversity of age classes and vegetative types, and reduced the susceptibility of vegetation to some types of insects and diseases. Intense fires during droughts assured grassland and aspen stand maintenance while impeding conifer encroachment. Fire also provided conditions for lodgepole pine stand regeneration.

Historically, fire frequency was low, as little as every six years in lower elevations and up to every 250 years in the higher elevations (primarily in densely timbered stands on north facing slopes). Compared to other areas of the BTNF, the project area has had a very low occurrence of large fires.

Wildfire suppression on the BTNF began around the turn of the century with the creation of the Federal Forest Reserves. Within the LSA area (USDA-FS, 1999), wildfires have averaged 2.6 fires per year. Fifty-four of the 125-recorded wildfires in this larger assessment area were classified as human-caused. Historically, fire starts burned between 100 and 3,000 acres during moderate drought seasons. Now, aggressive initial attacks have contained wildfire starts to an average of less than five acres. Fire starts smaller than one-quarter of an acre at higher, more remote elevations, are not normally detected and burn out naturally when burning conditions are low.

Fire suppression combined with natural tree and sagebrush mortality has resulted in high levels of down and dead woody material in the older conifer timber condition classes and

decadent stands of sagebrush and aspen. These natural fuels commonly range from 20 to 40 tons per acre and contribute to the potential for large uncontrolled wildfires.

Prescribed fire is a tool that has been successfully used to reduce high levels of fuel loading, restore ecosystem health and variability, and improve the quality of watersheds and wildlife habitats. A prescribed fire is initiated only when certain predetermined conditions are met. These conditions are contained in the prescribed fire plan developed for each burn area, and include the variables of air temperature, humidity, air speed, and fuel moisture, as described in the plan objectives.

These burns are only ignited when the predicted weather and fuel conditions allow for minimized smoke impacts on the air quality and public health (USDA-FS, 2005a). Mechanical piling of heavy fuels and burning when weather and fuel moisture conditions are appropriate assure a safe and less damaging fire to soils and surrounding resources. This method can be used near private lands when fuel loading is too high to conduct a safe broadcast burn. Mechanical piling, together with broadcast burning, would be used to lessen the heavy fuel loads in the project areas.

A top priority in National Fire Plan direction is the development of a collaborative fuel treatment program that identifies and prioritizes "Communities at Risk" to address the wildland/urban interface. The Forest Service is also required to identify and implement, fuels treatment projects, especially adjacent to private lands (Chief of the Forest Service, 2003). Both Red Cliff and the Upper Green urban interfaces are high on the priority list for "Communities at Risk" in the project area.

C. Effects

Fire Regime Condition Class an Illustration of Proposed Vegetation Treatments:

Landscape FRCC would be reduced in a majority of the HUC units after treatment. Alternative 1 would continue to decrease age-class diversity and increase FRCC over time, and would likely show a decrease in total aspen-dominated acres due to natural conifer invasion and succession to conifer forest conditions.

Historically, wildland fires burned in a mosaic from 30 to 70 percent of the project area; therefore, an average of 50 percent burned to un-burned area per treatment unit is used for this assessment. This effects assessment compares the Proposed Action and its alternatives using the percent of aspen in the desired seedling age-class versus the percent in young and middle-aged, and mature and old, using the desired low FRCC as described in **Section B.**, as the benchmark.

Projected changes in the DFCs would result from the prescribed burning and mechanical treatments (or lack thereof) contained in the Proposed Action and its alternatives. These changes are measured as a percent related to low, medium, and high FRCC.

The objectives of this project include moving toward characteristic vegetation and fuel conditions and FRCC1. In this analysis, changes that move the project area towards the overall objective are considered beneficial while those that do not are considered to be inconsistent with the goals and objectives for the project area and the Upper Green assessment area as a whole.

Table 2. Fire Regime Condition Class of Landscapes within and adjacent to the Pinyon Osborn Analysis Area by 6th Order Hydrological Unit "Analyzed post-treatment with 50% removal of overstory in all vegetation types where treatments are proposed".

HUC 6 Name	PNVG Strata	% Composition	Strata FRCC Departure	PNVG-FRCC	Landscape-Departure	Landscape-FRCC
Green River Mill Creek	SPFI1	47	63	Moderate 2	60	Moderate 2
	ASPN3-	12	50	2		
	CSAG1	33	65	2		
	SAGE1	8	50	2		
Roaring Fork	SPFI1	71	50	2	51	2
	CSAG1	15	65	2		
	ASPN3	14	50	2		
Wagon Creek	SPFI1	28	73	High 3	65	2
	SAGE1	45	62	Moderate 2		
	ASPN3	8	50	2		
	CSAG1	19	77	High 3		
Tosi Creek	SPFI1	52	69	High 3	56	2
	ASPN3	4	50	Moderate 2		
	AMDW	20	15	Low 1		
	CSAG1	22	83	High 3		
	SAGE1	2	74	3		
Gypsum Creek	SPFI1	75	66	Moderate 2	63	2
	ASPN3	7	50	2		
	CSAG1	18	65	2		
Green River Lime Creek	SPFI1	48	64	2	65	2
	SAGE1	5	75	High 3		
	CSAG1	39	80	3		
	AMDW	5	9	Low 1		
	ASPN3	3	56	Moderate 2		
Green River Boulder Creek	SPFI1	79	75	High 3	70	High 3
	ASPN3	17	50	Moderate 2		
	CSAG1	4	85	High 3		

Potential Natural Vegetation Group (PNVG), 6th Order Hydrological Unit Code (HUC6),
Landscape = HUC6
PNVG's: SPFI1=Interior West Lower Subalpine Forest #1
ASPN3=Aspen (with High Elevation Conifers)
CSAG1=Sagebrush-Cool (Mountain Big Sagebrush)
SAGE1=Sagebrush-Other (e.g., Silver Sagebrush)
AMDW=Alpine Meadows

Alternative 1 (No Action)

Under Alternative 1, there would be a long-term loss of managed seedling/sapling habitat (0 percent versus the existing less than 1 percent), although seedling/sapling habitat may be created through stand-replacing fires. Alternative 1 would provide the greatest

amount of mature conifer forest (91 percent). This is likely to increase to nearly 100 percent as the pole and young forest mature if no further activities occur. Alternative 1 would result in the long-term loss in the current aspen stands due to the natural conifer invasion and succession to conifer forest conditions. Landscape FRCC would remain high.

Alternative 2 (Proposed Action)

The Proposed Action would provide the greatest amount of age-class diversity in all vegetation types within the Project Area and would do the most to achieve the DFCs. Also, the more open canopy forest conditions created through fuels reduction would provide for certain aspects of seedling/sapling habitat, including grass/forb vegetation as well as conifer regeneration. Further changes in age class diversity would result from the prescribed burning of conifers on Pinyon Ridge inside the Bridger Wilderness and outside along its western boundary. The proposed burns would be hot, resulting in stand-replacing fires in some areas. Historical fire burn patterns are used to determine the actual proportion of forest stands that would be replaced and converted to an early seral condition in this analysis. Historically, wildland fires burned in a mosaic from 30 to 70 percent of the project area; therefore, an average of 50 percent burned to un-burned area in the Pinyon Ridge Roaring Fork and Wilderness Units are used for this assessment.

Assuming that approximately 50% of the acres of aspen would be-converted to the seedling/sapling stage as a result of prescribed burns, the Proposed Action would provide for an increase in the seedling/sapling growth stage, from the current 15 percent to approximately 46 percent (a 31% increase).. This also assumes that none of the 15 percent existing seedling/sapling stage would grow into the mature stage during the next 10(+-) years. Landscape FRCC would decrease in a majority of the watersheds **(Table 2. as compared to Table 1.).**

Fire and Fuel Management

Treatments under the proposed action were designed and placed on the landscape with consideration given to size and scale, with the primary goal of improving desired future conditions (DFCs) for the project area. Utilizing FRCC as a measurement tool, the treatments contained in the proposed action would provide for the greatest movement towards low landscape FRCC1 or to characteristic vegetation and fuel characteristics. Fire behavior reduction objectives would also be accomplished by reducing and/or modifying fuels over a large landscape. Alternative 1 (No Action) would not benefit project area DFCs. FRCC would remain unchanged and/or increase in departure from historic conditions. Fire behavior reduction objectives for the "communities at risk" of Red Cliff and Upper Green urban interface would not be accomplished.

Application of the various prescribed burning/mechanical vegetation and fuel reduction projects that are described in the Proposed Action would result in projected changes to FRCC. Visual comparisons between **Table 1.** and **Table 2.** show the changes in PNVG, FRCC, and landscape FRCC.

The overall objective for fire and fuels management is to improve the project area DFC. By moving the area toward more characteristic vegetation and fuel conditions (FRCC1),

we can measure our effectiveness at meeting our goals and objectives. In this analysis, treatments that maintain or move the project area towards FRCC1 are considered beneficial while those that do not are considered to be inconsistent with the goals and objectives for the project area and the Upper Green assessment area as a whole.

Alternative 1 (NO ACTION)

Movement towards FRCC1 would not be made under Alternative 1 and no improvement to the DFCs would occur. Landscape FRCC would remain at levels found in **Table 1**. Fuels objectives related to a reduction of future potential fire behavior in the event of a wildland fire would not be met in any of the analyses area. Private property and structures will remain at risk in the event of a future wildland fire.

Alternative 2 (Proposed Action)

The Proposed Action would provide the greatest movement towards the FRCC1; therefore, the most improvement to DFCs. Strata Departure, PNVG FRCC, Landscape Departure, and Landscape FRCC would all show improvement when the project size is of significant stature to influence the total PNVG of the landscape. Additional projects and natural succession on treated areas, over time, would move landscapes in the project area towards FRCC1 and/or would meet stated objectives for desired future conditions.

D. Cumulative Effects

Aspen Forest

Cumulative effects for the Proposed and Alternative Actions include premature grazing by domestic livestock, wild ungulates, and lagomorphs on the growth and establishment of aspen seedlings after treatment. These impacts have occurred in the past, are currently occurring, and will occur in the future. However, application of Forest Plan Standards and Guidelines, Mitigation Measures and Monitoring activities applied prior to, during and after treatment will ensure success. Livestock management activities will be impacted and local planning will be one of the keys to manage livestock away from the treatment areas. The Wyoming Game and Fish Department should provide valuable expertise and experience in helping to lessen the impacts from wildlife on establishment of valued habitat components.

The LSA area (USDA-FS, 1999) is used for the cumulative effects analysis. Currently, aspen comprises approximately 15,906 acres. The total amount of aspen would not change measurably under the proposed action.

Given that approximately 40 percent of the aspen found in the LSA occurs within the project area, management activities under the Proposed Action have a positive effect on the overall health of the LSA's aspen stands due to improved age-class diversity, reduced fire risks, and the decrease in conifer encroachment. The opposite is true for Alternative 1, No Action.

Conifer Forest

The LSA area (USDA-FS, 1999) is used for the cumulative effects analysis. The conifer harvest that took place during the period of 1956 to date affected approximately 2,795

acres, which is about 3 percent of the LSA. These harvests had some impacts on the soil and water resources during the road building and hauling time periods which lasted during the timber sale activity. There were some changes in mature forest habitat for wildlife. This may have affected those species that favor late successional habitat while the increased forage may have benefited other species that favor earlier successional stages. The harvests did move portions of the LSA toward the Desired Future Conditions by reducing some of the acreage of mature/overmature spruce/fir and increasing the amount of younger aged lodgepole pine. The use of the clearcutting regeneration method along with the slash piling that followed harvest served to decrease the fuel loading and broke up some of the continuous patches of timber which lowered the fire risk on a small portion of the LSA. The harvests resulted in more grass and forb type for a period of time after regeneration which benefited the grazing resource by adding some transitional range. The building of roads for timber harvest provided better access for fire control crews and recreational use.

Currently, conifer forest comprises approximately 107,000 acres (40 percent) of the 267,532-acre LSA. Management activities under the Proposed Action and its alternatives would not change the total amount of conifer forest. The various actions proposed under the Proposed Action would positively affect conifer species composition and age-class diversity within the LSA on a localized basis. Under all alternatives, the LSA is not cumulatively meeting objectives for increase in lodgepole pine, whitebark and decreasing spruce/fir.

Even though the Proposed Action would contribute towards the Upper Green DFCs, they alone would not achieve the LSA's species and age-class diversity objectives. Other vegetation management projects would be required do this. The continued occurrence of insect and disease outbreaks and stand-replacing fires could negate the positive benefits from active management within the project area unless other coordinated projects are undertaken within the LSA to reduce these risks.

Fire and Fuels Management

The cumulative effects for Fire and Fuels Management includes past actions of wildland fire suppression over an extended period of time. This has allowed an increase in all fuel quantities over the project area which has not experienced a historical fire return interval. This has contributed to the presence of older age, later seral stages in all of the vegetation types, as well as, increased fuel loadings. The proposed action will begin to move the analyses area and surrounding watersheds towards FRCC1 and the DFC; however, additional fuels/vegetation projects will be needed in the future to reach the DFC and FRCC1. Reasonably foreseeable actions/impacts affecting Fire and Fuels Management would include Wildland Fire Use (WFU) Events (natural fire starts that are allowed to burn under an approved Wildland Fire Use Implementation Plan) that would assist further in reaching the DFC and FRCC1 over time. The effects of reasonably foreseeable WFUs will be similar to the proposed treatments in this document, as related to FRCC. These WFU events will be very limited under Alternative 1 and only become feasible to implement after the treatments from the Proposed Action have taken place.

Air Quality

A. Issue Statement or Issue to be Addressed

No Issues related to air quality were raised during the public scoping process.

B. Existing Conditions

Prescribed burns generate smoke that contains air pollutants, including fine particulate matter, which can cause health problems, especially for people suffering from cardiopulmonary illnesses. Dispersion of these particulates can exceed health standards and may occur downwind of prescribed burns. Also, prescribed burns may have impacts on Class I wilderness area air quality as smoke can diminish views and impact scenic vistas.

The Wilderness Act of 1964 as amended in 1978 was enacted to "establish a National Wilderness Preservation System for the permanent good of the whole people, and for other purposes." It defines wildernesses as areas "untrammeled by people that offer outstanding opportunities for solitude and directs agencies to manage wilderness to preserve natural ecological conditions (Section 2320.6)." This act is the basis for wilderness management and "with certain exceptions, the Act prohibits motorized equipment, structures, installations, roads, commercial enterprises, aircraft landing, and mechanical transport." The framework for controlling air pollutants in the United States is mandated by the 1970 Clean Air Act (CAA), as amended in 1977 and 1990. In 1999, minor revisions that addressed visibility were added (sections 7491 and 7492), and were published on July 1, 1999 as the Regional Haze Rules. The CAA was designed to "protect and enhance" the quality of the nation's air resources. This act expands on the Wilderness Act and directs the Forest Service to protect Class I air quality standards in certain wilderness areas and Class II standards in the remaining wilderness areas. State Implementation Plans (SIPs) are developed by each state to implement the provisions of the CAA. The SIPs describe the State's actions to achieve and maintain the "National Ambient Air Quality Standards" (NAAQS).

The EPA and states designate upper limits on concentration levels for the criteria pollutants to protect public health. Federally designated maximum concentration levels are called NAAQS and are defined as the amount of pollutant above which detrimental effects to public health (or welfare) may result. Areas that have air pollution levels that exceed the NAAQS are designated as "non-attainment" areas. State Implementation Plans (SIPs) are developed by each state to implement the provisions of the CAA. The SIPs describe the State's actions to achieve and maintain the NAAQS.

Non-attainment areas are areas that exceed the NAAQS for air pollutants. Sheridan County is the only county in Wyoming that is in a non-attainment area for particulate matter smaller than 10 micrometers (PM_{10}) (EPA). Sheridan County is located 180 miles northeast of the proposed project area on the border between Wyoming and Montana. Burning in the project area would not impact Sheridan County due to dispersion, and prevailing winds move primarily to the east. The Moose Gypsum project area is in an "attainment area" and meets the NAAQS.

Class I areas are set aside under the Clean Air Act to receive stringent protection from air quality degradation. Mandatory Class I areas are those with certain Federal designations in existence prior to the 1977 amendments to the Clean Air Act.

These include:

- International parks,
- National wilderness areas that exceed 5,000 acres in size,
- National memorial parks that exceed 5,000 acres in size, and
- National parks that exceed 6,000 acres in size.

Class I areas in the BTNF include the Bridger Wilderness and the Teton Wilderness. Class I areas in the Shoshone National Forest that might also be affected are the Washakie Wilderness (approximately 30 miles to the north), the Popo Agie Wilderness (Class II that is located approximately 30 miles to the southeast), the North Absaroka Wilderness (approximately 70 miles to the north) and the Fitzpatrick Wilderness (approximately 1.5 miles to the east). The Gros Ventre Wilderness (Jackson Ranger District) is considered a Class II area and the Wind River Indian Reservation roadless area is not classified, but is considered sensitive to visible impairments.

The State of Wyoming Air Quality Standards and Regulations (WAQS&R) have specific guidelines for vegetative burning that cover emissions, smoke, visibility impairment, and permitting requirements. Chapter 10 of these regulations establishes restrictions and requirements on specific burning practices. Chapter 10 is organized in four different sections that cover the following restrictions and requirements:

Section 1 Introduction to Smoke Management.

Section 2 Regulates refuse burning; open burning of trade wastes, for salvage operations, for fire hazards, and for fire fighting training; and vegetative material open burning.

Section 3 Specifically regulates emissions from wood waste burners.

Section 4 Regulates sources of vegetative burning for the management of air quality emissions and impacts from smoke on public health and visibility.

Any prescribed burns within the BTNF shall be required to meet the standards and regulations of the WAQS&R (WYDEQ, 2005).

C. Effects

In order to comply with Forest Service policy and WAQSR, as well as Federal regulations, burn plans are required for all prescribed burning projects. The Forest Service would develop burn plans to include prescription parameters, monitoring, safety contingencies and contacts, and mitigation measures (Smoke NEPA Guidelines). Chapter 10 of the WAQSR covers smoke management. Under Section 2, Open Burns, the Vegetative Material Burning Guide provides guidelines for meeting Wyoming DEQ requirements. Part of the requirements is to provide a scope of the project, which includes the estimated emissions, in PM_{10} tons per day. This estimate is used to determine if the burn is a Planned Burn Project, according to WAQSR rules. The following table, **Table 1.**, can be used for this estimate, and shows how many acres or cubic feet of a vegetation type will release 0.25 tons of PM_{10} emissions. If estimated

emissions of the burn project exceed 0.25 tons/day PM_{10}, then it becomes a Planned Burn Project, and is subject to the requirements of WAQSR Chapter 10, Section 4. The proposals are likely to be categorized as a Planned Burn project under WAQSR rules and would have to meet those requirements.

Table 1. Acreage and Pile Volume Emissions Equivalency Conversion

Vegetation Type	0.25 Tons PM_{10} Emissions
Field Crops	16 acres
Shrub Land	8 acres
Forest	6 acres
Grass	25 acres
Weeds (ditches, fencelines)	12 acres
Shrub/Forest Piles	1,250 cubic feet

The Forest Service has several significant criteria associated with Air Quality and has a continuous monitoring program to determine if they are being met. Among these are visibility and Acid Neutralizing Capacity (ANC) of lakes. The air quality monitoring program also includes a National Atmospheric Deposition Program (NADP) site, WY-98, which collects data on the chemistry of precipitation.

Alternative 1 (No Action)

There would be no air quality effects from burning, as there would be no prescribed burns.

Alternative 2 (Proposed Action)

The primary effects on air quality are from prescribed burns of conifer forest, aspen, sagebrush, and non-commercial forest. Prescribed burns would have a short-term impact on visibility in the BTNF, but these controlled burns would likely reduce impacts from wildfires. The Proposed Action proposes prescribed burning on up to 24,289 acres containing a mixture of sagebrush, grass, aspen, and conifer vegetation. A mix of broadcast and pile burning would be utilized.

There are several mitigation techniques that could be used to reduce smoke production and its impacts to bring them into conformance with WAQSR rules. As part of the burn plan, permitting and coordination with state officials would be required. These techniques are used to reduce fuel loading and/or consumption, to reduce smoke incursions and concentrations, and to notify neighbors of planned burns.

D. Cumulative Effects

There are several partially developed natural gas fields south of the project area, located on BLM land. Further development of these fields could have a cumulative effect on the air quality in the Project Area, from emissions from diesel motors on the gas rigs, and other potential sources. The Jonah Infill project, which is located approximately 50 miles south east of the site, could add 3,100 new wells to the 450 wells presently operating in the Jonah Field area. The Jonah Infill EIS published in early 2006, provides data and

modeling for effects on the Upper Green River Airshed. In addition, 700 to 900 wells have been approved on the Pinedale Anticline Gas Field, which is also on BLM property. Proposals to allow the addition of winter drilling in the Pinedale Anticline Field are currently being considered by the BLM, and would impact the air quality by adding to the present drilling season, which has been spring through fall.

Besides the current natural gas drilling and proposals on BLM land, the BTNF is considering a proposal for oil and gas leasing on 44,600 acres in the Big Piney Ranger District, which would add more particulates to the air, and thus potentially decrease air quality.

Range Resources and Rangeland and Shrubland Vegetation

A. Issue Statement or Issue to be Addressed

Vegetation Management
This issue addresses internal and public concerns regarding:

- Vegetation recovery after treatments
- Effects of livestock and wildlife on treatment areas

B. Existing Conditions

The project area contains portions of two grazing allotments: the Upper Green River, and Roaring Fork allotments. The proposed project activities would occur in the Upper Green River Allotment and Roaring Fork Allotments. The Upper Green River Allotment is primarily within the Green River Drainage of the Colorado River System and contains approximately 130,100 acres. It has a permitted grazing obligation for 7,565 head of adult cattle (cow/calf) and 43 head of horses. This allotment has the largest permitted number of grazing livestock in the National Forest System. The current authorized period of use is from June 16 to October 15, which amounts to 30,432 "animal unit months" (AUMs).

There are four separate livestock management systems currently being carried out within this allotment. Deferred rotation is practiced in three areas, and rest rotation management is practiced in one area. Range riders are employed by the grazing permittees to help keep livestock distributed throughout the allotment for the purpose of obtaining a more even pattern of forage utilization. The District Ranger also issues annual livestock management instructions designed to protect and improve a specific area's vegetation or soil and/or water where at, or below, prescribed monitoring standards.

A stock driveway in the Upper Green River Allotment is divided into two main sections: the Marsh Creek-Boulder Creek Driveway and the Green River Bottom Stock Driveway. The Marsh Creek-Boulder Creek Driveway begins on Marsh Creek at the Forest boundary near McDowell Flats. The driveway parallels the Green River Lakes Road (road # 650) in some locations and then follows near the Green River from the Bend to the southern boundary of the project area. Permitted cattle use the driveway to go to and from the allotment, with the exception of some cattle trucked in for various reasons.

In 1924, the Roaring Fork Allotment was separated from the Upper Green River allotment by the Roaring Fork Drift Fence, at that time, 170 cattle and 130 head of horses were retained on the Roaring Fork Allotment, with an authorized season of use between June 16 and October 15. In 1937, records show that one permit allowed 55 head of horses, and that Upper Green River Cattle permittees also had 75 head of horses on the allotment.

In 1943, because of the importance of the allotment to the well-being of the Upper Green elk herd, the number of horses allowed to graze was reduced from 130 head to 55 head. In 1950, the 55 head horse permit was relinquished. Since that time the permitted grazing has remained at 170 head of cattle from June 16 to October 15 each year.

The Wyoming Game and Fish Commission established a winter elk-feeding program and feedground located just east of the bend of the Green River, and approximately two and a half miles north of the lower Green River Lake. The Commission moved the feedground west in 1948, off the allotment to a willow bottom riparian area near Moose Creek, due to the detrimental effect the concentration of elk had on aspen and on drier southern slopes in the old location. In the winter of 1970/71, the elk feedground was moved to its present location on a wet meadow-shrub site.

The Roaring Fork Allotment is located in the northeastern portion of the assessment area. It covers 8,300 acres, and has a current grazing authorization of 170 cattle units from June 16 to October 15 for 680 AUMs. Cattle are moved around the allotment periodically to help prevent livestock from congregating along the Green River bottom.

Rangeland Composition

Domestic livestock grazing occurs on landscapes that provide forage, water, and lounging for the livestock, and are located on terrain that is gentle enough to be preferred by livestock. Three major vegetation types dominate the portion of the project area grazed. The coniferous forest types are not included because the effects of livestock grazing are generally confined to the other vegetation types.

Existing vegetation in the project area is the result of past climatic regimes and disturbances, both natural and human-caused. Fire, timber harvesting, livestock grazing and other natural and human-caused disturbances have played significant roles in shaping existing vegetation conditions in the project area. These vegetation types are discussed in the following sections.

Shrubland

Shrubland cover consists of areas dominated by sagebrush. Vasey (mountain) sagebrush (used in determining FRCC) and big sagebrush occur below 9,000 feet and are the dominant sagebrush types on the project area. Idaho fescue is usually dominant in the understory, but Richardson's needlegrass may be dominant in some plant associations. Other common graminoids include slender wheatgrass, sedges, timber oatgrass, Columbia needlegrass, and prairie junegrass. Common forbs include sulphur buckwheat, lupine, rockcress, prairiesmoke, western yarrow, and northwest cinquefoil. Vasey (mountain) sagebrush is killed by fire.

Above 9,000 feet, subalpine (silver) big sagebrush (used to determine FRCC) is dominant, although not abundant, in the project area. Subalpine big sagebrush normally sprouts after fire has killed the above-ground stems. Sagebrush seed are normally only viable up to four years after natural seed dispersal.

Sagebrush ecosystems provide important food and cover for big game and other wildlife species. Many plant communities (e.g. aspen, mountain shrub, open conifer) occur in association with sagebrush communities (e.g. intra- and inter-community associations). Such mixed stands are important to a myriad of aquatic and terrestrial wildlife species. The distribution of sagebrush age class diversity also provides an important mixture of habitats in the ecosystem (Wyoming Interagency Vegetation Committee, 2002).

Within the project area, Pinyon Ridge provides important habitat for several wild ungulate species. Also, sagebrush borders the banks of the Green River and many of its

tributaries in the project area as part of the riparian zone, thus helping to provide important habitat for riparian wildlife associates.

Current landscape sagebrush has a high departure from characteristic vegetation and fuel conditions by containing a preponderance of mature and old stand classes.

Riparian
The riparian vegetation type includes areas dominated by willows, mountain silver sagebrush, shrubby cinquefoil, sedges, and tufted hairgrass.

Aspen
The aspen community types are important providers of habitat components for a variety of wildlife species; important providers of forage for permitted livestock; ground water release into the hydrological cycle; and visual relief and enjoyment for human beings. At present, significant acreage of the aspen type has been lost through natural vegetation succession. This loss will continue unless interruption to the process occurs or new early succession stage aspen is created.

Trends in Rangeland Vegetation
Key sites within key areas were selected and used to describe the existing vegetation condition in sufficient detail to evaluate the effects of domestic livestock grazing. Key areas are representative areas defined as, "a relative small portion of rangeland which, because of its location, grazing or browsing value, and/or use, serves as a monitoring and evaluation site" (USDA-FS, 2004b). A key area designation guides the general management of the entire area it is a part of, and will reflect the overall acceptability of current grazing management over the range. Vegetation and soil point data was collected during preparation for the Bridger-East Ecological Unit Inventory (EUI). Most of the vegetation data was collected from 1991 through 1995, although fieldwork continued through 1997.

The Pinedale Ranger District Range Staff Officer and allotment permittee representatives collect range plant utilization and ground cover data annually, at sites that could qualify as key sites, to determine current plant utilization and long-term vegetation trend. Permanent photo point references are photographed and used for visual comparisons of past and present vegetation based on the following R4 Ground Cover Thresholds.

Region 4 Ground Cover Threshold (Objectives) by Plant Community Type

Plant Community Type	R4 Ground Cover Threshold
Alpine grassland (Herblands)	<90% cover
Tall forb	<65% cover
Sage/grass	<70% cover
Aspen	<80% cover

Analysis of monitoring data gathered to date indicates that the vegetation trend is stable to up at all represented sites.

C. Effects on Range Resources
Available livestock forage would be greatest under the Proposed Action**.** Livestock forage in Alternative 1 would decrease over time as the younger growth stages in the overstory vegetation grow into the older growth stages.

As discussed in more detail below, the Proposed Action would meet the DFC by moving a third of the shrubland component into the 0 to 11 percent canopy cover class, but it would not provide benefits for the 11 to 20 percent class. The greater than 20 percent canopy cover class would contain most of the remaining two-thirds canopy cover. Alternative 1 shows a likely increase in the greater than 20 percent canopy cover class. Regardless of which alternative is chosen, the landscape of the project area and the Upper Green would continue to be dominated by denser canopy cover classes.

There will be no reduction in AUMs available to the permittee resulting from the proposed action and its alternatives. However, vegetation treatments within grazing allotments requires willingness on the grazing permittees part to work with the Forest Service to find alternative grazing options while treatment areas are rested prior to and after treatment.

There are a variety of methods available to exclude cattle from a given area. On a site-specific basis, felling of trees (jackstrawing) or the use of temporary fencing is possible. Cattle can also be moved to other portions of the same allotment, to other allotments, or to private lands. These actions can represent both an inconvenience and a financial burden to the permittee. Therefore, the method chosen will be worked out cooperatively with the grazing permittees to achieve both the resource objectives and reduce the impacts on the permittees. This will be done at the time of project implementation.

Available Livestock Forage

This effects assessment compares the Proposed Action and its alternatives with the available livestock forage as being either greater or lesser by alternative action. More forage is produced as the landscape vegetation trends closer to FRCC1 (low). This is compared to the desired changes in vegetation age-class diversity or as a measure in crown density, in the case of sagebrush. More livestock forage is produced in the earlier vegetation growth stages.

Alternative 1 (No Action)

Alternative 1 would see a long-term loss of available livestock forage due to natural succession of overstory vegetation to old age condition classes, thus reducing forage production.

Alternative 2 (Proposed Action)

The Proposed Action would provide for the most opportunity to start moving vegetation toward FRCC1 and towards early vegetation age classes. Available livestock forage would be greatest under the Proposed Action.

Shrubland (Sagebrush/Grassland)

The two sagebrush vegetation types and the herbland vegetation type comprise approximately 32,638 acres of the project area. Since these vegetation types are not mutually exclusive, they are combined for this analysis. Approximately 10,713 acres of these combined vegetation types (shrubland and herbland) would be subject to treatment on the 21,200-acre Pinyon Ridge treatment area under the Proposed Action. Aspen and conifer would also be treated on Pinyon Ridge. Historically, wildland fires burned in a mosaic from 30 to 70 percent of the project area; therefore, an average of 50 percent burned to un-burned area per treatment unit is used for this assessment. No manipulation projects would occur under Alternative 1.

The DFC calls for a more diverse mix of age classes and structures. The desired mix for canopy cover is: approximately one third in 0 to 11 percent canopy cover, approximately one third in 11 to 20 percent cover, and approximately one third in greater than 20 percent canopy cover.

This effects assessment compares the Proposed Action with the changes in canopy cover and in the sagebrush Potential Natural vegetation (PNVG) Fire Regime Condition Classes (FRCC1-3) with 1 being low or most desired and 3 being high or least desired in terms of the amount of departure from the historical natural fire regime. FRCC2 is moderate departure. The FRCC classes correspond somewhat to the DFCs.

Alternative 1 (No Action)

Under Alternative 1, the trend would be to grow the 11 to 20 percent canopy cover class into the greater than 20 percent sagebrush canopy cover class. The likelihood of stand replacement wildfires will increase over time.

Alternative 2 (Proposed Action)

The Proposed Action would provide the greatest amount of canopy cover in the 0 to 11 percent class with approximately 5,356 acres impacted (10,713 acres available at a 50 percent burn rate) out of a 32,638 total sagebrush/grassland acres (16.4 percent in 0 to11 percent canopy cover class) to meet the DFC. The Proposed Action does the most to meet low PNVG FRCC1 (From a high to a moderate FRCC).

D. Cumulative Effects

Cumulative effects for the Proposed Action include grazing by domestic livestock and wild ungulates, rodents, and lagomorphs on grass, forbs and browse plant species trying to become established after treatment. These impacts have occurred in the past, are currently occurring, and will occur in the future. However, application of Forest Plan Standards and Guidelines, Mitigation Measures and Monitoring activities applied prior to, during and after treatment will ensure success. Livestock management activities will be impacted and local planning will be one of the keys to manage livestock away from the treatment areas. The Wyoming Game and Fish Department should provide valuable expertise and experience in helping to lessen the impacts from wildlife on establishment of valued habitat components.

The LSA (USDA-FS, 1999) is the basis for the cumulative effects analysis. Currently, sagebrush comprises approximately 80,300 acres (30 percent) of the 267,532-acre LSA (note that the LSA assessment is significantly larger than the project area). There would be no cumulative impacts beyond the project area as no other active sagebrush management is occurring, or planned, within the LSA at this time. Management activities under the Proposed Action and its alternatives would not change the total amount of sagebrush in this area, nor would the results of active management under the Proposed Action affect the LSA's overall sagebrush structure and age-class distribution. Additional sagebrush management projects would be required to achieve the shrubland DFC.

Noxious Weeds

A. Issue Statement or Issue to be Addressed

There were no key noxious weeds resource issues or concerns identified during the public scoping process.

B. Existing Conditions

Noxious weed presence and strategies for dealing with them have been identified at a Forest-wide level. Several noxious weed management strategies were analyzed in a recent Forest-wide environmental assessment (EA). An integrated noxious weed management strategy was chosen to address the issues. The EA concluded that existing weed infestations on the Forest are sufficiently limited in extent that they are not significantly affecting the productivity of National Forest System Lands. In addition, the effects analysis concluded that the weed management strategy currently in place would result in a reduction, or no net gain, in environmental effects from noxious weed infestations.

More recently a Forest-wide strategy and implementation plan was approved for the Forest. Many of the implementation actions were already taking place across the Forest, including public education activities, reporting requirements, and cooperative efforts among multiple public and private entities. A formal process for early detection of weed infestations and rapid response with treatment was identified in the implementation plan. Currently, the BTNF is combining multiple formal inventories into a single Geographic Information System (GIS) based inventory which will be updated annually.

Noxious weeds are known to occur in several portions of the project area. Known areas that contain noxious weeds include: sections along the Green River Lakes Road, in the Green River Lakes Campground and trailheads, and in horse corrals. Most weeds in the project area are in established visitor-accessible areas near motorized travel routes, particularly along user created roads, campgrounds and trailheads. Noxious weeds will continue to be identified, surveyed, mapped and treated. No additional project-specific inventories will be conducted, as these inventories are an ongoing activity. However, prior to project implementation, areas will again be visually assessed for the presence of weeds during standard operations.

From 1999 to 2004, enhanced weed control in cooperation with Sublette County, has included spraying for Canada thistle and Musk thistle, and the release of biological control agents for these two thistles. The Forest Plan Noxious Weeds Control Standard states: “Effective management of noxious weeds will be accomplished by cooperating with the Wyoming Department of Agriculture and County weed control districts, using Integrated Pest Management techniques, following the procedures outlined in the Bridger-Teton Environmental Assessment for noxious weed control and appropriate technical guides. No toxic chemicals will be applied in a manner that will adversely affect non-target species” (USDA-FS, 1990). Noxious weed status within the project area and vicinity, including species presence, priority, and estimated areas of infestation, is presented in the following table.

The establishment of non-native plant species not designated as “noxious,” but which have the potential to out-compete native species has also occurred within the project area,

including the Bridger Wilderness. These non-native, invasive species include, but are not limited to, Downey brome, Kentucky bluegrass, and Smooth brome.

Noxious Weed Status within the Project Area

Common Name	Scientific Name	Listed in Wyoming	Forest Priority	Acreage
Black Henbane	*Hyoscyamus niger*	Yes	Yes	Not Recorded
Canada thistle	*Cirsium avense*	Yes	Yes	5 Acres
Common burdock	*Arctium minus*	Yes	No	Not Recorded
Musk thistle	*Carduus nutans*	Yes	Yes	1 Acre
Perennial pepperweed	*Lepidium latifolium*	Yes	No	Not Recorded
Sulfur cinquefoil	*Potentilla recta*	Yes	Yes	< 1 Acre
Yellow toadflax	*Linaria vulgaris*	Yes	Yes	Not Recorded

C. Effects on Noxious Weeds

The Proposed Action would result in a higher potential for the establishment and spread of noxious weeds in the project area due to the acreage of vegetation treated. Alternative 1 would not result in any direct or indirect effects to the risk of noxious weed infestation as no ground disturbing activities would be implemented. Current weed infestation problems would continue, particularly along travel routes and in dispersed camping areas. Implementation of the sagebrush, grass, and aspen treatments have the potential to result in noxious weed infestation as all treatments would disturb the soil. Depending on the intensity of the prescribed fires combined with soil moisture conditions, some burning treatments could actually destroy the seed viability of some weed species. In some cases, however, fire could increase the opportunities for noxious weeds to spread into areas of bare ground exposed after a burn.

D. Cumulative Effects

Past, present, and reasonably foreseeable actions that could affect the introduction or presence of noxious weeds in the Analysis Area include: livestock grazing, vehicular use on and off roads, dispersed camping, special recreation events, timber sales, vegetation treatments, and prescribed burning. Cumulative effects from past actions are not significant due to the limited amount of area they have affected. Present and reasonably foreseeable actions will pose the potential for introduction of noxious weeds and there spread; however, monitoring and treatment along with mitigation measures will continue to reduce the threat.

Soils

A. Issue Statement or Issue to be Addressed

Watershed Health
This issue addresses internal and public concerns regarding:

- The contribution of sediment to the Green River and its tributaries
- Water quality
- Potential impacts to wetlands and riparian areas

Indicators to assess the issue above include:

- Results of WEPP modeling of sediment from vegetation treatments.
- Acres of potential soil erosion.
- Affected acres of riparian and wetlands.

B. Existing Conditions

This section describes the existing soil conditions within each treatment type. Information from field observations, the Ecological Unit Inventory, and slope data are presented.

The Ecological Unit Inventory (EUI) completed in 1997 for the project area includes maps and corresponding map unit descriptions which provide detailed descriptions of ecological types, landforms, geology, parent materials, soils and potential natural vegetation types. Soil properties and interpretations are summarized, and management implications related to the proposed action are included for each ecological unit (see glossary) within the project area. Soils information within each treatment area is summarized for Compaction and Erosion hazard ratings, and **Tables 1 and 2** indicate their relative distribution by treatment type. Complete documentation including detailed plot information can be found in the Bridger East Ecological Unit Inventory (EUI) document (USDA-FS, 1997b). Detailed soil descriptions and associated plot data that support the EUI are available at the Supervisors Office.

Soil compaction hazard ratings for soils within the mechanical treatment units are used as indicators to assess the relative risk of inducing soil compaction through mechanical harvest techniques The rating criteria were adopted from the *Region 4 Soil Interpretive Guide May 1995* and the *NRCS National Forestry Manual*.

When soils are compacted the macropore space decreases, bulk density increases, and the soil structure is damaged. Decreased soil porosity reduces infiltration and percolation, increases surface runoff, and encourages erosion. The physical, chemical and biological effects of compaction restrict plant growth resulting in an overall reduction in soil productivity.

The ratings are based on the soil textural class, coarse fragment content and shape, organic horizon thickness and soil structure, and are based on weighted averages of the top 12 inches of mineral soil. This rating assumes **moist or wet soils.** Dry soils are not as easily compacted as moist or wet soils. Frozen ground also tends to minimize the

effects of compaction. Areas with "severe" or "moderate" compaction hazard ratings may require restrictions on use during high moisture conditions.

Soils with a slight limitation rating will generally not suffer a long-term reduction in their natural productivity as a result of timber harvest activities. Soils with a moderate limitation rating will suffer a significant reduction in their long-term natural productivity capability. However, soils with a moderate rating can be managed for sustained natural productivity by controlling the timing and intensity of use. Their natural productivity can be restored through the application of relatively simple soil compaction amelioration treatments. Soils with a severe limitation rating will generally suffer a reduction in their long-term natural productivity level if timing and intensity of use is not controlled.

The polygons for each mechanical treatment type were intersected with the soils polygons to generate the distribution of each type of soil within a treatment unit. Table 1 provides the relative area of a specific compaction hazard rating for the soils within each mechanical treatment type.

Table 1. Soil Compaction Hazard Ratings for Mechanical Treatment Units.

TREATMENT TYPE	COMPACTION HAZARD RATING	ACRES
Mechanical Treatments		
Kendall Warm Springs	Moderate	268
	Severe	485
Kendall Guard Station	Moderate	200
	Severe	373
Dollar Lake	Moderate	743
	Severe	815
	Wetland	3
Pinyon Ridge	Moderate	1384
	Severe	2077
	Wetland	519

Soil erosion hazard ratings for soils within both the mechanical and prescribed fire units are used as indicators to assess the relative risk of erosion that may occur as a result of the treatments. Activities associated with the proposed action that may disturb the soil surface include; log skidding and prescribed fire.

Erosion hazard ratings are based on slope, k-factor, and rock fragments on the surface layer. "Slight" refers to soils where erosion is unlikely under ordinary climatic conditions. "Moderate" refers to soils where some erosion is likely and control measures may be needed. "Severe" refers to soils where erosion is very likely and control measures for vegetation reestablishment on bare areas and structural measures are advised.

The polygons for each treatment type were intersected with the soils polygons to generate the distribution to each type of soil within a treatment unit. Table 2 provides the area of a specific erosion hazard rating within each treatment type.

Table 2. Area of Erosion Hazard Rating within each treatment type.

TREATMENT TYPE	EROSION HAZARD	ACRES
Pinyon Ridge Prescribed Fire Units		
Wilderness Unit	Moderate	2018
	Severe	278
	Rock and Talus	165
	Water	5
Mud Lake East	Slight	3796
	Moderate	2167
	Wetlands	99
	Water	15
Mud Lake West	Slight	3511
	Moderate	1385
	Wetland	103
	Water	11
Roaring Fork	Slight	2646
	Moderate	4840
	Wetland	103
	Water	10
Mechanical Treatments		
Kendall Warm Springs	Slight	485
	Moderate	268
E. Kendall Guard Station	Slight	53
	Severe	520
Dollar Lake	Slight	238
	Moderate	1034
	Severe	286
	Wetland	3
Pinyon Ridge	Slight	519
	Moderate	2942
	Wetland	519

The Water Erosion Prediction Project (WEPP) soil erosion model was used to evaluate sediment production and delivery for the various vegetation treatments within the project area. The WEPP model was developed by an interagency group of scientists including the USDA's Forest Service, Agricultural Research Service, and Natural Resources Conservation Service, and the Department of Interior's Bureau of Land Management and Geological Survey.

The WEPP model is a complex computer program that describes the processes that lead to erosion. These processes include infiltration and runoff; soil detachment, transport, and deposition; and plant growth, senescence, and residue decomposition. For each day of simulation, WEPP calculates the soil water content in multiple layers and plant growth/decomposition.

The WEPP model contains several web based interfaces and users can select which interface is appropriate for the type of treatment. For the vegetation treatments,

Disturbed WEPP was used to determine modeled rates of erosion and sediment delivery to the base of slopes/adjacent stream channels for each treatment type under existing conditions (No Action alternative) and under the action alternative. For the cumulative effects section, the WEPP Road interface was used to model the erosion from the roads to adjacent streams and at crossings.

Basic input paramenters used by the WEPP model include slope length and gradient, climate, soil texture, rock content and ground cover. Digital Elevation Models (DEM) and Digital Orthographic Quadrangles (DOQ) were used along with treatment unit boundaries to identify slopes adjacent to streams where erosion from the proposed treatments could cause sedimentation. These areas were then transected in GIS to provide information on slope length and gradient. Records of transect locations by treatment type are available in the project record.

For climate, monthly mean precipitation data from the Kendall Ranger Station was used to develop a custom climate for the project area (http://www.wcc.nrcs.usda.gov/snotel). The Kendall Ranger Station is located in the southwestern corner of the project area south of the junction of forest road 600 and 650 about 2 miles north of the forest boundary (Reference Figure 1.1-2). Soil textures, rock content and ground cover were taken from the Ecological Unit Inventory data (USDA Forest Service 1997b).
Results and specific assumptions for each treatment type modeled are included in section C. - Effects of the Proposed Action. The project record contains documentation for the model, which includes hard copy print outs of results and a spreadsheet documenting input parameters, assumptions and results (see soil_erosion_analysis.xls). Additional documentation and input datasheets are also available at:
http://forest.moscowfsl.wsu.edu/fswepp/docs/distweppdoc.html.

B.1 Mechanical Treatments

Most of the aspen stands that are being considered for management occur on the lateral moraines of past glaciers. The ridges of the moraines are usually dry and coarse textured. Slope ranges from 0 to 36 percent based on 10m DEM data and transects used for the WEPP model. Table 3 lists slope ranges of each treatment unit.

Presently the soils in the aspen stands are stable. Generally the soil is completely covered with native vegetation, and erosion is not a concern. Many sites have a good quantity of seedling aspen growing. The only areas in these aspen stands that show any impact are the result of livestock grazing. Ground cover is marginal and bare soil is exposed along the stock driveway and bedding areas.

Slope ranges from 0 to 43 percent based on 10m DEM data and transects used for the WEPP model. The highest percent slope occurs in the Kendall Guard Station unit which ranges from 14 to 40 percent. Table 3 lists slope ranges of each treatment unit.

The compaction and erosion hazards of soils in the proposed mechanical treatments are summarized in Tables 1 and 2. Severe compaction hazard ratings occur on 3750 acres. Moderate compaction hazard ratings occur on the remaining 2595 acres. Severe erosion hazard ratings occur on 806 acres. Moderate erosion hazard ratings occur on 4244 acres. Slight erosion hazard ratings occur on the remaining 1295 acres. There and 521 acres of wetlands within the treatment areas.

Table 3. Slope ranges of treatment units (from transect data used for WEPP).

TREATMENT TYPE	SLOPE RANGE
Prescribed Fire Units	
Wilderness Unit	0 - 50
Mud Lake East	3 - 35
Mud Lake West	8 - 26
Roaring Fork	8 - 37
Mechanical Treatments	
Kendall Warm Springs	9 - 24
Kendall Guard Station	14 - 40
Dollar Lake	7 – 25
Pinyon Ridge	10-40

B.2 Prescribed Fire Treatments

These aspen stands are extensively used by wildlife the whole year and the same aspen stands are used for livestock grazing. Some areas in these stands are severely impacted, by animal activity. Soil in the shading and bedding areas is compacted, overland flows are common and the grasses, forbs and aspen seedlings are absent. The aspen stands occur on lateral moraines on the east and north side of the Green River valley. Seeps and small springs occur in this landtype.

Slope ranges from 0 to 50 percent based on 10m DEM data and transects used for the WEPP model. The highest percent slope occurs in the Wilderness unit which ranges from 0 to 50 percent. Table 3 lists slope ranges of each treatment unit.

The erosion hazards of soils in the proposed prescribed fire treatments are summarized in Table 2. Severe erosion hazard ratings occur on 278 acres. Moderate erosion hazard ratings occur on 10410 acres. Slight erosion hazard ratings occur on the remaining 9807 acres. There are 536 acres of water, 165 acres of rock and talus, and 519 acres of wetlands within the treatment area.

C. Effects of the Proposed Action and No Action Alternative on Soils

This section discloses the direct and indirect impacts of the proposed action and the no alternative on soil erosion and watershed health. The impacts are described for each component of the proposed action and no action alternatives.

ALTERNATIVE 1 (NO ACTION)

Under Alternative 1, the present condition in the watershed would continue to be stable, as there would be no aspen-sagebrush management occurring.

ALTERNATIVE 2 (PROPOSED ACTION)

Mechanical Treatments

The Proposed Action for the Mechanical Treatment areas would have some impacts on the soil resource from the prescribed fire and limited mechanical methods that are to be used to regenerate the aspen stands. Potential problem sites occur when aspen stems are piled and then burned. This potential impact can be reduced if the piles are burned in the winter and when the soil is wet.

The use of machinery will result in some surface soil disturbance. The type of machinery used, wheeled tractor or crawler tractor, will be a factor in the amount of soil compaction and soil surface disturbance. The amount of compacted soil will be less, since skid trails should not be used, or decking locations. The main form of detrimental soil disturbance will occur under the burn pile.

Wetlands Associated with the Mechanical Treatment Units

According to the Ecological Unit Inventory data, there are about 521 acres of wetlands associated with the mechanical treatment units. The wetland areas are typically small pockets of willows located along seep areas. These areas will be avoided to the extent possible.

Erosion Modeling for Mechanical Treatments

Each mechanical treatment unit was modeled to determine the total amount of soil erosion that could possibly occur and the amount of sediment that could possibly occur and would potentially be delivered through a buffer to the base of the slope, or to a stream. The model was run for each treatment followed by broadcast or pile burning for each unit. Model results and specific assumptions for each individual unit are available in the project record (see soil_erosion_analysis.xls). Following are results of the model for the Proposed Action. Erosion from the No-Action Alternative for all treatments is assumed to be zero.

Table 4 lists the average, 10 year return period, and probability of soil erosion in tons per year for all the acres in a treatment unit. The model assumes that every acre in each treatment unit, however this is unlikely to be the case. The average amount of soil erosion immediately following the prescribed burn ranged from 111 to 432 tons per year.

The amount of erosion from the 10 year return period event ranged from 573 to 5962 tons per year. The probability that erosion will occur ranges from 10 to 44 percent. The average amount of soil erosion one year after the prescribed burn ranges from 2.86 to 54.4 tons per year.

Table 4. Modeled Soil Erosion.

Unit & Total Acres	Effects following:	Average soil erosion (tons/yr)	10 year return period soil erosion (tons/yr)	Soil erosion probability %
Kendall Warm Springs	prescribed burn	111.29	573.37	22-30
	1 year after prescribed fire	2.68	0.00	4
Kendall Guard Station	prescribed burn	432.00	5962.00	24-44
	1 year after prescribed fire	54.40	284.80	18
Dollar Lake	prescribed burn	226.52	693.33	10-44
	1 year after prescribed fire	2.86	0	6

Table 5 lists the average, 10 year return period, and probability of sediment in tons per year delivered through a buffer by treatment unit. The average amount of sediment delivered ranges from 0.03 to 12.44 tons per year. The amount of sediment delivered

from the 10 year return period event ranged from 0 to 30.7 tons per year. The probability that sediment delivery will occur ranges from 2 to 38 percent.

Table 5. Modeled Sediment Delivery to Streams.

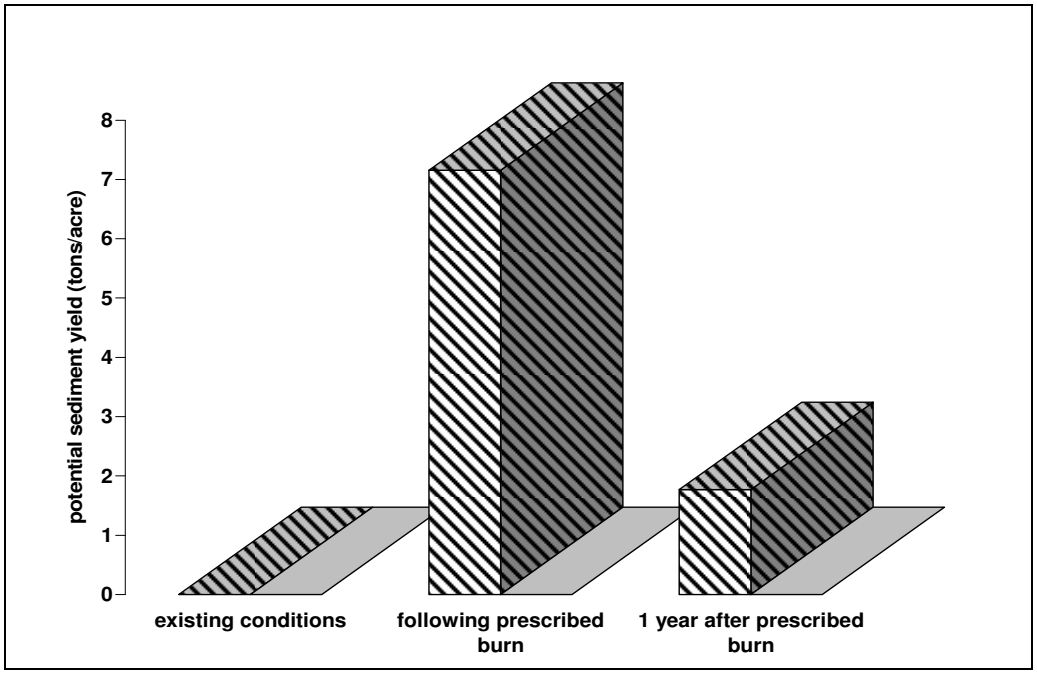
Unit & Total Acres	Effects following:	Average sediment delivery (tons/yr)	10 year return period sediment delivery (tons/yr)	Sediment delivery probability %
Kendall Warm Springs; 753	prescribed burn	2.05	105.88	12
	1 year after prescribed fire	2.00	0.00	2
Kendall Warm Springs; 753	prescribed burn	1.18	0.00	6
Kendall Guard Station; 573	mechanical treatment	11.39	46.02	18
	prescribed burn	384.48	978.66	40
	1 year after prescribed fire	55.55	56.48	18
Kendall Guard Station; 573	prescribed burn	1.78	0.70	12
Dollar Lake; 1561	prescribed burn	21.47	28.35	12
	1 year after prescribed fire	1.18	0.00	4
Dollar Lake; 1561	prescribed burn	95.44	77.11	34
	1 year after prescribed fire	3.80	0.00	8
Dollar Lake; 1561	prescribed burn	48.84	172.70	22
	1 year after prescribed fire	1.51	0.00	2

Prescribed Fire Treatments

The use of fire to manage aspen, sagebrush, grass and forbs usually has very little impact due to the lower heating temperatures near the soil surface. The prescribed burn area must have a buffer zone about 200 feet from any live water, flowing streams and ponds, and wet areas such as riparian areas. The vegetative buffer strip will be a sediment filter area if overland flow should occur. Most of the aspen, grass and forb plants will re-sprout in the same growing season after the burn. This greatly reduces the potential for surface water flows and erosion to occur. The new vegetation should be allowed to grow and establish a good root system for two full growing seasons after the burn, before any management use such as grazing. The sagebrush will re-establish itself, but this will take longer, since the seeds are transported in from adjacent sites.

Where prescribed fires occur, all of the soil is not left unprotected in the project area. Fire would burn in a mosaic pattern, at different intensity levels, and some areas may not burn at all. Soil erosion may increase for a short time on the steeper slopes but vegetation would begin to sprout immediately after the fire if adequate soil moisture is available. Figure 1 depicts modeled erosion after the prescribed burn and 1 year after the prescribed burn for units with loam and sandy loam soil textures.

Figure 1. Modeled potential erosion following a burn treatment.



Since not all the prescribed fire units will be burned at once, soil within prescribed fire areas would not be disturbed significantly and erosion would be minimal. The prescribed fire would kill the standing aspen and consume part of the sagebrush plants, however, some of the overstory would remain for soil protection. Where fire occurs under down aspen trees, there is a potential to overheat the soil but not to the same extent as under burn piles.

The burn areas would start to revegetate soon after the burn, and soil stability would return within one to two full growing seasons. The greatest impact on these sites would be the impact of livestock grazing before the burn areas are well vegetated. All burn areas need to be rested until at least 60 percent ground cover is achieved (see Mitigation Measures).

Wetlands Associated with the Prescribed Fire Units

According to the Ecological Unit Inventory data, there are about 519 acres of wetlands associated with the prescribed fire units. The wetland areas are typically small pockets of willows located along seep areas. These areas will be avoided to the extent possible.

Erosion Modeling for Prescribed Fire Units

Each prescribed fire treatment unit was modeled to determine the total amount of soil erosion that could possibly occur in the entire unit burned and the total amount of sediment that could possibly occur and would potentially be delivered through a buffer to the base of the slope, or to a stream. The results are displayed in Tables **6** and **7** and show soil erosion or sediment delivered for the average, 10 year return period, and the probability that erosion will occur. The 10 year return period event has a 10 percent chance of occurring in a given year. The model was run for each prescribed burn unit to describe the effects following the burn and then 1 year after. Model results and specific

assumptions for each individual unit are available in the project record (see soil_erosion_analysis.xls). Following are results of the model for the Proposed Action. Erosion from the No-Action Alternative for the prescribed fire treatments is assumed to be zero.

Table 6 lists the average, 10 year return period, and probability of soil erosion in tons per year by treatment unit. The average amount of soil erosion ranged from 381 to 1661 tons per year immediately following the burn. The amount of erosion from the 10 year return period event ranged from 1782 to 5594 tons per year. The amount of average erosion is significantly less 1 year following the burn because vegetation will quickly re-establish itself in this area. The probability that erosion will occur ranges from 2 to 32 percent.

Table 6. Modeled erosion from prescribed burn units.

Burn Unit	Effects following:	Average soil erosion (tons/yr)	10 year return period soil erosion (tons/yr)	Soil erosion probability %
Wilderness	prescribed burn	381.53	1782.42	18-30
	1 year following burn	11.04	0.00 ± 0.00	4
Mud Lake East	prescribed burn	1661.29	4982.33	18-32
	1 year following burn	51.23	0.00	6
Mud Lake West	prescribed burn	446.41	1169.60	12-28
Roaring Fork	prescribed burn	1447.98	5593.79	22-30
	1 year following burn	21.50	0.00	2-6

Table 7 lists the average, 10 year return period, and probability of sediment in tons per year delivered through a buffer by treatment unit. The average amount of sediment delivered ranges from 10.7 to 23.4 tons per year. The amount of sediment delivered from the 10 year return period event ranged from 0 to 6.4 tons. The probability that sediment delivery will occur ranges from 2 to 12 percent.

Table 7. Modeled sediment delivery for prescribed burns.

Burn Unit	Effects following:	Average (tons/yr)	10 year return period (tons/yr)	Probability %
Wilderness	prescribed burn	23.48	0.00	2-6
	1 year following burn	5.45	0.00	2
Mud Lake East	prescribed burn	15.81	0.00	2-8
Mud Lake West	prescribed burn	14.31	5.23	10
	1 year following burn	3.54	0.00	2
Roaring Fork	prescribed burn	10.73	6.36	2-12

D. Cumulative Effects

The cumulative effects that could affect the project area are continued livestock grazing, recreational firewood cutting, seasonal dispersed recreation, and the use and creation of user-created user roads. These continued activities have the potential to negatively interact with the direct and indirect effects of the Proposed Action and the No Action Alternative.

Different forms of recreation occur in the project area year-round. Dispersed recreation sites account for the majority of effects in the project area. The most severe impacts on

the soil resource occur in the spring and fall, when the soils are moist to wet. During the summer months, the soils are usually dry, except during the short duration summer rainstorms. Dispersed recreation sites are estimated to be about 0.25 acres in size. Presently there are about 200 dispersed recreation sites in the project area, totaling 50 acres. Some of these sites are adjacent to the Green River and other small streams.

Many of the dispersed sites are very close to the river and side channels. The compacted soil caused by years of vehicle and foot traffic produces sediment to the streams when water flows across the sites due to the loss of a vegetative buffer. The loss of riparian vegetation, grasses, forbs and willows, also reduces the stability of the streambank.

User-created roads in the project area are associated with dispersed recreation activities, dispersed camping, hunting, fishing, and firewood collection. Some of the user-created roads are also associated with grazing. The additional use and creation of user-defined roads that may occur in the project area could add cumulatively to the effects of the Proposed Action and Alternative 1 (No Action) on soil resources, as each mile of road removes about 1.5 acres from soil production. It is assumed that each user-created road and roads to dispersed campsites are 12 feet wide. The width of the road multiplied by the length divided by 43,560 (square feet per acre) equals acres in roads (1 mile of road equals 1.5 acres). These areas include fords and stream crossings where poor culvert location and function lead to water laden sediment draining directly from the road into the stream. Roads that were well designed and surfaced with gravel have the least problems with erosion and sedimentation. The roads with a running surface of only the native soil are very muddy when wet, and very dusty when dry.

Grazing activity has the greatest overall impact on the project area, since most of the project area falls within grazing allotments. The aspen and sagebrush in the driveway along the Green River is severely impacted from erosion, soil compaction, and the excessive removal of vegetative understory. Localized areas within aspen stands and riparian areas have also received high levels of impact by livestock (USDA-FS, 2004b).

Grazing in the project area could add cumulatively to the impacts of aspen, sagebrush, and grass management on soil resources under the Proposed Action and Alternative 1 (No Acion). However, these impacts would be minor and short-lived, as the increased erosion discussed under the direct and indirect impacts would be short-term and temporary. Further, mitigation has been suggested to allow for proper regeneration of vegetation. As long as the burn areas are rested from grazing for a period sufficient to allow for the growth and development of regenerating plants, the action alternatives would improve the quality of the soil in the project area, overall. The re-establishment of plants would help protect the soil and minimize the potential for soil erosion.

Soils in the project area have had no impact from timber harvesting or fuel management activities in the past ten years except for some local firewood gathering. All of the old timber sales in the area are now re-vegetated with new seedling conifers, grasses and forbs. Bare soil was not observed in any of the old cutting units that were evaluated, associated with the removal of timber. The only bare soil that was seen was associated with the movement of livestock, like cow trails. The grasses, forbs and young conifer trees were growing very well.

Fisheries and Watershed

A. Issue Statement or Issue to be Addressed

Watershed Health
This issue addresses internal and public concerns regarding:

- The contribution of sediment to the Green River and its tributaries
- Water quality
- Fisheries
- Potential impacts to wetlands and riparian areas

Threatened Endangered Species, Sensitive Species and Wildlife Habitat
This issue addresses internal and public concerns regarding:

- Impacts to threatened, endangered, and sensitive species from this project

B. Existing Conditions

The Pinyon Osborn analysis area is in the upper drainages of the Colorado River and Snake River systems and is within the historic range of Colorado River cutthroat trout (CRC) and Snake River cutthroat trout (SRC). CRC are limited in the Project Area streams by competition with non-native salmonids and habitat loss. SRC are abundant in the Analysis area (Snake River drainage) but are not found within the project area. The streams around the Pinyon Osborn area contain primarily brook, brown, lake, rainbow, and some cutthroat trout. The Green River Basin also supports five endangered fish species, none of which are potentially impacted by the proposed project.

Aquatic habitat in the analysis area is both abundant and varied. There are approximately 295 miles of streams and 130 lakes (2,200 acres) within the analysis area. The major perennial rivers and streams in the project area include the Green River, Wagon Creek, Roaring Fork Creek, and Moose Creek. Small segments of Tepee Creek and Tosi Creek are also in the western portion of the analysis area and connect with the Green River. The majority of the lakes in the analysis area are small. However, a few larger (> 25 acres) lakes are also present, including Dollar Lake, Mosquito Lake, and the Lower Green River Lake. Nearly all the streams support some kind of fish life, at least for part of the year. Of the 130 lakes, 55 (1,600 acres) support trout populations, and 75 lakes (600 acres, mostly within the wilderness area) have no fish.

There is one USGS gaging station in the vicinity of the analysis area. The gage is on the Green River at Warren Bridge 14 miles downstream from the Forest boundary (as well as from the lower boundary of the analysis area) and measures the flow from the 468-square mile watershed upstream from it. The gage has historical streamflow data from October 1931 to the present (missing records: September 1992 to October 1993). This flow regime characterizes the hydrology of the project area.

Most streamflow in the analysis area results from the melting of snow that accumulates at elevations above 9,000 feet. Therefore the subalpine and alpine portions of the Forest are the principal source of streamflow year round. Peak streamflows at the Warren Bridge gage generally occur from mid May through June in response to snowmelt. Flows

remain high into July, when peak flows subside and upstream irrigation diversions begin to deplete streamflow; USGS peak flow data has notations beginning in 1995 that discharges are affected to an unknown degree by regulation or diversion.

B.1 Management Indicator Species

Management Indicator Species (MIS) are those species whose population changes are believed to reflect the effects of land management activities. Four types of MIS are identified in the *1990 Bridger Teton National Forest Land and Resource Management Plan*; harvested species, ecological indicator species, Forest Service sensitive species, and federally listed threatened and endangered species. Twenty-three MIS occur on the BTNF; seven mammals, four birds, three fish, two amphibians, and seven plant species. Only the fish species are discussed in this report.

The Project Area considered for this analysis is shown in Figure 1. Environmental effects for some fish species are also described within the Analysis Area, which encompasses all of the vegetation treatment areas, also shown in Figure 1. Only those fish species present or suspected in the Analysis Area will be carried further in the analysis (Table 1). The fish species that are not present or do not have habitat in the Analysis Area would not be impacted by this project and are not further discussed.

For population and habitat status for MIS across the Forest, refer to the BTNF MIS Report (USDA Forest Service 2007) located in the project record.

Table 1. Fisheries MIS on the Bridger-Teton National Forest within the Analysis Area (USDA Forest Service 1991 & 2005c)

Common Name	Scientific Name	MIS type	Species Presence
Fish			
Rainbow trout	*Oncorhynchus mykiss*	Harvest	Known
Colorado River cutthroat	*Oncorhynchus clarkii pleuriticus*	Sensitive/Ecological	Known
Snake River Fine-spotted / Yellowstone cutthroat	*Oncorhynchus clarkii spp.*	Sensitive/Ecological	Known
Colorado pikeminnow	*Ptychocheilus lucius*	T&E	Not Known
Humpback chub	*Gila cypha*	T&E	Not Known
Bonytail chub	*Gila elegans*	T&E	Not Known
Razorback sucker	*Xyrauchen texanus*	T&E	Not Known
Kendall Warm Springs dace	*Rhinichthys osculus thermalis*	T&E	Known

B.1.1 Harvest MIS

The rainbow trout is native to the coastal streams of western North America from Alaska to Baja, California. Since before the turn of the 21st century, this species has been introduced as a game fish into cool and cold water habitats around the world and Wyoming (Baxter and Stone 1995). They generally occupy fast moving stream habitats but are highly diversified in habitat tolerance and thrive throughout the state. This species does occur in the Upper Green River and some of its tributaries. Population trend data indicates rainbow trout are steady to declining (due to lack of stocking from Wyoming Game and Fish Department (WGFD) and competition with brook and brown trout) throughout the BTNF. Rainbows could occur in almost every stream within the project area (USDA Forest Service 2007). The rainbow trout is a widely introduced game species; while it is generally considered a stream-dwelling species, it also thrives in lakes. Rainbow trout are a popular species for sport fisheries and occur throughout the BTNF as a result of stocking in streams and rivers. Native sport fish species within the project area include the Colorado River and Snake River cutthroat. The Colorado River cutthroat once inhabited all habitats in the Upper Green River Drainage not blocked by natural barriers (CRCT Conservation Team 2006). The Colorado River cutthroat trout have declined to less than ten percent of their historic range. They have been replaced by non-native trout, including rainbow, brook, brown, lake trout, golden trout, and grayling in the stream and lake systems of the Upper Green River. Snake River cutthroat trout have also been replaced by non-native trout species in their historic range. However, populations of this subspecies have not declined significantly in their native range.
Other trout species, including lake, brown, rainbow, and brook trout, and kokanee, could enter the project area during seasonal migration up the Green River from Fontenelle Reservoir and Finger lakes near Pinedale (USDA Forest Service 1999). Of the main tributaries, brook, cutthroat, and rainbow trout are present in Roaring Fork and Wagon creeks; and brook and rainbow trout are present in Moose Creek (WGFD 2001). Native CRC populations are present in Tepee, Tosi, and Rock Creeks, mainly west and southwest of the project area.

B.1.2 Ecological MIS

Colorado River and Snake River cutthroat trout: Discussed under Sensitive MIS.

B.1.3 Threatened and Endangered MIS

This section identifies the existing condition of threatened and endangered species within the Analysis Area. A detailed Biological Assessment for federally listed threatened and endangered species is located in the project record. T&E species that are found on the BTNF and are known or suspected to occur within the area of influence of the Analysis Area are shown in Table 1.

The Kendall Warm Springs dace is a small subspecies of the speckled dace. The only known population of this dace occurs in the warm springs near the Kendall Guard Station. These springs occur within the project area, approximately 32 miles north of Pinedale, Wyoming. The Kendall Warm Springs dace is restricted to about 900 feet of spring water at temperatures of 85 degrees Fahrenheit, and probably spawn several times a year. The Kendall Warm Springs are thermal springs located at an elevation of 7,840

ft. and consist of numerous seeps and springs scattered along the north face of a small limestone ridge (Gryska 1996). The main channel is surrounded by aquatic vegetation that is often heavy in the pools (USFWS 1989). The fish probably have never survived in the Upper Green River below the warm springs. Kendall Warm Springs dace are the only fish known to occur in the available habitat. Adult dace may occur in the main current, but most remain in the pools or eddies where plant growth or other debris breaks the current (Binns 1978). Previous threats to the dace included bathing facilities and soap products, livestock grazing, and collection of the dace for fishing bait. The spring habitat is signed and fenced with a bridge over the creek before it enters the Upper Green River to protect the fish from grazing and other land use activities.

Though the Kendall Warm Springs is within the analysis area, it is unlikely there would be any direct, indirect or cumulative effects from the proposed action. Therefore, **"no effect"** to Kendall Warm Springs dace is anticipated but they will be carried through the document.

B.1.4 Sensitive Species MIS

Colorado River cutthroat trout (CRC) have been repeatedly petitioned for Threatened species status and last found "**Not Warranted**" as of June 2007. Colorado River cutthroat trout are currently limited to a few small headwater streams of the Green River and upper Colorado River in Colorado, Utah and Wyoming. There are also populations in several high elevation lakes of the Rocky Mountains as a result of stocking efforts. Most of these lake populations are not self-sustaining due to the lack of adequate spawning streams (Spahr et al. 1991).

Colorado River cutthroat trout require cool, clear water and well-vegetated stream banks for cover and bank stability. In-stream cover in the form of deep pools and boulders and logs also is important. Colorado River cutthroat trout are adapted to relatively cold water and thrive at high elevations (Spahr et al. 1991). There are several CRC populations in the Upper Green River sub-basin but are isolated in small stream segments on public lands.

Historically the Upper Green River drainage and its tributaries were occupied with Colorado River cutthroat trout. Suitable habitat still exists, but currently there is no occupied habitat (CRCT Conservation Team 2006).

Native CRC populations are present in Tepee Creek, Tosi Creek, and Rock Creek, mainly west and southwest of the project area.

Snake River fine-spotted cutthroat trout (SRC) have also been repeatedly petitioned for Threatened species status and last found "**Not Warranted**" as of February 2006. Management actions initiated in the past several decades appeared to stabilize, and occasionally improve the probability of persistence of the Yellowstone cutthroat trout. More recent events, including the introduction of non-indigenous lake trout (*Salvelinus namaycush*) in Yellowstone Lake (the stronghold of YSC), the spread of *Myxobolus cerebralis*, the causative agent of whirling disease, and climate change resulting in recent drought in the Intermountain West have resulted in further population declines in many areas. Petitioners have filed an intent to sue but have taken no action. Snake River fine spotted cutthroat trout (SRC) have similar habitat requirements as the CRC. SRC are

found throughout their original range in the upper Snake River above Palisades Dam (Van Kirk and Benjamin 2001). There are approximately 1,476 miles of river and streams and 3,116 acres of lake on the BTNF that support SRC. Wyoming Game and Fish Department manages these populations as wild populations with the exception of some lakes that are stocked. Recent population estimations indicate abundant cutthroat trout populations throughout the Snake River Basin above Palisades Reservoir (Novak and Kershner 2005). Current distribution and species diversity data indicates that Snake River cutthroat trout are well distributed and are the dominant trout species in the Upper Snake River portion of the Forest (Novak and Kershner 2005). The Snake River fine-spotted cutthroat is sometimes listed as a subspecies distinct from Yellowstone cutthroat trout (Behnke 1992), but this distinction has not been officially recognized taxonomically (May 1996). Threats to the species include disease, habitat loss, and competition and hybridization with non-native trout.

In the analysis area, this subspecies of cutthroat trout inhabits South Fork Fish Creek and Strawberry Creek. Since no management activities are proposed in this watershed for the action alternative, SRC is not carried further in this analysis.

C. Effects

Table 2. Effects Determinations for Implementing Alternative 2 for Intermountain Region Sensitive Fish Species Known or Suspected to Occur Within the Area of Influence of the Project Area.

Species	Determination
Colorado River Cutthroat Trout	MIIH
Snake River Cutthroat Trout	MIIH
Rainbow Trout	MIIH

NI: No Impact
MIIH: May impact individuals or habitat but not likely to trend towards Federal listing or cause a loss of viability.

C.1 Effects on Harvested Management Indicator Species

Harvested MIS fish species are rainbow trout.

Alternative 1 - No Action

Under Alternative 1**,** current stream conditions are expected to continue as they currently exist or along their existing trends (e.g., if channel condition is currently declining, it would continue to decline without intervention). If a stand replacing fire were to occur due to lack of fuels treatments, it is possible that channels could be adversely affected.

Current management of the forest and ongoing activities in the BTNF have not changed the flood frequency for the Green River at Warren Bridge. Under Alternative 1, no additional vegetation removal would take place, so runoff processes would continue to function as they currently do. In the long run, existing disturbed areas would continue to recover, forested areas experiencing insect infestations and disease would die and

produce new canopy openings, and the aspen, sagebrush and grass communities would continue to be replaced with conifers and older sagebrush. Runoff processes would adjust to these changes as well as any larger-magnitude disturbances that might occur, e.g., if fuels continue to increase and a large wildland fire occurs and burns at high intensity levels, water yield could increase if large portions of the existing timber stands burned, with subsequent recovery of pre-fire hydrologic conditions as vegetation became reestablished.

Indirect effects would continue primarily as a result of dispersed recreation activity and unmanaged OHV use. These indirect effects would occur mostly in the Green River corridor.

Alternative 2 - Proposed Action

The amount of water runoff change associated with the various proposed treatments under Alternative 2 would not likely induce a measurable change in the annual water yield or peak stream flow in most 6th order HUCs. There is a possibility that there could be a change in stream flows in the Roaring Fork HUC if prescribed fires for sagebrush and grass burn more than 80 percent of the treatment units at one time. Proposed sagebrush, grass and aspen treatments would take place over a ten year period, however, and such areas on the Pinedale Ranger District normally recover within two years, so staged implementation of the burning is unlikely to produce any measurable changes in runoff.

Indirectly, all of the vegetation treatments under the Proposed Action have the potential to impact stream habitat in the project area. Conifer, fuels reduction, aspen, and sagebrush, grass and aspen treatments have the potential to impact aquatic habitat through erosion and subsequent delivery of sedimentation into adjacent streams. In addition, any skid trails utilized for mechanical treatment activities adjacent to these streams would create a short-term risk of stream sedimentation. However, temporary skid trails created for mechanical treatment operations would be obliterated. The relative risk of erosion-induced sedimentation would range from slight to moderate for the aspen, fuels reduction, and conifer vegetation treatments, and from slight to moderate for the sagebrush, grass, and aspen treatments**.** It is not known if the current levels of fine sediment in spawning gravels are in the acceptable range.

C.2 Effects on Ecological Management Indicator Species

Ecological MIS fish species are the Colorado River and Snake River cutthroat trout, covered under Sensitive MIS (Table 1).

C.3 Effects to Sensitive Management Indicator Species

Sensitive MIS fish species are the Colorado River and Snake River cutthroat trout.

For Both Alternatives:

There would be no direct or indirect effects to Sensitive species as they are not currently found in the project area. See *Harvested Management Indicator Species* write-up for overall effects to the fisheries resource.

D. Cumulative Effects

Past, present, and reasonably foreseeable management actions that could affect watershed resources in the Analysis Area include: livestock grazing, vehicular use on roads, off-

road vehicle use, recreation trails, fishing, elk feedgrounds, dispersed camping, special recreation events, and general overall increase in use and visitation due to the population growth in the Pinedale area and United States in general - in addition to the activities proposed in this document.

Livestock grazing, vehicular use on roads, recreation trails, and the big game migration corridors have been occurring for 100 years or more and are minor contributors to cumulative effects. All people/recreation oriented activities are what have changed the most and will probably be what continues to change the most into the future.

Cumulative effects from past timber sales on water and riparian resources are not measurable in the project area due to the limited amount of area they have affected and due to the length of time since they were harvested. Therefore, the cumulative effects from past timber sales in the BTNF are not considered to be significantly contributing to the cumulative effects realized in the project area.

One consideration that has not been analyzed but is potentially important under both alternatives is for downstream States on the Colorado River system to make a call for water. The states in the southern tier of the Colorado River system have been in a drought and have been experiencing a large influx of people. It may become mandated for the State of Wyoming to send its waters to downstream users. If or when this happens, the State of Wyoming may move forward with already proposed plans to dam the Green River somewhere above Warren bridge potentially backing water up onto the Forest. With impoundments comes the innate desire of today's fishermen to illegally stock their favorite game fish, more than likely a warmwater sport fish such as walleye. Any warmwater fish introduction would likely be detrimental to CRC and the other native fish within the drainage.

Although there have been minor short-term effects from past and present activities, cumulatively they are not contributing to significant environmental effects when added to the direct or indirect effects of Alternative 2 for the Pinyon-Osborn Environmental Assessment.

Wilderness and Inventoried Roadless Analysis

A. Issue Statement or Issue to be Addressed

Fire Management and Ecosystem Sustainability
This issue addresses internal and public concerns regarding:

- Reducing the risk of catastrophic wildfire
- Reintroducing fire into the project area as a natural disturbance tool (enhancing spatial-temporal heterogeneity)
- Moving the project area vegetation towards a more natural range of variability
- Timing of proposed treatments

B. Existing Conditions

Wilderness
The project area includes the northwestern boundary of the Bridger Wilderness. The Bridger Primitive Area was created in 1931, and in 1964 the Bridger Wilderness was designated under the 1964 Wilderness Act. The Bridger Wilderness was 392,169 acres in size when it was designated in 1964; however its size was increased by an additional 36,000 acres in 1984 with the passage of the Wyoming Wilderness Act. Its present size is 428,169 acres.

The BTNF Land and Resource Management Plan designated four different DFCs for management of wilderness areas on the Forest, three of which are within the study area. They are DFC 6A (Pristine), DFC 6B (Primitive), and DFC 6C (Semi-primitive). Each of these DFCs has defined management objectives and strategies with the ultimate goal to ensure that natural conditions exist within the wilderness. (See BTNF Land and Resource Management Plan for definitions). Additional management direction for the Bridger Wilderness is identified in the 1995 Bridger Wilderness Action Plan.

The Bridger Wilderness is one of the most heavily visited wilderness areas in the western United States. Visitor use within the area is calculated annually using trailhead registration forms, organized group permits, recreational stock permits, outfitter use-reports, and Wilderness Ranger reports of visitor contacts. Approximately 75 to 80 percent of use originates from out of the state, and 3 percent from out of the country. Summer use accounts for approximately 95 percent of the total use, while fall hunting and winter use accounts for the remaining 5 percent. Approximately 25 percent of the entire wilderness use occurs in the northern end of the wilderness, some of which lies within the project area. This use primarily originates from the Green River Lakes Trailhead, the third most heavily used access trailhead for the Bridger Wilderness.

There are four primary trail corridors originating from Green River Lakes Trailhead. These corridors are depicted in **Table 1.**

Table 1. Green River Lakes Trailhead Corridors

Trail Corridor	DFC	Percent of Use[2]
Green River Corridor	DFC 6C	55% of total use
Clear Creek Corridor	DFC 6B	28% of total use
Porcupine Creek Corridor	DFC 6B	12% of total use
Roaring Fork Corridor[1]	**DFC 6A, 6B, 12**	**5% of total use**

[1]Outside of Wilderness [2]Based on Trailhead Use

There are four trailheads within the study area that were abandoned. They are the South Gypsum, Pot Creek, Jim Creek and Boulder Basin trailheads. These trailheads and associated trails were removed from the Pinedale Ranger District maps to meet Forest Plan objectives for DFC 6A (Pristine), trail-less areas. There are no signs leading to these trailheads, and bulletin boards are not located at these sites. Each of these trailheads is monitored to determine resource conditions and to assess abandonment effectiveness.

Prescribed Burning Inside the Bridger Wilderness

Human-ignited prescribed burning is proposed inside and outside of the Bridger Wilderness along its western boundary. This proposed burn is adjacent to the western and southern base of the Osborn Mountain Research Natural Area (RNA).

To date, although lightning strikes are fairly common within this area, all but one lightning-caused fire started within the project portion of the Bridger Wilderness have been suppressed upon detection, primarily due to extensive fuel buildup along the wilderness boundary and concern for fire escaping outside of the wilderness. This has resulted in unnatural fuel buildups along the wilderness boundary, which adversely affects all resources dependent upon natural fire. In addition, the entire Green River Corridor, including a large stand of lodgepole pine on the southern base of Osborn Mountain inside and outside the wilderness boundary, has been infested with Mountain pine beetle, which has greatly increased the potential for fire escape along this portion of the wilderness boundary.

The particular unit inside the Bridger Wilderness was proposed by an interdisciplinary team of specialists to use manual (human) ignition following a Prescribed Fire Plan to reintroduce fire in the proposed area to follow a more natural fire regime, aid succession of fire dependent vegetation, and reduce fuel loadings. This type of treatment would allow future natural fires inside and outside the wilderness to burn and play a natural role in ecosystem management. Currently, with the presence of the Green River Lakes Campground and Trailhead coupled with unnatural heavy fuel buildup, there has been concern for life and property outside the wilderness for allowing natural fires to run their course. In this proposed area of the wilderness, fuel treatment outside the wilderness would not be sufficient to achieve fire management objectives inside or outside of the wilderness as a whole.

As per Forest Service Manual (FSM) 2324.21 and 2324.22, two types of prescribed fires may be approved for use within wilderness: those ignited by lightning and allowed to burn under prescribed conditions and those ignited by qualified Forest Service officers. Forest Service managers may ignite a prescribed fire in wilderness to reduce unnatural

buildups of fuels only if necessary to meet at least one of the two following wilderness fire management objectives: (1) permit lightning caused fires to play, as nearly as possible, their natural ecological role within wilderness or (2) reduce, to an acceptable level, the risks and consequences of wildfire within wilderness or escaping from wilderness, and if all of the following conditions are met:

a. The use of prescribed fire or other fuel treatment measures outside of wilderness is not sufficient to achieve fire management objectives within wilderness;
b. An interdisciplinary team of resource specialists has evaluated and recommended the proposed use of prescribed fire;
c. The interested public has been involved appropriately in the decision; and
d. Lightning-caused fires cannot be allowed to burn because they will pose serious threats to life and/or property within wilderness or to life, property, or natural resources outside of wilderness.

The purpose of this human-ignited prescribed burn is to meet the DFC identified in the 1995 Bridger Wilderness Action Plan that specifies the following: "Fire management emphasizes preservation of wilderness values and allows natural processes of ecological change to operate freely."

Inventoried Roadless

Portions of the Pinyon Osborn Vegetation Treatments Project Area are located within three Inventoried Roadless Areas (IRAs)**;** activities are proposed in two of the IRAs. The third IRA is just a small portion resulting from how the project area boundary was drawn and is not analyzed. The action alternatives are proposed within IRAs to address the goals and objectives of the 1990 *Bridger-Teton National Forest Land and Resource Management Plan* and to help move the project area toward the desired conditions described in that plan and in the 1999 *Upper Green Landscape Assessment*.

The proposed actions within the project area are designed to restore vegetative health and desired vegetative species composition, improve watershed conditions, restore fire as an important tool in maintaining vegetative species diversity and health, reduce heavy fuel-loading in the Wildland Urban Interface (WUI) (particularly near private in-holdings and along a high-use recreation corridor), and improve wildlife habitat.

#3012 – Mosquito Lake/Seven Lakes IRA: A portion of the project area within the Pinyon Ridge and Mosquito Lake areas lies within the Mosquito Lake/Seven Lakes IRA. Portions of this IRA located adjacent to the Bridger Wilderness and Fitzpatrick Wilderness have retained a primitive character except where Level 2 Roads exist. The remainder of this IRA, including the Pinyon Ridge and Mosquito Lake areas, contains many Level 2 Roads, several developed inholdings, and some range improvement structures.

#3011 – Little Sheep Mountain Inventoried Roadless Area: The Little Sheep Mountain IRA, located between the Green River Lakes Road #650 and the Moose-Gypsum Road #680, lies within the project area. This IRA is physically disconnected from the West Slope Winds IRA and the Bridger Wilderness by Moose-Gypsum Road #680, by a heavy system of designated Level 2 Roads, and by several well developed private in holdings in the Red Hills Subdivision. The following activities highly affect the potential for this IRA to meet primitive character: year-long recreation use and

private firewood removal along the Green River Lakes Road and Moose-Gypsum Road; activities originating from the Red Hills in-holding; and activities originating from a well-developed subdivision located just outside the Forest boundary at the beginning of the Moose-Gypsum Road.

Inventoried Roadless Areas are characterized by the following Wilderness attributes:

Natural Integrity/Apparent Naturalness
Natural integrity is the extent to which long-term ecological processes of an area are intact and operating. Impacts to natural integrity are measured by the presence and magnitude of human-induced change to an area. Apparent naturalness is a measure of past and present activities on the appearance of naturalness of the area to most people using that area.

#3012 - Mosquito Lake/Seven Lakes IRA: This IRA is rated as high for this attribute directly adjacent to the Bridger and Fitzpatrick Wilderness boundaries, and low for this attribute further from the two Wilderness boundaries, including the Pinyon Ridge and Mosquito Lake areas. The natural integrity of this IRA has been primarily affected by the following physical or man-caused impacts: fire suppression, road construction, unimproved road creation, recreation impacts such as illegal ATV trails, in-holding developments, and range improvements.

Aspen, grass, and sagebrush treatments primarily using prescribed fire are also proposed within the project area of this IRA. Both of these proposed actions would positively affect the natural integrity and apparent naturalness of this IRA. Some mechanical treatments associated with the aspen burning may be necessary to achieve prescribed burn objectives in these aspen stands. This may cause short-term impacts to this attribute within this IRA, however the effects of this proposed action would be short-term having to do with cut aspen logs and stumps. Mitigations such as flush cutting stumps and burning cut aspen would help minimize the short-term impacts of this activity on the natural integrity of this IRA.

#3011 - Little Sheep Mountain IRA: This IRA is rated as medium to low for this attribute. The portion of this IRA located on and immediately north of Little Sheep Mountain is rated as medium. The remaining portion (approximately 4/5ths) of this IRA, located west, east, and south of Little Sheep Mountain, is rated as low for this attribute. The natural integrity of this IRA has been substantially altered by human activities located between this IRA and the West Slope IRA and Bridger Wilderness. The Moose-Gypsum Road, past timber harvest activities, and a heavy network of constructed and unimproved roads exist between this IRA and the West Slope IRA. Other physical or man-caused impacts include: fire suppression, recreation impacts (heavy impacts at popular camping sites, illegal ATV trails, etc.), personal-use firewood removal, in-holding developments, and range improvements.

Aspen treatments primarily using prescribed fire are also proposed within the project area of this IRA, which will positively affect the natural integrity and apparent naturalness of this IRA. Fuels treatments, primarily for wildlife habitat enhancement and fuel reduction, are also proposed within this IRA. Some mechanical treatments associated with the aspen and fuels burning operations may be necessary to achieve prescribed burn

objectives in these aspen and timber stands. This may cause short-term impacts to this attribute within this IRA.

Remoteness/Solitude/Opportunities for Primitive Recreation
Remoteness is a measure of distance from the sights and sounds of civilization. Solitude is a personal and subjective value, defined as isolation from the sights, sound, and presence of others as well as human development. Opportunity for Primitive Recreation is a measure of the undeveloped, non-motorized recreation experiences available, including a high degree of challenge and risk, within an area. Physical factors that can create or promote primitive recreation settings include topography, vegetative screening, and proximity to human impacts/developments such as roads, logging operations, and private housing developments.

#3012 - Mosquito Lake/Seven Lakes IRA: The opportunity for remoteness, solitude, and primitive recreation experience is high within this IRA directly west and adjacent to the Bridger Wilderness. However, the portion of this IRA within the project area containing the Pinyon Ridge and Mosquito Lake areas is rated low for these attributes, primarily due to well-established Level 2 Roads throughout the project area portion of this IRA. In addition, activities associated with the highly-used Green River Lakes and Green River Corridor, located just outside of the southern boundary of this IRA, greatly affect the visual and audio character within the Pinyon Ridge portion of this IRA, further reducing the opportunity for remoteness and solitude in this portion of the IRA.

#3011 - Little Sheep Mountain IRA: The opportunity for remoteness, solitude, and primitive recreation experience is low within this IRA primarily due to its physical location between the Green River Lakes and Moose-Gypsum Roads, which fragment this IRA from the West Slope Winds IRA and Bridger Wilderness. Human developments surround this IRA, and illegal ATV routes are commonly created throughout this area, primarily associated with the two developed subdivisions located directly adjacent to or within this IRA. Some Level 2 Roads and a portion of the Moose-Gypsum Level 3 Road also exist within this IRA. Sights and sounds of civilization exist throughout most of this IRA, particularly during the summer and fall months.

Special Features
This attribute recognizes special values of ecological, geologic, scenic, historical or cultural significance.

#3012 - Mosquito Lake/Seven Lakes IRA: The ecological, geologic, and scenic features within the project area portion of this IRA are most significant in the Pinyon Ridge area. The scenic quality of Pinyon Ridge, as viewed from the Green River Lakes Road #650, is spectacular, although negatively affected by a house built within the past ten years on a private in-holding located on the lower 1/3 of this ridge, just north of the Green River Lakes Developed Site. The Roaring Fork area, adjacent to the Bridger Wilderness in this IRA also contains exceptional elk habitat. The eastern base of Osborn Mountain, a Research Natural Area, is also located within this IRA, while the mountain itself lies inside the Bridger Wilderness.

The proposed actions within this IRA would not significantly alter the special features of this IRA except possibly for short-term scenic affects from prescribed burning on Pinyon Ridge. Prescribed burning in the Pinyon Ridge portion of this IRA would be expected to

improve the scenic features on this ridge by improving the health and vigor of aspen stands over the long-term. The aspen, sagebrush, and grass treatments would also benefit wildlife habitat in this IRA. No known cultural or historic features would be adversely affected by the proposed actions.

#3011 - Little Sheep Mountain IRA: The ecological, geologic, and scenic features within the project area portion of this IRA are significant on Little Sheep Mountain, which also provides important habitat for elk, and insignificant for the remainder of this IRA. Remnants of tie-hack logging camps are also located in several sites within this IRA.

The proposed actions within this IRA would not be expected to significantly alter the special features within this IRA. No known cultural or historic features would be adversely affected by the proposed actions.

Wilderness Manageability/Boundaries

This element relates to the ability of the Forest Service to manage an area to meet size criteria (5,000+ acres), the resulting configuration of the potential Wilderness or addition of the roadless area to adjacent designated Wilderness, and the interaction of the other attributes discussed above.

#3012 - Mosquito Lake/Seven Lakes IRA: The portion of the project area within this IRA that lies directly adjacent to the Bridger Wilderness has retained its primitive character. The location and high degree of primitive character within this portion of this IRA make this portion of the IRA a viable consideration for eventual addition to the Bridger Wilderness. The remainder of the project area within this IRA, including the Pinyon Ridge and Mosquito Lake areas, could be added to the Bridger Wilderness, but this addition would be difficult to manage due to its proximity to the highly developed Green River Corridor. The configuration of this area would also make management of this area as a separate Wilderness difficult, particularly regarding the extensive motorized roads which have been well-established within this portion of the IRA. Motorized road closures within these areas are already difficult to enforce within these two areas, primarily because the terrain and vegetation offer open invitation for motorized trespass.

Proposed actions within the project area portion of this IRA would not be expected to significantly affect the manageability of this IRA.

#3011 - Little Sheep Mountain IRA: This IRA is physically separated from the West Slope IRA and the Bridger Wilderness primarily by the Moose-Gypsum Road and associated activities, including present and past timber and firewood removal between this IRA and the West Slope IRA. Privately developed in holdings located between this IRA and the West Slope IRA would also affect its ability to be effectively managed as Wilderness if added to the Bridger Wilderness. Although this 14,851-acre IRA meets the minimum 5,000 acre criteria for consideration for Wilderness designation, this IRA would be difficult to manage if it were designated and managed as a separate Wilderness.

Proposed actions within this IRA would not be expected to alter the manageability of this IRA as potential Wilderness.

C. Effects

Wilderness

Alternative 1 (No Action)
No vegetation benefits in or outside the Bridger Wilderness would be achieved under this alternative. Indirect effects of continued old age classes of vegetation would compound over time. Allowing natural ignitions in the future could cause unwanted fire effects over larger areas.

Alternative 2 (Proposed Action)
The proposed human-ignited prescribed burn would specifically meet wilderness objectives for this area by:

1. Removing the unnaturally heavy fuel buildup along the western wilderness boundary to create a fuel break between wilderness and non-wilderness. This would create a buffer so that naturally occurring fires (lightning-caused) could be allowed to burn within the Bridger Wilderness with less risk of having such fires escape from the wilderness; and
2. Removing the unnaturally heavy buildup of fuel through human-ignition would help restore the natural ecological balance and fire regime within this area and open the door for future natural-ignitions to serve their natural ecological role within this portion of the Bridger Wilderness.

Inventoried Roadless
Potential effects to the area's roadless character are outlined under the following roadless area characteristics.

Soil, Water, and Air

The effects of the alternatives to soil, water, and air are described at length elsewhere in this chapter. This is a summary of those effects in relation to Inventoried Roadless Areas (IRAs) for all action alternatives.

#3012 – Mosquito Lake/ Seven Lakes - Aspen and Sagebrush/Grass treatments only. The primary activity in this IRA is burning of sagebrush, grass and aspen. In both action alternatives, effects are anticipated to be short-term in nature. There is a low risk of soil disturbance and sedimentation following treatment. The Bridger Wilderness, a Class I Airshed, forms the eastern border of the project area. The State of Wyoming Air Quaility Standards and Regulations would be met for all burning activities, and any effects should be short-term in nature. If necessary, additional mitigation may be considered in the burn plans for individual projects.

The other vegetation activity within this IRA is the mechanical treatment of conifer encroachment and mechanical treatment to regenerate aspens stands. Both of these treatments should have no measurable impact on soil, water and air.

In the long-term, the proposed vegetation activities would improve habitats, improve the overall health of the vegetation, and should improve soil and water conditions within this IRA.

There are no watersheds within this IRA that are unique or critical.

#3011 – Little Sheep Mountain - This IRA is experiencing high conifer mortality throughout much of its area due to insects and disease. This mortality has reached epidemic proportions in both lodgepole pine and Subalpine fir stands. As a result, the private inholdings that are inside this IRA are at extreme risk from a catastrophic fire. There are a number of treatment areas that are designed to reduce the risk of catastrophic fire inside this IRA. This area of the Forest has been identified as a high priority for treatment in the Communities at Risk Assessment.

Sources of Public Drinking Water

There are no public drinking water systems within 50 miles downstream of this project. The only likely effect to water quality within the two IRAs is minor sediment production during project implementation. (See the Soils and Water sections in this chapter for more information). This project would have no effect on public drinking water.

Diversity of Plant and Animal Communities

All action alternatives for this project should improve diversity of plant and animal communities within the two IRAs. The changes in age structure and plant communities should benefit most species of plants and animals. This is described at length elsewhere in this chapter.

Habitat for Threatened, Endangered, Proposed, Candidate, and Sensitive Species and for those Species Dependent on Large, Undisturbed Areas of Land

Habitat for these species has been discussed at length in other sections of this chapter.

#3012 - Mosquito Lake and Seven Lakes: Habitat would improve over time as a result of the vegetation treatments and the road closures that would take place within the IRA. There would be short-term impacts during and immediately following project implementation.

#3011 - Little Sheep Mountain: Treatments in this IRA have the greatest potential for impacts to habitat. This is explained in detail earlier in this chapter. Many of the affects are already occurring due to the heavy mountain pine beetle mortality. Most of the treatments would have long-term beneficial affects, however the WUI fuels reduction near the private inholdings have the potential for longer term effects. This is due to the prescription calling for low amounts of down woody material and limited lower crowns and ladder fuels. This creates an open stand that does not provide the naturally-buffering for those inholdings and extending the edge effect they create.

Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized Classes of Recreation Opportunities

#3012 - Mosquito Lake and Seven Lakes: This IRA is extremely large and provides a diversity of recreation opportunities. The eastern portion that borders the Bridger Wilderness has excellent primitive and semi-primitive, non-motorized recreation opportunities.

The western portion of the IRA is heavily roaded but is only moderately to lightly used by recreationists, with the heaviest use during the fall. This area provides excellent semi-primitive motorized opportunities with moderate semi-primitive non-motorized opportunities. This project should not affect motorized opportunities.

Opportunities for non-motorized recreation would remain at a moderate level.

Vegetation treatments would not change any of the opportunities for recreation within this IRA.

#3011 – Little Sheep Mountain: This IRA is heavily roaded but is only moderately to lightly used by recreationists, with the heaviest use during the fall. This area provides excellent semi-primitive motorized opportunities with moderate to low semi-primitive non-motorized opportunities. Non-motorized opportunities are primarily associated with the upper reaches and north side of Little Sheep Mountain. This project should not affect motorized opportunities.

Opportunities for non-motorized recreation would remain at a moderate to low level.

Vegetation treatments would not change any of the opportunities for recreation within this IRA.

Reference Landscapes

#3012 - Mosquito Lake and Seven Lakes: The eastern portion of this IRA could be used as a reference landscape. It has had limited motorized activity and is a stark contrast to the western portion of the IRA, which is heavily roaded, with extensive human evidence and presence. The Pinyon Ridge and Roaring Fork drainage are very scenic. As discussed earlier, recreation opportunities within this IRA are primarily associated with fall big-game hunting.

#3011 - Little Sheep Mountain: This IRA has no opportunities to be used as a reference landscape due its shape, past human activities, and ongoing human uses within and adjacent to this IRA.

Landscape Character and Scenic Integrity

#3012 - Mosquito Lake and Seven Lakes: The landscape character and scenic integrity are high in the eastern portion of this IRA, with a moderate rating for the remainder of the IRA. The action alternatives for this project would have minor short-term impacts with beneficial long-term impacts.

#3011 - Little Sheep Mountain: The landscape character and scenic integrity are moderate to low within this IRA. The high number of existing roads, extensive past timber harvest, and private inholdings have significantly impacted this IRA. The action alternatives for this project would have minor short-term impacts with beneficial long-term impacts. The action alternatives for this project would have both short and long-term affects to the landscape character and scenic integrity associated with vegetation treatments. The majority of the treatments would have short-term (one to five year) impacts on scenery and naturally appearing landscapes. Scenery should actually improve over much of the area due to regeneration of decadent aspen and sagebrush stands.

Traditional Cultural Properties and Sacred Sites

This project should have no affect on traditional cultural properties within either of the two IRAs. In addition to Forest Plan Standards and Guidelines and BMPs, mitigation has been designed to prevent significant effects to these resources.

Other Locally *I*dentified Unique Characteristics

Kendall Warm Springs is located just outside the western boundary of the Little Sheep Mountain IRA. The project has been designed to avoid any impacts to this unique feature. There are no other known unique characteristics that may be affected by this project within the three IRAs.

D. Cumulative Effects

The cumulative effects for Wilderness and Inventoried Roadless Areas include minor short term impacts to recreation opportunities during any implementation of the proposed action. Short term visual impacts are expected until vegetation recovers after a growing season. Visitor use may be disrupted with closures during burn implementation. Visitor use patterns are not expected to change with either alternative. Implementation of the proposed action would provide the most benefits to Wilderness and IRA's related to vegetation and fire adapted ecosystems. Reasonably foreseeable actions/impacts affecting Wilderness would include Wildland Fire Use (WFU) Events that would assist further in reaching DFC over time. These WFU events will be limited under Alternative 1 and would be more feasible to implement after treatments from Alternative 2 have taken place.

Heritage Resources

A. Issue Statement or Issue to be Addressed

No issues were raised during the scoping process related to archeology and heritage resources.

B. Existing Conditions

Cultural resource surveys conducted in the Upper Green River area has resulted in the discovery of a number of prehistoric and historic sites. Prehistoric sites are identified as surface scatters of artifacts and stone tools indicative of the hunter and gatherer tribes who frequented the area on a seasonal basis. Some artifacts found at these locations may be as old as 8,000-9,000 years however a majority of the sites tend to date to the last 4,000 years of prehistory. Many of these sites also contain surface and subsurface fire pits and hearths which have to potential to provide additional data on the settlement and subsistence patterns of the prehistoric inhabitants of this area. The size of some of the prehistoric sites suggests that residential base camps were present and probably revisited over time. These base camps may provide a critical link in the seasonal movement between the interior of the Green River Basin and high elevation areas of the Wind River Mountains and the Jackson Hole area. An analysis of the site data indicates that for prehistoric sites in the upper Green River watershed, the average distance to permanent water was approximately 178 meters, the average slope on which these sites were found was 5.6%, and the average distance to major changes in vegetation communities was 61.5 meters. Site density for prehistoric sites tends to diminish on steeper slopes or within heavily forested areas.

The historic period is also well represented in the Upper Green River area. By the early 1800s, Euro-American explorers and trappers had made their way into the study area. Some historians point to John Colter as the first of the mountain men to visit the Upper Green River country in 1807, and others were soon to follow. In 1811, Wilson Hunt crossed the Continental Divide at Union Pass, and descended Wagon Creek into the Upper Green River Valley. Hunt was bound for the mouth of the Columbia River on the west coast with the intent of establishing a trading headquarters for the American Fur Company. The Upper Green River became well known as prime beaver trapping country, and over the next 20 years, fur trapping on the Green River and its tributaries became intense. By 1840 the demand for beaver pelts declined, and coupled with the decimation of the beaver population, the trapping industry ended in the Green River country. There have been no sites in the project area that can specifically be dated to this time period.

The next major influx into the Upper Green came in 1867. With the arrival of the transcontinental railroad in southern Wyoming, the demand for railroad ties was great. The vast timber resources along the Upper Green provided an ideal source for these ties. Charles Delony was contracted to provide these ties, and in 1867 set up a cook shack, commissary, bunkhouse, and saw mill on the banks of the Green River near the present day Forest boundary. Delony continued to cut and haul ties from this area until 1870 when his contract with the railroad was met. The tie hack operations came to brief halt but began again in 1895 with the creation of the Green River Lumber and Tie Company.

The headquarters for this operation were located at what is now the Kendall Guard Station. Tie hack operations were to continue along the Green and its tributaries until 1904. The remains of many of these early tie hack cabins can still be seen throughout the area and tend to be concentrated in the Klondike Hill area and in the forested areas east of the Green River.

Early homesteaders and "dude ranchers" made their way into the study area during the late 1800s and early 1900s. Livestock grazing probably began in the area between 1885 and 1890. In 1916 the Upper Green River Cattle and Horse Growers Association formed to make efficient use of the 188,000 acres of grassland and sagebrush in the valley. The association began with 20 members who pooled their 11,377 head of cattle. Cattle grazing became an important tradition in the study area, and this tradition continues today. The Osborn Homestead at the outlet of the lower Green River Lakes and the Billy Wells Dude Ranch on the east terrace of the Green River south of Dollar Lake are two examples of historic sites that date to this time period.

C. Effects

Alternative 1 (No Action)

There would be no direct effects to historic properties under this alternative. However the build up of fuels with dead, down, dying and diseased conifer and heavy sagebrush cover could lead to uncontrolled wildfires that could destroy historic properties. This would represent an indirect effect to cultural resources if the no action alternative were selected.

Alternative 2 (Proposed Action)

There will be no direct effects to historic properties under this alternative. All historic properties within the project area will be clearly demarcated in the field and communicated directly or via maps given to project implementation staff, prior to implementing any associated activity that have the potential to affect historic properties. Communication on site avoidance requirements will occur so that the information can be incorporated into plans, contracts, and other documents.

There is the potential for indirect effects to cultural resources under this alternative. Prescribed burns have the potential to uncover previously unidentified sites resulting in greater ground visibility and exposed artifacts. This could lead to un-authorized collection of artifacts which would diminish the scientific and cultural value of these sites. These indirect effects would diminish over time as vegetation cover becomes re-established.

D. Cumulative Effects

It has been observed that the primary effects to heritage resources on the BTNF result from intensive human activity, such as dispersed recreation, two-track roads, constructed roads, trails, and project development. When such activities occur on significant historic or archeological sites the result is often exposed subsurface soil deposits or artifacts. These exposed sites are then susceptible to further damage from erosion processes, inadvertent or intentional vandalism, as well as livestock or big game trampling. As the Upper Green River area continues to receive increased human activity, there remains the potential for an increase in the cumulative effects to heritage resources.

Wildlife

A. Issue Statement or Issue to be Addressed

Threatened Endangered Species, Sensitive Species and Wildlife Habitat
This issue addresses internal and public concerns regarding:

- Changed wildlife patterns as a result of treatments
- Habitat management opportunities for all wildlife species
- Impacts to threatened, endangered, and sensitive species from this project
- Support for objectives expressed by wildlife management agencies

B. Existing Conditions

The BTNF Land and Resource Management Plan (USFS 1990) provides guidance for management of wildlife habitat on the BTNF. The project area is located in DFC's 6A, 6B, 9A, 10 and 12. In DFC's 6A and 6B, management emphasis is on maintenance of native animal and plants species with special emphasis on preservation of Threatened, Endangered, and Sensitive species and their habitats. In DFC 10 and 12, habitat is managed to achieve the game and fish populations, harvest levels, success and recreation day objectives identified by the Wyoming Game and Fish Department. In DFC's 9A, habitat management for fish and wildlife is not an objective. This is because these are administrative sites. Provisions are given for managing calving areas, winter range, and hiding and security cover for big game.

B.1 Management Indicator Species (MIS)

This section identifies the existing condition for MIS. MIS are those species whose population changes are believed to reflect the effects of land management activities. Four types of MIS are identified in the BTNF Land and Resource Management Plan; harvested species, ecological indicator species, Forest Service sensitive species, and federally listed threatened and endangered species. Twenty-three MIS occur on the BTNF; seven mammals, four birds, three fish, two amphibians, and seven plant species. Only those wildlife species present or suspected in the project area (Table 1) will be carried further in the analysis. The wildlife species that are not present or do not have habitat in the project area would not be impacted by this project and are not carried further in this analysis. For Plant MIS refer to the Sensitive Plant and other Plant MIS Sections B.1.5 and B.1.6. For population and habitat status for MIS across the Forest, refer to the BTNF MIS Report (2007) located in the project record.

Table 1. Wildlife MIS on the Bridger-Teton National Forest.

Common Name	Scientific Name	MIS type	Species Presence in Project Area
Mammals			
Grizzly Bear*	*Ursus arctos horribilus*	Sensitive	Known

Elk	*Cervus elaphus nelsoni*	Harvest	Known
Mule deer	*Odocoileus hemionus*	Harvest	Known
Moose	*Alces alces shirasi*	Harvest	Known
Bighorn sheep	*Ovis canadensis canadensis*	Harvest/Ecological	Known
Pronghorn antelope	*Antilocarpa americana*	Harvest	Known
Pine marten	*Martes Americana origins*	Ecological	Suspected
Birds			
Bald eagle*	*Haliaeetus leucocephalus*	Sensitive	Known
Peregrine falcon*	*Falco peregrinus anatum*	Sensitive	Suspected
Whooping crane	*Grus americana*	T&E	Not Suspected
Brewer's sparrow	*Spizella breweri*	Ecological	Suspected
Amphibian			
Boreal toad	*Bufo boreas*	Ecological	Known
Boreal chorus frog	*Pseudacris triseriata maculate*	Ecological	Known

*The grizzly bear, bald eagle, and peregrine falcon have been removed from the T&E Species list since they were designated as MIS on the BTNF. They are now managed as Sensitive Species.

B.1.1 Harvest MIS

Elk are habitat generalists. During the summer, they spend the majority of their time in alpine and subalpine habitats. During the winter, elk movements are restricted by forage availability and snow conditions. Elk migrate to lower elevations where snow depth is shallow, and typically inhabit coniferous forests interspersed with riparian areas as well as south-facing slopes with sagebrush and other shrubs and aspen forests. A majority of the elk that summer in the project area migrate to feed grounds in the winter. The project area is located within one elk herd unit (107-Green River). The Green River elk herd have a stable population trend. The Green River herd had an estimated 2006 population of 2,567 elk with an objective of 2,500 elk.

Mule deer are habitat generalists. They are often associated with early-successional vegetation and use rocky brushy areas, open meadows, open forests, and recent burns. In the winter when snow pack becomes deep, mule deer migrate to lower elevations. The project area contains spring, summer, and fall habitat for mule deer. The project area is located within one mule deer herd unit (104- Sublette). The mule deer population trend for this herd has been relatively stable, but is currently below management objectives.

This herd had an estimated 2006 population of 26,474 deer with an objective of 32,000 deer.

Moose use a variety of habitats from dense coniferous, deciduous, or mixed forests to shrublands, open meadows, grasslands, and riparian areas. Moose typically move to lower elevation willow dominated riparian areas in the winter. The project area contains year-round habitat for moose. An important crucial winter range for moose is located along the Upper Green River. The project area is located within one moose herd unit (105- Sublette). The Sublette moose population has been trending slightly downward with an estimated 2006 population of 4,066 moose with an objective of 5,500 moose.

Bighorn sheep are found in a variety of habitats from alpine mountain meadows to desert grasslands, although they generally use mountainous areas. Sheep typically prefer high elevation alpine habitats with steep escape terrain adjacent to open foraging areas. Summer ranges are primarily at higher elevations in sub-alpine habitats, whereas winter ranges are generally at lower elevations, where precipitation is low, in areas dominated by sagebrush and grassland. However, some bighorns also winter at high elevations on windswept slopes, as do members of the Whiskey Mountain herd in the northeast corner of the project area, in the Bridger Wilderness. The upper elevations of the project area contain year-round range for the Jackson (Herd #107) and Whiskey Mountain (Herd #609) bighorn sheep herds, and a portion of their migration route occurs in the northeast portion of this area. The exact number of animals utilizing the project area is not known, as the area comprises only a small portion of the total herd unit. The Jackson bighorn population has been relatively stable in recent years with an estimated population of 388 sheep in 2006, but remains below the herd unit objective of 500 sheep. The Whiskey Mountain bighorn population also has been relatively stable with an estimated population of 582 sheep in 2006, but is well below the herd unit objective of 1,350 sheep.

Pronghorn antelope utilize sagebrush and grassland habitats in Wyoming. The project area provides spring, summer, and fall range for a limited number of pronghorn from the Sublette herd unit (#401), which is the most migratory pronghorn population in the United States. No winter range is present. The project area also provides a crucial migration route that links the Jackson Hole area summer range with winter range near the Pinedale Mesa, and additional ranges to the southeast. Specifically, these pronghorn utilize a route that runs along the west side of the Green River from the Forest boundary north to Bacon Ridge and Bacon Creek and continues into the Gros Ventre River drainage. The Sublette antelope population has been trending upward with an estimated population of 60,100 antelope in 2006 and a herd unit objective of 48,000 antelope.

B.1.2 Ecological MIS

The pine marten is an ecological indicator for old-growth forests. It inhabits old-growth coniferous forests in the Rocky Mountains. Spruce-fir dominated stands are preferred, but stands of lodgepole pine and limber pine are also used. Marten are dependent on the structural diversity associated with late successional or mature forest stands for denning, resting and foraging habitat, thermal and escape cover, and for gaining access to winter sites for resting and foraging. Downed logs and snags are important habitat features. The American marten has undergone major reductions in distribution in the western U.S., primarily due to reduction and fragmentation of habitat from timber harvest. Suitable

habitat for pine marten is present in the project area in late-successional spruce-fir habitats.

In *Distribution of Lynx and Other Forest Carnivores in the Wyoming Range, Southcentral Wyoming- Final Report* (Squires et al. 2003), marten tracks were recorded during the winters of 2000, 2001, and 2002. In 2001, during the most intense track surveys of the 3-year study, a total of 87 individual marten tracks were observed, 4 individual tracks were recorded in 2000, and 47 individual tracks in 2002. Marten tracks were detected on virtually all survey routes in 2001. This would indicate that marten are common throughout the survey area (Wyoming and Salt River Ranges). In addition, based on snow-track habitat selection analysis, marten preferred spruce-fir forests and two-story stand structure to open areas.

During the winter of 2005-2006, Endeavor Wildlife Research Foundation (EWR) collected marten track data while conducting lynx research on the BTNF (Linnel and Berg 2007). Marten tracks were detected on 35 of 40 track survey days. A total of 304 tracks were observed with an average occurrence of 6.8 tracks/km surveyed. The highest encounter rates on the BTNF were found in gap-phase lodgepole pine, mixed conifer, and spruce-fir. Most survey data was collected on the Buffalo Ranger District with a limited amount collected on the Big Piney Ranger District.

The Brewer's Sparrow is an ecological indicator for sagebrush habitat. The Brewer's sparrow is a sagebrush-obligate, being restricted to sagebrush habitats during the breeding season and perhaps year-round. They are likely a common summer resident where suitable sagebrush habitat is present in the project area. Big sagebrush habitat is abundant in the project area. It represents about 17,810 acres of the project area.

The Rocky Mountain Bird Observatory (RMBO) recently completed breeding bird surveys from 2002 to 2006 on the BTNF. During these 5 years of surveys, the RMBO observed a total of 369 sparrows along 22 survey routes. These surveys included BLM land adjacent to the BTNF along the "Piney Front".

A total of five North American Breeding Bird Survey routes occur on the BTNF. Species occurrence data collected from 1968 to 2003 was analyzed at the route level to determine species trend per route. Four of the routes showed a positive trend during this period (+3.3, +18.1, +8.8, and +29.1 percent increase in the number on each route). One route showed a negative trend of -16.2 percent/year (BBS GIS data). Transect data was not collected for every route during every year of the survey period and these surveys were not specifically targeting sagebrush habitat. Depending on the route, the number of years that survey data was collected ranges from 8 to 21 years. Regionally in Wyoming, Brewer's sparrow population trends have been relatively stable with a -0.9 percent decrease in the occurrence of Brewer's sparrows on survey routes from 1968-2005 (USGS 2007).

The boreal toad and boreal chorus frog are ecological indicator species for wetland habitat. The boreal toad is a Wyoming species of special concern. The boreal toad occupies montane forest habitats between 7,500 and 12,000 feet and requires breeding ponds, summer range, and winter refugia at various stages of its life history. It inhabits marshes, wet meadows, and the margins of streams, beaver ponds, and glacial ponds.

The boreal chorus frog is found throughout Wyoming and across the BTNF. This frog inhabits non-flowing bodies of water such as marshes, ponds, and small lakes in all life zones, from lower elevation to alpine areas above timberline. They are rarely found far from permanent water.

Suitable habitat for the boreal toad/chorus frog exists in the project area. Surveys conducted in and near the project area in 1999 and/or 2002 resulted in numerous observations of boreal toads and chorus frogs, with the toad observations occurring primarily along Gypsum Creek, and the frog observations occurring throughout the project area (USFS 2006). Further, incidental sightings of these species were recorded during fish surveys and other site visits between 1992 and 2003 (USFS 2006).

One boreal toad and two boreal chorus frog breeding sites that are being monitored by the Forest are located within the project area. The boreal toad site was last monitored in 2007 with +500 tadpoles present. The two boreal chorus frog sites were also monitored in 2007. No frogs were present. The boreal chorus frog sites have suffered from continued drought conditions. None of these sites occur within proposed vegetation treatment areas.

B.1.3 Threatened and Endangered MIS

This section identifies the existing condition of threatened and endangered species within the project area. A detailed Biological Assessment for federally listed threatened and endangered species is located in the project record. T&E species that are found on the BTNF and are known or suspected to occur within the area of influence of the project area are shown in Table 2.

Table 2. Threatened and Endangered Species Known or Suspected to Occur Within the Area of Influence of the Project Area.

Species	**Federal Status**	**Species Presence**
Canada Lynx (*Lynx canadensis*)	Threatened	Suspected
Gray Wolf	Experimental	Known

Canada lynx inhabit high elevation areas where deep snows give them competitive advantage over other predators. Mature or late-successional multi-storied spruce-fir forests provide the primary foraging habitat for lynx in the southern portion of their range including the project area. These forests can support snowshoe hares (*Lepus americanus*), the primary prey species for lynx, as well as red squirrels, an important alternate prey species. Conifer-aspen forests, particularly those with dense regeneration or an extensive shrub and woody debris understory component, and willow riparian areas may also be important for prey species, as they provide both forage and cover. Historically, lynx individuals have been documented in the project area (WYNDD 2005).

Lynx habitat within the project area consists primarily of mature lodgepole pine, mature spruce-fir, and conifer-aspen forest types. Within the Pinyon-Osborn Rx Fire Treatment Area, lynx habitats consists of mature spruce-fir forests that generally lack a well developed understory. Within the Mechanical Treatment Area, lynx habitat consists of conifer encroached aspen that is patchy with numerous small openings. High quality multi-storied conifer stands do not occur in any of these treatment areas.

The project area is located within three Lynx Analysis Units (LAU); Fish Creek South, Roaring Fork West, and Big Twin West (Table 3). These LAU's have been lightly impacted by recent wildfires or timber harvest. In general, clearcuts older than 30 years after harvest should be providing winter snowshoe hare habitat in these LAU's. About 249 acres, 166 acres, and 219 acres of lynx habitat in the Fish Creek South, Roaring Fork West, and Big Twin West LAU's, respectively, is in this condition. Vegetation treatments are not proposed in the Fish Creek South LAU, therefore no change in lynx habitat will occur in this LAU and it will not be discussed further.

On February 28, 2008, the U.S. Fish and Wildlife Service proposed revising the Canada lynx critical habitat designation to include lands on the Bridger-Teton National Forest. The BTNF is within the Greater Yellowstone Unit of proposed critical habitat.

Table 3. Canada Lynx Habitat in the LAU's Encompassing the Pinyon-Osborn Project Area.

LAUs	Total Lynx Habitat	Lynx Habitat in Early Seral Condition [1]
Fish Creek South	38,634	3,057 (7.9)
Roaring Fork West	17,162	400 (2.3)
Big Twin West	24,065	764 (3.1)

[1] Acres of lynx habitat currently in early seral forest structure due to fire or timber harvest that currently does not provide winter snowshoe hare habitat. Percent of lynx habitat in this condition is in parenthesis. Timber harvest acres only include clearcuts less than 30 years old.

Gray wolves are native to the BTNF and were extirpated by humans by the late 1920's. Wolves were reintroduced in Yellowstone in 1995-96. Populations became established within two years after reintroduction and have been increasing since the initial reintroduction. The total wolf population in Wyoming increased from 252 wolves in 2005 to 311 wolves in 2006. Wolf numbers outside of Yellowstone National Park increased from 134 wolves in 2005 to 175 wolves consisting of 23 packs in 2006 (USFWS et. al. 2006). The Northern Rockies population segment of wolves was officially de-listed in March 2008, but was re-listed in July 2008 pending a federal court case.

Abundant prey species consisting of elk, moose, and mule deer are found in the project area during various times of the year with elk being the primary prey species for wolves in the region. Individual wolves and wolf packs have occupied the project area, but continue to be removed due to livestock depredation.

B.1.4 Sensitive Species MIS

This section identifies the existing condition for sensitive species within the project area. The wildlife species listed in Table 4 have been designated as Sensitive by the Intermountain Region of the Forest Service and may occur within the project area. Suitable habitat exists in the project area for these species. For Sensitive plants refer to the Sensitive Plants Section B.1.5.

Table 4. Intermountain Region Sensitive Fish and Wildlife Species Known or Suspected to Occur Within the Area of Influence of the Project Area.

Species	Species Presence
Grizzly bear (*Ursus arctoshorribilis*)	Known
Wolverine (*Gulo gulo*)	Suspected
Bald Eagle (*Haliaetus leucocephalus*)	Known
Peregrine Falcon (*Falco peregrinus anatum*)	Suspected
Three-toed Woodpecker (*Picoides tridactylus*)	Suspected
Trumpeter Swan (*Cyngus buccinators*)	Known
Boreal Owl (*Aegolius funereus*)	Suspected
Great Gray Owl (*Strix nebulosa*)	Suspected
Northern Goshawk (*Accipiter gentilis*)	Known
Greater Sage grouse (*Centrocercus urophsianus*)	Known
Columbia spotted frog (*Rana pretiosa*)	Suspected

Grizzly bears require cover for thermal, resting, and security cover. Optimum habitat consists of large areas with diverse vegetation communities, free from human disturbance. Grizzly bears are opportunistic feeders and will prey or scavenge on most available food, including ground squirrels, ungulates, carrion, and fish. In areas or times where high protein food sources are not available, grizzlies rely on the stems, leaves, roots, tubers, and bulbs of grasses and forbs, the berries of shrubs, and the cambium and pine nuts of conifers. Availability of specialized food sources such as whitebark pine stands, fish spawning streams, and ungulate winter ranges are seasonally important. Den sites are usually far away from human activity in mountainous terrain over 6,000 feet in elevation on steep slopes when deep snow accumulates.

The project area lies within the Greater Yellowstone Area (GYA). The GYA currently provides habitat for one of the five remaining populations of grizzly bears in the contiguous United States. Grizzly bears in this region were listed as Threatened under the ESA in 1975 and were de-listed in 2007.

Habitat for grizzly bears is present throughout the BTNF, with optimum habitat in the wilderness areas. Grizzly bears inhabit the Buffalo Ranger District and portions of the Jackson and Pinedale Ranger Districts. Grizzly bears are known to be present, but the project area is outside of the Primary Conservation Area (PCA). A large portion of the treatment units are roaded and thus do not provide secure habitat for bears. The eastern half of the Pinyon-Osborn Rx Fire Treatment Area provides the most secure habitat within any of the treatment units. The project area is within the BTNF Food Storage Area (#04-00-104).

Wolverines inhabit high mountain forests of dense conifers (primarily in true fir cover types), as well as subarctic-alpine tundra. Wolverines studied in central Idaho preferred mature montane forest in association with subalpine rock and scree habitats. They move seasonally between higher and lower elevations in search of food, with the higher elevation habitat types generally preferred in the summer and both high and low altitude sites used during the winter. Wolverines are widespread, however, their populations occur in low densities, and they are difficult to observe. Therefore, the frequency of sightings may not reflect the actual size of the population.

Wolverines have been documented in three locations southeast of the project area in the Bridger Wilderness (WYNDD 2005). Although wolverines have not been observed in the project area, suitable habitat is present, and their presence is likely, in low numbers, particularly where human presence is low.

Bald eagles are closely associated with water, and their nest sites are commonly found less than 1 mile from a lakeshore or riverbank. Large trees are necessary to support eagle nests. Alternate nests are commonly found within, or in close proximity to, the stand containing the nest. Old-growth stands, with their structural diversity and open canopies provide important habitat for eagles because snags and open-canopied trees located near the nest site and foraging areas offer favorable perches. Bald eagles with access to open water or alternate food sources near their nesting territories may not migrate in winter; however, many eagles migrate southward to areas with available prey.

Summer and winter bald eagle habitat is abundant in the project area. Fish, waterfowl, and carrion provide plentiful food sources, and discharge from Kendall Warm Springs often keeps a large stretch of the Green River ice-free throughout the year. There are no known winter roost sites in the project area. However, small numbers of eagles do winter along the Upper Green River.

WGFD conducts annual nest surveys on the Forest and monitors nest territory occupancy and productivity. One known, occupied, bald eagle nest site is present in the project area, in the vicinity of Dollar Lake. The associated eagle pair has used a number of alternative nests in this general area. One alternate nest for this pair is located within a mechanical treatment unit. This nest was last active in 2007. A second nest territory is located adjacent to the project area, at the southeastern end of Lower Green River Lake. This nest was last occupied in 2006.

Peregrines nest high on cliff ledges often near water because of the abundance of avian prey associated with such sites. Foraging habitat includes wetlands, riparian gorges, mountain valleys and lakes, which support populations of small to medium sized birds, in particular shorebirds and waterfowl.

Suitable nesting habitat for peregrine falcon is minimal on the Forest, however, foraging habitat and limited nesting habitat are present in the project area. One active peregrine eyrie (nest) is located northwest portion of the project area, and falcons, likely from this pair, have often been seen foraging along the Green River corridor. Falcons have also been sighted in the project area near the Upper Green River Lakes and seen perching on the small cliff band near the Moose-Gypsum Road (S. Patla, WGFD, personal communication, 2005 *in* USFS 2006), which is adjacent to the project area.

Three-toed woodpeckers inhabit montane stands of coniferous, deciduous, and mixed trees. In Wyoming forests, they are found in large, unbroken stands of mature spruce-fir and lodgepole pine, where they tend to be associated with recent fires and bark beetle infestations. They require snag densities of 1 per 5 to 7 acres. Three-toed woodpeckers excavate a new cavity for nesting each year, which, in the GYA, is generally located in moist, coniferous forests on relatively gentle terrain. They prefer snags at least 12 inches DBH and at least 15 feet in height. Their nests are anywhere from 5 to 50 feet above ground.

Suitable habitat for three-toed woodpeckers is present in the mature lodgepole pine and spruce forests in the project area, particularly in areas with high levels of insect infestation and recent burns. Surveys for this species were conducted concurrent with goshawk surveys in the project area in June and July of 2002 and 2004 (USFS 2006). Woodpeckers were documented in several locations during these survey efforts.

Trumpeter swans nest on a wide variety of freshwater ponds and lakes, and occasionally rivers, and select sites that are partially sheltered. They prefer wetland areas with an abundance and diversity of submergent aquatic plants, as they rely on these plants for food. The same nest sites and territories are often used each year. Wintering takes place on large lakes.

More recently, this pair has nested near Mud Lake. The entire stretch of the Upper Green River between Mud Lake and Dollar Lake provides habitat for swans during ice-free months, and potential nesting habitat is present in the old ox-bends and sloughs. Single birds and groups of swans are frequently seen in suitable habitat throughout the project area during spring, summer, and fall, especially along Upper Green River. In 2007, trumpeter swans successfully nested within the project area at Mud Lake and Mosquito Lake. Each pair produced 2 cygnets (WGFD 2007).

Boreal owls are found primarily in western Wyoming and in the Sierra Madre range of south-central Wyoming. They inhabit mature, high-elevation forests of Engelmann spruce, subalpine fir, and/or mature lodgepole pine. Interspersed mature aspen stands are also important, as they usually provide more nesting cavities than spruce or fir.

They require large areas of interspersed forests, as home ranges are usually greater than 2,500 acres. These owls prefer a structure that is typical of mature and old growth forests (i.e., large downed logs, high overstory canopy, open understory, multi-layered canopy, and large snags). They also prefer areas with small forest openings (such as wet meadows) or an open stand structure for foraging, and will avoid large meadows and young forest stands because of decreased mobility and prey access.

The project area provides suitable nesting and foraging habitat for boreal owls. No surveys have been conducted for this species in the area, but their presence is likely where suitable habitat exists.

Great gray owls inhabit montane stands of coniferous, deciduous, and mixed trees, usually bordering small openings or meadows. Semi-open areas near dense coniferous forests, where small rodents are abundant, provide optimal roosting and nesting habitat for these owls. They utilize broken-top snags, stumps, dwarf-mistletoe platforms, and old

hawk or raven nests for nesting. They feed mostly on voles and pocket gophers across their range, but may take other small mammals and birds.

Suitable habitat for great gray owls is present in the project area. An unconfirmed observation of a great gray owl was documented during goshawk surveys of the project area in 2002, and owls have been confirmed during surveys elsewhere on the BTNF in 2002 and 2003 (USFS 2006). Although great gray owls have not been confirmed recently in the project area, they likely are present where suitable habitat exists.

Northern goshawks inhabit montane stands of coniferous, deciduous, and mixed trees. They tend to select stands containing relatively large diameter trees and high levels of canopy closure for nesting, and nest sites are often located close to a perennial water source. In a study conducted in south-central Wyoming and northeastern Utah, northern goshawks primarily selected lodgepole pine and aspen trees on moderate slopes (ranging from 1 to 34 percent) for nesting. Goshawks exhibit high nest-site fidelity and may maintain several alternative nest sites within a territory.

Suitable habitat for northern goshawks is present in the forested portions of the project area. Surveys for northern goshawks were conducted in the project area in 2002 and 2004 (USFS 2006). One goshawk nest was located adjacent to the project area in 2002 near Gypsum Creek. This nest was last active in 2007.

The greater sage-grouse is an upland game bird that is entirely dependent upon sagebrush communities for all stages of its life cycle, with extensive areas of this habitat type required year-round. Sage-grouse have a high fidelity to their seasonal habitats (breeding, late brood-rearing, and wintering habitats), and females commonly return to the same areas to nest each year. Depending on geographic location, breeding activities occur from March through early summer. Most sage-grouse nests are located under sagebrush plants that provide overhead cover, with 15 to 30 percent canopy cover preferred. Late brood-rearing habitats, used from summer into fall, usually have less dense sagebrush canopy than nesting habitats and generally have a higher proportion of grasses and forbs in the understory. Riparian meadows, springs, and streams are also used during this time, especially in dry years, as these areas produce the forbs and insects necessary for juvenile birds. Because the diet of chicks consists of forbs and insects, diverse plant communities with abundant insect populations are especially important.

The project area provides potential brood rearing habitat for the greater sage-grouse along the northern and western portions of the Green River. No lek sites are known in the project area and no historic lek sites have been recorded in the vicinity.

Columbia spotted frogs are found in areas where permanent, quiet water is present, such as marshy edges of ponds or lakes, algae-grown overflow pools of streams, or springs. Emergent and submergent vegetation and willows are considered important habitat features. Following the spring breeding season they may move considerable distances from water, often frequenting mixed conifer and subalpine forests, grasslands, and sagebrush if puddles, seeps, or other water is available.

Potentially suitable spotted frog habitat exists within the project area. The Forest Service and WGFD conducted surveys for spotted frogs in the project area in 1999 and 2002, and frogs were observed in several locations near the northern tributaries of the Green River

(USFS 2006). Further, incidental sightings were recorded during fish surveys and other site visits between 1992 and 2001(USFS 2006).

B.1.5 Sensitive Plant Species

Eighteen plant species designated as Sensitive by the Intermountain Region of the Forest Service occur on the BTNF and are also plant MIS on the Forest. Of these, six are known to occur in the Pinyon-Osborn project area (WYNDD 2005, 2006), and are listed in Table 5. Only those species that are within vegetation treatment units will be carried further in this analysis. Species occurring outside of treatment units will not be impacted by the proposed vegetation treatments.

Table 5. Intermountain Region Sensitive Plant Species Known to Occur in the Project Area and their Presence within Proposed Treatment Units.

Species	**Species Present in Treatment Unit**
Boreal Draba (*Draba borealis*)	No
Narrowleaf goldenweed *(Haplopappus macronema var. linearis)*	No
Payson's bladderpod *(Lesquerella paysonii*)	No
Greenland primrose *(Primula egaliksensis)*	Yes
Naked-stem parrya *(Parrya nudlicaulis)*	No
Rockcress draba *(Draba densifolia apiculata)*	No

Greenland primrose is a mid-seral stage species that inhabits wet meadows along streams and calcareous montane bogs at elevations ranging from 6,600 to 8,000 feet. Flowering occurs between May and July and fruits are produced between June and August. This species has been observed in two disjunct populations in Wyoming, in Sublette and Gallatin counties. There is one known population within the Pinyon-Osborn Rx Fire Treatment Area along the Upper Green River.

B.1.6 Other Plant MIS (Aspen)

Quaking aspen is an Ecological Indicator Species for aspen habitats on the BTNF. This tree species is found throughout Wyoming's major mountain ranges and makes up about 9 percent of the total forested land base on the BTNF. Aspen is generally considered a seral species in the Rocky Mountain Region and on the BTNF. It rapidly pioneers disturbed areas, but eventually is replaced by more shade-tolerant conifers. Aspen is common in the project area covering about 6,332 acres within it. A majority of the aspen in the project area is mature.

B.1.7 Neotropical Migrant Birds and Montane Riparian Habitat

Executive Order (EO) 13186, signed January 10, 2001, lists several responsibilities of federal agencies to protect migratory birds. This includes development of a Memorandum of Understanding (MOU) between the USDA Forest Service and USDI Fish and Wildlife Service to promote and strengthen conservation of migratory birds.

Neotropical migratory birds (NTMB) use a variety of habitats in the project area during the breeding season including riparian, aspen, conifer, and sagebrush habitats.

Priority species for Wyoming have been identified in the Wyoming Bird Conservation Plan (Nicholoff 2003). Many of these birds are known to use habitats within the project area. Population trends for priority species have been estimated from the North American Breeding Bird Survey results and are available on the USGS Patuxent Wildlife Research Center website. Level I and Level II priority species in this plan are considered for this analysis and are defined as follows:

Level I: Priority bird species clearly needing conservation action. Declining population trend and/or habitat loss may be significant. This includes species which Wyoming has a high percentage of, and responsibility for, the breeding population, monitoring, and the need for additional knowledge through research into basic natural history, distribution, etc.

Level II: The action and focus for these species is monitoring. Declining population trends and habitat loss are not known to be significant at this point. Level II includes species which Wyoming has a high percentage of, and responsibility for, the breeding population. It also included species whose stability may be unknown, and species that are peripheral for breeding in the habitat or state, or for which additional knowledge may be needed.

Of the habitat types described in the Wyoming Bird Conservation Plan (Nicholoff, 2003), five are considered the highest priority for Wyoming, including montane riparian, plains/basin riparian, shortgrass prairie, mid-elevation conifer and shrub-steppe. The shortgrass prairie type is essentially absent in the project area. Therefore, this habitat type and its associated birds are not further discussed. Mid-elevation conifer habitat is abundant in the project area, and is addressed under the northern goshawk, great gray owl, and three-toed woodpecker in Section B.1.4. Potential impacts to other NTMBs associated with this habitat type would be similar to those described for these species. Shrub-steppe habitat is present in the project area and is addressed under the greater sage-grouse and Brewer's sparrow, in **Sections B.1.4 and B.1.2**, respectively. Potential impacts to other NTMBs associated within this habitat type would be similar to those described for these species. Riparian areas make up a small amount of the project area. However, because riparian areas appear to be inordinately important to, and commonly used by, NTMBs, the area of analysis for NTMBs is the suitable montane riparian habitat in the project area. The plains/basin riparian habitat type occurs at elevations generally lower than those in the project area, and is not further discussed.

Montane riparian areas provide habitat for numerous NTMBs. These areas are typically dominated by willows, alder, dogwood, Rocky Mountain maple, and water birch, and can include narrowleaf cottonwood, spruce, and sedges and rushes at mid- to upper-elevations (Nicholoff, 2003). The diversity of structure and cover provides nesting habitat, hiding and thermal cover, and food (insects, seeds and vegetation) for a variety of bird species. The water bodies provide a source of free water and food for aerial insectivores. The habitat is limited in the project area, occurring primarily along the Upper Green River and its main tributaries. Nine Level I and II priority bird species are associated with montane riparian areas, including the Calliope hummingbird, broad-tailed hummingbird, willow flycatcher, Hammond's flycatcher, American dipper, MacGillivray's warbler, Wilson's warbler, bald eagle, and harlequin duck.

C. Effects

This section discloses potential impacts to MIS that could occur under the Proposed Action and alternatives. Potential direct and indirect effects are described by species, by alternative, and cumulative effects are summarized by species category in Section D. Effects to species by alternative may be combined where appropriate due to similar impacts or no impacts.

C.1 Effects on Harvested MIS (Elk, Mule Deer, Moose, Pronghorn, Bighorn Sheep)

Alternative 1 (No Action)

Under Alternative 1, no vegetative treatments would occur. Therefore, the potential beneficial and negative impacts from these activities on harvested species discussed below under the Alternative 2 would not be realized. The existing condition would be maintained, and associated impacts to harvested species would continue. For example, available browse and forage would continue to decline in big game ranges and migration routes due to succession of habitat toward mid and late seral conditions. Vegetation would continue to mature, insect infestation and disease would continue to spread, and the risk of catastrophic wildfires, and associated impacts to big game and their habitat would persist.

Alternative 2 (Proposed Action)

Elk: The Pinyon-Osborn Rx Fire treatment units overlap crucial elk winter range and three overlap parturition areas. Treatments would result in a reduction in sagebrush canopy cover and a corresponding reduction in the amount of thermal and hiding cover in winter range and birthing areas. Further, burning, if it occurred during the parturition period, could cause direct mortality to calves and temporary displacement of adults. However, this would be a short-term impact, and with implementation of the big game calving mitigation measures, this latter impact would be avoided.

Conversely treatments of sagebrush and grass in the Mud Lake West, Mud Lake East, and Roaring Fork units would also provide a long-term benefit to elk by increasing the forage available in wintering and parturition areas. Likewise, treatment of aspen in these units would greatly benefit elk by providing additional forage and cover and thereby improving winter and parturition range. The regeneration of aspen would enable the elk to stay on Pinyon Ridge longer in the fall before moving to the Green River Lake feedground, and enable them to leave the feedground earlier in the spring. Treatments in the Wilderness unit on Pinyon Ridge would not measurably affect elk winter range, as this area consists primarily of conifers, but it could impact calving areas by removing cover provided by forest stands.

In the mechanical treatment areas elk may be temporarily displaced during project implementation. Long-term benefits for elk are expected due to increased forage from regenerating aspen stands.

Mule Deer: Depending on timing of treatments, they could potentially disturb deer on transition and summer range. Disturbance from noise and human presence could range from short-term startle response to avoidance during treatment. Broadcast burning also creates the slight potential for mortality and temporary displacement of individual deer.

Vegetation treatments could also increase available forage in transitional and summer range.

Moose: Two of the Pinyon-Osborn Rx Fire Treatment units (Mud Lake East and Roaring Fork) overlap critical moose winter range and/or parturition areas. Treatments would result in a reduction in sagebrush and aspen canopy cover and a corresponding reduction in the amount of thermal and hiding cover in moose habitat. Further, burning could cause direct mortality to calves, if conducted during the parturition period. However, with implementation of the big game calving mitigation measures, this latter impact would be avoided. Conversely, treatment of aspen in these units would result in long-term benefits to moose, as they would increase the amount of available browse.

Bighorn sheep: None of the proposed vegetation treatments have the potential to negatively impact bighorn sheep habitat, as no treatment units overlap crucial sheep winter range. However, prescribed burning of conifers in the Wilderness unit of the Pinyon-Osborn Rx Fire Treatment Area would benefit sheep in adjacent winter range, at least in the short term, by increasing grass available for forage.

Pronghorn: The vegetation treatments would not negatively impact the pronghorn antelope, as no winter range or birthing areas are present in the project area and the crucial migration route that links summer range with winter range for the Grand Teton National Park antelope population does not bisect any treatments units. However, the burn treatments on Pinyon Ridge could benefit antelope in the long term by improving forage condition.

C.2 Effects on Ecological MIS

Alternative 1 (No Action)

No vegetative treatments would occur under Alternative 1. Therefore, the potential impacts from some of these activities on wildlife ecological indicator species discussed below under the action alternative would not be realized. The existing condition would be maintained, and associated impacts to ecological indicators would continue. For example, (1) the risk of stand-replacing fires and associated impacts to old-growth associated species such as marten would continue and (2) sagebrush would continue to mature and decline, thus DFCs for this community and associated wildlife species would not be realized, and future habitat for sagebrush obligate species would decline.

Alternative 2 (Proposed Action)

The pine marten is associated with mature and old-growth coniferous forests. Therefore, vegetative treatments in spruce-fir dominated forests have the potential to impact marten habitat by shifting the vegetation to early seral conditions. It should be noted, however, that only mature forest stands would be treated; no designated old-growth would be impacted. Project implementation in the Mechanical Treatment Area would reduce the downed logs and snags that provide denning habitat, escape cover, and/or a source of food for marten. However, it is possible that prescribed fires could increase the amount of large, down woody material over time. Further, Forest Plan guidelines for snags and down woody material would be followed, so it is likely that these habitat features would not be limiting after project implementation. If martens were present when burning treatments were implemented, potential mortality of individuals could result. However, the likelihood of mortality is low given the mobility of this species. Given the relatively

small area of mature conifer forests that would be treated compared to the extent of suitable habitat in the project area and the high densities of snags and large volumes of downfall in the forest stands from insect and disease outbreaks, it is unlikely that this project would negatively affect populations of pine marten.

The Brewer's sparrow is a sagebrush-obligate species and would therefore have the potential to be impacted by the treatment of sagebrush. About 3,826 acres (7,652 acres available at a 50 percent burn rate) of big sagebrush habitat would be treated on Pinyon Ridge.

Mechanical and burn treatments would fragment sagebrush habitat to some degree in the project area and remove shrubs used as nesting habitat. This could temporarily reduce the number of sparrows that would potentially nest in the project area. However, past research has found that where treatments occurred on up to 50 percent of an area, the abundance of Brewer's sparrows did not change (Short 1984). Therefore, as only 21 percent of the big sagebrush habitat in the project area would be treated, the abundance of sparrows in the project area is not expected to decline substantially.

Treatment of sagebrush/grasslands in the Pinyon Ridge units would also increase the amount of grass and forb cover in some areas, thus changing the types of foods available to sparrows. Burning could result in direct mortality to adult individuals or young of the year if burning takes place during the nesting period.

As the health of the sagebrush in the project area would improve, and the condition would move toward more historic age classes and structure, habitat for a greater number of sagebrush associated species would be provided.

Boreal toads and chorus frogs inhabit wetlands during the breeding season. Although toads may migrate to upland habitats outside of the breeding season, this analysis is restricted to wetland habitats since these species are indicators for wetlands. This project has the slight potential to impact breeding habitat for boreal toads and chorus frogs. Temporary or small permanent breeding ponds could potentially be impacted by sediment. However, the ponds that would have the highest likelihood of being impacted with sediment load are those that often dry up prior to larval metamorphosis, thus lessening this potential impact. Impacts would be further reduced or eliminated by buffering wetland habitat from treatment and by implementing erosion control measures (see mitigation measures).

C.3 Effects to Sensitive MIS

Effects determinations for sensitive species for Alternative 2 are summarized in Table 6. Alternative 1 would have "No Impact" to sensitive species because no disturbance to sensitive species or their habitat would occur. Therefore, the potential negative and beneficial impacts from some of these activities on sensitive fish and wildlife species discussed below under Alternative 2 would not be realized. The existing condition would be maintained, and associated impacts to sensitive species would continue. For example:

- Conifer forests would continue to mature, insect infestation and disease would continue to spread, and the risk of catastrophic wildfires, and associated impacts to wildlife and their habitat would persist;

- Aspen stands would continue to mature, conifer encroachment would continue, and young aspen and associated sensitive species habitat would become more limited;
- Sagebrush would continue to mature and move away from historic size and structural conditions, and the quality of sage grouse habitat would decline.

Table 6. Effects Determinations for Implementing Alternative 2 for Intermountain Region Sensitive Fish, Wildlife, and Plant Species Known or Suspected to Occur Within the Area of Influence of the Project Area.

Species	**Effects Determination***
Grizzly bear	MIIH
Wolverine	NI
Bald Eagle	MIIH
Peregrine Falcon	NI
Three-toed Woodpecker	MIIH
Trumpeter Swan	MIIH
Boreal Owl	MIIH
Great Gray Owl	MIIH
Northern Goshawk	MIIH
Greater Sage grouse	MIIH
Columbia spotted frog	NI
Greenland Primrose	NI

* NI: No Impact
MIIH: May impact individuals or habitat but not likely to trend towards Federal listing or cause a loss of viability.

Alternative 2 (Proposed Action)

Grizzly Bear: Under the Proposed Action, vegetation treatments have the potential to impact grizzly bears. The human presence and noise associated with mechanical treatment, burning, and road use could directly disturb bears using the treatment units. This could result in temporary displacement of the bears during project implementation. A large portion of the treatment units are roaded and thus do not provide secure habitat for bears so any displacement impacts are expected to be minimal and short-term as bears are less likely to use these areas.

Treatment of sagebrush and aspen stands would provide a long-term benefit to grizzlies by increasing the availability of foraging opportunities in the future. Contractors would be required to follow the BTNF Food Storage Order (#04-00-104).

Wolverine: Vegetation treatments have the potential to impact habitat for wolverine, although the likelihood of impacts to individuals is low, since wolverines, if present, would be present in low numbers. The removal of vegetation through fire or mechanical treatment would reduce the availability of small mammal prey. However, this impact would likely be minor in conifer stands given the large volumes of fallen trees and other fuels on the forest floor and the relatively small portion of forested habitat that would be modified across the Forest. Potential wolverine den sites would not be impacted, as vegetation treatments would not occur in habitat types typical for denning. Conversely, treatment of aspen stands would create a future increase in prey items for wolverine, for the period of time that the stands remained in an early seral condition. Since only a small proportion of forest is proposed for treatment in the project area, and since adjacent, contiguous forest is present, these impacts are not expected to impact populations of this species.

Bald Eagle: Of the vegetation treatments under the Proposed Action, only the treatments in the Mechanical Treatment Area have the potential to impact bald eagles. Specifically, the currently active (2007) bald eagle nest within the treatment unit near Dollar Lake. Human activity and noise associated with these treatments could directly disturb eagles if conducted during the nesting season. This disturbance could result in temporary displacement or abandonment of the nest. However, this disturbance would be mitigated by conducting these activities outside of the nesting season or if this specific nest is inactive (see mitigation measures). With implementation of mitigation, no adverse impacts to bald eagle populations are expected. The treatment within the Mechanical Treatment Area east of Dollar Lake would likely improve the nest stand by reducing the risk of losing the site to catastrophic fire and improving the vigor of the remaining trees.

Peregrine Falcon: No direct impacts to peregrine falcons would result under Alternative 2. It is likely that implementation of the treatments on Pinyon Ridge/Osborn Mtn. would result in a shift, over time, in bird communities inhabiting these vegetation communities. However, as falcons primarily forage on larger birds along the Upper Green River, this would not notably impact composition or availability of prey.

Three-toed woodpecker: Where treatments occur in mature conifer forest could potentially impact the three-toed woodpecker. Direct mortality to woodpeckers and the insects that they feed on could result from the proposed burning activities. However, burning of conifer stands in the Pinyon Ridge/Osborn Mtn Rx Fire Treatment Area will increase habitat for three-toed woodpeckers.

Mechanical removal of live and dead standing trees and down wood, especially in the mature lodgepole pine and spruce forests, would reduce the current and future source of insects eaten by the woodpeckers and the current and future source of cavity-bearing trees used for nesting. However, because of the Forest's epidemic insect problems, these habitat features are not limiting. Further, since only a small proportion of forest habitat is proposed for treatment in the project area, these impacts are not expected to impact woodpecker populations on the Forest.

Trumpeter Swan: Potential impacts to swan nesting habitat could result from vegetation treatment within the Pinyon-Osborn Rx Fire Treatment area, if the treatments modified and/or removed aquatic plants around lakes, ponds, and wetlands, specifically, vegetation associated with Mud Lake. However, with implementation of mitigation measures that would buffer riparian areas from impacts to vegetation, and by not treating areas within the vicinity of nesting habitat during the nesting season, potential impacts could be avoided (see mitigation measures). The proposed vegetation treatments would not have the potential to impact other suitable nesting habitat in the project area.

Boreal Owl, Great Gray Owl, and Northern Goshawk: All of the vegetation treatment has the potential to impact boreal owl, great gray owl, northern goshawk individuals, and their habitat. Removal of habitat through mechanical treatment and prescribed fire would temporarily reduce habitat available to these raptors. Burning has a slight potential for direct mortality of some prey species, and potentially to the raptors, if implemented when these species may be present.

No raptor nests are known in the treatment areas. However, if raptors were nesting in proximity to the vegetation treatments, nesting activities could be disrupted.

Greater Sage Grouse: Treatment of sagebrush on Pinyon Ridge has the potential to impact the greater sage-grouse. Although no breeding populations are known in the project area, suitable habitat occurs. Removal of sagebrush through burning would temporarily reduce the suitability and availability of summer habitat for this species. Further, if grouse were present during burning operations, direct mortality of the birds could result. Impacts to late brood-rearing habitat would be less pronounced, depending on the spatial arrangement of treatments and the remaining sagebrush cover. Increases in grasses and forbs from these treatments would improve late brood-rearing habitat as long as the appropriate density of sagebrush remained intact. No other proposed activities would impact the greater sage-grouse.

Greenland Primrose: Greenland Primrose occurs in a riparian area therefore with implementation of mitigation measures in no impacts are anticipated.

C.4 Effects to Other Plant MIS (Aspen)

Alternative 1 (No Action)

Under Alternative 1 direct impacts to aspen would include the long-term loss of aspen habitat due to conifer encroachment. Aspen stands would continue to mature, conifer encroachment would continue, and young aspen would become more limited.

Alternative 2 (Proposed Action)

The Project Area contains about 6,332 acres of aspen. Of this total, about 4,139 acres would be scheduled for prescribed burning and/or mechanical treatments under the Proposed Action. About 502 acres occur in the mechanical units on the south end of the project area and about 3,637 acres on Pinyon Ridge. Assuming a 100 percent treatment, this would result in about 65% of the aspen in the project area being converted to early seral condition. Treatment objectives range from 60-100% treatment in aspen.

Implementation of Alternative 2 would result in a long-term benefit to aspen by reducing the amount of acres of conifer encroached aspen and increasing the amount of acres of aspen in early seral condition across the landscape.

C.5. Effects on Neotropical Migrant Birds (NTMBs) and Montane Riparian Habitat

Alternative 1 (No Action)

No vegetative treatment would occur under Alternative 1. Therefore, the potential impacts on NTMBs discussed below under the Alternative 2 would not be realized. The existing condition would be maintained, and associated impacts to NTMBs would continue. Movement towards desired future conditions for conifer, aspen, and sagebrush habitat composition, and associated NTMB communities, would not occur. This would result in a reduction in diversity of NTMBs in the project area.

The following assessment is restricted to montane riparian migratory bird species, as NTMBs associated with other habitat types are addressed elsewhere in this document. It should be noted, however, that the vegetation treatments proposed would move the Forest towards DFCs for conifers, aspen, and sagebrush. The shift in seral condition in these habitats in portions of the project area would reduce habitat for some species and increase it for others. Overall, implementation of these treatments would result in an increase in diversity of neotropical bird species in the project area.

Alternative 2 (Proposed Action)

Impacts to riparian habitat of most Priority Level I and II montane riparian NTMBs are not anticipated under the Proposed Action as riparian habitat would not be disturbed. An exception would be the potential impacts to the bald eagle. Although vegetation treatments are proposed along and/or in the vicinity of the Green River and its main tributaries, they would occur at least 100 feet from the shore of streams (see mitigation measures). Therefore, nesting habitat, hiding and thermal cover, and food for the other seven species would not be modified or degraded. An exception would be in cases where riparian buffers cannot be protected from prescribed fire within a reasonable cost constraint, or the Forest defines a vegetation prescription that allows/recommends lightly burning through riparian areas. In these scenarios, additional mitigations, such as seasonal constraints to reduce fire severity, may apply. If riparian areas were burned, nesting and foraging habitat and hiding and thermal cover could be impacted. However, if burning occurred when the vegetation was moist and green, impacts would be minimal. Although there could be some visual and/or audio disturbance of vegetation treatments, it is unlikely to disturb these species, as nesting for these smaller species is typically disturbed only if it occurs very close to their nests. Further, the riparian vegetation would buffer some of this disturbance.

The proposed vegetation treatments have the potential to increase available food and habitat (insects and seeds) to those NTMBs that are not restricted to riparian areas. For example, habitat for cavity nesting NTMBs would increase in areas that are prescribed burned.

C.6 Effects to Threatened and Endangered Species

This section discloses potential effects to threatened and endangered species. Potential direct and indirect effects are described by species, by alternative, and cumulative effects are summarized by species category in Section B.1.3. Effects to species by alternative may be combined where appropriate due to similar impacts or no impacts. Further analysis of effects to T&E, including effects determinations, conservation strategies, and recovery guidelines and goals, is included in the Biological Assessment located in the project record.

Lynx:

Alternative 1 (No Action)
Under Alternative 1, no vegetative treatments would occur. Therefore, the potential negative and beneficial impacts from these activities on lynx discussed below under Alternative 2 would not be realized. The existing condition would be maintained, and associated impacts to lynx would continue.

For example,

- Conifer forests would continue to mature, insect infestation and disease would continue to spread, and the risk of catastrophic wildfires, and associated impacts to lynx habitat would persist;
- Aspen stands would continue to mature, conifer encroachment would continue, and young aspen habitat would become more limited.

Alternative 2 (Proposed Action)
All of the vegetation treatments have the potential to indirectly impact Canada lynx. Although it is not known if a resident population exists in the project area, lynx have historically used the project area including in proximity to the proposed treatment areas. Acres of lynx habitat that would potentially be impacted by each vegetation treatment type are displayed by LAU in Table **7**. Overall with implementation of all vegetation treatments, the percentage of lynx habitat that would be in early seral forest structure that currently does not provide winter snowshoe hare habitat post treatment (including that which was early seral prior to treatment) would be 13% for the Roaring Fork West LAU and 7% for the Big Twin West LAU (Table x.x). Multi-storied mature or late-successional stands that provide adequate horizontal cover would not be treated. Under the Proposed Action, the Northern Rockies Lynx Management Direction (NRLMD) objectives, standards, and guidelines for vegetation management (USFS 2007) would be met. The proposed treatment consists of less than 1 percent of the proposed critical habitat within the Greater Yellowstone Unit, therefore there would be insignificant effects to the function of the critical habitat unit and the primary constituent elements. This is because the primary constituent elements of the critical habitat unit function on a broad landscape scale and the relatively small habitat changes that may result from the proposed change in the condition of lynx habitat would have insignificant affects to the primary constituent elements, and are unlikely to change how the elements function within the unit.

Table 7. Vegetation Treatment Acres in Lynx Habitat by LAU under the Proposed Action

Lynx Analysis Unit	Lynx Habitat in Mechanical Treatment Area	Lynx Habitat in Pinyon Ridge/ Osborn Mtn. Rx Fire Treatment Area	Lynx Habitat in Early Seral Condition after Treatment[2]
Roaring Fork West	1,069	1,536	2,237 (13 %)[1]
Big Twin West	824	0	1,588 (7 %)

[1]Assumes 50 percent stand replacement of conifers on Pinyon Ridge/Osborn Mtn. (768 acres impacted).

[2] Includes existing acres in early seral condition that currently does not provide winter snowshoe hare habitat. Percent of total lynx habitat in LAU in this condition is in parenthesis.

Gray Wolf:

Alternative 1 (No Action)

Under Alternative 1, no vegetative treatments would occur. Therefore, the potential negative and beneficial impacts from these activities on wolves discussed below under Alternative 2 would not be realized. The existing condition would be maintained and associated impacts to wolves and their prey would continue.

Alternative 2 (Proposed Action)

Gray wolf packs have repeatedly formed and used the project area. This area is used by both wild and domestic ungulates. Vegetation treatment of these areas would increase the forage and browse for, and subsequent use by, ungulates, thereby increasing prey opportunities for wolves. If future wolf packs form in this area and begin preying on domestic livestock, control activities would likely continue.

D. Cumulative Effects to Wildlife

Continued grazing in the Upper Green River grazing allotments and past, present, and future vegetation treatments have the potential to interact with the direct and indirect impacts of the Proposed Action, resulting in cumulative effects to wildlife resources. Species that may be cumulatively impacted include; aspen, elk, moose, mule deer, pronghorn antelope, Brewer's sparrow, pine marten, and Canada lynx.

The continuation of cattle grazing in the project area would add cumulatively to the effects of the Proposed Action on harvested and ecological indicator MIS habitat. Grazing in recently treated aspen and sagebrush stands could prolong recovery of these sites after treatment. This could reduce quantity and quality of wildlife habitat. Implementation of post treatment cattle grazing mitigations and treating large areas at once will reduce the potential cumulative effects on the treated areas.

Resting pastures post-treatment or utilizing other range management techniques would allow grasses and aspen suckers to get established before potentially being impacted by cattle grazing. Wild ungulates would have immediate access to these areas. Treating large

areas would distribute potential grazing and browsing effects from cattle and wild ungulates across a larger area, there by reducing the impacts to aspen and Brewer's sparrow habitat even further.

The continuation of cattle grazing in the project area would not add cumulatively to the effects of the Proposed Action on threatened, endangered, and sensitive species. Primary cattle grazing areas and lynx habitat do not overlap.

Very little forested vegetation has been treated in and adjacent to the project area in the recent past. As a result, past projects in forested areas are not expected to add cumulatively to the Proposed Action.

Due to the results of the large scale beetle epidemic, salvage of dead and dying conifers may take place in and adjacent to the project area in the near future. Actual amount of acres is unknown at this time. No negative impacts to Harvest and Ecological MIS, other than pine marten habitat, are anticipated when adding these potential projects to the Proposed Action. The removal of standing dead trees could reduce habitat on a site-specific basis (treatment units) for pine marten. Cumulatively the effects would be negligible due to the availability of mature conifer forests that would remain in and adjacent to the project area. No designated old-growth would be treated.

The treatment of aspen and beetle killed forest has the potential to cumulatively add to the Proposed Action for lynx. Virtually, any treatment within conifer dominated stands will decrease the amount of lynx habitat to some degree. Cumulatively, all future projects will be designed to meet the objectives, standards, and guidelines for vegetation management (USFS 2007) in the NRLMD.

Appendix A - List of Preparers

This appendix lists interdisciplinary team members responsible for preparing the environmental assessment, including background documents. Experience listed is as of January 2009.

Team Members:

Mark Randall – Team Leader / AFMO Fuels
BS Animal Science. 12 years experience in fire/fuels management. Prepared fire and vegetation analysis, air quality analysis, GIS analysis, and editor.

Gary Hayward – Wilderness / Trails / Outfitter-Guide Administrator
BS Rangeland Management. 12 years experience in Wilderness Management. Prepared wilderness and inventoried roadless analysis.

Jamie Schoen – Forest Archeologist
BS Anthropology. 20 years experience in archeology. Prepared heritage resources analysis.

Joe Neal – Fisheries Biologist
BS Wildlife Conservation and Management-Fisheries Option. 15 years experience in fisheries. Prepared fisheries and watershed analysis and Biological Assessment/Evaluation for TES fish species.

Thomas Peters – District Ranger
BS Wildlife Management. 31 years experience. Provided line officer direction for the project.

Cory Mlodik – Wildlife Biologist
BS Wildlife Biology. 13 years experience in wildlife. Prepared wildlife analysis and Biological Assessment/Evaluation for TES wildlife species.

Chad Hayward – Range Management Specialist
BS Rangeland Management. 13 years experience in rangeland vegetation and watershed ecology. Prepared range, shrubland vegetation, and noxious weeds analysis.

Eric Winthers – Forest Soil Scientist
BS Soil Science. 21 years experience in soils. Prepared soils analysis.

Appendix B - References

Allen, A.W. and J.G. Cook. 1984. Habitat suitability index models: pronghorn antelope. US Fish and Wildlife Service. FWS/OBS-82/10.65. June.

Baxter, G.T. and M.D. Stone. 1995. Fishes of Wyoming. Wyoming Game and Fish Department, 290 pp.

Behler, J. L. and F. W. King. 1985. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf, Inc., New York.

Behnke, R.J. 1979. Monograph of the native trouts of the genus Salmo of western North America. Report funded for and by USDA-FS, USFWS, and USDI-BLM. 163 pp.

Behnke, R.J. and D.E. Benson. 1983. Endangered and threatened fishes of the Upper Colorado River Basin. Ext. Serv. Bull. 503A, Colorado State University, Fort Collins. 38 pp.

Behnke, R. J. 1992. Native trout of western North America. American Fisheries Society Monograph, Bethesda, MD.

Bethlamy, N. 1975. A Colorado episode: beetle epidemic, ghost forests, more streamflow. Northwest Science, v.49, no.2. pp.95-105.

Binns, N.A. 1978. Habitat Structure of Kendall Warm Springs, With Reference to the Endangered Kendall Warm Springs Dace. Wyoming Game and Fish Department, Fisheries Tech. Bull. No. 3.

BLM (USDI-Bureau of Land Management). 2003. Draft BLM sage-grouse habitat conservation strategy. BLM Sage-Grouse Team, Washington, D.C. Released August 21, 2003.

Brockmann, S. 1995. Controlling streambank erosion. Habitat Extension Bulletin No. 51, Wyoming Game and Fish Department.

Burton, T.A. 1997. Effects of basin-scale timber harvest on water yield and peak streamflow. J. American Water Resources Assn., v.33, no.6. pp. 1187-1196.

Cerovski, A.O., et al. 2004. Atlas of birds, mammals, amphibians, and reptiles in Wyoming. Wyoming Game and Fish Department, Nongame Program, Lander, WY. 206 pp.

Chapman, D. W. and K. P. McLeod. 1987. Development of criteria for fine sediment in Northern Rockies ecoregion. United States Environment Protection Agency, Water Division, Report 910/9-87-162, Seattle, WA, USA.

Cheng, J.D. 1989. Streamflow changes after clear-cut logging of a pine beetle-infested watershed in southern British Columbia, Canada. Water Resources Research, v.25, no.3, pp. 449-456

Chief of the Forest Service. 2003. 5100 letter of December, 2003, identifying and prioritizing Communities at Risk.

Chumley, T. W., B. E. Nelson, and R. L. Hartman. 1999. Atlas of the vascular plants of Wyoming.

Clarkson, R.W., and M.R. Childs. 2000. Temperature effects of hypolimnion-release dams on early life history stages of Colorado river basin big-river fishes. Copeia 2000:402-412.

Copeland, J. 1996. Biology of the wolverine in central Idaho. M.S. Thesis, University of Idaho, Moscow. 138 pp.

CRCT Conservation Team. 2006. Conservation agreement for Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) in the States of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins. 10p.

Crowe, D. M. 1986. Furbearers of Wyoming. Published by the Wyoming Game and Fish Department.

Dissmeyer, G.E., ed. 2000. Drinking water from forests and grasslands: a synthesis of the scientific literature. Gen. Tech. Rep. SRS-39. Asheville, NC: USDA-Forest Service, Southern Research Station. 246pp.

Druse, S.A. 1990. U.S. Geological Survey Water-Supply Paper 2375. National Water Summary 1988-89 –

Floods and Droughts: Wyoming. Cheyenne, WY.

Dunne, T. and L.B. Leopold. 1978. Water in environmental planning. W.H. Freeman and Company, San Francisco. 818 pp.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The Birder's Handbook: A Field Guide to the Natural History of North American Birds. Simon and Schuster/Fireside Books, New York.

Emmett, W.W. and M.G. Wolman. 2001. Effective discharge and gravel-bed rivers. Earth Surface Processes and Landforms. v. 26: 1369-1380

Farnes, P., McCaughey, W. and Hansen, K. 2003. Role of fire in determining annual water yields in mountain watersheds. In: Wallace, L. (ed.), An Ecosystem of Change: Ten Years After the Yellowstone Fire.

Farnes, P.E. 2000. Effects of the 1988 Yellowstone fires on the 1997 Yellowstone River peak flow. Rev. 4/2000. Unpublished report. 11pp.

Federal Guide for Watershed Analysis - Version 2.2. (August 1995). Ecosystem analysis at the watershed scale; Regional Interagency Executive Committee.

Fertig, W. and G. Beauvais. 1999. Wyoming plant and animal species of special concern. Wyoming Natural Diversity Database, Laramie, Wyoming. Unpublished report and database query on the yellow billed cuckoo.

Frison, George C. 1975. Archeological reconnaissance survey of the Bridger-Teton National Forest. Report No. 1. USDA Forest Service, Intermountain Region.

Fritts, S.H., E.E. Bangs, and J.F. Gore. 1993. The relationship of wolf recovery to habitat conservation and biodiversity in the northwestern United States. Landscape and urban planning C: 1-11, Elsevier Science Publishers B.V., Amsterdam.

Furniss, M.J., Flanagan, S., and McFadin, B. 2000. Hydrologically-connected roads: an indicator of the influence of roads on chronic sedimentation, surface water hydrology, and exposure to toxic chemicals. In Stream Notes, USDA Forest Service, Stream Systems Technology Center, July 2000. Available at http://www.stream.fs.fed.us/streamnt/pdf/SN_7-00.pdf

Graham, R. T., et al. 1999. The northern goshawk in Utah: habitat assessment and management recommendations. Gen. Tech. Rep. RMRS-GTR-22. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 42 pages.

Greater Yellowstone Bald Eagle Working Group. 1996. Greater Yellowstone bald eagle management plan: 1995 update. Greater Yellowstone Bald Eagle Working Group, Wyoming Game and Fish Dept., Lander, WY. 47 pp.

Gryska, A. 1996. Development of a monitoring protocol and description of several life history aspects of Kendall Warm Springs Dace (Rhinichthys osculus thermalis). M.S. Thesis. University of Wyoming. 171 pp.

Hammerson, G.A. 1986. Amphibians and reptiles in Colorado. Published by Colorado Division of Wildlife. Denver, CO.

Hann, W.J., Bunnell, D.L. 2001. Fire and land management planning and implementation across multiple scales. Int. J. Wildland Fire. 10:389-403.

Hardy, C.C., Schmidt, K.M., Menakis, J.M., Samson, N.R. 2001. Spatial data for national fire planning and fuel management. International Journal of Wildland Fire 10:353-372.

Harrelson, C. C., Rawlins, C. L., & Potyondy, J. P. 1994 . United States Department of Agriculture; An Illustrated Guide to field technique, Stream Channel Reference Sites.

Hawksworth, F.G. and O.J. Dooling. 1984. Lodgepole pine dwarf mistletoe. USDA-Forest Service. Forest Insect and Disease Leaflet No. 18. 11p.

Hayden-Wing Associates. 2005. Management Indicator Species, Bridger-Teton National Forest. Prepared

for the Bridger-Teton National Forest. March. Update of June 2004 version.

Hayward, G.D., P.H. Hayward, and E.O. Garton. 1993. Ecology of boreal owls in the Northern Rocky Mountains, USA. Wildlife Monographs. 124: 1-59.

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, GIS/ISC Laboratory, Dept. of Environmental Studies, Univ. of CA, Santa Cruz 95064.

Helvey, J.D. 1972. First-year effects of wildfire on water yield and stream temperature in north-central Washington. In: Csallany, S.C.; McLaughlin, T.G.; Striffler, W.D., eds. Watersheds in transition; 1972 June 19-22; Fort Collins, CO. Urbana, IL: Amer. Water Res. Assn.: 308-312. Vol. 14.

Hickenbottom, J.A.S. 2001. A comparative analysis of surface erosion and water runoff from existing and recontoured Forest Service roads: O'Brien Creek Watershed, Lolo National Forest, Montana, USA. Master's Thesis, University of Montana. 166pp.

Interagency Fire Regime Condition Class – Methods – Great Basin Geographic Area – Spring 2004 (Fire Regime Condition Class Version 1.0.5, April 14, 2004).

Lenon, N., K. Stave, T. Burke, and J.E. Deacon. 2002. Bonytail (*Gila elegans*) may enhance survival of razorback suckers in rearing ponds by preying on exotic crayfish. Journal of the Arizona-Nevada Academy of Sciences 34(1):46-52.

Licht, L. 1986. Food and feeding behavior of sympatric red-legged frogs, Rana aurora, and spotted frogs, *Rana pretiosa*, in southwestern British Columbia. Canadian Field Naturalist 100: 22-31.

Linnel, M., and N. Berg. 2007. Endeavor Wildlife Research Foundation: American marten track surveys 2005-06 report. Endeavor Wildlife Research Foundation.

MacDonald, Lee H. 2000. Predicting and managing cumulative watershed effects. Retrieved from http://www.cnr.umn.edu/FR/courses/fr5153/Macdonald.pdf

Madson, C. 1996. Tropical connections. Wyoming Wildlife, Wyoming Game and Fish Department publication.

Marsh, P.C., and W.L. Minckley. 1989. Observations on recruitment and ecology of razorback sucker: lower Colorado River, Arizona-California-Nevada. Great Basin Naturalist 49:71-8.

Matthews, J.R., and C.J. Moseley (editors). 1990. The Official World Wildlife Fund Guide to Endangered Species of North America. Volume 1. Plants, Mammals. xxiii + pp 1-560 + 33pp. appendix + 6pp. glossary + 16pp. index. Volume 2. Birds, Reptiles, Amphibians, Fishes, Mussels, Crustaceans, Snails, Insects, and Arachnids. xiii + pp. 561-1180. Beacham Publications, Inc., Washington, D.C.

May, B. E.. 1996. Chapter 2, Yellowstone cutthroat trout (*occorhynchus clarki bouvieri*) in conservation assessment for Inland Cutthroat Trout: distribution, status, and habitat management implications. USDA-FS, Intermountain Region, Ogden, UT. June, 1996.

Mech, D.L. 1970. The wolf, the ecology of an endangered species. University of Minnesota Press, Minneapolis. 384 pp.

Miller, W.H., D.L. Archer, J. Valentine, H.M. Tyus, R.A. Valdex, and L.R. Kaeding. 1982. Final Report: Colorado River Fishery Project. U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, UT.

Minckley, W.L., P.C. Marsh, J.E. Brooks, J.E. Johnson, and B.L. Jensen. 1991. Management toward recovery of the razorback sucker. Pages 303-357 in Battle against extinction: native fish management in the American West. University of Arizona Press, Tucson. xviii + 517 pp.

Miskus, D. National Drought Summary. US Drought Monitor. Retrieved November 9, 2004, from http://drought.unl.edu..

NatureServe Explorer. 2005. An Online Encyclopedia of Life.

http://www.natureserve.org/explorer/servlet/NatureServe?init=Species

Nicholoff, S. H., compiler. 2003. Wyoming Bird Conservation Plan, Version 2.0. Wyoming Partners In Flight. Wyoming Game and Fish Department, Lander, WY.

Novak, M.A. and J. C. Kershner. 2005. Molecular genetic investigation of Yellowstone cutthroat trout and finespotted Snake River Cutthroat Trout. A report in partial fulfillment of: Agreement # 165104, State of Wyoming. USDA-FS and Utah State University, July 2005.

NWIS Site Inventory for USA: Site Map for the Nation. USGS 13015000 Gros Ventre River At Zenith Wy. Retrieved January 5, 2005, from http://waterdata.usgs.gov.

Peterson, R.L. 1955. North American Moose. University of Toronto Press and the Royal Ontario Museum of Zoology and Paleontology. Toronto.

Podruzny, S., S. Cherry, C. C. Schwartz, and L. A. Landenburger. 2002. Grizzly bear denning and potential conflict areas in the Greater Yellowstone ecosystem. Ursus13:19-28.

President of the United States. 2001. Executive Order 13186. Responsibilities of Federal Agencies to Protect Migratory Birds. Federal Register, Volume 66, No. 11, January 17 2001.

Rees, Amanda. 1991 Upper Green River Valley Overview; A History of the Cultural Landscape. United States Forest Service, Bridger-Teton National Forest.

Reid, L.M. 1993. Research and cumulative watershed effects. Gen. Tech. Rep. PSW-GTR-141. Albany, CA. PSW Research Station, Forest Service, USDA. 118 pp.

Reiners, W. A., & Members of the Rocky Mountain Ecosystems Workshop Group, Chapter 7, Natural Ecosystems I. The Rocky Mountains.

Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Basselt, P.L. Kennedy, D.A. Boyce Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States. Rocky Mountain Forest and Range Experiment Station, South-west Region Forest Service. USDA Forest Service, General Technical Report GTR-RM-217. 90 pp.

Ritter, S. Undated Bulletin. Wing and Talon: Wyoming's eagles and hawks. Wyoming Wildlife Worth Watching, Wyoming Fish and Game Department publication.

Romme, Bill. 2004. Variability in Historical Aspen Dynamics, From Managing Aspen in Western Landscapes Conference Proceedings, September 21-24, 2004 Hunter Conference Center, Cedar City , Utah. http//extension.usu.edu/forestry/utahforest/foresttypes_04aspenconference.htm and http://olieto.ext.usu.edu/p416479223/.

Rosenberg, Robert G. 1990. Wyoming's last frontier; Sublette County, Wyoming. High Plains Press, Glendo, Wyoming.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO. Printing: Printed Media Companies, Minneapolis, MN. 380pp.

Ruediger, B., et al. 2000. Canada Lynx conservation assessment and strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT.

Ruggiero, L. F., et al. 1994. The scientific basis for conserving forest carnivores. American Martin, Fisher, Lynx, and Wolverine in the Western United States. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. General Technical Report RM-254. 184 pp.

Sauer, J. R., J. E. Hines, and J. Fallon. 2004. The North American breeding bird survey, results and analysis 1966 - 2003. Version 2004.1, USGS Patuxent Wildlife Research Center, Laurel, MD.

Schmidt, K.M, Menakis, J.P. Hardy, C.C., Hann, W.J., Bunnell, D.L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report, RMRS-GTR-87, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins,

CO.

Schnackenberg, E.S. and MacDonald, L.H. 1998. Detecting cumulative effects on headwater streams in the Routt National Forest, Colorado. J. Amer. Water Resources Assn., v.34, no.5, pp.1163-1177.

Seethaler, K. 1978. Life History and Ecology of the Colorado Squawfish (*Ptychocheilus lucius*) in the upper Colorado River basin. Thesis, Utah State University, Logan.

Seyedbagheri, K.A. 1996. Idaho forestry best management practices: compilation of research on their effectiveness. Gen. Tech. Rep. INT-GTR-339. Ogden, UT: USDA-FS, Intermountain Research Station. 89pp.

Shaw, Jan. 2005. Forest Reserve Funds and PILT funds for Sublette County for the past five years. Wyoming Department of Audit. Personal telephone call with Dave Aspitarte, 16 March.

Short, Henry L. 1984. Habitat suitability index models: Brewer's Sparrow. Habitat Evaluation Procedures Group, Western Energy and Land Use Team. U.S. Fish and Wildlife Service. Fort Collins, CO.

Sigler, W.F., and R.R. Miller. 1963. Fishes of Utah, Utah Department of Fish and Game, Salt Lake City, Utah. 203 pp.

Skinner, Holly L. 1985. Only the river runs easy; a historical portrait of the upper Green River Valley. Pruett Publishing Company, Boulder, Colorado.

Spahr, R., L. Armstrong, D. Atwood, and M. Rath. 1991. Threatened, endangered, and sensitive species of the intermountain region, USDA-Forest Service, Intermountain Region, Ogden, UT.

Squires, J.R. and L.R. Ruggiero. 1996. Nest-site preference of northern goshawks in southcentral Wyoming. Journal of wildlife management. Vol 60. no. 1(1996) p. 170-177.

Squires, J.R., and N.J. DeCesare, S. Tomson, L.F. Ruggiero, and B. Oakleaf. 2003. Distribution of lynx and other forest carnivores in the Wyoming Range, southcentral Wyoming. Final Report. Rocky Mountain Research Station, US Forest Service and Wyoming Game and Fish Department.

States West Water Resources Corporation. 2001. Green River Basin Water Planning Process.

Stegman, S.V. 1996. Snowpack changes resulting from timber harvest: interception, redistribution, and evaporation. Water Resources Bulletin, 32(6): 1353-1360.

Stevens, L.E., B.T. Brown, J.M. Simpson, and R.R. Johnson. 1977. The importance of riparian habitat to migrating birds. Pp. 156-164 in: The Importance, Preservation, and Management of the Riparian Habitat, a Symposium. USDA Forest Service General Technical Report RM-43. Fort Collins, CO.

Sullivan, J. 1994. *Bufo boreas*. USDA-Forest Service. Retrieved from http://www.fs.fed.us/database/feis/

Switalski, T.A., Bissonette, J.A., DeLuca, T.H., Luce, C.H., and Madej, M.A. 2004. Benefits and impacts of road removal. Front. Ecol. Environ. 2(1): 21-28

Thomas, A. E. 2001. Amphibians of the eleven contiguous western states and Alaska. Prepared for the Bureau of Land Management and Idaho Department of Fish and Game. July.

Thomas, J.W., et al. 1979. Deer and elk. Chapter 8 in Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington. USDA Forest Service, Agricultural Handbook 553.

Tyus, H.M. 1985. Homing behavior noted for Colorado squawfish. Copeia 1985:213-215.

Tyus, H.M. 1991. Ecology and management of the Colorado squawfish. Pages 379-402 in W.L. Minckley and J.E. Deacon, editors. Battle against extinction native fish management in the American West. Univ. Arizona Press, Tucson.

Tyus, H.M., and C.A. Karp. 1989. Habitat use and streamflow needs of rare and endangered fishes, Yampa River, Colorado. U.S. Fish and Wildlife Service, biological Report 89(14). 27 pp.

U.S. Census Bureau. 1990. American Factfinder, DP-1: General Population and Housing Characteristics: 1990. Retrieved from http://factfinder.census.gov

U.S. Census Bureau. 1995. Population of Counties by Decennial Census: 1900 to 1990.

U.S. Census Bureau. 2000a. American FactFinder, DP-1: Profile of General Demographic Characteristics: 2000. Retrieved from http://factfinder.census.gov

U.S. Census Bureau. 2000b. American FactFinder, QT-H1: General Housing Characteristics: 2000. Retrieved from http://factfinder.census.gov

U.S. Census Bureau. 2000c. American FactFinder, QT-H14: Value, Mortgage Status, and Selected Conditions: 2000. Retrieved from http://factfinder.census.gov

U.S. Census Bureau. 2000d. American FactFinder, DP-3: Profile of Selected Economic Characteristics: 2000, Sublette County. Retrieved from http://factfinder.census.gov.

U.S. Census Bureau. 2000e. American FactFinder, DP-3: Profile of Selected Economic Characteristics: 2000, Wyoming. Retrieved from http://factfinder.census.gov.

U.S. Census Bureau. 2004a. Annual Estimates of the Population of Wyoming: April 1, 2000 to July 1, 2003. Retrieved from www.census.gov/popest/counties/tables.

U.S. Census Bureau. 2004b. Annual Estimates of the Population for Incorporated Places in Wyoming: April 1, 2000 to July 1, 2003. Retrieved from www.census.gov/popest/cities/tables.

U.S. Census Bureau. 2004c. Wyoming Quickfacts, Sublette County. Retrieved from http://quickfacts.census.gov/qfd/states.

U.S. Environmental Protection Agency (EPA). 2005. Green Book, Particulate Matter Nonattainment Areas. Retrieved from www.epa.gov/air/oaqps/greenbk/pntc.html.

U.S. Fish and Wildlife Service. 1982. Colorado River Fishery Project Final Report. Part I (42 pp.), Part II (356 pp.), and Part III (342 pp.). Prepared for the U.S. Bureau of Reclamation, Salt Lake City, UT. April 1982.

U.S. Fish and Wildlife Service. 1986. Pacific States Bald Eagle Recovery Plan. Portland, OR. August. 163 pages.

U.S. Fish and Wildlife Service. 1989. Biological Opinion on the Bridger-Teton National Forest Plan.

U.S. Fish and Wildlife Service. 22 May 1990. Proposal to determine the razorback sucker (*Xyrauchen texanus*) to be an endangered species. Federal Register 55(99):21154-21161.

U.S. Fish and Wildlife Service. 1993. Grizzly Bear Recovery Plan. Missoula, MT. 181 pp.

U.S. Fish and Wildlife Service. 1993. Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement and Recovery Action Plan, Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin. U.S. Fish and Wildlife Service, Denver, CO. 50 pp.

U.S. Fish and Wildlife Service. 1994. Establishment of a nonessential experimental population of Gray Wolves in central Idaho and southwestern Montana. Final Rule. Department of the Interior 50 CRF Part 17. Federal Register 59 (224): 60252-60281. November 22, 1994.

U.S. Fish and Wildlife Service., 2005. Nez Perce Tribe, National Park Service, Montana Fish, Wildlife and Parks, Idaho Fish and Game, and USDA Wildlife Services. 2005. Rocky Mountain Wolf Recovery 2004 Annual Report. D. Boyd, ed. USFWS, Ecological Services, 100 N Park, Suite 320, Helena MT. 72 pp.

U.S. Fish and Wildlife Service. 2007. National Bald Eagle Management Guidelines. USFWS, May 2007.

U.S. Fish and Wildlife Service, Nez Perce Tribe, National Park Service, Montana Fish, Wildlife & Parks, Idaho Fish and Game, and USDA Wildlife Services. 2007. Rocky Mountain Wolf Recovery 2006 Annual Report. C.A. Sime and E. E. Bangs, eds. USFWS, Ecological Services, 585 Shepard Way,

Helena, Montana. 59601. 235pp.

USDA-Forest Service. 1973. Forest Hydrology, Part II. 208pp.

USDA-Forest Service. 1974. Handbook Number 462. National Forest Landscape Management, Volume 2, Chapter 1.

USDA Forest Service. 1988. Forest Service Handbook 2509.22 - Soil and Water Conservation Practices Handbook. R-1, Missoula, Montana; R-4, Ogden, Utah.

USDA- Forest Service. 1990. Bridger-Teton National Forest Land and Resource Management Plan. (Forest Plan)

USDA Forest Service, 1991. Threatened, Endangered, and Sensitive Species of the Intermountain Region. Updated April 23, 2007.

USDA-Forest Service. 1994. Part III, Boreal Owls, in Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment. USDA Forest Service, General Technical Report RM-253. Technical Editors: G.D. Hayward and J. Verner.

USDA-Forest Service, USDI-BLM, and USDI NPS (National Park Service). 1996. Wild and Scenic River Review in the State of Utah. Process and Criteria for Interagency Use. July.

USDA-Forest Service. 1997a. Bridger-Teton National Forest. Properly Functioning Condition Assessment (PFC), September.

USDA-Forest Service. 1997b. Ecological Unit Inventory: Bridger National Forest, Eastern Part, Wyoming, Volumes 1,2 and 3, October, 1997

USDA-Forest Service. 1999. Upper Green Landscape Assessment. Bridger-Teton National Forest. Intermountain Region. Jackson, Wyoming. May

USDA-Forest Service. 2001a. Bridger-Teton National Forest fire effects monitoring handbook. 87pp.

USDA Forest Service. 2001b. Forest Service Handbook 2509.25 - Watershed Conservation Practices Handbook, Chapter 10 - Standards and Design Criteria. (December 2001). Forest Service Handbook Rocky Mountain Region (Region 2) Denver, Co.

USDA- Forest Service. 2003. Forest Service Handbook 2509.18, R-4 Soil Quality Guidelines, Chapter 2, Soil Quality Monitoring

USDA-Forest Service. 2004a. Watershed Assessment: Gypsum Creek – Hydrologic Unit Code 140401010205. USDA Forest Service, Pinedale Ranger District, Bridger-Teton National Forest, Pinedale, WY. 51 pp.

USDA-Forest Service. 2004b. Upper Green River Area Rangeland Project – Draft Environmental Impact Statement. Bridger-Teton National Forest, Pinedale Ranger District. February.

USDA-Forest Service. 2005a. Prescribed Fire, Logan Ranger District, Fall/Spring 2004/2005. Retrieved from http://www.fs.fed.us/r4/wcnf/ conditions/prescribed.burns/logan.prescribed.burn.brochure.pdf.

USDA- Forest Service. 2005b. Smoke NEPA Guidance. Retrieved from www.fs.fed.us/r1/gallatin/resources/air/index.shtml.

USDA-Forest Service. 2005c. Forest Plan Update. Ecological Indicators. June.

USDA Forest Service. 2007. Management Indicator Species for the Bridger-Teton National Forest.

U.S. Forest Service. Moose-Gypsum Final EIS and Record of Decision. USDA Forest Service. Pinedale R.D. May 2006.

U.S. Forest Service. Northern Rockies Lynx Management Direction: Record of Decision. USDA Forest Service. March 2007.

U.S. Forest Service. Occupancy and Use Order No. 04-00-104. U.S. Department of Agriculture, U.S.

Forest Service Regions 2 and 4. December 12, 2004.

United States Geological Survey (USGS). 2007. North American Breeding Bird Survey Trend Results – Wyoming. [Web page] Located at: http://www.mbr-pwrc.usgs.gov/cgi-bin/atlasa99.pl?WYO&2&05. Accessed September 13, 2007.

USGS (U.S. Geological Survey). 2002. Calendar year streamflow statistics for Wyoming. USFS 09188500 Green River at Warren Bridge, near Daniel, WY. Accessed on USGS website on November 12, 2004.

USGS 13015000 Gros Ventre River at Zenith Wy. Retrieved January 5, 2005, from http://waterdata.usgs.gov.

USGS Real-Time Water Data for the Nation. USGS 13015000 Gros Ventre River At Zenith Wy. Retrieved December 21, 2004, from http://waterdata.usgs.gov.

USGS Surface Water Data for USA: Monthly Streamflow Statistics for the Nation. USGS 13015000 Gros Ventre River At Zenith Wy. Retrieved January 5, 2005, from http://waterdata.usgs.gov.

USGS Surface Water for USA: Daily Streamflow for the Nation. USGS 13015000 Gros Ventre River At Zenith Wy. Retrieved January 5, 2005, from http://waterdata.usgs.gov.

Van Kirk, R. W. and Benjamin, L. 2001. Status and conservation of salmonid in relation to hydrologicintegrity in the Greater Yellowstone Ecosystem. Western North American Naturalist 61(3): 359-374.

Wemple, B.C., Jones, J.A., and Grant, G.E. 1996. Channel network extension by logging roads in two basins, western Cascades, Oregon. Water Resources Bulletin, v.32, no.6, pp.1195-1207.

WGFD (Wyoming Game and Fish Department), Undated Bulletin A. Wyoming Big Game Mammals – Elk.

WGFD (Wyoming Game and Fish Department), Undated Bulletin B. Wyoming Threatened and Endangered Species on the Edge.

WGFD. 2001. Basin Management Plan. Basin: Upper Green River Tributaries (7UG). Submitted by Hilda Sexauer, April 2001.

WGFD. 2003a. Big game job completion reports. Jackson-Pinedale Region.

WGFD. 2003b. Big game job completion reports. Lander Region.

WGFD. 2003c. Wyoming Greater Sage-Grouse Conservation Plan. June 24

WGFD. 2004a. Big game job completion reports. Jackson-Pinedale Region.

Wyoming Game and Fish Department. Swan Flight Data 2007. Susan Patla, WGFD. September 10, 2007.

WOS (Wyoming Observation System). 2005. Results of an information request for special status animal species in the Moose Gypsum Project area.

Wyoming Natural Diversity Database. 2005. Data compilation for USDA Forest Service Region 4, completed May 2, 2005. Unpublished report. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

Wyoming Natural Diversity Database. 2006. Data compilation for USDA Forest Service Region 4. Unpublished report 2006. Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

WYNDD (Wyoming Natural Diversity Database). 2004. Species location data provide to the Forest Service.

WYNDD. 2005. Species location data from a March 14, 2005 data request submitted by Bionomics Environmental Inc.

Wyoming Department of Environmental Quality (WYDEQ). 2001. Water quality rules and regulations. Wyoming Surface Water Quality Standards. Retrieved from http://deq.state.wy.us./wqd/surfacestandards/Downloads/11567-doc.pdf

Wyoming Department of Environmental Quality. 2004. Wyoming's 2004 305(b) State Water Quality Assessment Report and 2004 303(d) List of Waters Requiring TMDLs. Available at: http://deq.state.wy.us/wqd/watershed/Downloads/305b/305b_2004.pdf

Wyoming Department of Environmental Quality (WYDEQ). 2005. Air Quality Standards and Regulations (WAQSR), Chapters 2 and 10. Retrieved from http://deq.state.wy.us/aqd/smokemanagement.asp.

Wyoming Interagency Vegetation Committee. 2002. Wyoming Guidelines for managing Sagebrush Communities with Emphasis on Fire Management. Wyoming Game and Fish Department and Wyoming BLM. Cheyenne, WY. 53 pp.