BLUEWATER ECOSYSTEM MANAGEMENT PROJECT

Final Environmental Impact Statement

CHAPTER 1:

PROPOSED ACTION, PURPOSE AND NEED, AND DECISION TO BE MADE

1.0 Background

Over a century of livestock grazing, fire suppression, logging, road construction, predator control, and exotic species introductions have altered most Southwestern ponderosa pine forests from conditions that prevailed for thousands of years (Covington and Moore 1994, Swetnam et al. 1999). This has promoted the development of unnaturally dense stands of suppressed young trees that threaten remaining large trees through competition and by fueling increasingly extensive crown fires (Covington and Moore 1994, Covington et al. 1994).

Recent changes in forest management strategies, such as the 2001 Federal Fire Policy and the President's Healthy Forests initiative, have highlighted the need to restore Southwestern forests to a condition where fire can return to its previous role, one of frequent light fires that burn through the understory. A recent study "Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective" proposes to restore Southwestern ponderosa pine forests in a series of steps that include substantial timber stand structural manipulation through mechanical means, such as the thinning of small diameter trees, prior to the reintroduction of fire. This project is the initial step towards achieving that goal.

1.1 Proposed Action

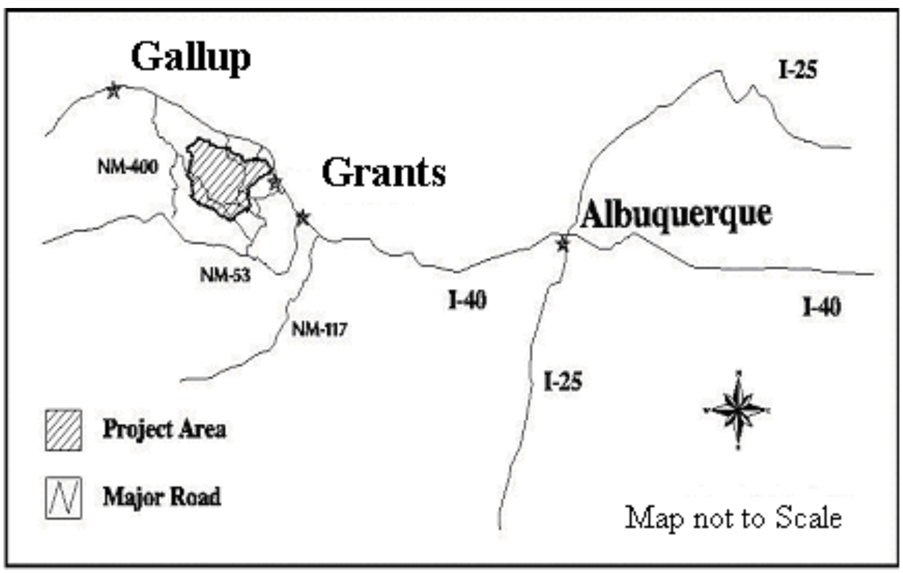
The USDA Forest Service, Cibola National Forest, Mt. Taylor Ranger District proposes to initiate vegetation treatments to restore ponderosa pine and piñon-juniper stands to a desired condition within the Bluewater Watershed in the Zuni Mountains. This project would be a first step towards achieving the goal of restoring the ecological integrity of these stands within this area. This involves implementing a strategy (as outlined in *Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective* (Allen, 2002)) that reduces the threat of destructive crown fires and returns stands within the project area to a condition where ecological processes, such as fire and insects, can exist without having catastrophic effects.

The proposed activities would be implemented over a period of 3 to 7 years. The proposed action would treat a total of approximately 23,925 acres of piñon-juniper stands and ponderosa pine stands to reduce fuel levels and restore the area to prior conditions that could support the return of fire within the ecosystem. Project objectives would be accomplished through the use of commercial and non-commercial product sales that would be used to help offset additional treatment costs.

Location

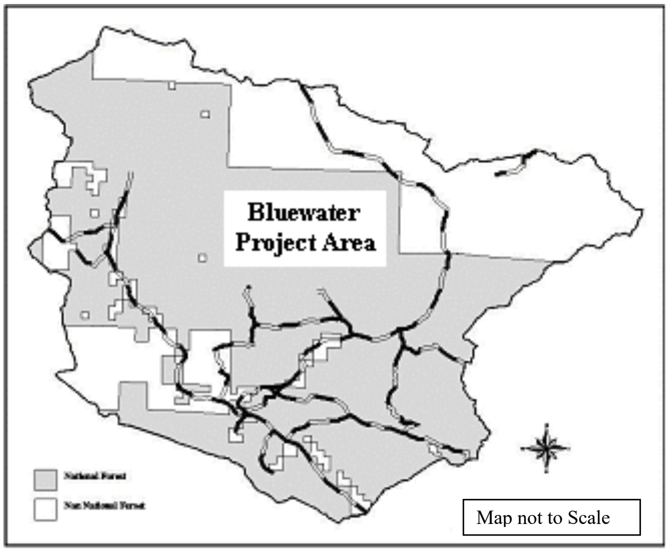
The Bluewater Ecosystem Management Project is located approximately 15 miles west of Grants, New Mexico (see Figure 1 for general location). The analysis area is approximately 114,400 acres in size, including 15,000 acres of private and tribal land. The project area is bounded by the Zuni River to the west, the Bluewater Lake community and tribal trust lands to the north, and the Agua Fria watershed to the east.

Figure 1 – *Bluewater Ecosystem Management Project Vicinity Map*



Within and adjacent to the Bluewater Geographic Area are approximately 50 miles of private land boundaries that interface with Forest Service boundaries (see Figure 2). Five additional miles of common boundaries with State and other Federal land adjoin the area to the north.

Figure 2 – ***Bluewater Ecosystem Management Project Area Land Ownership***



Treatment Activities and Environmental Protection Measures

Treatment units within the Project Area have been delineated into five different treatment types. These treatment types are: Piñon-juniper Wildland Urban Interface, Piñon-juniper control units, fuelbreaks, upland meadows, and ponderosa pine restoration areas. Each treatment type is further described below.

Piñon-Juniper Wildland Urban Interface

The piñon-juniper Wildland Urban Interface (WUI) is found along the northern forest boundary just south and west of the Village of Bluewater. Piñon-juniper woodlands are composed of a mosaic of species including piñon pine, juniper species, and ponderosa pine. Treatments would restore the grassland and shrub vegetation community and reduce potential high fire hazards found in selected areas that have been invaded by piñon-juniper. The following treatments are proposed for this analysis:

1. Approximately 885 acres of piñon-juniper stands would be patch cut through personal use and commercial fuelwood harvest.

2. Clumps and stringers of ponderosa pine and piñon-juniper would be thinned to meet vegetation and wildlife diversity objectives. Approximately 20 to 40 trees per acre would remain following treatment. The residual stand would reflect the species mix currently on site.

3. Patches of trees on north and east facing slopes five acres in size and at least 300 feet-wide, would be designated as thermal and hiding cover for large mammals and not treated. Approximately 70 acres have been identified for patch habitat.

4. Retain approximately 2 tons per acre of woody debris following treatment.

5. Non-useable forest products (i.e. small trees and limbs) would be treated by a prescribed low intensity broadcast burn conducted under proper conditions.

6. Existing roads would be used for control lines. However, an estimated 13 miles of handline would be constructed to provide additional support during broadcast burning.

7. No new system roads would be constructed and only existing system roads would be used for access. Approximately ½ mile of temporary high clearance road would be constructed to access treatment units. Temporary roads would be obliterated after treatments were completed.

8. Proposed treatments would occur over a period of 3 to 7 years.

Piñon-Juniper Control Units

There are three control units where the piñon pines and juniper trees were removed some 30 years ago to enhance rangeland forage production. These are the Twin Tanks, Las Tuces, and Salitre Mesa units, which are located in the northern part of the analysis area. The intent of this prescription is to remove piñon and juniper trees, which have grown in since the original treatment, to enhance the grassland/shrub community and reduce fuel continuity. The following treatments are proposed for this area:

1. Trees would be removed by hand (using chainsaws) on 2,565 acres. Slash would be lopped and scattered to reduce fuel loads.

2. Retain stringers and inclusions of pine species.

3. Maintain hiding and thermal cover where appropriate in 5 acre patches.

4. Non-useable forest products (i.e. small trees and limbs) would be treated by a prescribed low intensity broadcast burn conducted under proper conditions.

5. Construct an estimated 62 miles of control line by hand; although, existing roads and firelines would be used where possible.

6. No new system or temporary roads would be constructed and only existing roads would be used for treatment access.

7. The proposed treatments would occur over the next 3 to 5 years.

Fuelbreak

Reduce fuels along 10 miles (475 acres) of fuelbreak along the northern boundary of the project area. These areas are primarily piñon-juniper vegetation types with some ponderosa pine. The objective is to create a 400 foot-wide fuelbreak to reduce the continuity of crown fuels and provide protection to the Bluewater Lake community. The following treatments are proposed for this area:

1. Vary the width to incorporate geographic features, such as existing openings and rock outcrops as appropriate, to construct an effective fuelbreak.

2. Tree basal area within the fuelbreak would be reduced to less than 30 square feet per acre, with removal focusing on small diameter trees within the understory. Trees would be cut using chainsaws and limited material would be available for personal fuelwood.

3. Larger diameter trees would be retained where appropriate, while ensuring the discontinuity of fuels.

4. Non-useable forest products (i.e. small trees and limbs) would be treated by a prescribed low intensity broadcast burn conducted under proper conditions.

5. Construct an estimated 22 miles of control line by hand; although, existing roads or firelines would be used where possible. Prescribed burning would occur one or two seasons following mechanical treatment.

6. No new system or temporary roads would be constructed and only existing roads would be used for treatment access.

7. Proposed treatments would be implemented over a period of 3 to 5 years.

Upland Meadows

The objective of this treatment is to re-establish upland meadows to their pre-fire suppression condition. Several of these treatment areas were created during the 1980's in an attempt to reforest the sites. Fire suppression efforts have also allowed conifer species to encroach into these meadows. Most of the treatment areas are located south of Forest Road 421 between Rice Park and the junction of Forest Road 178. Other treatment areas are located between Sawyer and Agua Media along Forest Road 50. The following treatments are proposed for this area:

1. Treat trees less than 5 inches in diameter, on approximately 1,900 acres using hand and mechanical methods, such as: chainsaws, tree shearers, and hydro brush mowers.

2. Retain large diameter ponderosa pines and some smaller adjacent ponderosa pines in areas that exhibit historic tree evidence (large diameter logs and stumps).

3. Non-useable forest products (i.e. small trees and limbs) would be treated by a prescribed low intensity broadcast burn conducted under proper conditions. Control lines would be either existing roads or hand lines.

4. No new system roads would be constructed and only existing roads would be used for treatment access. Construct approximately 1 mile of temporary high clearance road to access treatment units. Temporary roads would be obliterated after treatments were completed.

5. The proposed treatments would occur over the next 3 to 5 years.

Ponderosa Pine Restoration Areas

This restoration treatment is designed to restore the ponderosa pine ecosystem and create stands that allow fire to return to its natural role. Thinning would also increase biodiversity by encouraging brush and grass growth, increase ecosystem resilience by incorporating a natural frequent fire return interval, and improve hydrologic function by reducing the basal area to historic conditions. Due to the size of the proposed treatment areas, this treatment type was divided into the three smaller treatment blocks: Redondo, Rice Park/Aqua Media, and Monighan. These treatment blocks were further divided into even smaller blocks to facilitate the timing of treatments in order to reduce potential impacts to resources. Treatment blocks were delineated and prioritized based on stand characteristics, fire risk, access availability, and wildlife objectives. The following treatments are proposed for this area:

1. Treat approximately 18,100 acres of ponderosa pine stands in the following treatment blocks:
    - **Redondo block** - located generally north of Forest Road 480 and north of Ojo Redondo Canyon, south of Bluewater Creek. Treatments are proposed for 7,996 acres. Existing basal area is as high as 170 square feet per acre in some areas.

    - **Rice Park/Agua Media block** - generally located north of Forest Road 50 and runs northwest to Cottonwood Creek. Treatments are proposed for 5,969 acres. Existing basal area is as high as 160 square feet per acre in some areas.

    - **Monighan block** - generally west of Lookout Mountain and east of Oso Ridge. Treatments are proposed for 4,135 acres. Existing basal area is as high as 155 square feet per acre in some areas.

2. The silviculture prescription would reduce basal area to an average of 30 to 70 square feet per acre across most of the treatment stands. Approximately 1,960 acres are prescribed for a higher basal area of 70 to 110 square feet per acre to meet northern goshawk habitat standards and guidelines for nesting and post-fledging areas as specified in the 1985 Cibola National Forest Land and Resource Management Plan (Forest Plan).

3. An uneven-aged silvicultural system would be applied to create a multi-aged stand structure with the majority of trees retained in the larger diameter classes. Thinning from below would create a non-uniform, clumpy structure with multiple age groups and a mix of species (pine, juniper, oak, etc.) represented across the landscape. Approximately 20 to 50 trees per acre would be retained depending on stand characteristics.

4. Large woody material (snags, logs, tree limbs) would be retained across the landscape in accordance with the Forest Plan standards and guidelines to meet wildlife habitat requirements.

5. All oaks greater than 10 inches in diameter would be retained.

6. Existing stand openings (1 to 4 acres in size) would be maintained in an early seral stage using prescribed fire.

7. Forest products would be made available to the public through personal use permits and commercial permits.

8. Non-useable forest products (i.e. small trees and limbs) would be treated by a prescribed low intensity broadcast burn conducted under proper conditions.

9. Construct an estimated 207 miles of control line by hand; although, existing roads or firelines would be used where possible.

10. No new system roads would be constructed and only existing roads would be used for treatment access. Construct approximately 29 miles of temporary high clearance road to access treatment units. Temporary roads would be obliterated after treatments were completed.

11. Proposed treatments would be implemented over a period of 5 to 7 years.

1.2 Purpose and Need for Action

There is a need to reduce fuels and restore ecological processes within the Bluewater watershed. This action responds to the goals and objectives outlined in the Forest Plan, as amended, and helps move the project area towards desired future conditions. This analysis tiers to the Forest Plan and conforms to all applicable management direction, including standards and guidelines. Therefore, the Mt. Taylor Ranger District proposes the above actions for the following reasons:

1. The Bluewater Geographic Area Assessment, conducted in 2000, identified this watershed as being in a critical condition because of the high fuel loads. The project area has vast acres of ponderosa pine and piñon-juniper stands that have a dense understory consisting of small diameter trees. These overstocked stands are at a risk of loss from catastrophic wildfire.

2. Meadow systems that were converted to ponderosa pine stands in the early 1980's are not functioning in the desired ecological capacity. These systems are important components to the overall forested landscape and provide a vital component for various wildlife species. The proposed action would restore these areas to a desired condition that would improve the hydrologic function within the watershed.

3. Reduce the threat of a catastrophic wildfire next to private property where people have built homes and communities.

4. Improve overall stand health and increase resistance from attacks of forest insects and disease.

5. Restore the dominance of more fire resistant ponderosa pine over fire intolerant species, such as Douglas-fir and juniper, which have become increasingly abundant.

6. Create conditions where wildfire intensities allow fire to resume its natural role and intensity in the forest mosaic of the Bluewater area within the framework of watershed restoration.

7. Create a condition where wildfire intensities in the Bluewater Wildland Urban Interface area at a level where fire suppression forces can safely remain on site in the event of an advancing fire.

1.3 Decision Framework

After reviewing environmental consequences of each alternative and how each one responds to the purpose and need, the Deciding Official will make a decision to either:

1. Implement the Proposed Action as stated above, or
2. Select a new alternative based on a modification to the Proposed Action that meets the purpose and need for action through some other combination of activities, or
3. Take no action at this time.

This decision would be consistent with the Cibola National Forest Land and Resource Management Plan and would not require any additional amendments.

1.4 Public Involvement

A Notice of Intent (NOI) to prepare an EIS for the Bluewater Ecosystem Management Project was published in the Federal Register on July 26, 2002. The NOI asked for public comment on the proposed action from July 26, 2002 to August 23, 2002.

The Cibola Forest publishes a Schedule of Proposed Actions quarterly each year. The Bluewater Ecosystem Management Project has appeared in that report since January 2001 and every quarter since. This report is mailed to persons who have requested information about Cibola National Forest projects.

In addition to the NOI and Cibola Forest Schedule of Proposed Action, as part of the public involvement process, the Mt. Taylor District Ranger took the following steps to inform the public about the proposed action and to solicit comments and concerns that they may have.

- Developed a mailing list of potentially interested and affected groups, individuals, and other governmental agencies and mailed a scoping letter describing the proposed action to approximately 140 individuals. The first scoping letter was mailed on March 13, 2002. Only one comment from that public scoping effort was received. A second scoping letter was mailed on June 18, 2002. Five letters from the public were received during that scoping effort.
- Consulted, verbally and in the field, with Reggie Fletcher, retired Southwest Regional Ecologist. Reggie Fletcher was the author of “Cibola National Forest Range of Natural Variability” (1998).
- Consulted, verbally and in the field, with Dr. Tom Atzet. Dr. Atzet was a primary author of the “Applegate Adaptive Management Area Ecosystem Health Assessment” (1994). The assessment addressed the importance of ecological disturbance processes in natural systems and acknowledged the historic role of fire as a key national disturbance that has been influential in shaping landscapes.

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- Consulted with Dr. Peter Stacey from the University of New Mexico. Dr. Stacey is one of the authors of the “Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective” technical paper.

- Consulted with Dr. Julio Betancourt a research scientist with the U.S. Geologic Survey. Dr. Betancourt is one of the technical reviewers of the “Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective” technical paper.

- Consulted with the Navajo Nation, the Pueblo of Acoma, the Pueblo of Laguna, and the Pueblo of Zuni.

- Hosted an Open House in Grants, NM on October 26, 2002 to discuss the proposed action and alternatives. Three members of the public attended the open house.

1.5 Issues

Using comments from the public, other agencies, and local Native American groups, the Interdisciplinary Team developed a list of issues to address. The Forest Service then separated those 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) National Environmental Policy Act (NEPA) regulations explains 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 why they were determined to be so, may be found in Appendix A.

As for significant issues, the Forest Service identified the following:

Issue 1: Protect Mexican spotted owl habitat by treating Protected Activity Centers (PAC) that have high fuel loads and are at risk to loss from fire or insect activity. (Indicator measure is acres of PAC treated.)

Issue 2: Expand the prescribe burn boundaries due to the need to reduce cost of line construction and the availability of personnel to complete control lines prior to burn. Expanding the boundaries would utilize road features as control lines instead of building line by hand, which is expensive, or building line by tractor, which can have potential resource impacts. Expanding the boundaries would reduce the amount of line constructed from 304 miles to 18 miles. (Indicator measures are acres of burn only treatment blocks and miles of handline constructed.)

Issue 3: Reduce the number of acres burned in the control units and upland meadow units and use pile burning to a greater extent in the WUI, the fuelbreaks, and ponderosa pine stands. Based on additional stand data, not all areas have high fuel loads that require the use of broadcast burning to reduce fuels. (Indicator measures are acres treated with prescribed fire and type of prescribed fire.)

1.6 Permits and Agency Approvals Required

In order to implement the proposed action, the following permits or authorizations would be obtained:

- Obtain a burn permit from New Mexico Environment Department Air Quality Bureau; as required by the New Mexico Smoke Management Memorandum of Understanding prior to prescribed burning.
- Consult with and obtain concurrence from the U.S. Fish and Wildlife Service on the Biological Assessment, addressing listed species, in accordance with Endangered Species Act.
- Consult with and obtain concurrence from the New Mexico State Historic Preservation Officer regarding identification evaluation, and determination of effect of the project on heritage resources to meet the requirements of Section 106 of the National Historic Preservation Act.
- Adhere to provisions within the 1977 Clean Water Act and Clean Air Act.

CHAPTER 2:

ALTERNATIVES

2.1 Alternatives Considered in Detail

The Forest Service developed three alternatives, including the Proposed Action and No Action alternatives, in response to issues raised during scoping. Thus, the following alternatives have been considered in detail in this Environmental Impact Statement:

1. Proposed Action (Alternative A): A complete description of this alternative has been provided in **Section 1.1: Proposed Action**. This alternative is the same as described in the June 18, 2002 public scoping letter. A map showing the location of proposed treatment units for this alternative is located in Appendix B.

2. No Action (Alternative B): Under this alternative, the Forest Service would not implement the proposed action as described above. Stands would remain in their current condition, and no vegetation would be removed to restore ecological functions. The Bluewater watershed ecosystem would remain at risk to loss from a catastrophic wildfire; should one occur in the future. The Forest Service would continue to manage and administer existing activities within the Bluewater watershed as approved in previous decisions or as provided in the Cibola National Forest Land and Resource Management Plan.

3. Preferred Alternative (Alternative C): During Interdisciplinary Team discussions, an issue was raised (*Issue 1*) regarding the need to begin restoration treatments within a Mexican Spotted Owl Protected Activity Center (MSO PAC). Therefore, this alternative would initiate restoration processes within 425 acres of Mexican spotted owl habitat, by reducing fuel loads and the subsequent risk of habitat loss if these areas were threatened by a catastrophic wildfire. A PAC was selected that represented high fire risk and where habitat characteristics would benefit from selected understory thinning and light prescribed burns. The area chosen for treatment represents less than 10% of all the PACs in this owl recovery area with known nest sites that have high fire risk conditions. No trees over 9 inches in diameter at breast height (DBH) would be removed and a 100 acre no treatment area would be established around the known nest sites. Slash created from thinning would be piled and burned in the fall if fuel levels exceeded wildlife needs.

   Additional burn acres would be incorporated into this alternative that would not include the use of mechanical thinning treatment, but instead would reduce fuel loads using prescribed fire only (*Issue 2*). An additional estimated 6,840 acres of broadcast burn would occur in areas outside of treatment stands identified in the proposed action alternative. Burn blocks have been increased in order to designate logical burn units that take advantage of existing roads, which can be used as fire control lines. Use of roads reduces burn treatment costs and meets the objective of restoration by returning fire into the ecosystem. This alternative would reduce the amount of control lines that would have to be constructed, since existing roads would be used as anchor points during burning operations. An estimated 18 miles would need to be constructed by hand under this alternative.

Mechanical thinning treatments within each unit would be the same as the proposed action; however, prescribed burning activities would vary for this alternative (*Issue 3*). Within the piñon-juniper Wildland Urban Interface unit and the fuelbreak unit, pile burning as opposed to broadcast burning would be used in areas where the fuel loads exceed 10 tons per acre after mechanical treatments were completed. Within the ponderosa pine uneven-aged management unit, a combination of broadcast burns and pile burns would be used to reduce fuels. Within the upland meadow unit, a broadcast burn would occur only in areas that were a part of a designated burn block, in order to use existing roads as fire control lines. Less than one-third of the proposed total upland meadow stands would be treated with prescribed fire. The remaining acres would still be treated by hand thinning using chainsaws, however no mechanized systems, such as tree shearers would be used. Within the piñon-juniper control units, no prescribed burning would occur. Instead, small trees, limbs and tops remaining after mechanical treatments were completed would be lopped and scattered, to a depth not exceeding 18 inches in height, and allowed to decompose over time. The majority of the piñon-juniper control units do not have excessive amounts of fuel concentrations, thus the use of prescribed fire to remove residual material would not be necessary.

The total number of acres treated under this alternative increases to 31,190. A map showing the location of proposed treatment units for this alternative is located in Appendix B.

2.2 Mitigation Measures Common to All Action Alternatives

The Interdisciplinary Team also identified various mitigation measures to have been included as part of both action alternatives. These measures, along with the Cibola National Forest standards and guidelines and best management practices, can be found in Appendix C.

2.3 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by the National Environmental Policy Act (NEPA) to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action scoping letter provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives were considered to be outside the scope of this project and not consistent with the purpose and need, in that they would not: 1) eliminate sufficient levels of the high fuel loads to reduce fire intensity; 2) improve stand health and increase stand resiliency to insects and disease; or 3) create a condition where wildfire intensities in the Bluewater Wildland Urban Interface (WUI) are at a level where fire suppression forces can safely remain on site in the event of an advancing fire. Some alternative suggestions were duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered, but dismissed from detailed consideration for reasons summarized below.

1. Diameter Limit Cuts: Restrict vegetation removal to tree less than 6 inches in diameter at breast height (DBH) for the ponderosa pine uneven-aged management units. In the WUI, piñon-juniper control units and fuelbreak units, only remove trees less than 6 inches in DBH for ponderosa and piñon pine species, and junipers less than 18 inches in diameter. No diameter limit would be placed on vegetation removed from the upland meadow units. This alternative will not be fully analyzed in this environmental document since it would not meet the purpose and need, which is to create stand conditions that are ecologically sustainable in a system that has a frequent fire return interval, nor would it create a forest stand structure that is fire resilient. Retaining all trees greater than 6 inches in diameter would result in a forest that is still too dense to meet the purpose and need. Ladder fuels would still be present and tree crown closure would leave stands vulnerable to catastrophic wildfire.

2. Total Landscape Treatment: This alternative proposes vegetation treatments across the entire Bluewater treatment area. Included in this alternative would be the construction of a 400 foot-wide fuelbreak along the entire National Forest System land boundary. This alternative was dismissed because not all areas are available or accessible for treatment. Habitat requirements for the Mexican spotted owl and the northern goshawk pre-empted the need for treatment in those areas. Thus, this alternative would not be compliant with the Forest Plan. Stands that were on steep slopes or were too far from established road systems were inaccessible for mechanical treatment. Lastly, the purpose and need for action is to reduce the risk of fire, threat of fire, and fire hazards by focusing on areas that have high fuel loads or stands that were adjacent to communities. This alternative would not have met this purpose and need.

3. Prescribed Burn Only: An alternative was considered that involves using prescribed burning to reduce ladder fuels across the entire project areas, without the use of mechanical thinning. However, because of the continuous multi-storied stands, steep slopes, and proximity to residential and recreational areas, the use of prescribed fire to thin the forest would present too great a risk in this area and could not be safely implemented without first reducing tree densities. Due to the level of risk and proximity to developed private property, this alternative will not be fully analyzed in the environmental document.

4. No Road Construction: This alternative would focus on treating only those areas that could be accessed from existing roads, thus no permanent or temporary roads would be constructed. This alternative would limit the ability to treat high priority areas and would not meet the purpose and need of the project, which is to restore ecological processes in areas at high risk that are not sustainable or are vulnerable to loss from a catastrophic wildfire.

2.4 Comparison of Alternatives

This section provides a summary and contrast of each alternative. Information in Table 1 is focused on activities and quantitative/qualitative differences between the alternatives. In addition, this table shows how each alternative addresses the significant issues discussed above in section 1.5 Issues and what indicator measures were chosen to measure those differences.

Table 1 - ***Comparison of Alternatives***

Comparison Of Alternatives						
Attribute	**WUIs**	**Control Units**	**Fuelbreak**	**Upland Meadows**	**Ponderosa Pine**	**Totals**
Total Acres Treated						
Alt A – Prop Action	885	2565	475	1900	18100	23925
Alt B – No Action	0	0	0	0	0	0
Alt C – Preferred Alt	885	2565	475	1900	25365	31190
Total Existing Roads[1] (miles)						
Maintenance Level 2	2.19	8.04	1.48	9.02	70.84	91.57
Maintenance Level 3	0.91	0.92	0	0.60	8.85	11.28
Unclassified (temp)	3.16	5.09	0.36	0.62	26.69	35.92
Temporary Roads Proposed for Construction (miles)	0.65	0	0	1.0	31.62	33.27
[1] Does not include road segments on non-Forest Service System lands or roads previously decommissioned.						
Acres Treated with Thinning						
Alt A – Prop Action	885	2565	475	1900	18100	23925
Alt B – No Action	0	0	0	0	0	0
Alt C – Preferred Alt	885	2565	475	1900	18525	24350
Acres Available for Public Fuelwood						
Alt A – Prop Action	885	0	475	0	18100	19460
Alt B – No Action	0	0	0	0	0	0
Alt C – Preferred Alt	885	0	475	0	18100	19460

Comparison Of Alternatives						
Attribute	**WUIs**	**Control Units**	**Fuelbreak**	**Upland Meadows**	**Ponderosa Pine**	**Totals**
Avg Thinning Volume Removed (mbf/acre) Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 3.5 0 3.5	 0 0 0	 0 0 0	 0 0 0	 1.32 0 1.32	 N/A
ISSUE 1: PACs Treated Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 0 0 0	 0 0 0	 0 0 0	 0 0 0	 0 0 425 acres	 0 0 425 acres
ISSUE 2: Expand Burn Blocks to Reduce Control Line Construction Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 0 0 0	 0 0 0	 0 0 0	 0 0 0	 0 0 6840 acres	 0 0 6840 acres
Proposed Handline Construction (Miles) Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 13 0 0	 62 0 0	 22 0 0	 0 0 0	 207 0 18	 304 0 18
ISSUE 3: Acres Treated w/ Prescribed Fire Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 885 0 885	 2565 0 0	 475 0 475	 1900 0 770	 18100 0 25365	 23925 0 27495

Comparison Of Alternatives						
Attribute	**WUIs**	**Control Units**	**Fuelbreak**	**Upland Meadows**	**Ponderosa Pine**	**Totals**
Type of Prescribed Fire Treatment Alt A – Prop Action Alt B – No Action Alt C – Preferred Alt	 Broadcast Burn None Pile Burn	 Brdcst Burn None None	 Broadcast Burn None Pile Burn	 Broadcast Burn None Minimal Brdcst Burn	 Broadcast Burn None Broadcast & Pile Burn	N/A

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Air Quality	Potential for smoke to affect the communities of Grants, Bluewater and La Jara Subdivision. Potential for smoke to impair visibility along Forest roads and highways. Would burn only on days when approved by the State and best chance for smoke dispersal.	Highest potential for smoke emission from wildfire.	Same as effects described for Alternative A. Increase in smoke generated by acres burned in larger burn blocks.
Effects to Aquatic and Terrestrial Wildlife and Plant Resources	Enhanced biological diversity. Treatments during nesting season may cause direct loss of individuals but not likely to result in long-term population decreases. Some species displaced during	Reduced herbaceous understory forage quality and quantity values. Loss of species diversity.	Same as effects described for Alternative A.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
	cutting and burning activities. Thinning and burning would result in enhanced habitat condition and productivity, with increase in plant and animal species diversity and composition. Increase in herbaceous vegetation.		
Effects to Management Indicator Species	Mule deer would benefit from thinning of woodland habitat and creation of early seral stage vegetation. Juniper titmouse would benefit from improved herbaceous understory development, which would support more insect populations. Merriam's wild turkey would benefit from improved understory forage conditions. No loss of cavity nesting habitat for pygmy nuthatch as snags would be retained. Treatments during nesting season may result in direct loss of individual nesting birds but not likely to result in long-term population decreases. Improved meadow forage conditions would benefit elk.	Forage values would not be improved for mule deer. Forage habitat for Merriam's wild turkey would continue to decline. Reduced meadow forage condition and habitat for elk.	Same as effects described for Alternative A.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Neotropical Migratory Birds	Treatment activities may result in direct loss of individual nesting birds but loss not likely to result in long-term population decreases. Some species displaced during thinning and burning activities. Habitat components would be enhanced in the long-term.	Reduced forage values. No displacement of birds. No increase in age class diversity and stand structure.	Same as effects described for Alternative A.
Effects to Threatened, Endangered, Candidate, Proposed, and Sensitive Species	May effect but would not adversely effect MSO. Activities would not destroy or negatively alter critical habitat for MSO. Foraging areas for MSO would be enhanced. Areas would continue to provide snags and down logs for prey habitat. Seed producing plants would be enhanced, thus providing increased forage for prey species for the MSO and goshawk. Herbaceous cover improved, which benefits prey species for goshawk. Thinning and burning would protect older age class trees from disease, insects and drought, thus providing habitat for goshawk.	No effects to MSO habitat in short term but decrease in habitat value in long term as diversity declines. Goshawk habitat becomes densely stocked with high levels of hazardous fuels. Replacement nest trees would not be produced in suitable habitat. Overcrowded stands become unsuitable for goshawk nesting.	Same as effects described for Alternative A. Additional protection of MSO habitat through fuel reduction in a Protected Activity Center.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Heritage Resources	Potential for damage to sites during road maintenance, public fuelwood removal, prescribed burning, and removing vegetative cover. Would reduce risk of catastrophic wildfire. Obliteration of existing temporary roads would reduce road density. Mitigation and monitoring would eliminate direct and indirect effects of thinning and burning activities. Effects to traditional cultural properties would not occur since sites not treated.	No impacts to sites from thinning and burning activities. However, this alternative has greatest potential for impacts from catastrophic wildfire. Also has greatest potential from fire suppression activities and rehabilitation efforts. No obliteration of existing temporary roads thus no change in road density. Risk of wildfire would impact traditional cultural properties.	Same effects as described in Alternative A. However, there would be no impacts to sites from removing small diameter (< 5 inches) trees using chainsaws and lopping and scattering slash without burning. Reduce amount of handline construction would reduce potential for impacts. Pile burning would have less potential for impacts to sites.
Effects to Noxious Weeds	Potential for weeds to be brought in on equipment and by public during fuelwood gathering activities. Mitigation measures would reduce potential but not eliminate it.	No direct, indirect or cumulative effects on spread of noxious weeds.	Same effects as described in Alternative A. Use of pile burning would expose more mineral soil and increase risk of weed seeds becoming established.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Fire and Fuels	Burning would increase diversity of stand densities while reducing fuel loads. Canopy cover reduced to less than 40% in most areas. Number of trees per acre reduced to 20-50 in thinned stands outside of fuelbreaks and 10-15 per acre within fuelbreaks. Large diameter fuels would remain. Broadcast burning would cause tree mortality. Under average worst fire conditions, flame lengths would be less than 10 feet from forest floor, with minimal chance of crown fire.	Tree density in ponderosa pine stands would continue to increase, resulting in mortality of mature trees and increases in fuel loads. Future wildfires would be suppressed, however, suppression efforts would become more difficult as conditions worsen with time. Under average worst fire conditions, flame lengths would be 4-6 feet from forest floor, and 70-150 feet in crowns.	Same effects for canopy cover and trees per acre. Areas that were thinned only with no burning would not be at risk for fire escape. Use of roads instead of handlines and pile burning instead of broadcast burning would create less risk of fire escape. Pile burning would cause less tree mortality and bole scorch. Under average worst fire conditions, flame lengths would be less than 10 feet from forest floor, with minimal chance of crown fire. Broadcast burning un-thinned stands would result in some tree mortality.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Hydrology and Soil Resources	No long-term adverse effects to soil loss. Short-term increase in erosion but recovery of groundcover would occur within 2-5 years. Handline construction would cause increase in erosion due to removal of topsoil and ground cover. Increases surface erosion in thinned areas until herbaceous vegetation recovered. Construction of temporary roads would increase potential for erosion; however, obliteration of these roads and existing temporary roads would reduce future erosion levels. Use of mitigation measures and BMPs would reduce risk of erosion.	Ground cover would remain high, but reduction in understory vegetation. High canopy cover to intercept rainfall and reduce soil erosion. High risk of catastrophic wildfire, which would result in severe soil loss.	Same effects as described in Alternative A, however, significantly less handline construction and use of pile burning would reduce potential for surface erosion.
Effects to Recreation	No direct effects to developed campsites. More fuelwood available to campers. Minimal effects to dispersed recreation. Slash remaining after treatment would impede hunters and equestrian travel.	Reduced opportunities for dispersed recreation activities and hunting should a catastrophic wildfire occur in the watershed.	Same effects as described in Alternative A.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Effects to Range Resources	No significant effect to livestock movement. Forage productivity would increase in upland and meadow areas. Potential to affect pasture rotation. Use of a planned thinning and burning schedule would minimize impacts. Extensive use of broadcast burning could result in loss of standing forage crop. Re-growth in following year would result in improved forage. Use of broadcast burning in meadows can cause overuse in following year.	No effects to forage availability, livestock movement, or pasture rotation. No improvement in forage production in understory or meadows.	Same effects as described in Alternative A, except more use of pile burning and less use of fire in meadows. Fewer pastures affected by prescribed burns.
Effects on Socio/ Economic Factors	Minimal change to public access by obliterating existing temporary roads, however these roads are currently used only by ATVs and motorcycles. Increased public fuelwood collection. Short-term impacts from smoke during prescribed burning activities. Noise from thinning activities would be audible in immediate area. No change in rural lifestyles. Potential for contract work for thinning, thus economic gain to local communities.	No change in access to public lands. No impacts from prescribed burning to communities, however, potential for adverse smoke impacts increases in the event of a catastrophic wildfire. No direct economic benefit associated with fuel reduction work. Greatest potential for loss of life and private property due to wildfire.	Same effects as described in Alternative A. Less visual impacts from pile burning. Higher probability of using Forest Service crews for burning activities than of using contract crews.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Environmental Justice	No disproportional affects to low income or minority populations.	No disproportional affects to low income or minority populations.	No disproportional affects to low income or minority populations.
Effects to Timber and Silvicultural Resources	Reduced canopy cover would stimulate herbaceous and shrub growth. Broadcast burning would remove organic matter build-up and allow for seed germination. Trees remaining after thinning treatment would increase in size and a greater rate. High intensity broadcast burns could create harsh conditions for seed establishment. Mitigation measures would be used to reduce fire intensity. Meadow habitat would be restored by removing encroaching conifers and releasing grass and forbs. Thinning would create multi-aged forests, increase stand diversity, and restore ecological processes. Stands would be able to survive wildfire. Potential old growth stands that were treated would move toward the desired state in less time. Trees would be better able to resist insect attacks. Thinning would reduce crown closure in the short-term below an	Stand density would continue to increase causing a decline in understory vegetation. This would result in depletion of the herbaceous seed bank and setback in re-establishment of native vegetation. Trees would continue to encroach into meadow habitat, causing a loss of forage species. Dense stands would become more susceptible to insect attacks. Loss of natural openings in the stand. Loss of large diameter trees as they become impacted by surrounding understory growth. Increasing ladder fuels and dense crown canopy would increase the fire hazard.	Same effects as described in Alternative A. However, use of pile burning would reduce the risk of high intensity burns. Not burning in some treatment areas would mean nutrient cycling takes longer than in burned areas. Slash left on site would slightly increase the fire risk until small fuels decomposed. Thinning within the MSO PAC would reduce the potential for loss of critical habitat during a wildfire. Broadcast burning in un-thinned stands would increase the risk of tree mortality from scorching and crowning.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
	average 40% for the watershed, which is below levels associated with goshawk habitat. In the long-term, residual trees would use additional resources to improve growth rates and close canopies.		
Effects to Transportation Systems	All proposed temporary roads would be decommissioned after use An estimated 16 miles of existing temporary roads would also be decommissioned after use, thus lowering the overall road density. Routine maintenance would occur on system roads and drainage structures would be improved.	No changes to the transportation system or road density would occur. No deferred road maintenance would occur in the immediate future.	Same effects as described in Alternative A.
Effects to Visual Resources	There would be effects to visual resources by implementing this alternative, however, effects would be subordinate to the natural characteristics of the landscape. There would not be a change to Visual Quality Objective (VQO) levels.	If a catastrophic wildfire would to occur in this watershed, there would be a significant decrease in visual quality.	Same effects as described in Alternative A. The use of pile burning and not burning in some areas would reduce the potential for scorch and the visual impacts from prescribed burning. The MSO PAC is located away from roads, thus any thinning or burning activities would not be visible to most forest visitors.

Comparison Of Alternatives			
Resource	**Alternative A (Proposed Action)**	**Alternative B (No Action)**	**Alternative C (Preferred Alternative)**
Unavoidable Adverse Effects	Based on the resource analysis prepared, there would be no unavoidable adverse effects from implementing this alternative.	There would be no unavoidable adverse effects by implementing this alternative, unless a catastrophic wildfire occurred in the future.	Based on the resource analysis prepared, there would be no unavoidable adverse effects from implementing this alternative.
Irreversible and Irretrievable Commitments of Resources	Based on the resource analysis prepared, there would be no irreversible and irretrievable commitment of resources by implementing this alternative.	Retaining the stands in their overstocked condition would create irreversible and irretrievable effects should a catastrophic wildfire occur in the future.	Based on the resource analysis prepared, there would be no irreversible and irretrievable commitment of resources by implementing this alternative.

CHAPTER 3:

AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

3.0 Introduction

This Chapter summarizes the physical, biological, social, and economic environments of the analysis area and the affects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the previous chapter. The affected environment is presented first under each resource area and followed by the environmental consequences for each alternative; which includes direct, indirect, and cumulative effects.

3.1 Air Quality

The Bluewater watershed is located within the Middle Rio Grande Basin Airshed. All airsheds in New Mexico are based on watershed boundaries developed by the New Mexico Water Quality Control Commission.

The Clean Air Act of 1977, which was amended in 1990 and in 1999, requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The NAAQS were established to set limits to protect public health, including the health of sensitive populations such as asthmatics, children and the elderly, as well as to protect against decreased visibility, damage to animals, crops, vegetation, and buildings. The EPA set NAAQS for six principal pollutants referred to as "criteria" pollutants. These pollutants are: lead, sulfur, dioxide, nitrogen dioxide, and ozone, particulate matter (PM) less than 10 microns in diameter (PM-10), and carbon monoxide. In 1997, the EPA issued a standard for 2.5 micron-size particulate matter (PM-2.5), however, that decision is currently part of a legal challenge that has not been resolved.

The primary pollutants produced in smoke during combustion of organic material includes: carbon dioxide (CO2), particulate matter (PM-10), nitrogen oxides (NO_x), and hydrocarbons. Lead, ozone, and SO_2 could be by-products, but these compounds would occur in insignificant amounts. Wood smoke consists of dispersed airborne solids and liquid particles, which can remain, suspended in the atmosphere from a few seconds to several months. There are no emission factors for some of the other by-products produced by smoke.

The First Order Fire Effects Model (FOFEM) was used to determine how much particulate matter would be produced by either alternative. The results of that model for conditions that would be expected, as part of no action or part of an action alternative, are provided in Table 2.

Table 2. ***Anticipated Total Smoke Emissions by Alternative***

Emission Matter	Proposed Action	No Action (w/ wildfire)	Preferred Alternative	Pile Burning
PM 10	441 lbs/acre	656 lbs/acre	441 lbs/acre	336 lbs/acre
PM 2.5	374 lbs/acre	556 lbs/acre	374 lbs/acre	284 lbs/acre
CO	4,253 lbs/acre	6,745 lbs/acre	4,253 lbs/acre	3,422 lbs/acre

** PM = Particulate Matter
CO = Carbon Monoxide

3.1.2 Environmental Consequences

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

There would be no direct effects to the air quality or human health from Alternative B. The indirect effects to the air quality would occur when a wildfire had escaped initial attack efforts and burned in unmanaged stands or in untreated fuels. Down material combined with ladder fuels from the understory would act as fuel sources for possible wildfire ignitions. At that time there would be a higher level of particulate matter released than in prescribed burning because of the greater amount of fuel consumed. Any wildfire in the area would have a much different and greater impacts than a prescribed fire that is under a controlled situation.

If a wildfire escaped initial attack and burned within the watershed the smoke impacts would be substantial on the communities of Bluewater, Grants, Thoreau, and La Jara subdivision. Table 2 shows the FOFEM results that would be expected from a catastrophic wildfire. The cities of Albuquerque, Cuba, Santa Fe, and other small communities in between would be impacted by smoke from a wildfire in the Bluewater watershed. As an example, the Cerro Grande and Rodeo/Chediski wildfires burned for over two weeks impacting many of the surrounding communities with dense smoke.

Prescribed fire impacts usually last for a short period of time and are managed, as well as, mitigated. Impacts from poor air quality created by wildfires can last for weeks, as experienced in Northern California and Southern Oregon in 1987 and in various parts of the Northern Rockies and Arizona in 1988 and 2000. Since Alternative B would not implement any action resulting in prescribed burning, there would also be no risk for an escaped prescribed burn that could result in additional tree mortality.

There would also be no direct effects to air quality by dust or exhaust caused by tree thinning and removal operations under Alternative B, since these activities would not occur.

Effects Common to Both Action Alternatives

There are three communities that could be affected by smoke from prescribed burning in the Bluewater watershed. They are Grants, Bluewater and La Jara Subdivision. Number of burn days would vary depending on burn windows.

Of the six NAAQS criteria pollutants, it is PM-10 and PM-2.5 that are of the greatest health concern. Carbon monoxide is another major product of wildfire smoke, but as a gas, it is quickly diluted in the atmosphere. Carbon monoxide can be of concern to firefighters and those conducting prescribed burns that are working within close proximity to the source of smoke.

Particulate matter has the potential to impair human health and visibility. PM-10 causes eye, nose, and throat irritation. Because of PM-10's relatively larger size, it remains in the upper respiratory tract. Due to PM-2.5's smaller size, it travels to the lungs and can cause more serious health impairments, such as chronic respiratory disease, emphysema, or lung cancer.

Volatile organic compounds are also produced, but EPA does not consider these criteria pollutants. The combustion of organic material also produces organic hydrocarbons that can affect human health. The two most important classes of compounds associated with organic hydrocarbons are polynuclear aromatic hydrocarbons and aldehydes, which can break down into certain carcinogens. Emissions containing these substances solely from fire pose a negligible risk of cancer for the general public because generally they are produced in very small amounts (Sandberg and Dost 1993).

In addition to health concerns associated with particulates and other emissions, high levels of particulate matter can impair visibility. Significant visibility impairment can lead to highway accidents or problems with landing planes at airports. Some air quality researchers believe that prescribed burns, such as those included in this proposal, should be analyzed based on visibility standards because these kinds of low intensity fires would occur under natural conditions where fire is part of the ecosystem (Haddow et al. 1998).

Smoke production is the one of the most evident direct and indirect effect of prescribed fire. Many factors contribute to the amount of smoke produced from a burn, including: weather conditions, combustion processes, fuel properties (moisture, loadings, arrangement), and type of burn. The effects of smoke on air quality are of short duration due to regulatory requirements, weather factors, the qualities of smoke, and smoke impact reduction measures. Smoke created by burning activities would temporarily reduce air quality. Much of the burning and subsequent loss of air quality would occur in the fall season when fuel moisture and atmospheric conditions are conducive to meeting all resource objectives, primarily smoke dispersion, and fire intensity. With prescribed burning, smoke can be held to a minimum duration and intensity, although burning can temporarily reduce air quality. However, prescribed burning can reduce the acute impacts to air quality from wildfires in the long-term. Levels of emissions from prescribed burning are below established health standard levels. While wildfires often produce levels of emissions that are doubled of the established Federal health standards. It is also important to understand the role that time of seasons (Fall, Spring, Winter, and Summer) in which burns are implemented have on potential air quality impacts. Spring burning conditions have the least impact on air quality. The reasons for this are summarized below:

- Large woody fuel and duff moistures are high. High fuel moistures in large woody fuels and duff limit the amount of fuel consumed. This limits the amount of emissions produced. In addition, smoldering fires are less likely to persist when duff is moist.
- Spring weather patterns and normal daytime heating lessens the chance for temperature inversions. Without inversions, the chances for the cumulative effects of air pollution to have health impacts are minimized as dispersion and ventilation cleanses the airsheds.
- Unstable weather patterns allow for better smoke dispersion during the actual burning process.

For alternatives A and C, smoke generated from within the project area could affect the air quality in the project area. Prescribed burning can cause smoke management concerns, especially if smoke drifts into populated, non-attainment, or Class I airsheds. Federal and state ambient air quality standards have been established for PM-10 (particulate matter less than or equal to 10 micro meters) concentrations. Either action alternative would be carried out in accordance with the established standards at the time of implementation. The principal impact to air quality in Class I airsheds from prescribed burning is the temporary visibility impairment caused by smoke. This may reduce the quality of forest recreation experiences, as vistas beyond the boundaries of the Class I airsheds may be temporarily obscured by smoke and haze. The conditions that may reduce visibility also produce visual benefits, as spectacular sunsets can be attributed to smoke on the horizon produced by prescribed burning. Smoke from prescribed burning would likely collect in nearby valley bottom areas for a short time following burning. Proximity to the burn and wind direction would determine how much individual residents would be affected. Most prescribed burning within the project area would be conducted in the fall due to the short burn windows experienced under springtime conditions. During the fall time, when most of the burning would be conducted, smoke would usually diminish within 1-5 days for each burn area. Fall smoke levels take several days longer to disperse because of the possibility of inversions that allow smoke to settle in the valleys or trap larger volumes of smoke.

The levels of smoke anticipated from is not expected to be a health concern, with the exception of people living directly adjacent to the burns who are severely sensitive to smoke. Public announcement steps would be taken prior to prescribed burning to alert nearby residents of intended burn dates and possible duration of smoke.

Dust and exhaust from vehicles during timber harvest would contribute limited short-term effects to air quality. Effects would be localized to the immediate vicinity of the operations. Much of the wood to be removed from thinning operations would be in the form of fuelwood. These types of operations use smaller trucks and equipment than those found typically in commercial logging operations. While there would be some commercial removal of sawlogs from the project area, impacts to air quality are expected to be light and short in duration from dust and exhaust. This is mostly due to the limited amount of volume per acre that is to be cut and removed. On larger sawlog removal contracts, dust abatement contract provisions are required to limit road dust.

While the smoke produced for prescribed burning activities can have much less impact than from wildfires, it can still contribute to conditions that are unpleasant for local residents and forest users. In addition, there is a slight risk that prescribed burns could burn out of control, becoming destructive wildfires.

Cumulative Effects

Regional haze problems can develop from the cumulative effects of particulate matter, which can travel great distances. Regional haze can sometimes result from multiple burn days and/or multiple owners creating dust or smoke in the airshed over too short a period of time. The cumulative particulate load may be the result of prescribed burning, stoves, and other urban and industrial sources. The causes of regional haze are difficult to identify. Prescribed burning treatments would be coordinated with the State EPA to ensure that burns were conducted during times of optimal smoke dispersion, thus there would be limited cumulative effects of combining prescribed burn smoke with that from other landowners.

Past, present, proposed and reasonably foreseeable activities were reviewed to determine cumulative effects to air quality. Because impacts to air quality from forest management activities are short-lived, past activities do not contribute to cumulative effects. Burning associated with foreseeable actions, other projects as well as the adjacent projects outside the project area can be expected. Some smoky days are likely to occur from reasonably foreseeable actions. Although smoke from burns outside the project area would also have a visual impact on the project area, the impacts to local residents would not be as great as burns generated within the area. Residents in and around the project area would continue to experience effects of smoke from reasonably foreseeable actions. Implementation of the project may increase the number of days that smoke is produced.

Temporary seasonal effects on air quality are unavoidable under any of the action alternatives. Prescribed fire is an integral part of ecosystem restoration management that includes mechanical and fuel reduction treatments to improve forest health and forage production to name a few. These activities would be scheduled when air dispersion is good. The temporary impacts of smoke from prescribed debris burning and road dust from vehicles associated with proposed activities would have minor, short-term effects on visual quality and recreation use. While smoke produced from this project would not cumulatively increase the amount of smoke affecting air quality, the duration or number of potentially smoky days could increase.

Other foreseeable actions include but are not limited to activities in association with ecological restoration treatments including but not limited to fuelwood and special forest products gathering for commercial and personal use. These activities would include burning 1-3 years post mechanical treatment and would add to the cumulative effects to air quality. The cumulative effects on regional air quality due to forest management activities are difficult to quantify. Because prescribed burning reduces fuel loadings, the potential for fires escaping initial attack is reduced. Therefore, the long-term effects of smoke from wildfires on air quality are reduced. Other forest activities affecting air quality include: livestock grazing, road maintenance, administrative road use, and public recreational use would also occur within the project area. These activities are not expected to contribute to cumulative effects to air quality.

As discussed earlier, prescribed burning of forest fuels is a minor contributor of PM-10 emissions when compared to other sources. Under favorable weather conditions, the impact of all PM-10 contributors is minimized. However, under stagnant atmospheric conditions, smoke from prescribed burns, wildfires, residential wood burning, wind blown dust, vehicle exhaust, road dust and other sources of air pollution can create a short-term, unhealthy impact on local air quality. Weather patterns, topography, and fuel characteristics during the fall burning season are key factors affecting air quality. Fall burning would have a greater potential to impact air quality over springtime burning.

Smoke from prescribed burning associated with present, proposed and foreseeable activities, combined with that of other PM-10 producing activities in the region has the potential to temporarily reduce air quality in the area. Smoke may drift into Albuquerque on rare occasions. Visibility may be temporarily reduced while prevailing weather influences mix and disperse smoke. This condition can also produce visual benefits as stated earlier. Possible effects could be minimized on fall burns by fewer forest visitors, waiting for higher fuel moisture (less emissions) conditions, and burn on days that have better smoke dispersion. Minimizing effects would serve to reduce impacts from other PM-10 producing activities. These anticipated impacts are considered to be within a reasonable range for these activities, and pose no significant health or environmental effects. The impact of prescribed burning and road dust would have temporary seasonal impacts on the air quality. Reduction of air quality would constitute a short-term irretrievable resource impact.

3.2 Aquatic and Terrestrial Wildlife and Plant Resources

Wildlife habitat types found within the proposed Bluewater Ecosystem Management Area includes: piñon (*Pinus edulis*)-juniper (*Juniperus* spp.) woodland (12,875 acres), ponderosa pine (*Pinus ponderosa*)/ponderosa pine-oak (*Quercus* spp.) forest (85,313 acres), mixed-conifer forest (5,290 acres), mountain grassland (5,390 acres) and riparian (400 acres). Each wildlife habitat type found within the analysis area supports a variety of wildlife species, with some of these species having high economic, public interest and/or sensitivity values.

The analysis area includes approximately 1,600 acres of the Wingate Habitat Protection Area (HPA) on the far west boundary of the project area, which was cooperatively developed by the New Mexico Department of Game and Fish (NMDGF) and Cibola National Forest. The Wingate HPA was developed to protect big game species on their winter range during times of high animal stress due to a lack of forage and adverse weather conditions. This area is closed to motorized vehicles from November 16 through April 1 for the protection of wintering big game herds. The Wingate HPA road closure is jointly enforced by the

NMDGF and Cibola National Forest to prevent animal harassment and stress from the motorized vehicles when these animals are concentrated within this winter range area.

3.2.1 Habitat Types

Piñon-Juniper Woodlands

The analysis area has 12,875 acres of piñon-juniper woodland habitat type support a variety of wildlife species. Avian species commonly found within piñon-juniper woodlands includes: the plain titmouse (*Parus inornatus*), piñon jay (*Gymnorhinus cyanocephalus*), black chinned hummingbird (*Archilochus alexandri*), common bushtit (*Psaltriparus minimus*), mourning dove (*Zenaida macroura*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*), western bluebird (*Sialia mexicana*), northern flicker (*Colaptes auratus*), and black-throated gray warbler (*Dendroica nigrescens*).

Mammal species commonly found within piñon-juniper woodlands includes: the deer mouse (*Peromyscus maniculatus*), piñon mouse (*Permyscus truei*), brush mouse (*Peromyscus boylei*), big brown bat (*Eptesicus fuscus*), Yuma myotis (*Myotis yumanensis*), rock squirrel (*Citellus variegatus*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus auduboni*), porcupine (*Erethizon dorsatum*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes fulva*), bobcat (*Lynx rufus*), mountain lion (*Felis concolor*), and mule deer (*Odocoileus heminous*).

Reptile species commonly found within piñon-juniper woodlands includes: the side-blotched lizard (*Uta stansburiana*), short-horned lizard (*Phynosoma douglassii*), western whiptail (*Cnemidophorus tigris*), many-lined skink (*Eumeces multivirgatus*), tree lizard (*Urosaurus ornatus*), common collard lizard (*Crotaphytus collaris*), and western rattlesnake (*Crotalus viridis*).

Amphibian species commonly found within piñon-juniper woodlands include the southern spadefoot (*Scaphiopus multiplicatus*).

The analysis areas piñon-juniper woodlands provide a variety of wildlife species with homes and food resources [i.e., nuts, berries, small seeds (piñon nuts and juniper berries are of particular importance), and browse] that are readily available forage for consumption by small to large animal species. These habitats provide prey species for predators, such as the red-tailed hawk and coyote. The majority of prey species are rodents, which heavily rely on the food resources provided by piñon-juniper woodlands for survival.

Other habitat features common to the piñon-juniper woodlands include crucial winter range habitat for large mammals (such as mule deer) and birds (such as resident/migratory raptor species). These areas provide important browse species for small to large mammals, especially mule deer, which is a management indicator species (MIS) for the piñon-juniper woodland key vegetation type as listed in the Forest Plan. Piñon-juniper woodlands constitute important winter range habitat for the Rocky Mountain elk (*Cervus elaphus*), which is a listed MIS for the mountain grassland key vegetation type in the Forest Plan. Piñon-juniper woodlands provide forage for mule deer and Rocky Mountain elk, which are dependent upon shrub species provided by these habitats during the winter months for energy, nourishment, and survival. Piñon-juniper woodlands provide travel corridors for mule deer and Rocky Mountain elk. These habitats provide animals with thermal cover protection during the winter months from extreme cold temperatures for the conservation of body energy reserves. Dead and down woody materials found within these habitats are used for nesting and resting (especially by small to medium mammals and birds). Piñon-juniper woodlands provide important snag habitats used by cavity nesting species.

In some piñon-juniper woodland areas, the absence of re-occurring low to moderate intensity wildfires has resulted in decreased understory development (plant cover, species diversity, reproduction of desirable herbaceous/shrub species, increased soil erosion), and the loss of open habitats due to encroachment of piñon and juniper trees into openings. The highly competitive nature of piñon and juniper species for soil nutrients and available soil water precludes the existence of more desirable plant species within these habitats. The chemicals produced by piñon and juniper species act as a natural herbicide to effectively remove other vegetation species from around these trees, thus, enhancing piñon and juniper competition for available water and nutrients in the soil. This is reflected by the build-up of growth inhibiting chemicals on the soil surface and upper soil profile around piñon and juniper trees. Wildlife species dependent on diverse habitats encounter limiting factors due to the lack of understory vegetation development when piñon and juniper trees preclude these species from developing.

Ponderosa Pine and Ponderosa Pine-Oak Forests

The Bluewater analysis area's 85,313 acres of ponderosa pine and ponderosa pine-oak forests support a variety of wildlife species. Avian species commonly found within ponderosa pine and ponderosa pine-oak forests includes: the hairy woodpecker (*Picoides villosus*), northern flicker, Steller's jay (*Cyanocitta stelleri*), black-headed grosbeck (*Pheucticus melanocephalus*), band-tailed pigeon (*Columba fasciata*), American robin (*Turdus migratorius*), western bluebird (*Sialia mexicana*), solitary vireo (*Vireo solitarius*), spotted towhee (*Piplo erythrophthalmus*), black-billed magpie (*Pica pica*), common raven (*Corvus brachyrhynchos*), great horned owl (*Bubo virginianus*), flammulated owl (*Otus flammeolus*), and Merriam's wild turkey (*Meleagris gallopavo merriami*).

Mammal species commonly found within the ponderosa pine and ponderosa pine-oak forests includes: the red squirrel (*Tamiasciurus hudsonicus*), Abert's squirrel (*Sciurus aberti*), deer mouse, least chipmunk (*Eutamias minimus*), big brown bat, Yuma myotis, porcupine, longtail weasel (*Mustela frenata*), gray fox (*Urocyon cinereoargenteus*), coyote, black bear (*Urus americanus*), mule deer, and Rocky Mountain elk.

Reptile species commonly found within the ponderosa pine and ponderosa pine-oak forests includes: the tree lizard, short-horned lizard, many-lined skink, Sonoran gopher snake (*Pituophis melanoleucus affinis*), and western rattlesnake.

Amphibian species commonly found within the ponderosa pine and ponderosa pine-oak forests include the southern spadefoot.

Ponderosa pine and ponderosa pine-oak forests provide homes, forage, and cover for many wildlife species. Habitat features common in these forest types includes: roost/nest trees, snags, large downed logs, trees with cavities constituting habitat for cavity nesters, abundant needle litter providing nutrient rich habitats for insects (and insect prey base species), browse, thermal cover, travel corridors, grassy forest openings, birthing areas for elk and deer, and water sources.

The ponderosa pine and ponderosa pine-oak forests provide habitat for the northern goshawk (*Accipiter gentalis*), a Southwestern Region sensitive species, as documented by the presence of post-fledging family areas (PFAs) and their associated foraging habitats in this forest type. Effects on habitat for the northern goshawk are an important consideration when proposing activities within ponderosa pine and ponderosa pine-oak forests. These habitats provide prey species for avian predators, such as: the northern goshawk, Cooper's hawk (*Accipiter cooperii*), great horned owl, coyote, and bobcat. The Forest Plan standards and guidelines (page 71-7) for the northern goshawk state that ponderosa pine forest canopy covers are to average 40+ percent for Vegetative Structural Stage (VSS) Classes 4, 5 and 6 across the landscape. The occurrence of VSS classifications within the Bluewater analysis area ponderosa pine and ponderosa pine-oak forests is as follows:

- VSS Class 1
    - average crown cover is 12 percent
    - occurs over 5.7 percent of the area
- VSS Class 2
    - average crown cover is 44 percent
    - occurs over 10.1 percent of the area
- VSS Class 3
    - average crown cover is 44 percent
    - occurs over 50.3 percent of the area
- VSS Class 4
    - average crown cover is 37 percent
    - occurs over 22.2 percent of the area
- VSS Class 5
    - average crown cover is 34 percent
    - occurs over 9.2 percent of the area
- VSS Class 6
    - average crown cover is 40 percent
    - occurs over 0.8 of the area
- Uneven-aged
    - average crown cover is less than 35 percent
    - occurs over 1.6 percent of the area

Within the proposed treatment areas northern goshawk nesting sites and post-fledging family areas (PFAs) are identified as VSS Class 4, 5, 6 and uneven aged timber stands. There are 749 acres of PFAs in the analysis area that have an average of 35% canopy cover. Of those, 551 acres have been identified as nesting sites that have a canopy cover averaging 24 percent. Except for within VSS Class 2 and 3, the average crown cover is less than 40 percent in the analysis area, which does not meet Forest Plan standards and guidelines for the northern goshawk. The Forest Plan standards and guidelines directs that within northern goshawk post-fledging family areas (PFAs) ponderosa pine canopy cover is to be 1/3 60%+ and 2/3 50%+ in VSS Class 4, or 50%+ in all of VSS Class 5 and 6 timber stands. Ponderosa pine nesting sites are to contain only VSS 5 and 6, with the entire canopy closures between 50 and 70 percent.

Additional information about the existing vegetation condition within ponderosa pine/ ponderosa pine-oak forests is provided later in this chapter under the Timber/Silviculture section.

Ponderosa pine-oak forests are considered to be important wildlife habitat areas since they provide diverse vegetation and food resources ranging from herbaceous, small seeded plants (grasses and forbs) to browse plants used for forage and large seeds (mast production, primarily acorns). These food resources are readily available to a variety of animal species and support an abundance of prey base species for predators.

The Merriam's wild turkey, which is a listed MIS for the ponderosa pine key vegetation type in the Forest Plan, is dependent upon acorn mast food resources commonly found in ponderosa pine-oak forest type. In addition, this forest habitat type provides high protein, insect food resources for the rearing of wild turkey poults.

Ponderosa pine and ponderosa pine-oak forests provide habitat for the Federally listed threatened Mexican spotted owl (*Strix occidentalis lucida*), as documented by the presence of owl PACs within the project area. Protected habitat management areas for the Mexican spotted owl within ponderosa pine-oak forests are those sites where timber harvest has not occurred within the past 20 years and have slopes greater than 40 percent. Restricted habitat management areas for the owl include ponderosa pine-oak forests with slopes greater than 40 percent, and do not take into consideration when the last harvest entry occurred.

Hundreds of acres within the analysis area's ponderosa pine-oak forests are vegetated by densely stocked sapling sized stands of ponderosa pine. In those areas diverse, productive understory vegetation necessary for the maintenance/enhancement of wildlife population's species diversity, richness and productivity is lacking. Within the ponderosa pine and ponderosa pine-oak forests there are few older or old growth age class timber stands with sufficient levels of snags and large downed logs that make up quality wildlife habitat.

Mixed-Conifer Forest

The 5,290 acres of mixed-conifer forest provide important habitat features for wildlife species. Avian species commonly found within mixed-conifer forests includes: the black-headed grosbeck, band-tailed pigeon, western bluebird, hairy woodpecker, northern flicker, mountain chickadee (*Parus gambeli*), spotted towhee, and great horned owl.

Mammal species commonly found within mixed-conifer forests includes: the red squirrel (*Tamiasciurus hudsonicus*), Mexican woodrat (*Neotoma stephensi*), little brown bat, Yuma myotis, longtail weasel, shorttail weasel (*Muestela rixosa*), gray fox, coyote, black bear, mule deer, and Rocky Mountain elk.

Reptile species commonly found within mixed-conifer forests includes: the many-lined skink, tree lizard, short-horned lizard, and western rattlesnake.

Amphibian species commonly found within mixed-conifer forests include the Woodhouse toad.

Mixed-conifer forests provide stands of old growth forest habitat, with associated downed logs and understory woody debris, which are important habitat features. Springs, seeps and other water sources are more common in the mixed-conifer habitat type, as are rock outcrops and snags. Mixed-conifer habitat forests provide important summer range for both mule deer and Rocky Mountain elk. The water resources associated with this habitat type are especially important during years of extended drought.

Downed logs and woody debris provide important habitats for insects and small to medium size animals. Many of these animals comprise the prey base for predatory species such as the northern goshawk and Mexican spotted owl. Numerous snag trees within mixed-conifer forests provide important cavity habitats for both avian and mammal species, such as the flammulated owl, which is dependent upon the existence of tree cavities for nesting and residence habitats.

The Forest Plan standards and guidelines directs that mixed-conifer canopy cover for VSS Class 4 should average 1/3 60%+ and 2/3 40%+, VSS Class 5 should average 40%+, and VSS Class 6 should average 60%+. Within PFAs, mixed-conifer forest should average 60%+ in VSS Class 4, and 70%+ for VSS Class 5 and 6 timber stand areas. The project area current VSS Classes for mixed conifer is similar to those that existed for ponderosa pine and ponderosa pine-oak forests, which are well below the canopy covers directed by the Forest Plan. Additional information about the existing vegetation condition within mixed conifer forests is provided later in this chapter under the Timber/Silviculture section.

Mountain Grassland

There are 5,390 acres of mountain grassland habitat in this analysis area that supports a variety of wildlife species. Avian species commonly found within mountain grasslands includes: the mourning dove, house wren (*Troglodytes aedon*), rock wren (*Salpinctes* *obsoletus*), American robin, western bluebird, mountain bluebird (*Sialia currucoides*), western meadowlark (*Sturnella neglecta*), northern mockingbird (*Mimus polyglottos*), and Cassin's sparrow (*Aimophila cassinii*).

Mammal species commonly found within mountain grasslands includes: the valley pocket gopher (*Thomomys bottae*), deer mouse, northern grasshopper mouse (*Onychomys leucogaster*), longtail vole (*Microtus longicaudus*), desert cottontail, mountain cottontail (*Sylvilagus auduboni*), badger (*Taxidea taxus*), coyote, red fox, gray fox, mule deer, and Rocky Mountain elk.

Reptile species commonly found within mountain grasslands includes: the southern plateau lizard (*Sceloporus undulates*), common collard lizard, short-horned lizard, many-lined skink, Sonoran gopher snake, and western rattlesnake.

Amphibian species commonly found within mountain grasslands includes: the southern spadefoot, red-spotted toad (*Bufo punctatus*), and Woodhouse toad (*Bufo woodhousei*).

Mountain grasslands provide homes and forage for a variety of mammals ranging from small rodents, which consume both seed and vegetal plant matter, to large ungulates such as the Rocky Mountain elk (as previously stated, the MIS for this key vegetation type within the Cibola National Forest). Rodent populations inhabiting mountain grasslands provide an important prey base resource for many predator species. Migratory and resident raptor species, such as the northern goshawk, coyote, and badger, are commonly observed hunting within this vegetation type.

Mountain grassland habitats provide important forage resources for Rocky Mountain elk and mule deer. The early spring "green-up" of grasses and forbs within these habitats provide needed sources of Vitamin A for mule deer and Rocky Mountain elk coming off of winter range. This is an important factor for the reproductive success of these species, as depleted Vitamin A reserves can cause spontaneous abortion in pregnant mule deer does and Rocky Mountain elk cows. This is especially true for animals that have endured a hard winter that was preceded by drought during the previous spring and summer months. These conditions typically result in a decrease of availability and quality of green forage for herbivores.

Mountain grasslands provide feeding and nesting areas for both migratory and resident bird populations. Many of these avian species are dependent upon mountain grassland habitats for the seed resources produced, and insects flourishing in, these areas for food. Grassland dependent bird species construct ground nests within these habitats, and within surrounding wooded areas, from vegetation grown within mountain grasslands. The Merriam's wild turkey forages on seeds and insects produced within mountain grassland habitats. Sources of high protein, such as insects, produced within these habitats are important for successfully raising turkey poults.

Within Bluewater, mountain grassland habitat availability has been reduced as a result of encroaching conifer trees. Tree encroachment into these open habitats has resulted from past management practices including excessive livestock grazing use, and the exclusion of low to moderate intensity wildland fire events that thin understory trees.

Riparian

There are 400 acres of riparian habitat in this analysis are that supports the greatest diversity and richness of wildlife resources inhabiting analysis area. Avian species commonly found within riparian habitats includes: the mallard duck (*Anas platyrhynchos*), Virginia rail (*Rallus limicola*), violet-green swallow (*Tachycineta thalassina*), mourning dove, broad-tail hummingbird (*Selasphorus platycercus*), belted kingfisher (*Megaceryle alcyon*), northern flicker, piñon jay, Clark's nutcracker (*Nucifraga columbiana*), Stellar's jay, common raven (*Corvus corax*), mountain chickadee (*Parus sclateri*), house wren, American robin, and mountain bluebird.

Mammal species commonly found within riparian habitats includes: the deer mouse, piñon mouse, mountain cottontail, big brown bat, beaver (*Castor canadensis*), longtail weasel, coyote, red fox, gray fox, and mule deer.

Reptile species commonly found within riparian habitats includes: the tree lizard, many-lined skink, and western rattlesnake.

Amphibian species commonly found within riparian habitats includes: the southern spadefoot, red-spotted toad, and Woodhouse toad.

Fish species found within streams associated with riparian vegetation habitats includes: rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), white sucker (*Catostomas commersoni*), central stoneroller (*Campostoma anomalum*), goldfish (*Carassius auratus*), and fathead minnow (*Pimephales promelas*). The occurrence of the above fish species has been verified by the New Mexico Department of Game and Fish (NMDGF) year 2002 fish survey of Bluewater Creek.

Riparian habitats constitute a small segment of Bluewater, yet these areas are a key habitat component for over 80 percent of the wildlife species occurring within the analysis area. Riparian habitats can be especially diverse in animal species composition, with many bird species being "riparian obligates". The continued availability and health of riparian ecosystems directly impacts the continued population health of many avian species, such as the Federally listed endangered southwestern willow flycatcher (*Empidonax trailii extimus*), which is a neo-tropical migrant and riparian habitat obligate species. The southwestern willow flycatcher has been documented as nesting within the riparian habitat associated with Bluewater Creek.

Within the project area, riparian habitats are found along Bluewater Creek, Cottonwood Creek, Sleeping Bear Spring, Sawmill Wetland, Rice Park, Elk Spring, Post Office Flat Spring, Cabin Spring, and McDaniel's Spring. The upper portion of Bluewater Creek is in a riparian pasture where livestock are managed to enhance riparian habitat attributes. This area has been fenced from livestock grazing use since the late 1990's. Livestock occasionally enter the exclosure as a result of gates being left open or down fences due to recreation and wildlife pressures. The lower portion of Bluewater Creek (Andrews Cabin to the Forest boundary, approximately 3.5 miles of creek habitat) is fenced to totally exclude permitted livestock grazing. Spring habitats are also fenced to prevent livestock entry from occurring within these sensitive areas, especially the spring sources.

Within some of the spring and wetland sites, woody species composition and age class diversity are not meeting desired habitat condition. Less than desirable riparian woody species composition, plant vigor, availability, reproduction, stand structure, and diversity is considered to be a result of past livestock grazing practices. Many of the spring and wetland sites are fenced for habitat protection purposes. Many of these fenced riparian habitat areas have declined in condition due to the impacts of past resource use (timber harvest, recreation, permitted livestock grazing), which resulted in a cumulative negative impact. These protected riparian habitat sites are expected to quickly recover to the desired site condition. Key riparian habitats within the analysis area are monitored so that site conditions can be identified, and long-trend data for these sites can be recorded.

Aquatic habitats provide for fish populations of high interest sport fishing species including the brown and rainbow trout. Several species of minnow, chub, and sucker also inhabit these aquatic habitats, as well as, aquatic macro-invertebrates that provide a prey base for fish species.

Wildlife Habitat Improvements

The Mt. Taylor Ranger District has constructed several wildlife habitat improvements within the analysis area. These existing wildlife habitat improvements would need to be protected during thinning and burning activities. A complete list is included in Appendix C.

3.2.2 Management Indicator Species

The Cibola National Forest Land and Resource Management Plan (USDA Forest Service, 1985, as amended) identified 15 Management Indicator Species (MIS) to be representative of each major vegetation type found within the Forest (Cibola Forest Plan, page 68-3). These species serve as indicators to detect important changes within each of these habitat types. The Bluewater MIS Assessment has been completed for this analysis (see Appendix E for report) and is tiered to the Forest MIS Assessment. Of the 15 MIS identified within the Forest level MIS Assessment, eight of these were chosen to represent habitat changes within the project area. The MIS species and their representative habitats are displayed in Table 3.

Table 3 – ***Management Indicator Species by Habitat Type***

MIS	HABITAT TYPES					
	Piñon-Juniper	Ponderosa Pine	Ponderosa Pine-Oak	Mixed Conifer	Mountain Grassland	Riparian
Mule deer	X					
Juniper titmouse	X					
Pygmy nuthatch		X	X			
Merriam's turkey		X	X			
Rocky Mountain Elk				X	X	
Black bear				X		
Hairy woodpecker				X		
House Wren						X

X - MIS occurring within this habitat type

Piñon-Juniper Woodland

The MIS for piñon-juniper woodlands are the mule deer and juniper titmouse. The mule deer is important from the standpoint of economic value and public interest. Mule deer inhabit the Bluewater analysis area on a yearlong basis. Early and mid-ecological site stages of plant succession, with an abundance of browse and forbs, represent higher quality mule deer habitats than those areas in later stages of plant succession. Mule deer prefer habitats with a diverse mixture of plant species than those sites dominated by single species plant communities.

The Bluewater analysis area is included in the NMDGF Northwest Corridor Deer Restoration Project; which is a collaborative effort between that agency, Bureau of Land Management, Rocky Mountain Elk Foundation, Mule Deer Foundation, New Mexico State Land Office, Native American pueblos and tribes, Council of Outfitters and Guides, and U.S. Forest Service. This collaborative mule deer management action was brought about due to declining deer population numbers since the middle part of the twentieth century in Northwestern New Mexico and throughout the state. The Northwest Corridor Deer Restoration Project is designed to address habitat issues by implementing an array of prescriptive habitat management actions to improve and restore quality habitat. Interventions may include a variety of direct habitat manipulations and habitat protection measures (i.e. road closures).

The juniper titmouse is a resident piñon-juniper woodland inhabitant that nests in cavities. This bird is the sole titmouse commonly found throughout most of the Western United States. Older age class piñon and juniper trees, with open canopy stands, constitute primary nesting habitat for this bird.

Ponderosa Pine and Ponderosa Pine-Oak Forests

The MIS for ponderosa pine and ponderosa pine-oak forests are the pygmy nuthatch (*Sitta pygmaea*) and Merriam's wild turkey. The pygmy nuthatch is a ponderosa pine and ponderosa pine-oak forests resident. This bird is primarily a cavity nester and prefers mature, old growth ponderosa pine forests with soft snags for foraging for insects and nesting purposes.

The Merriam's wild turkey is generally found within ponderosa pine and ponderosa pine-oak forests, along with piñon-juniper woodland habitats. The Merriam's wild turkey is common within the analysis area. Its nest sites are generally located along edges of small forest openings and within a half-mile of streams or other water sources. Slopes greater than 50 percent are preferred for nesting, perching, and roosting. Residual cover provided by grass, deciduous shrubs or woody slash is important for nesting and brood rearing activities. Small openings less than 5 acres in size, dominated by grasses and forbs, and interspersed throughout the forest are an essential component of wild turkey foraging habitat. Such openings should comprise at least 10 percent of the home range for this species. Within the analysis area, very little of the existing ponderosa pine and ponderosa pine-oak forest habitats provide small openings which are important for the continued conservation of the Merriam's wild turkey.

Mixed-Conifer Forests

The MIS for mixed-conifer forests are Rocky Mountain elk, black bear, and the hairy woodpecker. The black bear is both omnivorous and opportunistic, and requires woodland cover. The black bear's diet varies according to the seasonal availability of food sources. Black bears eat spring grass, berries, nuts (particularly acorns and pine nuts), dead animals, wild animals (rodents, deer fawns and elk calves, bird nests, etc.), and is an occasional predator of domestic livestock. Due to the availability of water resources associated with this habitat type, mixed-conifer forests are especially important to the black bear during the hot summer months and periods of drought. These areas provide both sources of food and water to the black bear during these stressful times. Most forested areas within the Forest are populated by black bear. Refer to the *Mountain Grassland* section for the Rocky Mountain elk information.

The hairy woodpecker is a resident cavity excavator found in several habitat types with large diameter snags. This bird is fairly common in mature mixed-conifer forests.

Mountain Grassland

The MIS for mountain grasslands is the Rocky Mountain elk. Rocky Mountain elk are common within the Bluewater area and can be found within the analysis area on a yearlong basis. Elk prefer open, grassy meadows located less than ½ mile from water. Sedges (***Carex*** spp.) and bunch grasses are preferred for forage by these large herbivores. Hiding cover for Rocky Mountain elk commonly occurs in timber stands ranging from 30 to 60 acres in size, with 70 percent canopy cover. Road density is also an important habitat consideration with optimum road spacing at less than ¼ mile of primary road per section (1 section = 640 acres).

Riparian

The MIS for riparian habitat is the house wren, which is a summer inhabitant of the Bluewater analysis area. This bird is found in shrubs and brushy habitats, and often nests in cavities. The house wren utilizes a variety of substrates for nesting. The house wren preys on plentiful insect populations occurring within the riparian habitat type.

3.2.3 Neotropical Migrant Birds

The proposed Bluewater analysis area falls within the Southern Rockies/Colorado Plateau Conservation Region of the New Mexico Bird Conservation Plan (NMBCP), which was developed by New Mexico Partners-In-Flight (NMPIF). The United States is divided into 37 Bird Conservation Regions, with the above region encompassing the Bluewater analysis area. The NMBCP provides a strategy for the conservation of birds and their habitats throughout New Mexico. The NMPIF has developed a high priority species and habitat list, which is monitored by the U. S. Geological Survey (USGS) and the Cibola National Forest. Annually, the USGS conducts the Bluewater Lake Breeding Bird Survey (BBS) and the Forest conducts the Bluewater Creek BBS. This data is utilized to track the status of high priority species within the Bluewater analysis area. In 2002, these survey efforts detected the presence of two New Mexico high priority species, the Virginia's warbler (*Vermivora virginiae*) and red-naped sapsucker (*Sphyrapicus nuchalis*), within the vicinity of the analysis area. Monitoring efforts for these species would continue as part of the Bluewater Ecosystem Management Project monitoring plan. For more information on the Virginia's warbler and red-naped sapsucker reference the Neotropical Migratory Bird Analysis in Appendix F.

3.2.4 Threatened, Endangered, Proposed, Candidate and Sensitive Species

Several animal and plant species lists were reviewed to determine potential threatened, endangered, proposed, candidate and sensitive species occurring in the analysis area. Three lists that were consulted includes: the U.S. Fish and Wildlife Service Master List of Threatened, Endangered, Proposed and Candidate Species Which May Occur In Cibola County; Regional Forester's Sensitive Species List; and Inventory of Rare and Endangered Plants of New Mexico. Species other than those described below (including plants) were considered but not evaluated because they are not known to occur within the assessment area or within the habitat types previously described. A Biological Assessment and Evaluation was completed for this analysis, and is attached as Appendix G.

Threatened, Endangered, Proposed and Candidate - Animal and Plant Species

Threatened, endangered, proposed and candidate animal species occurring, possibly occurring or having potential habitat in the analysis area include the Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and bald eagle (*Haliaeetus luecoephalus*). Refer to the Biological Assessment and Evaluation in Appendix G for more information regarding these species. No other threatened, endangered, proposed or candidate plant species are known to occur within the Bluewater analysis area.

Mexican Spotted Owl

The Federally listed threatened Mexican spotted owl is known to inhabit the analysis area, with six known nesting territories or protected activity centers (PACs) occurring within the analysis area. Forest management guidelines for the Mexican spotted owl are specified in the Forest Plan (Amendment No. 7, September 1996), and are summarized in Appendix C. All potential Mexican spotted owl habitats within the assessment area have been inventoried according to survey protocol.

The Forest Plan provides for three levels of habitat management (protected, restricted, and other forest/woodland types) for the Mexican spotted owl. Protected areas within the Bluewater analysis area are the six delineated PACs; along with mixed conifer and ponderosa pine-oak forest with slopes greater than 40 percent where timber has not been harvested in the last 20 years. Restricted lands include all mixed-conifer, ponderosa pine-oak and riparian forests outside of PACs. Other forest and woodland types include all ponderosa pine, spruce-fir, woodland and aspen forests within the analysis area and within a ½ mile buffer beyond the perimeter of the planning area. The specific guidelines for Mexican spotted owl habitat management range from protected habitats having the most restrictions to other forest and woodlands having the least restrictions.

Management of habitats for the Mexican spotted owl is an important consideration, with risk of habitat loss due to catastrophic wildfire being a primary concern. The Mexican spotted owl and its habitat are managed under the Mexican Spotted Owl Recovery Plan (USDI, Fish & Wildlife Service, 1995) that provides for three levels of habitat management. There are 8,056 acres of protected habitat (6,535 acres in PACs and 1,521 acres outside of PACs) and 6,725 acres of restricted Mexican spotted owl habitat within the analysis area.

Southwestern Willow Flycatcher

One breeding territory for the Federally listed endangered southwestern willow flycatcher occurs within the analysis area. A one-mile long portion of Bluewater Creek has been identified and is annually monitored for occupancy according to protocol. For the past 15 years Bluewater Creek has been managed for the enhancement of riparian resources by limiting permitted livestock grazing use, eliminating roads and limiting public access. Beaver have colonized portions of Bluewater Creek, resulting in improved water flow and streamside willow (*Salix* spp.) reproduction. For the last several years, the southwestern willow flycatcher breeding territory has not been occupied. Future flycatcher occupancy of the Bluewater Creek breeding territory may be dependent upon continuing establishment of willow patches until these shrub areas are large enough to be more attractive for inhabitation.

Western Yellow-billed Cuckoo

Although potential habitat for the Federal candidate western yellow-billed cuckoo exists along Bluewater Creek, this bird has not been located on either the USGS Bluewater Lake or Forest Bluewater Creek BBS within the analysis area. There are no known breeding territories for this species in the analysis area.

Bald Eagle

The Federally listed threatened bald eagle is a migratory, winter resident of the Bluewater Lake and Bluewater Creek, occasionally utilizing habitats within these areas for hunting, roosting, resting and perching. The bald eagle forages within these areas from late fall to early spring hunting fish, small to medium size mammals and waterfowl, along with making opportunistic use of road killed carrion.

Sensitive Species

The Regional Forester's wildlife sensitive species which are known to inhabit, or could potentially inhabit, the Bluewater analysis area includes: the Cebolleta pocket gopher (*Thomomys bottae paguate*), northern goshawk, osprey (*Pandion haliaetus*), loggerhead shrike (*Lanus ludovicianus*), gray vireo (*Vireo vicinor*), Texas horned lizard (*Phyrnosoma cornutum*) and Rio Grande sucker (*Catostomus plebius*). In addition to the above, the American peregrine falcon (*Falco peregrinus anatum*), a Federal endangered species recently de-listed from the endangered species list, occurs within the analysis area. The American peregrine falcon is managed under a Memorandum of Understanding between the U.S. Fish & Wildlife Service, NMDGF and U.S. Forest Service. No sensitive plant species are known to occur within the analysis area.

Cebolleta Pocket Gopher

The Regional Forester's sensitive Cebolleta pocket gopher's potential habitat consists of either valley or mountain meadow landscapes, with preference for loam soil sites. The Cebolleta pocket gopher has not been known to inhabit the analysis area. The Bluewater analysis area has not been surveyed for Cebolleta pocket gopher inhabitation.

Northern Goshawk

The Regional Forester's sensitive northern goshawk is known to inhabit the analysis area, with seven known goshawk breeding territories or post-fledging family areas (PFAs) occurring within the analysis area. Management guidelines for the northern goshawk are specified in the Forest Plan (Amendment No. 7, September 1996), and are summarized in Appendix C. In addition to the Forest Plan, the Management Recommendations for the Northern Goshawk in the Southwestern United States (USDA Forest Service General Tech Report 217, 1992) outlines the desired forest conditions for the home range used by a breeding pair of goshawks. All potential northern goshawk habitats within the assessment area have been inventoried according to protocol.

The Forest Plan and Management Recommendations for the Northern Goshawk in the Southwestern United States set forth the habitat management guidance (standards and guidelines) for the northern goshawk. The Bluewater analysis area's seven PFAs each includes: six nesting areas per pair of nesting goshawks for known nest sites, old nest sites, areas where historical data indicates goshawks have nested there in the past, and where goshawks have been repeatedly sighted over a two year or greater time period but no nest sites have been located. The six nest sites are 30 acres in size, of which three are presently suitable for occupancy and the other three are managed toward achieving suitable conditions in the future. Each 420-acre PFA surrounding the six nest sites comprises the defended territory for the nest. A 5,400 acres goshawk foraging area surrounds each PFA. Al totaled, the management area for each nesting area covers approximately 6,000. The risk from catastrophic wildfire is one of the primary management concerns regarding the northern goshawk.

The northern goshawk is a forest habitat generalist known to use a wide variety of timber stand age classes, structural conditions and successional stages. The goshawk preys on large to medium sized birds and mammals. Management Recommendations for the Northern Goshawk in the Southwestern United States outlines desired forest conditions for the home range used by a breeding pair of goshawks. The recommendation also promotes the viability of at least 14 important prey species including the Stellar's jay, northern flicker and Abert's squirrel. The management guidelines recommend forest structural stages and habitat components desirable for the goshawk and its 14 important prey species. Many timber stands within the Bluewater analysis area current forest conditions do not meet those recommendations. Vegetation management actions are currently needed to bring habitat areas lacking the forest components recommended in the goshawk management guidelines into compliance with those guidelines. Forest structural stages currently lacking are small forest openings comprising habitats for a healthy prey base and older age class trees or timber stands. Snags and large downed woody material are currently present in sufficient quantity and quality to meet the goshawk habitat guidelines, and habitat management in the future would be designed to maintain or enhance those features. Riparian condition is also an important feature of goshawk habitat. Currently, portions of the riparian habitat in the analysis area are functioning at risk. Future riparian habitat management and enhancement projects are currently being considered.

Osprey

The osprey is on the U. S. Forest Service Region 3 list of sensitive species, and is rare to uncommon in New Mexico. This bird is strongly associated with streams, reservoirs, lakes and wetlands. The osprey feeds entirely on fish, and often use snags for lookout platforms, perching and resting. The osprey may occasionally inhabit Bluewater Lake and Bluewater Creek. This inhabitation would be on a migratory basis. There is no documentation of osprey nesting within the analysis area.

Loggerhead Shrike

The Regional Forester's sensitive loggerhead shrike is not known to occur within the analysis area, although suitable habitat for this bird occurs in open shrubby grasslands with a scattering of small trees within the analysis area. The loggerhead shrike is generally uncommon in the state and has been found to be absent in areas with suitable habitat. This bird has not been found to occur along either the USGS Bluewater or Forest Bluewater Creek BBS. Habitually, the loggerhead shrike exhibits affinity to localized habitats in areas of documented occupation within the Southwestern United States. The analysis area has not been well surveyed for loggerhead shrike occupancy within much of this bird's potential habitat.

Gray Vireo

The Regional Forester's sensitive gray vireo is not known to occur within the analysis area, although suitable habitat for this bird occurs within piñon-juniper woodland habitats within the analysis area. The gray vireo is generally uncommon in the state and has been found to be absent in areas with suitable habitat. This bird has not been found to occur along either the USGS Bluewater Lake or Forest Bluewater Creek BBS. Habitually, the gray vireo exhibits affinity to localized habitats in areas of documented occupation within the Southwestern United States. The analysis area has not been well surveyed for gray vireo occupancy. Limiting factors for this species may include a lack of abundance and distribution of herbaceous, understory vegetation within piñon-juniper woodlands.

Texas Horned Lizard

The Regional Forester's sensitive Texas horned lizard has habitat within the piñon-juniper woodlands in the Bluewater analysis area. This habitat consists of piñon and juniper trees with sparse understory plant growth consisting of bunch grasses, cactus, and other shrubs. Habitats for the Texas horned lizard are comprised of sandy, loamy, hardpan or rocky soil substrates with some loose soil material present for these lizards to bury themselves in. Habitat for this lizard within the analysis area also includes burrows of other animals, and rocky areas that provide hiding cover and shelter from the sun on hot days.

Rio Grande Sucker

The Regional Forester's sensitive Rio Grande sucker has potential habitat in Bluewater Creek, and its tributaries. In 2002, the NMDGF sampled Bluewater Creek within the analysis area to monitor fish population species composition. The Rio Grande sucker was not found during this monitoring effort. Streams that provide gravel, cobble, backwater, pool and riffle habitats constitute potential habitat for the Rio Grande sucker. This species is rarely found in streams with heavy loads of silt and organic debris. Potential habitat limiting factors for this fish within the analysis area are elevated sediment deposition which could hinder reproduction and stream dewatering, as well as hybridization with the white sucker (*Catostomas commersoni*).

Peregrine Falcon

One American peregrine falcon eyrie, which is active during most years, occurs within the analysis area in the vicinity of Bluewater Creek. This falcon habitat consists of a cliff substrate with associated populations of prey base avian species.

3.2.5 Environmental Consequences

No Action (Alternative B)

Direct and Indirect Effects

A continuation of current habitat conditions and trends would continue across the analysis area for the near future. Due to not implementing any of the management actions proposed within the two action alternatives, over the long term, reduced forage quality and quantity values within the project area's wildlife habitats would be expected to occur. For the short term, the Bluewater analysis area would continue to provide a variety of wildlife species with homes and food resources (including prey species) and current habitat values.

With implementation of this alternative long term wildlife population's diversity/richness and habitat values, acres of habitat type and potential for catastrophic, wind-driven canopy wildfire occurrence would be expected to change. The potential for increased occurrence of stand replacing fires would increase under this alternative, resulting in loss of cover for some species. As forest and woodland stand structures change, so do affected wildlife habitat areas. Selection of this alternative would be expected to result in long term reduced forage quality and quantity values as forest/woodland areas reflect reduced plant composition due to increased loss of species diversity. Piñon-juniper woodland and ponderosa pine forest canopies would become more closed, while understory plant species diversity would be further reduced due to the effects of tree competition for soil nutrient/water resources and sunlight. Increased development of piñon-juniper and ponderosa pine reproduction stands would result as trees continued to encroach into open habitats.

Implementation of this alternative would result in the retention of older age class timber stands producing piñon seed and juniper berries for wildlife consumption. Denser woodland stands would have substantially less understory vegetation but would furnish more escape, thermal and hiding cover. These habitat values could change if a stand replacing wildfire were to occur.

By not implementing a thinning treatment in ponderosa pine restoration ares, stands would continue to increase in canopy cover, which would result in reduced herbaceous understory forage production for mule deer, Rocky Mountain elk, black bear, turkey, raptor prey species, and other wildlife species. In the long term these areas could become even more densely stocked with young trees creating ladder and hazardous fuel accumulations leading to the increased potential for catastrophic wildfire. Wildlife populations likely to occur in diverse stands of ponderosa pine with a healthy herbaceous and shrubby understory would be less abundant on the analysis area in the long term

Fuel breaks would not be created in the urban interface resulting in increased potential for habitat loss as a result of catastrophic wildfire.

Mountain meadow (grassland) maintenance treatments would not occur resulting in reduced herbaceous forage production for wildlife use and benefit.

Management Indicator Species

The mule deer and juniper titmouse would not benefit from improved herbaceous forage quality and quantity within treated understory habitats, and a higher biological diversity and density of prey species would not occur. Old large cavity excavated trees used by the juniper titmouse, and other cavity dependent species, would be retained. Forage produced within piñon-juniper woodlands would not be impacted unless destroyed by wildfire, drought, or insect infestations. Mule deer would not benefit from increased lower succession/ecological site seral stages, and forage values would not be improved. Hiding cover would remain adequate for mule deer. There would be no displacement of wildlife as a result of treatment activities.

Species would not benefit from additional diverse age class timber stand structure. Roost trees, and older age class timber stands used by Merriam's wild turkeys would not be improved in the long term. Forage habitat and species for Merriam's wild turkey would continue to decline due to a lack of sufficient sunlight on the forest floor. Snags used by the pygmy nuthatch would not be affected since none would be removed. The Merriam's wild turkey would continue to occur in the analysis area, but may occur in reduced numbers, while the pygmy nuthatch's population would be expected to remain stable.

Rocky Mountain elk would not benefit from improved mountain meadow (grassland) habitat and forage conditions. Elk would not be temporarily displaced from habitat areas since no treatment operations would occur.

There would be no change to stand conditions in either mixed conifer or riparian habitat. Thus, there would be no direct, indirect or cumulative effects to the black bear or the hairy woodpecker, which occupy mixed conifer forests, or the house wren, which occupies riparian areas. Neither of these habitat types was proposed for project activities.

Neotropical Migratory Birds

The two known neotropical migratory bird species found in the analysis area (Virginia's warbler and red-naped sapsucker) would not benefit from improved quality and quantity within treated habitats, and a higher biological diversity and density of species (including insect prey species) would not occur. Old large cavity excavated trees used by cavity dependent species would be retained. Forage resources (seeds and insects) produced within piñon-juniper woodlands would not be impacted unless destroyed by wildfire and drought. Bird species would not benefit from increased lower succession/ecological site seral stages, and forage values would not be improved. There would be no displacement of neotropical migratory birds as a result of treatment activities.

Neotropical migratory bird species would not benefit from additional diverse age class timber stand structure. Forage habitat would continue to decline due to a lack of sufficient sunlight on the forest floor. Bird species would continue to occur in the analysis area, but may occur in reduced numbers.

Threatened, Endangered, Candidate, Proposed and Sensitive Species

Mexican Spotted Owl

Biological diversity within piñon-juniper woodlands and forested areas would not be increased so Mexican spotted owl prey base species would not benefit. Fuelbreaks would not be created in WUI areas; thus, potential for habitat loss as a result of catastrophic wildfire would increase. Habitat management objectives for the Mexican spotted owl would not be met. The risk of catastrophic wildfire would continue.

Biological diversity within the ponderosa pine/ponderosa pine-oak forests would not increase and Mexican spotted owl prey availability would not increase. Since mountain meadows (grasslands) serve as a fuelbreaks, the benefits associated with the maintenance of these habitats would not be realized.

Mexican spotted owl foraging habitat would not be affected in the short-term but may decrease in value in the long term as trees become more crowded and site biological diversity is reduced. The high fire potential PAC would not be treated to abate fire risk and would be subject to loss as a result of catastrophic wildfire.

Northern Goshawk

Biological diversity within piñon-juniper woodlands and forested areas would not be increased so northern goshawk prey base species would not benefit. Fuelbreaks would not be created in WUI areas, thus potential for habitat loss as a result of catastrophic wildfire would increase. Management objectives for the northern goshawk would not be met. The risk of catastrophic wildfire would continue.

Biological diversity within the ponderosa pine/ponderosa pine-oak forests would not increase and northern goshawk prey availability would not increase. Since mountain meadows (grasslands) serve as a fuel breaks, the benefits associated with the maintenance of these habitats would not be realized.

Northern goshawk nest sites, PFAs and foraging areas would not be managed, and in the long term could become densely stocked with young small diameter trees creating ladder fuels and hazardous fuels accumulations leading to the potential for catastrophic wildfire. Within PFAs, nest sites would not be actively managed and it is likely that replacement nest trees would not be produced in suitable habitat. Benefits to the northern goshawk would not occur resulting in stagnant conditions for goshawk nesting habitat. Objectives specified in the Forest Plan and management recommendations for the northern goshawk would not be implemented. In the long term, the analysis area may become unsuitable for goshawk nesting as trees continue to be overcrowded with poor understory production and the average stand diameter increases very little.

Southwestern Willow Flycatcher

Implementation of the no action alternative proposed under this analysis would have *No Effect* for the southwestern willow flycatcher, or its potential habitat.

Western Yellow-billed Cuckoo

Implementation of the no action alternative proposed under this analysis would have *No Effect* for the western yellow-billed cuckoo, or its potential habitat.

Bald Eagle

Implementation of the no action alternative proposed under this analysis would have *No Effect* for the migratory bald eagle, or its potential habitat.

Cebolleta Pocket Gopher

Implementation of the no action alternative proposed under this analysis would have *No Effect* for the Cebolleta pocket gopher. Over the long term, mountain meadow (grassland) habitat would be lost due the encroachment of trees, thus, reducing the availability of these open habitats for potential Cebolleta gopher inhabitation.

Osprey

Implementation of the no action alternative proposed under this analysis would have *No Effect* on migratory osprey, or its potential habitat.

Loggerhead Shrike

Implementation of the no action alternative proposed under this analysis would have *No Effect* for the loggerhead shrike. Over the long term, mountain meadow (brushy grassland) habitat would be lost due the encroachment of trees, thus, reducing the availability of these open habitats for potential loggerhead shrike inhabitation.

Gray Vireo

Implementation of the no action alternative proposed under this analysis would have *No Effect* on the gray vireo, or its potential habitat.

Texas Horned Lizard

Implementation of the no action alternative proposed under this analysis would have *No Effect* on the Texas horned lizard, or its potential habitat.

Rio Grande Sucker

Implementation of the no action alternative proposed under this analysis would have *No Effect* on the Rio Grande sucker, or its potential habitat.

<u>Cumulative Effects</u>

Within the analysis area, no treatment of wildlife habitat areas would occur. Over the long term, wildlife habitat values such as forage production, understory species diversity, and prey base habitat would decline. This holds true for all wildlife species, including management indicator species, neotropical migratory birds, threatened, endangered, protected, candidate and special status species.

In addition, the potential for the recruitment of new Mexican spotted owl PACs (breeding pairs) and northern goshawk PFAs (breeding pairs) would not occur on a landscape/watershed basis. Habitat values for these birds would decline on a landscape/watershed basis over the long term.

Over the long-term, the potential for catastrophic, wind-driven canopy fire occurrences within the analysis area would increase with possible destructive impacts on affected Mexican spotted owl PACs (breeding pairs and offspring) and northern goshawk PFAs (breeding pairs and offspring).

Proposed Action (Alternative B)

Direct and Indirect Effects

The implementation of management actions proposed under this alternative would result in enhanced biological diversity within the affected treatment areas, as directed within the Forest Plan. The Forest Plan addresses expected future conditions within the Forest, with the implementation of timber harvest and overstory modifications resulting in increased diversity of plant and animal species/populations by changing the pattern, distribution, and age classes of overstory vegetation. This alternative contains a number of management actions planned to enhance and protect a multitude of resources. The following expected impacts on wildlife populations and habitats, resulting from the implementation of this alternative, would be in compliance with the management requirements (Appendix C) and expected future conditions addressed within the Forest Plan. Those management requirements include snag retention, timber rotation age, growing stock levels, old growth retention, hiding cover, feature protection and size/dispersal of openings.

Wildland Urban Interface (WUI) Treatment

This alternative includes the vegetative manipulation of piñon-juniper woodland to mitigate hazardous fuel loadings within wildland urban interface (WUI) areas. Approximately 885 acres of piñon-juniper woodland stands would be patch cut, with tree clumps and stringers thinned to met vegetation/wildlife habitat diversity objectives. Within WUI areas 20 to 40 trees per acre would remain following treatment. This would result in the retention of thermal/hiding cover, escape habitat, resting habitat and pine nut food sources to meet wildlife needs. Patches of trees on north and east facing slopes would be identified for retention (not treated), which would result in meeting thermal and hiding cover requirements for small to large animals.

Within treated areas approximately two tons per acre of woody debris would remain on the ground creating micro-habitats for small animals, insects and the retention of soil moisture for plant (forage) growth. Small trees and limbs would be treated by a prescribed, low intensity broadcast burn to accomplish the release of nutrients from plant debris into the soil profile, which would result in enhanced wildlife forage quality and quantity in affected areas. The retention of two slash piles per acre measuring at least six feet in diameter and four feet high within treated areas that are ½-mile mile from water, protection of large crowned cone-bearing piñon trees, and protection of cavity excavated trees and oak underbrush species would result in further enhancement of wildlife habitat values.

The Merriam's wild turkey, and other small to medium size animals would benefit from nesting habitat, hiding habitat and increased insect populations within created slash piles. Seed eating mammals and birds would continue to have food resources provided due to the protection of large crowned cone-bearing piñon trees. Cavity nesters, such as the juniper titmouse, would continue to have nesting habitat provided within the treatment area due to the protection of cavity trees. Desirable understory browse species, such as oak, would be would still be available within treated areas for utilization by resident and migratory wildlife populations.

The treatment of WUI areas conducted during the nesting season may result in the direct loss of individual nesting bird, mammal and reptile species, but the loss is not likely to result in long term population decreases. Some species of wildlife may be displaced from the immediate areas during cutting, burning and fuelwood gathering activities. Broadcast burns to remove treatment slash would not be conducted during the primary breeding season for most wildlife species. Burns would be low intensity and most wildlife in the area would be able to escape without harm.

The proposed establishment of 13 miles of fire control line by hand, the utilization of existing roads and establishment of only temporary roads to be obliterated would have no impacts on either resident or migratory wildlife populations inhabiting the project areas where these actions would be implemented.

Piñon-Juniper Control Units

This alternative includes the removal piñon and juniper trees to enhance the project area's grassland/shrub habitat component's forage productivity and quality attributes. The proposed cutting of piñon and juniper trees, lopping-scattering of slash debris and implementation of prescribed low intensity broadcast burning within 2,565 acres of the project area would result in enhanced wildlife forage (herbaceous and browse species) quality and quantity. This increase would be due to reduced plant competition between trees and browse species for soil water and nutrient resources and increased sunlight. A more diverse and healthy piñon-juniper woodland wildlife habitat would result from the implementation of this alternative. Two slash piles per acre measuring at least six feet in diameter and four feet high would be left within treated areas that were ½-mile from water. The same impacts on wildlife species addressed for WUI areas, including treatment during the nesting season, would be expected to result from the removal of piñon and juniper trees from grassland/shrub habitats.

One of the key limiting factors for Rocky Mountain elk and mule deer is winter range capability and capacity to support wintering populations of these large herbivores. Enhanced large ungulate winter range capability and capacity values would result from the implementation thinning treatments. The retention of tree clumps in five acre patches and stringers would meet wildlife habitat escape cover, resting habitat, thermal cover, travel corridor, hiding habitat, and forage habitat requirements.

The proposed construction of 62 miles of fire control line to support prescribed burning activities would not result in impacts on the resident and migratory wildlife populations, as these control lines would be naturally re-vegetated soon after prescribed burning activities are completed.

The prescribed low-intensity broadcast burning would result in: 1) ash deposition nutrient release back onto the soil surface and into the soil profile; 2) the creation of "edge effect" and increased plant diversity; 3) reduced potential for catastrophic fire; 4) and increased sunlight to desirable low- and mid-canopy plants. The above effects would result in enhanced wildlife habitat condition and productivity; with an expected increase in animal and plant species richness, diversity, and composition within affected areas. The proposed prescribed burning activities to treat slash would not be conducted during the primary breeding season for most wildlife species. Planned low intensity burning activities would allow for wildlife species inhabiting the treatment area to escape without harm.

Piñon-juniper woodland treatments conducted during the nesting season may result in the direct loss of individual nesting bird, mammal and reptile species, but the loss is not likely to result in long term population decreases. Some species of wildlife may be displaced from the immediate areas during cutting, burning and fuelwood gathering activities.

Fuelbreak

The proposed creation of ten miles (475 acres) of fuelbreak along the northern boundary of the project area would result in the development of additional herbaceous and browse forage within established fuelbreak areas for use by resident and migratory wildlife populations. Establish three slash piles at least six feet in diameter and four feet high per acre in fuelbreak corridors located within ½-mile of water, as directed by the Forest Plan, to provide habitat for wild turkey nesting and small animals. The same expected impacts on wildlife resources referenced for WUI and piñon-juniper control units, including those expected impacts discussed for prescribed low-intensity broadcast burning, would be expected within the treated fuelbreak areas.

The proposed fuelbreak would be designed to ensure the discontinuity of ground and canopy fuels, and to reduce the chances of wind-driven, catastrophic, canopy wildfire occurrence. Basal area of stands within the fuelbreak would be reduced to less than 30 square feet per acre by thinning from below. Leave trees would be marked to ensure that the largest diameter trees remain on-site. These actions would be expected to result in the increased protection of the project area's wildlife habitats from the devastating effects of catastrophic wildfire, the removal of trees to a basal area which would enhance the establishment of forage species within treated areas and the retention of larger trees which provide nesting habitat for cavity nesters and seed (mast) production for animal consumption.

The removal of fuelwood within fuelbreak areas, construction of 22 miles of fire control line by hand, and the construction and subsequent obliteration of temporary roads would not impact wildlife resources within or adjacent to affected treatment areas.

Fuelbreaks created during the nesting season may result in the direct loss of individual nesting bird, mammal and reptile species, but the loss is not likely to result in long term population decreases. Some species of wildlife may be displaced from the immediate areas during cutting, burning and fuelwood gathering activities. Prescribed burn treatments to remove slash would not be conducted during the primary breeding season for most wildlife species. Burns would be low intensity and most wildlife species inhabiting the treatment area would be able to escape into adjacent areas without harm.

Upland Meadows

The proposed treatment of 1,900 acres of upland mountain meadows (grasslands) to restore these areas to pre-fire suppression condition would have positive impacts on affected wildlife populations and their meadow habitats. This proposed vegetation manipulation action would include the use of hand and mechanical cutting methods; including the use of chainsaws, tree shearers and hydro-brush mowers to remove encroaching trees from these areas.

The removal of encroaching ponderosa pine, piñon and juniper trees may be effective for 10 to 15 years unless the re-established meadow areas are maintained on a scheduled basis to effectively retard re-encroachment. The proposed treatment would occur within areas whose ecological condition would normally be in a mountain meadow seral stage (early to mid-). These treatments would result in the removal of enough berry, pine nut and seed producing trees (mast production) to impact resident and migratory mammals and bird populations inhabiting the treatment area. Some species of wildlife may be displaced from the immediate area into adjacent areas, during cutting, burning and fuelwood gathering activities. This would not result in noticeable impacts on affected wildlife populations, as these animals would easily migrate out of the treatment areas into adjacent habitat areas not being treated.

The retention of large diameter and smaller diameter ponderosa pine trees in past-forested areas would provide edge, hiding and escape cover for wildlife populations. The re-established mountain meadow habitats would provide improved forage production, low ground cover, horizontal habitat diversity and high edge contrast.

The proposed treatment with prescribed low intensity broadcast burning would result in the same impacts on wildlife species referenced for both Piñon-Juniper control units and Fuelbreak areas.

The proposed maintenance of upland mountain meadows would increase habitat diversity for northern goshawk prey species, and would meet management objectives and recommendations specified in the Forest Plan.

The re-establishment of upland mountain meadow habitats would provide increased quality and quantity of herbaceous and shrubby forage for mule deer, Rocky Mountain elk, Merriam's wild turkey and many other small to large animal species which inhabit the project area. Animals utilizing this habitat type extensively for foraging areas would benefit from the establishment of enhanced forage resources.

Treatment and maintenance activities conducted during the nesting season would most likely result in the direct loss of individual nesting bird, mammal and reptile species, but the loss is not likely to result in long term population decreases. Some species of wildlife would be displaced from the immediate areas during thinning, prescribed burning and fuelwood gathering activities. The use of prescribed low intensity broadcast burns to remove treatment slash would not be conducted during the primary breeding season for most wildlife species, and most wildlife inhabiting the burn area would be able to escape without harm.

The construction and subsequent obliteration of one mile of temporary road to access treatment units, would not impact the resident and migratory wildlife populations in those areas.

Ponderosa Pine Restoration Areas

The proposed ponderosa pine restoration treatment would enhance wildlife habitat values by returning the natural fire regime and increasing plant species biodiversity (with associated enhancement of forage resources for animal consumption). The thinning of 18,100 acres of ponderosa pine timber stands would enhance wildlife habitat values. Within the Redondo treatment areas current basal areas values are as high as 170 square feet per acre. To meet suitable northern goshawk nest timber stand standards [60 square feet per area for piñon-woodlands and 120 to 140 square feet per acre for ponderosa pine forest (USDA, 1992)] approximately 1,960 acres of northern goshawk nesting and PFA habitat areas are prescribed for a higher basal area of 70 to 140 square feet per acre. This would result in the continued conservation and management of northern goshawk habitats within the analysis area as directed by the Forest Plan.

An uneven-aged silvicultural management system would be applied to create a multi-storied timber stand structure, with the majority of trees retained in the larger diameter classes. Thinning from below would create a non-uniform, clumpy timber stand structure with multiple age groups and a mix of tree species (piñon, ponderosa pine, juniper, oak) represented across the landscape as directed by the Forest Plan. Approximately 20 to 50 trees per acre would be retained depending on timber stand characteristics. To continue to meet Forest Plan northern goshawk habitat conservation and management objectives, large woody material (snags, logs, tree limbs) would be retained across the landscape. All oak trees greater than 10 inches DBH would be retained and stand openings of one to four acres in size would be maintained with prescribed burn treatments. Larger trees suitable for cover, roosting, nesting and snag recruitment would be produced in the long term by removing smaller diameter trees that are currently competing for soil water/nutrients and sunlight. Trees in the three youngest VSS Classes would be thinned with non-uniform spacing so that faster tree growth and crown development would occur. These proposed timber stand management actions would assure the continuation of northern goshawk habitat conservation.

The implementation of this alternative would result in creating timber stand conditions where the natural fire regime (low to moderate wildland fire intensities and frequent fire return interval) would be restored to resume its natural role. A by-product of meeting this objective would be increased wildlife habitat diversity, ecosystem resilience, improved hydrologic function, and an improved ability to safely suppress wildfire.

Forest wildlife species benefiting from the proposed timber stand treatments prescribed in this alternative would include northern flicker, Steller’s jay, Abert’s squirrel and numerous small rodent populations. This would result in increased populations of prey base species for avian predators such as the northern goshawk and Mexican spotted owl.

This alternative proposes making fuelwood available to the public through personal use permits or commercial sales. There would be no direct or indirect impacts to resident or migratory wildlife populations or their habitats within the treatment area.

The proposed low intensity prescribed broadcast burning would result in the same impacts on wildlife species referenced for both piñon-juniper control units and fuelbreak areas.

Treatment and maintenance activities conducted during the nesting season would most likely result in the direct loss of individual nesting bird, mammal and reptile species, but the loss is not likely to result in long term population decreases. Some species of wildlife would be displaced from the immediate areas during thinning, prescribed burning and fuelwood gathering activities. The use of prescribed low intensity broadcast burns to remove treatment slash would not be conducted during the primary breeding season for most wildlife species, and most wildlife inhabiting the burn area would be able to escape without harm.

The establishment of 207 miles of fire control lines which would naturally and quickly re-vegetate, and the construction and subsequent obliteration of 32 miles of temporary road to access treatment units, would not impact the resident and migratory wildlife populations.

Mixed-Conifer Habitat Management

No impacts on resident or migratory wildlife populations inhabiting mixed-conifer habitats within the analysis area would occur with the implementation of this alternative, as no actions are proposed for this habitat type. There would be no impacts on mixed-conifer wildlife habitats with the implementation of this alternative.

Management Indicator Species

Habitat types for management indicator species most affected by proposed activities area piñon-juniper woodlands, ponderosa pine/ponderosa pine-oak forests and mountain meadow habitats.

Piñon-Juniper Woodland

Within the piñon-juniper woodland habitat proposed treatment areas the mule deer and juniper titmouse are the two species most affected by changes to habitat conditions.

Mule deer would benefit from thinning of woodland habitat and the creation of early seral stage habitat, which would result in enhanced understory plant diversity and increases in herbaceous and browse forage quality and quantity. The retention of escape, hiding and thermal cover, along with increased edge effect, would be expected from the implementation of this alternative. Winter use of treated areas by mule deer would not be expected to be disturbed by human activities associated with the implementation of this alternative, as most human activity would not occur during the winter months due to road closures and snow depth.

Prescribed broadcast burning activities may displace mule deer temporarily, but these animals would readily return to burned areas and benefit in the short and long terms from enhanced forage quality and quantity.

The juniper titmouse would benefit from the improvement of herbaceous understory development, which would support higher diversity and density of insect prey populations. Large, cavity trees used by the titmouse, and other cavity dependent species would be retained, thus, a reduction in cavity nesting substrates would not result from the implementation of this alternative. Public fuelwood activities occurring during the nesting season would result in some direct habitat loss for the titmouse if woodcutters removed snags with excavated cavities. Some bird displacement would temporarily occur due to human presence. Treatments conducted during the nesting season may result in the direct loss of individual nesting birds, but the loss is not likely to result in long term population decreases. Some birds may be displaced from immediate treatment areas during thinning, prescribed burning and fuelwood gathering activities.

Ponderosa Pine/Ponderosa Pine-Oak Forest

Within ponderosa pine/ponderosa pine-oak forest habitats the Merriam's wild turkey and pygmy nuthatch would encounter changes in habitat conditions with implementation of this alternative. The Merriam's wild turkey would benefit from improved understory forage conditions created by the fuelbreaks, the creation of three slash piles per acre in fuelbreak areas within ½-mile of water, and the thinning of 18,100 acres of ponderosa pine forest areas. The wild turkey would benefit from the addition of diverse age class timber stand structure. The availability of roost trees, and older age class timber stands to be used by turkeys for roosting sites, would be improved in the long term with the implementation of this alternative. Small forest openings used by wild turkey hens for the rearing of turkey poults would be maintained, and high protein insect and seed resources for bird consumption would be increased.

The pygmy nuthatch would not be impacted by loss of cavity nesting habitat with the implementation of this alternative. Snags used as a nesting substrate by the pygmy nuthatch, as well as other cavity nesting species, would be retained. These species would continue to have access to trees with excavated cavities due to the habitat protection measures proposed within this alternative. Populations of the pygmy nuthatch would continue to occur within the analysis area and remain at stable numbers. The pygmy nuthatch would not be displaced as a result of snag removal, and foraging habitat would be enhanced as a result of the implementation of this alternative. These birds would continue to forage in the analysis area since it is likely that herbaceous vegetation would become more productive, with a commensurate increase in insect prey availability.

Treatments conducted during the nesting season may result in the direct loss of individual nesting birds, but the loss is not likely to result in long term population decreases. Some birds may be displaced from the immediate areas during thinning, prescribed burning and fuelwood gathering activities.

Mountain Meadows

The Rocky Mountain elk would benefit from improved mountain meadow forage conditions as a result of this alternative. Rocky Mountain elk would continue to utilize treated and nontreated mountain meadow habitats within the analysis area, especially if hiding cover is maintained nearby. Elk use of treated habitats would be expected to increase as forage conditions (quality and quantity values) improve. Elk may temporarily be displaced into adjacent habitat areas during treatment operations.

Mixed Conifer and Riparian Areas

There would be no activities proposed within stand conditions in either mixed conifer or riparian habitat. Thus, there would be no direct, indirect or cumulative effects to the black bear or the hairy woodpecker, which occupy mixed conifer forests, or the house wren, which occupies riparian areas.

Neotropical Migratory Birds

Treatment and maintenance activities conducted during the nesting season would most likely result in the direct loss of individual nesting Virginia's warbler and red-napped sapsuckers (and possibly other neotropical migratory bird species), but the loss is not likely to result in long term population decreases. Some species of neotropical migratory birds would be displaced from the immediate project area during proposed management thinning, burning and fuelwood gathering activities. The use of prescribed low intensity broadcast burns to remove treatment slash would not be conducted during the primary breeding season, and most neotropical birds inhabiting the burn area would be able to escape without harm. In the long term, habitat components for the Virginia's warbler, red-napped sapsucker (and possibly other neotropical migratory birds) inhabiting the analysis area would be enhanced by the implementation of management activities directed under this alternative.

Threatened, Endangered, Candidate, Proposed and Sensitive Species

Mexican Spotted Owl

Habitat for the federally listed Mexican spotted owl would be impacted by implementation of this alternative. Management actions analyzed in this alternative "*may effect but would not adversely effect*" the Mexican spotted owl. Implementation of proposed activities would not destroy or negatively alter critical, crucial, suitable or potential habitat for the Mexican spotted owl. Mexican spotted owl nest and roost sites would be protected during treatment operations, which would be limited during the breeding season of March 1 to August 31 to assure that these activities would not affect nesting birds.

Piñon-juniper woodlands serve as "other forest and woodland types" for the Mexican spotted owl. Piñon-juniper woodland treatments proposed under this alternative are designed to enhance prey base species populations, which would have positive affects on the owl and the quality of foraging habitat areas. Berry and nut (mast) producing trees, as well as the development of woody debris, snag retention and development of older age classes would result in increasing prey base species (small rodent and bird populations). Herbaceous cover would be improved, thus benefiting prey species used by the Mexican spotted owl.

The creation of fuelbreaks would reduce the risk of catastrophic wildfire in the analysis area, which would meet Forest Plan primary management objectives related to the conservation and management of Mexican spotted owl PACs (protected areas), restricted areas, riparian habitats and other forested vegetation types which constitute habitat.

Mexican spotted owl habitat areas within ponderosa pine/ponderosa pine-oak forest foraging areas would be enhanced, as these areas would continue to provide snags and woody debris which are important habitat attributes for prey base species constituting the diet for the owl. In ponderosa pine/ ponderosa pine-oak habitats all trees greater than 24 inches DBH and large oaks would be retained. This would further conserve and enhance habitat for Mexican spotted owl prey base species. Biological diversity within ponderosa pine/ponderosa pine-oak timber stands would be enhanced, thus increasing prey abundance.

The maintenance of upland mountain meadow habitats would reduce the risk of wind-driven, catastrophic, canopy wildfire within the analysis area, thus, meeting primary Forest Plan management objectives for the conservation and management of habitat attributes for the Mexican spotted owl. Seed producing plant populations within the treatment area would be enhanced, thus, enhancing habitat for Mexican spotted owl prey base species populations. This would result in enhanced prey base species population richness and diversity within treated mountain meadow habitat areas.

Southwestern Willow Flycatcher

The implementation of the management actions proposed under this alternative would have *No Effect* on the southwestern willow flycatcher or its potential habitat.

Western Yellow-billed Cuckoo

The implementation of the management actions proposed under this alternative would have *No Effect* on the southwestern willow flycatcher or its potential habitat.

Bald Eagle

The implementation of the management actions proposed under this alternative would have *No Effect* on the migratory, wintering bald eagle its potential habitat.

Cebolleta Pocket Gopher

The implementation of the management actions proposed under this alternative would have *no direct effect* on populations of the Cebolleta pocket gopher that currently may occur within mountain meadow (grassland) areas proposed for treatment. Over the long term implementation of this alternative would maintain treated mountain meadow (grassland) habitats in this vegetation type for potential inhabitation by the Cebolleta pocket gopher.

Osprey

The implementation of the management actions proposed under this alternative would have *No Effect* on the migratory osprey or its potential habitat.

Loggerhead Shrike

The implementation of the management actions proposed under this alternative would have direct effect on populations of the loggerhead shrike that currently may occur within mountain meadow (shrubby grassland) areas proposed for treatment. Over the long term implementation of this alternative would maintain treated mountain meadow (shrubby grassland) habitats in this vegetation type, which would maintain/increase the potential inhabitation by the loggerhead shrike.

Gray Vireo

The implementation of the management actions proposed under this alternative would have *no direct effect* on populations of the gray vireo that currently may occur within piñon-juniper woodland areas proposed for treatment. Over the long term implementation of this alternative would maintain treated piñon-juniper woodland habitats in a seral stage condition with increased/enhanced herbaceous understory vegetation, which would increase the potential for inhabitation by the gray vireo.

Texas Horned Lizard

The implementation of the management actions proposed under this alternative would have *No Effect* on the Texas horned lizard. Potential habitat within treated areas would be maintained for potential inhabitation by the Texas horned lizard.

Rio Grande Sucker

The implementation of the management actions proposed under this alternative would have *No Effect* on the Rio Grande sucker or its potential habitat.

Northern Goshawk

Piñon-juniper woodlands serve as foraging areas for the northern goshawk. Proposed piñon-juniper woodland treatments have been designed to enhance prey species populations within treated areas. Berry and nut (mast) producing trees as well as woody debris, snags, and older age class trees would be retained, thus, foraging habitat for the goshawk would be conserved as directed by the Forest Plan. Herbaceous cover would be improved, which would benefit habitat for prey species used by northern goshawk. Goshawk prey base species would also benefit from improved herbaceous understory production, with expected increases in insect and prey species availability. Treatment activities occurring during the breeding/nesting season may cause a disruption of activities, but this disruption is not likely to decline goshawk population.

The creation of fuelbreaks would reduce the risk of wind driven, catastrophic, canopy wildfire within the treatment area, thus, meeting Forest Plan habitat management objectives for the northern goshawk. The northern goshawk would be benefited, in the long term, by protecting the habitat areas from the likely occurrence of a stand replacing wildfire.

Within ponderosa pine/ponderosa pine-oak forest habitats proposed treatments would result in maintaining goshawk nest areas. Proposed thinning and prescribed burning treatments would protect existing older age class trees from disease, drought and fire, and move canopy cover to the desired levels by removing understory trees presently competing for soil moisture/nutrients and sunlight. Thinning from below treatments would result in non-uniform tree spacing and stand clumps, which would be a desired result. No proposed treatments would be conducted within nesting areas from March 1 to September 30.

Proposed thinning in northern goshawk PFAs to attain and maintain desired timber stand structure attributes would result in long term establishment of desired canopy cover. Where treatments are needed to attain or maintain desired canopy cover attributes these actions would be implemented. The proposed thinning of timber stands would result, over the long term, in canopy covers maturing to meet the desired 40 percent level. This would be due to reduced competition for soil nutrient/water resources (from excess trees which would be removed) and the enhanced capture of sunlight energy by the remaining trees. The remaining overstory trees would develop fuller canopies, thus, developing tree stand canopies, which would meet Forest Plan requirements of 40 percent cover.

The maintenance of upland mountain meadow habitats would reduce the risk of wind-driven, catastrophic, canopy wildfire within the treated stands, thus, meeting Forest Plan management objectives for the conservation and management of habitat attributes for the northern goshawk. Seed producing plant populations within the treatment area would be enhanced, thus, providing habitat for northern goshawk prey base species populations. This would result in prey base species population richness and diversity within treated areas.

American peregrine falcon

The American peregrine falcon, and its associated eyrie and nesting territory, within the analysis area would not be impacted by any actions proposed under this alternative. As directed by the Forest Plan, protection measures would be implemented to assure the protection of the falcon and its nesting substrate. Falcon prey base species would be enhanced by the proposed activities outlined within this alternative.

Preferred Alternative (Alternative C)

Direct and Indirect Effects

The same direct and indirect effects identified for the Proposed Action would apply if this alternative were selected for implementation.

Management Indicator Species

The same environmental impacts identified for the Proposed Action would apply if this alternative were selected for implementation.

Neotropical Migratory Birds

The same environmental impacts identified for the Proposed Action would apply if this alternative were selected for implementation.

Threatened, Endangered, Candidate, Proposed and Sensitive Species

Mexican Spotted Owl

The habitat for the federally listed Mexican spotted owl would be impacted by the implementation of this alternative. Management actions undergoing analysis for this alternative "*may effect but would not adversely effect*" the Mexican spotted. Implementation of the activities described in this alternative would not destroy or negatively alter critical, crucial, suitable or potential habitat for the Mexican spotted owl. Mexican spotted owl nest and roost sites would be protected during treatment operations, which would be limited during the breeding season of March 1 to August 31 to assure that these activities would not affect nesting birds.

The effects on the Mexican spotted owl identified in the Proposed Action would also apply under this alternative. However, implementation of this alternative would result in additional protection of Mexican spotted owl habitat through the abatement of wildfire within a PAC identified as having high risk, hazardous fuel component attributes. This alternative would treat 425 acres of a PAC by thinning smaller (less than 9-inch diameter) trees to remove ladder fuels and reduce hazardous fuel loads. This would result in reducing the potential of a wind-driven, catastrophic, canopy wildfire occurrence within the treated PAC. This type of fire would result in the mortality/loss of the nesting pair and/or offspring. A 100-acre "no treatment area" has been designated in the most desirable habitat immediately surrounding the Mexican spotted owl roost site as directed by the Forest Plan. To assure that the best management practices for the management of Mexican spotted owl PACs can be determined for future habitat actions, pre and post treatment monitoring would be conducted in the treated PAC to determine habitat occupancy by owl and to determine habitat changes.

The initial treatment of the owl PAC would be done with chainsaws and slash would be piled. Slash piles would be burned in the fall when snow is on the ground or surrounding fine fuels are wet. These actions would help to prevent fire from entering into the 100-acre core area.

Prescribed burning would not be done within any other PACs. This would assure that Mexican spotted owl conservation and habitat guidelines set forth within the Forest Plan are adhered to.

As described in the Proposed Action above, Mexican spotted owl nest and roost sites would be protected during treatment operations under this alternative. Treatment operations would be limited during the breeding season of March 1 to August 31.

Northern Goshawk

The same environmental impacts identified for the Proposed Action Alternative would apply if this alternative were selected for implementation

American Peregrine Falcon

The same environmental impacts identified for the Proposed Action Alternative would apply if this alternative were selected for implementation.

Southwestern Willow Flycatcher

The implementation of the management actions proposed under this alternative would have the same effects for the southwestern willow flycatcher as discussed under the Proposed Alternative B.

Western Yellow-billed Cuckoo

The implementation of the management actions proposed under this alternative would have the same effects for the western yellow-billed cuckoo as discussed under the Proposed Alternative B.

Bald Eagle

The implementation of the management actions proposed under this alternative would have the same effects for the migratory bald eagle as discussed under the Proposed Alternative B.

Cebolleta Pocket Gopher

The implementation of the management actions proposed under this alternative would have the same effects for the Cebolleta pocket gopher as discussed under the Proposed Alternative B.

Osprey

The implementation of the management actions proposed under this alternative would have the same effects for the osprey as discussed under the Proposed Alternative B.

Loggerhead Shrike

The implementation of the management actions proposed under this alternative would have the same effects for the loggerhead shrike as discussed under the Proposed Alternative B.

Gray Vireo

The implementation of the management actions proposed under this alternative would have the same effects for the gray vireo as discussed under the Proposed Alternative B.

Texas Horned Lizard

The implementation of the management actions proposed under this alternative would have the same effects for the Texas horned lizard as discussed under the Proposed Alternative B.

Rio Grande Sucker

The implementation of the management actions proposed under this alternative would have the same effects for the Rio Grande sucker as discussed under the Proposed Alternative B.

Cumulative Effects

Since 1966 timber stand manipulations, ranging from reforestation to overstory removal, have occurred within the analysis area. These actions have resulted in the opening of forest canopies and increased plant/forage biomass production within the understory. As past vegetation manipulation actions have occurred, these treatment areas have reverted to lower ecological site seral stages, which have provided a concomitant correlation of improved wildlife habitat capabilities (enhanced forage quality and quantity) that serve as attractants to resident and migratory wildlife populations. In particular, Rocky Mountain elk and mule deer have benefited from these areas of enhanced forage resource availability. Due to the large analysis area impacted by either the proposed action or preferred alternative, the areas treated would receive increased use by Rocky Mountain elk and mule deer due to the same beneficial enhancement of forage resources that has previously occurred within past timber sale areas. In addition, surrounding habitat areas within the watershed would receive reduced inhabitation by Rocky Mountain elk and mule deer as these animals start to utilize the treated sites. The same would apply for other wildlife populations inhabiting the analysis area.

Management Indicator Species

Identified MIS populations occurring within the analysis area would exhibit, on a landscape/watershed basis, the same cumulative impacts identified above. Due to the enhanced forage values resulting from the implementation of either action alternative, the identified populations of MIS would move into these more productive, lower ecological site seral stage areas and away from other areas with higher ecological site seral stage structure. This migration of MIS into new treatment sites would generally redistribute these species across the landscape/watershed into treatment areas as proposed treatments occur.

Neotropical Migratory Birds

The same cumulative impacts identified above would also occur for neotropical migratory birds which inhabit or may inhabit the analysis area. This would result from birds utilizing more forage (insect/plant) productive habitats verses utilizing higher ecological site seral stage areas with lower forage (insect/plant) production values.

Threatened, Endangered, Protected, Candidate and Special Status Species

Mexican Spotted Owl

The implementation of this alternative would result in the same enhanced habitat (prey base species) forage values addressed above. As small animal populations increase within newly treated areas the Mexican spotted owl would benefit from improved chances of foraging success within these areas of lower ecological site seral stage. In addition, the analysis area would offer improved opportunities for the recruitment of newly established owl PACs due to the enhancement of habitat values on a landscape/watershed basis.

Under the preferred alternative, the treatment of a Mexican spotted owl PAC would initiate needed conservation measures to mitigate the potential for catastrophic, wind-driven canopy fire occurrence which would destroy PACs and habitat areas, increasing the possibility of losing owl breeding pairs and nestling reproduction. The cumulative impact of this action consists of utilizing the same actions for the protection of other owl PACs when success of the implementation this proposed management action are verified. Those future protection activities of other owl PACs would be analyzed under a separate NEPA document/analysis.

Northern Goshawk

The implementation of this alternative would result in the same cumulative impacts discussed above for Mexican spotted owls. There would be improved opportunities for the recruitment of newly established Northern goshawk PFAs.

3.3 Fire and Fuel Resources

The objective of the Bluewater Ecosystem Management Project is to reduce the potential for crown fire initiation and spread within the watershed by removing surface, ladder and crown fuels. Wildfires often escape initial attack control measures, thus threatening residential areas, water supply and natural resources. Wildfires burning in forest stands that have not been previously thinned pose a high risk of escaping initial attack. Leaving accumulations of freshly cut logs and slash on site may attract beetles that can damage or kill nearby trees. This would cause an increase in dead trees, which would increase the fuel hazard. Therefore, the Bluewater project has been proposed to reduce the risk of catastrophic wildfire and remove excessive amounts of fuel accumulations.

In order to determine what was the affected environment, the best available information was used, which included vegetation and fuels data taken from a variety of sources, including stand examinations, fuel inventories, aerial photo interpretation, scientific research literature, and field reconnaissance by professional foresters and fuel specialists. In a case where the District did not have field data, the data from stands that were similar in nature were used to predict existing condition.

3.3.1 Fire Risk

Fire risk is the potential for a fire to ignite or start given certain parameters and conditions. Fire starts can be a result of human ignition or natural ignition in the form of lightning. The Bluewater watershed is used extensively by the public for camping, hunting and day trips, particularly along Forest Roads 178, 480, 180 and in the Ojo Redondo Campground. This level of public use increases the potential for human caused fires. Based on historical fire start data this area also has a high number of fires that are caused by lightning each year. On average, the watershed has between 5 and 20 lightning caused fires annually.

3.3.2 Fuel Models

Fuel, weather and topography combine to determine the intensity and speed a fire burns. Fuel conditions are defined by quantity and arrangement and have been categorized into 13 standard descriptive fuel models (Anderson 1982). Fuel models are used as one of the inputs in the BEHAVE computer model to determine flame height and rate of spread for a wildfire. The dominant fuel models in the watershed are fuel models 2, 9 and 6. Fuel model 2 represents one of the “grass” fuel models where dead grass, twigs, needle litter and a small amount of green grass are the primary carrier of fire. Fuel model 9 represents “timber litter” fuel models, where the fuel to carry a surface fire consists primarily of needles, twigs, and branches from trees. Fuel model 6 represents a “brush” model, where the primary carrier of fire is heavy brush with a high live to dead ratio. The project area is about 60% fuel models 2 & 9 and 40% fuel model 6. Fires burn differently in each fuel model under the same weather conditions because of differences in size, the amount of material, and fuel moisture. During average summer fire conditions (not extreme) when dead fuel moisture averages 8%, live fuel moisture is 100% and effective wind speed at mid-flame height is 5 miles per hour a fire in the various fuel models would have the characteristics identified below in Table 4.

Table 4 – *Predicted Fire Behavior with Different Fuel Models Present in Project Area*

	Fuel Model		
	Model 2	**Model 9**	**Model 6**
Flame Length	4 to 6 feet	2 to 3 feet	2 to 3 feet
Rate of Spread	2,112 feet/ hour	495 feet/ hour	1,914 feet/hour

3.3.3 Factors Affecting Fire

Slope and Aspect

Slope affects fire spread and intensity. Fire burns faster and hotter upslope than down slope or on level ground. Slopes in the Bluewater watershed represent a wide range of conditions, ranging between zero (flat) and 60 percent.

Aspect affects fire spread and intensity based on the direction the slope is facing and the overall vegetation and soil moisture. A south-facing slope is hotter and dryer than a north-facing slope. The south-facing slope will have different vegetation, which will typically burn with more intensity than a north-facing slope. Bluewater Creek roughly divides the watershed with 1/3 in the southeast part of the watershed and 2/3 in the northwest. Both sides of Bluewater Creek contain sub-drainages and intersecting ridges that run perpendicular to the creek, which means all aspects, are contained within the watershed.

Fire Weather

Fire season in New Mexico usually occurs from April 1st to July 20th in most years. It is characterized by low humidity, strong winds, and unstable atmosphere. The wind blows down canyon predominately from the west, Southwest and south. On-site weather observations taken from a portable Remote Automated Weather Station (RAWS) have shown that winds ranging from 10 to 30 mph are common in the late spring and early summer. Winds of this speed coupled with low relative humidity and the current fuel conditions can create an environment that will support extreme fire behavior.

Forest Canopy

Canopy closure (or percent canopy cover) directly affects a fire's ability to continue burning in the tree crowns. Canopy closure averages 35% across the project area, with higher closure on north and east facing slopes. At approximately 40% canopy closure, tree crowns are close enough together to allow fire to rapidly jump from tree to tree and become what is termed a "running crown fire."

Data for canopy cover was derived from stand exam inventories and field reconnaissance. Stand exams were conducted in each of the major vegetation types in the project area, at various elevations and in different Terrestrial Ecosystem Survey (TES) map units.

Species Composition

Vegetation is described in terms of major forest species type, diameter class, number of trees per acre, and percent canopy cover. Forest types are defined by the dominant and co-dominant tree species in the overstory. The major forest types within the project area are:

- Piñon Pine and Juniper (*Pinus edulis, Juniperus monosperma* and *Juniperus depeana*;
- Ponderosa Pine (*Pinus ponderosa*);

Ponderosa pine forests cover 33% of the watershed. Historically, ponderosa pine in the Southwest experienced low-intensity fires every 5 to 20 years (Touchan and Swetnam 1991; Covington and Moore 1994; Weaver 1951). The lack of low-intensity, high frequency surface fires in the ponderosa pine zone has encouraged major changes in the species composition over the past 80 to 90 years. The historic fire regime generally created and maintained open, park-like ponderosa pine forests (Biswell et al.1973, Brown and Davis 1973, Cooper 1960, Hall 1976). Without frequent low-intensity fires, stand composition has shifted to greater numbers of ponderosa pine regeneration trees. The thick bark of large ponderosa pine trees promotes survival in low to moderate intensity fires (Biswell et al. 1973). Long-term exclusion of fire from the area has altered the fire regime, which has resulted in substantially increasing the number of trees, reducing tree sizes, and affecting a species ability to survive surface fires. Wildfire ignitions during high-risk weather conditions with current fuel conditions are likely to become large scale, stand replacing fires. Crown fires in the ponderosa pine type are absent in the historic local and regional fire scar records (Touchan and Swetnam 1991), indicating that current stand conditions are an aberration attributable to recent fire exclusion.

Piñon-juniper woodlands occupy approximately 13% of the watershed, primarily on the northern edge and within private land adjacent to the community of Bluewater. Historically in the Southwest, woodlands were varied in their relative stand density (Albert 1848a, 1848b, Leopold 1951). The pattern of tree patches in woodlands is influenced by soil depth, nutrients, microbes, drought, plant competition, fire, grazing, and insect-pathogen attack (Gehring and Whitham 1995, Klopatek et al. 1990, Leopold 1924). Some of the existing piñon-juniper stands in the project area are sufficiently open to subdue a running crown fire. However, there are dense patches where herbaceous vegetations could allow such a fire to quickly spread from tree to tree.

Surface Fuel Accumulations

The existing dead and down fuel loading in the project area is considered light (Sackett 1979), ranging from four to six tons per acre. However, surface fuel loading is gradually increasing as more trees die due to intense competition for limited resources. Dense stands of trees are under stress because of limits to soil moisture and nutrients. Stressed trees are also susceptible to loss from insects and disease. As trees die and fall over, surface fuel loads increase as depicted in Figure 3. If a fire did occur in this area with this increased level of fuel loading, there would be a loss of mature trees and change in forest structure.

Figure 3 – ***Fuel loading increasing as stressed trees die and fall over.***

Ladder Fuels and Surface to Crown Base Heights

The structure and composition of forest vegetation affects fuel loads and fire behavior (Van Wagner 1977). Multi-storied stand structure and continuous overstory forest canopies create conditions conducive to crown fires (Van Wagner 1977). Ladder fuels are defined as small diameter understory trees growing beneath larger diameter trees. These small trees provide for a continuous vertical fuel arrangement that encourages crown fire initiation (Van Wagner 1977), by carrying surface fire into the crowns of the overstory trees.

Within the analysis area ladder fuels tend to be sparser on the south and west aspects than on north and east aspects because of lower soil moisture and higher air temperatures. A fuel inventory showed that approximately 400 trees per acre have created extensive ladder fuels on the east slopes in contrast to approximately 100 trees per acre on the south slopes, where ladder fuels are not considered a problem.

Another measure of ladder fuels is surface to crown base height (CBH), or distance from the ground to the bottom of the tree crown. Low crown base heights have been shown to initiate crown fire behavior (Alexander 1988). The existing ladder fuels generally begin at about four to five feet from the ground as shown in Figure 4. The surface to base heights average five feet on the south slopes and are within 1 foot of the ground on many north and east aspects due to the presence of shade tolerant fir trees. The CBH averages six feet across the watershed. With CBH this low a fire with flame lengths of three feet or more would quickly become a crown fire.

Figure 4 – ***A typical Ponderosa Pine stand in the Bluewater Watershed where dense thickets of young trees (1,000-to-2000 per acre) create ladder fuels beneath big old pines that average only 15-20 trees per acre.***

The desired condition is to have ground to crown base heights averaging 10 to 20 feet from the ground by reducing ladder fuels as shown in Figure 5.

Figure 5 - ***A stand that has had the surface to crown base height increased to a more fire resistant height.***

Stand Density Index

The Stand Density Index (SDI) measures competition between trees, or the relative density of the stand. SDI levels above 50% normal indicate that trees are under stress due to competition and are more susceptible to insect attacks. The higher the SDI the more competition between trees. The more competition between trees, the more stress they are under which results in slower growth rates and higher mortality rates. SDI values in the watershed currently range from between 12 and 86 percent, with an average of 35%.

Live Fuel Moisture

Low live fuel moisture is critical to crown fire initiation and spread. Crown fire potential increases when foliar moisture content drops below 120% of dry matter content (Agee 1996), which typically occurs in the Southwest beginning in May or June and when there are drought conditions. As an example, the live fuel moistures were 80% prior to the Cerro Grande Fire, which resulted in more than 40,000 acres burned by a catastrophic wildfire. Agee (1996) determined that it takes a flame height of 4 feet to initiate crown fire when foliar moisture content is below 120 % and as described above, surface to crown base heights are currently less than 5 feet in many areas within the Bluewater Watershed.

3.3.4 Environmental Consequences

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

Under this alternative there would be no attempt at reducing the fuel hazard or duplication of the historic low-intensity fire regime in the watershed. Wildfires would be suppressed because of the risk of unacceptable environmental and social consequences of letting a fire spread through the watershed. However, suppression would become more difficult as conditions worsen with time. The fuel hazard would continue to gradually increase. Based on current growth rates, most stands would remain in the 5-inch to 18-inch diameter classes for decades. Conifer invasion in the oak and aspen areas would continue. Stand density in the ponderosa pine types would continue to increase due to growth of understory trees, resulting in mortality of mature trees, which would create more fuel. Dense understories would also create ladder fuels.

The models used to predict fire behavior and fire effects are based on simplistic assumptions and have limitation. However, the internal consistency of a well-disciplined model allows it to be used to assess the impacts of changes in important variables (Albini 1978). Prescribed burns and wildfires were modeled using BEHAVE Plus and FOFEM fire models for various exposures and fuel models. The results of the FOFEM model have been discussed under the air quality section at the beginning of this chapter.

Analysis of weather data for the 20-year period from 1976 to 1996 showed a 37% chance of having a day during the fire season that would exhibit "average worst fire conditions". A fire burning under these conditions would be difficult to control under the no action alternative. There is a 20% probability of having an ignition occur on one of these days in any given year. These probabilities are conservative given that according to climate studies, 1976 to 1996 were the wettest 20 years since 136 B.C. (Mayer-Grission 1995).

Using the BEHAVE program, fire spread and flame lengths were modeled under conditions typical during fire season and in fuels and topography characteristic of the area if no fuel treatment were to occur. Under the average worst fire season conditions, with a temperature of 87 degrees Fahrenheit, relative humidity of 17 %, and 9 mph winds at 20 feet above tree top, a fire would generate flame lengths of four to six feet, sufficient for crown fire initiation when crown base heights are five feet and less, and live fuel moistures are less than 120 percent. A crown fire under these conditions can be expected to generate flame lengths of 70 to 150 feet (Rothermel 1991) and throw burning embers miles ahead of the fire. These embers would have a probability of 70 to 100 percent of starting more fires if they came into contact with receptive fuel, demonstrating how difficult it would be for suppression forces to contain the fire under the no action alternative.

Observations of prescribed burns and wildfires on the Mt. Taylor Ranger District indicate that computer-modeled flame lengths for surface fires may be underestimated. The BEHAVE fuel models assume a uniform fuel bed. Fuel beds almost always have pockets of "jackpot" fuels, typically large down pitchy logs where fire intensities can increase. Heavy infection by the parasite dwarf mistletoe in ponderosa pine can encourage crown fire initiation and spread (Koonce and Roth 1980). Ponderosa pine heavily infected with dwarf mistletoe "brooms" become drier, and the brooms are highly flammable and increase fire intensity (Arno and Harrington 1999, Hawksworth 1995). This parasite is prevalent in ponderosa pine though out the project area. The no action alternative would not remove heavily infected trees or reduce the spread of mistletoe.

Cumulative effects under this alternative would be a continued increase in stand density and fuel loadings. Stand density index (SDI) is currently approaching the upper limit of what is considered a healthy stand. As trees start to die because of high SDI, fuel loads would increase rapidly. The increased fuel loading would cause a wildfire to burn more intensely causing near 100 percent tree mortality and sterilizing soil. There would be increased soil erosion, which would adversely impact Bluewater Creek and Bluewater Lake. A wildfire burning under these conditions on the above stated "average worst fire day" would be very difficult to control and would threaten the community of Bluewater and possibly the La Jara subdivision. This fire would threaten these communities regardless if private landowners had created good defensible space and thinned around their properties. Even if the fire stopped at the private land the fire would throw fire brands up to one half mile into the community, which would still burn homes.

Research has shown that episodic fire helps control mistletoe, keep the ecosystem healthy and "fire proof" stands of trees. Fire exclusion and lack of vegetation manipulation is causing an unhealthy situation in the watershed and as data shows the watershed is approaching or portions are at critical thresholds of being in a unhealthy state.

Direct and Indirect Effects Common to Both Action Alternatives

The effects analysis indicates that the more acreage treated to reduce fuels, the more effective it would be in reducing wildfire intensity and spread and the severity of impacts. Fire behavior observations following the La Jara and Cerro Grande Fires indicate fuel reduction needs to be completed over large contiguous areas to effectively reduce the risk or impacts of a high-intensity crown fire. As more of the landscape is treated, it becomes more "fire safe" (Agee 1996). In the 1994 Wenatchee fires, the La Jara Fire and the Cerro Grande Fire, areas that had been thinned and prescribed burned within the past 20 years showed reduced wildfire behavior. Thinning followed by slash treatment, is the most effective way to achieve desired fuel reduction objectives.

Restoring fire to ponderosa pine forests can be used to meet important ecological objectives (Mutch and Cook 1996). Low to moderate intensity burning under conditions when duff moisture is above 75 percent would maintain the organic humus layer and minimize exposing bare soil. There would be no loss of long-term site productivity (Peterson and Sackett 1994). Burning would increase the diversity of stand densities across the landscape in the project area while reducing fuel loads.

The number of trees would be reduced to about 20 to 50 of the largest trees per acre in the thinned areas outside the fuel break and 10 to 15 trees per acre in the fuel break. SDI would be reduced to about 20 to 25 percent in thinned areas and to about 10 to 15 percent within the fuel break.

Crown base heights would be raised to the desired average of approximately 20 feet or higher (from the ground surface) in thinned areas, due to removal of ladder fuels. A 20-foot crown base height requires eight foot flame lengths to ignite the overstory when live fuel moistures is a 70%, a percent common in drought conditions.

Crown bulk density in thinned areas would be reduced to less than 0.17 lb/yd^3 and would be reduced the most with in the fuel break and the WUI areas.

Canopy cover in the thinned areas would be reduced to less than 40 percent. The crowns of the remaining trees would gradually grow and expand, and within 10 to 15 years after treatment, the canopy cover would once again approach 40 percent. Canopy cover in the fuel break would be reduced to 10 to 20 percent and would take a longer time to approach 40 percent closure.

Scattering the slash followed by low-intensity broadcast burning could be used in some selected areas to reduce fuels. Using cool broadcast burns on thinned, slash-covered ground would require drier conditions compared to pile burning. Broadcast burning scattered slash would spread a low-intensity surface over 75 percent or more of the burn unit. This type of burn mimics natural low-intensity fires and has many beneficial effects in fire adapted pine forest (Weise and Sackett 1996). There would be no adverse affect on soil from this type of burning as long as moisture guidelines were followed. Larger diameter fuels, greater than six inches in diameter, would not be consumed due to higher fuel moistures under these conditions. Experience with this type of burning in the Southwest has shown that logs take about 7 years to deteriorate before they would be consumed by a prescribed burn (Reinhardt et. al. 1991). Risk of an escaped fire would be low from this type of broadcast burn through thinned areas with slash scattered on the ground, as long as mitigation and monitoring measures are followed.

Proposed Action (Alternative A)

With this alternative all treatment areas would be broadcast burned. These areas include the Wildland Urban Interface (WUI), control units, fuelbreaks, Upland meadows, and the uneven aged Ponderosa Pine Restoration areas. The cost per acre of implementing broadcast burn on these areas would be very high-$1,086,000 at $60/ acre for 18,100 acres. The fuelbreak, WUI and control units would be broadcast burned with minimal success because of the light fuel loading. Risk of an escaped fire from these units is low.

There would be considerable soil disturbance from the high miles of handline construction. The time involved to complete 304 miles line for this alternative would be 76 days with crews working 8-hour days, with an estimated cost of $190,000.

Preferred Alternative (Alternative C)

This alternative would treat 425 acres of Mexican spotted owl habitat within a Protected Activity Center. Trees less than 9 inches DBH would be cut by chainsaw and excess fuel would be piled for fall burning. Pile burning would be completed when snow was on the ground or very high fine fuel moistures. By treating the PAC, the area would have less risk of a wildfire that enters the PAC from outside the PAC adversely affecting the area. A fire starting within the PAC would cause minimal damage as well. Pile burns would sterilize small areas of soil (30 square feet or less) and scorch few trees. However, mortality would be less than 5 percent of the total stand. Two to five piles per acre would be left for wildlife habitat. The BEHAVE model shows fire behavior if the fire crept between burning piles. Based on estimating fine fuel moisture of 15 to 20 percent, the maximum rate of spread would be 179 feet per hour to 119 feet per hour, respectively. The maximum spotting distance would be 528 feet given a 40-foot tall tree with a 9 mile per hour wind at 20 feet above treetop.

There would be considerable less handline construction under this alternative. An estimated 18 miles would have to be constructed since burn blocks have been expanded to include existing road systems. This would result in less soil disturbance and less expense for crew costs.

Control units and two-thirds of the upland meadows would be thinned only with no prescribed burning activities under this alternative. The level of slash left after fuelwood was removed would be minimal, thus there is no need to burn these units.

By using more pile burning than broadcast burning, and not burning areas that had light fuel loads, there would be less risk of escape fire during prescribed burning activities. All treatment units would still be thinned and fuel levels reduced, which would result in less tree mortality and a lower potential for catastrophic wildfire.

Direct and Indirect Effects of Pile Burning

Under this alternative broadcast burning would have to be completed using two prescriptions, one for areas that have been thinned and one for areas that have not been thinned. Pile burning would be completed with a third prescription. Pile burning could sterilize soil in the center of a burned area. Total burn area would be about 30 square feet per pile. Risk of a pile burn escaping would be very low, as these burns would be completed when fuel moisture is high.

Slash accumulations immediately after thinning would be an additional 10 to 15 tons per acre, enough to create 40 to 60 piles per acre, based on prior project experience. The piles would only cover approximately 10 percent of the treated acreage. Burning piles in the fall, winter or very early spring when fuel moisture is 15 to 20 percent would result in at least 60 to 80 percent fuel consumption in the piles. This would leave approximately 8 tons per acre residual slash, which would be an acceptable level. Based on results from the BEHAVE model, burning piles under calm wind conditions (4 to 10 mph winds at 20 feet above tree top) with sustained flame heights of less than 10 feet would result in a maximum spotting distance of 500 feet. If the surface fuel is moist or covered with snow, the probability of fire spreading from burning embers is zero.

Slash piles could become a fuel hazard by late spring and through the fire season of the following year if piles were not burned after an area had been thinned. This practice of leaving slash piles to dry during the fire season has commonly occurred throughout the Southwestern Region without resulting in any major fire events. If a fire were to ignite in the dry slash, it would be highly unlikely to develop into a spreading crown fire, due to lack of continuous surface, ladder and crown fuels in the treated stands.

Experience on this and other National Forests have seldom shown tree mortality from pile burning, even though tree scorching may occur. Since piles would be burned under conditions when surrounding surface fuels would not ignite, there would be little or no reduction in those surrounding surface fuel loads or depth.

Direct and Indirect Effects of Broadcast Burning in Previously Un-thinned Stands

Many research studies have shown that low-intensity prescribed burns are effective in reducing surface fuels, seedlings and small diameter saplings that can act as ladder fuels (Biswell 1960, Biswell 1989, Harrington 1987, Kalabodkidi and Wakimoto 1992, Sackett 1984, Wagle and Eakle 1979). The computer programs RXWINDOW and FOFEM can be used to determine the specific weather and fuel moisture conditions needed to obtain desired results. Burning provides substantially less control over tree stocking results compared to thinning with chainsaws (Stephens 1998). Stand structure, fuel quantity and fuel arrangement after a prescribed burn would be highly variable in un-thinned stands.

The reason for prescribed burning an additional 6,840 acres without first treating mechanically is to use existing roads as control line. Time and money would be saved by not having to construct many miles of hand line. This type of treatment would still meet the objective of reducing fuel loads. A low intensity broadcast burn generally kills understory trees less than five inches in diameter, and reduces the number of trees over six inches in diameter. These “cool” burns would not sufficiently reduce canopy cover (create openings) or reduce crown bulk densities on the majority of the burned areas. Crown bulk densities in the broadcast burn only areas would not be reduced below the desired threshold and could sustain crown fire spread through those portions of the project area. In order to reduce the risk of crown fire with only a broadcast burn, multiple treatments would have to be made over at least a 15-year period.

A tree’s survival during broadcast burning depends on: the tree species, size, vigor, live fuel moisture, fuel loading, topography, aspect, wind speed, air temperature and slope position (Harrington 1990). Most broadcast burning would be done in the fall when live fuel moistures are usually well above the critical crown fire threshold of 120 percent. The higher the live fuel moisture, the less likely that burning would kill green trees. Furthermore, fall burning occurs at a time when trees are generally dormant. Broadcast burning would likely result in crown scorch at the base of tree crowns. Scorching kills and prunes the lower branches, which beneficially increases the crown base height. Needle layer accumulations would likely return to pre-burn conditions within a year as the scorched needles fall. Many years of experience on the Cibola National Forest conducting broadcast burning in untreated stands in the fall shows that surface and ladder fuels would be effectively reduced but the overstory continuity of fuels would not be significantly reduced. The expected increase in herbaceous vegetation and shrubs would not be expected to affect future surface fire behavior (Scott 1998b), other than providing a medium for the surface fire to remain on the surface rather than in tree crowns.

There would be a slightly increased risk of a burn escaping the burn unit in areas that have no mechanical treatment. Areas surrounding these burn units would be treated first to ensure the burn stayed contained with in the burn block.

The First order Fire Effects Model (FOFEM) was used to determine effects from prescribed burning. Total surface fuel loads would be reduced 50-70 percent, and trees less than five inches in diameter could be reduced as much as 30 percent. However, experience with FOFEM indicates the model over predicts tree mortality and fuel consumption, especially in five to twelve inch trees. Years of experience of broadcast burning untreated stands have demonstrated that low-intensity burns would not kill the 5 to 12 inch diameter trees. Thus, it is expected that the use of broadcast burning alone would not affect the overstory in stands that were not thinned prior to the burn. Based on the BEHAVE model, fire behavior in the un-thinned blocks have a rate of spread of 845 feet per hour with fine fuel moisture of 5 percent, 15 miles per hour winds at 20 feet above treetop, and 80 degrees Fahrenheit. Tree mortality would be around 5 percent of the total stand.

Cumulative Effects

Cumulative effects analysis area for fuels and fire behavior is the entire treatment area. This analysis was based on fuel loads, topography, risk of fire ignition and spread and other factors described in the affected environment section above.

In considering the potential cumulative effects for this analysis, we considered the historical circumstances that created the current situation. The affected environment section described the current fuel conditions that are the result of historic land uses and climate patterns. The long-term cumulative effect has been a change from low-intensity high frequency fire regime to an infrequent, high intensity stand replacing fire regime.

This cumulative effects analysis also considered the current and future growth of wildland urban interface where the community boundaries meet the National Forest System lands. Increased human presence increases the probability of intentional or unintentional fire ignitions. The more homes there are in the interface the more difficult it is to suppress wildfires. In addition, more use from ATVs, hunters and woodcutters is increasing which increases risk of ignition.

In considering other current land uses and foreseeable future actions it is notable that there have been no vegetation management projects with in the analysis area in the last 5 years. There was some small acreage (less than 100) of pile burns completed 5 to 7 years ago. The acreage was small enough and treatment long enough ago that there would be no affect on the outcome of this project and no significant increase in cumulative effects.

Maintenance burns would be completed on the historical natural fire return interval of 10 to 15 years. These burns would be low intensity fires that would be similar to historical natural fire burn regimes. Effects from the maintenance burns would less than the original proposed burns in this analysis.

3.4 Heritage Resources

Past human uses of the analysis area has produced a variety of heritage resources: *archeological resources* such as prehistoric and historic structures, artifact scatters and trash areas, and *contemporary American Indian resources*, which are considered to be places of traditional use. Each resource is discussed separately in the following sections.

3.4.1 Archaeological Resources

Archeological Coverage

Approximately 24% of the entire Bluewater Watershed Project area has been inventoried for heritage resources by surveys documented in the Forest Service files from 1975 through September 2002. Thus, the total number of National Register eligible or potentially eligible archaeological sites is not known. Nearly all of the archeological surveys occurred on Forest Service administered land. Information within the 1996 Bluewater Geographic Area Assessment has been updated based on this analysis, using Heritage Survey and Heritage Site GIS layers. This analysis discloses information only about the currently known sites.

On the order of 130 reports have been written which deal with newly surveyed acres in the Bluewater area. Much of the survey work occurred from the mid-1980’s through the 1990’s as part of various timber sale analyses. In 2002, approximately 6,000 acres were surveyed under the Bluewater Ecosystem Management Project analysis. Each of the more recent surveys provided 100% coverage of the project area.

For the most part, the previous work is believed to provide reliable results in relation to intensity of coverage and site identification. However, some of the techniques used in the earlier surveys did not provide the intensive coverage that is now required to meet survey standards. The information obtained at that time is considered adequate to very good in most instances; however, some of these areas would require additional survey work before implementation.

Archeological coverage is fairly well distributed in space over the entire Bluewater project area, with a few notable exceptions. Much of the forested, high elevation sites have been inventoried; however, the lower elevation woodland areas are in need of additional survey work. Some of these gaps include:

- *Cottonwood Canyon and Las Tusas Valley to the north.*
- *The north central part of the Bluewater area near Pine Canyon.*
- *Kettner Canyon, Johnny Mack Corral Canyon, and Gurman Canyon*

Archeological Sites

Approximately 625 sites have been recorded in the areas surveyed within the Bluewater Watershed, resulting in an average overall site density of about 15 sites per square mile. Archeological resources exhibit a wide range of site types and represent occupation over a long span of time, including the earliest periods of human use of the Zuni Mountains. Much of the historic use during the early 1900's included sheep grazing and railroad logging, and are wide spread throughout the project area.

The recorded sites represent close to 660 site components since some sites exhibit occupation during both the prehistoric and historic eras, thus they are considered to be multi-component. Of the site components, 13% are of prehistoric age, 60% are of historic age. The remaining sites are of unknown age. Especially worthy of note are 4 Paleo-Indian components and 15 Archaic components. Sites representing these early hunting or hunting/gathering periods of human occupation are rarely recorded in the Zuni Mountains and are uncommon across the Southwest. A more detailed description of archaeological sites discovered during surveys can be found in the project record.

More than 50 site components date to the Ancestral Pueblo period when the economy was based on farming, and when higher elevation areas were commonly used for gathering plants, hunting animals, and collecting wood and stone materials. Just over 40% of the Ancestral Pueblo sites include features or structures. About half of these are rock overhangs used for shelter, which often contain wall alignments. Also included are 3 sites where structural room-blocks are present.

The historic site components are predominately Euro-American (including Hispanic) with a few identified as Navajo in origin .The Euro-American sites are related primarily to grazing, railroad logging and mining. They include large logging towns and numerous segments of logging railroad grades. Roughly a third of the Euro-American sites appear to be habitations sites (log cabins, milled lumber structures, sawmills, house foundations, dugouts). Another third of these sites consists of isolated livestock enclosures, which are most likely related to Hispanic sheep herding. The remaining third is comprised of various site types, primarily temporary camps, mining related sites, or trash areas.

The assignment of sites to Navajo origin was based foremost on the types of structures (hogans and sweathouses) and to a lesser degree on the types of artifacts present. A Navajo component is present at some of the railroad logging habitations and may represent the homes of Navajo railroad workers.

Site Significance

The significance of an individual site is evaluated under criteria established for eligibility to the National Register of Historic Places, including the condition of the site or its integrity. Most often the significant sites in the Bluewater Watershed area are eligible for their information potential, but a few are also eligible for their association with events that are important in our history or prehistory.

Fifteen sites in the Bluewater project area have been formally determined to be eligible to the National Register. These include 5 extensive historic sites (including the towns of Kettner, Copperton, and Sawyer) as well as 9 other historic habitation sites. One of the habitation sites also contains prehistoric tools that date to the Archaic period. Two prehistoric sites (an Ancestral Pueblo room-block, and a possible copper ore mining area with associated room-block of prehistoric or early historic Zuni origin) have also been made eligible to the National Register. The latter site, sometimes referred to as the Tchalchuitl or Chalchihuitl Mine, is listed on the New Mexico State Register of Cultural Properties. The ethnographic resource section further describes the significance of this site.

About 83% of the sites in the Bluewater Watershed area have either been determined eligible for listing on the National Register or no determination has been made. No determination on eligibility means that the significance of the site has not been formally evaluated. In that case, the site is protected from disturbance until the eligibility has been determined. However, it appears that most of these sites are livestock enclosures and a determination of 'not eligible' would probably be made once site data is recorded.

About 17% of the sites have been determined to be *not eligible* to the National Register. Most of these 'not eligible' sites are livestock enclosures. The information held by such sites is easily captured during survey recording, thus preserving on-the-ground features is not necessary once the data has been captured.

In sum, more than 500 of the recorded sites in the Bluewater Watershed area are eligible to the National Register or their eligibility is undetermined. These sites need to be protected at the present time until additional information can be obtained.

Site Condition

Because a large portion of the Bluewater Watershed area consists of forested land that was logged during the railroad-logging era, there are numerous historic sites that contain burnable features or structures. These sites include logging camps with log cabins and other wooden features and standing or partly standing railroad trestles. In cases where high fuel loading occurs near these burnable sites, there is a potential for the sites to be seriously damaged or destroyed by catastrophic wildfire. Other types of fire-sensitive archeological resources, that could be damaged by catastrophic wildfire or by post-fire processes such as erosion, are also present in the Bluewater Watershed area.

Additional information on site condition would need to be obtained prior to project implementation. Existing files indicate vandalism and illegal collection of artifacts has occurred. Further investigation of the narrative portions of the site records and the sites themselves needs to be done to accurately assess site condition.

The Zuni Mountain Historic Auto Tour provides the public with interpretation of the history of human use of the Bluewater Watershed area. Sites such as the logging town of Sawyer and the Diener mines are interpreted by means of a brochure and posted signs along Forest Roads 50, 480, and 178.

3.4.2 Contemporary American Indian Uses

Some information on traditional land use is available for the Acoma, Zuni, Laguna, and Navajo cultures. The following discussion incorporates information from published sources dealing with historical research, an unpublished map of Acoma and Laguna traditional land use boundaries provided by the Bureau of Land Management (USDA 2000), and general information obtained through tribal consultation (Benedict 1997 and 1999). A number of tribes have historically used, and continue to use areas within and adjacent to the analysis area for hunting, plant gathering, and other traditional activities.

Pueblo of Acoma

The eastern two-thirds of the analysis area is within the traditional use boundaries for the Acoma. Shrines may depict landmarks or boundaries (Holmes 1989). One of the historic travel-trade routes between Acoma and Zuni crossed Oso Ridge and is likely to occur within the analysis area. Blue Water Meadow is a traditional farming and grazing area for the Acoma. The location of this site is unknown but is probably along Bluewater Creek and so may be within or near the analysis area. The Acoma associate the Zuni Mountains as a whole with the western direction. The mountains are believed to be the home of the western rainmaker (Van Valkenburgh 1974, Ferguson and Hart 1985, Holmes 1989). The Pueblo of Acoma uses Cibola National Forest lands to obtain many types of products, including vigas, fuelwood, minerals, and bird feathers (Benedict 1997).

Pueblo of Laguna

At one time, the Zuni Mountains were the sacred mountain of the west for the Laguna. However, by the 1940s, they designated peaks closer to Laguna for their western boundary. The analysis area therefore appears to be outside the traditional use area for the Laguna. Nonetheless, the Laguna used many parts of the Zuni Mountains in the past for summer herding, as well as by the Acoma and Zuni (Van Valkenburgh 1974, Ferguson and Hart 1985, Holmes 1989). Herding activities are no longer a part of their existing use in this area.

Pueblo of Zuni

The Zuni Tribe uses Mt. Taylor to define the eastern extent of their traditional use area. The analysis area is within the traditional use area of the Zuni for a number of activities, specifically agriculture, grazing, hunting, plant and mineral collection, and religious use. The eastern end of the Zuni Mountains is a deer hunting area with shrines especially important for hunting societies. One specific traditional locale (Tchalchuitl mines or *Akwalina: Yala:we)* is within the analysis area. It is a place where blue paint, turquoise, and land snails for religious purposes are collected (Ferguson and Hart 1985). An archaeological site has been recorded at this locale and this property is listed on the State Register of Historic Places. As noted above, the Zuni-Acoma trail may have crossed over the Continental Divide and through the analysis area (USDA 2000).

Navajo Nation

The analysis area is within the traditional use area of the Navajo, though details on locales and types of uses are not very definitive. It is likely that sites related to grazing, hunting, collecting of wild plants and offering locations are located within the analysis area. The Ramah Navajo may at times use the analysis area for religious or traditional purposes (Van Valkenburgh 1974, Ferguson and Hart 1985, Holmes 1989).

Through consultation with the Eastern Navajo Joint Land Board and individual Chapters, several existing uses have been identified in the Zuni Mountains. The Rice Park area is used for medicinal plant gathering (USDA 2000). Chokecherry is gathered in areas east of the analysis area (Benedict 1999) as well as in the Oso Ridge area, which forms the southern boundary of the analysis area (USDA 2000).

Navajo people collect semi-precious stones such as jet and turquoise, as well as certain geologic formations including: gypsum, raw alum, and certain clays. Each resource is often gathered in specific places (Bryan and Shirley 1978), some of which may occur on Cibola National Forest lands within the analysis area.

Tribal Consultation

The Cibola National Forest routinely consults with five tribes and numerous Navajo Chapters that may have used or may continue to use the Zuni Mountains for traditional cultural or religious activities. These tribes and chapters were consulted regarding the Bluewater Ecosystem Management project. The proposed projects were first introduced to the tribes and chapters in the Forest's annual consultation letter dated March 2001. Follow-up meetings were held with the five tribes and the proposal was discussed in a general sense. The Navajo expressed an interest in the project and mentioned in general some place names within the analysis area. The tribes and chapters were consulted again in 2002 once a specific project proposal had been developed. The proposed project was again outlined in the Forest's annual consultation letter dated May 2002. Follow-up consultation meetings were held in the latter half of 2002 and early 2003.

The Navajo acknowledged that the possibility exists for there to be offering trees within the general area of the piñon-juniper control units, but did not raise objections to the project. They identified a significant mineral collection site in the Zuni Mountains, but it is located well outside the analysis area and would not be affected by the project. The Pueblo of Zuni identified a traditional cultural property within the project area. Mitigation measures were developed in consultation with the Pueblo to ensure that the site would not be impacted as a result of the projects. The Hopi stated that archaeological resources should be avoided during any new road construction. The tribe wishes to defer to Zuni Pueblo for consultation on this project. No comment was received from Acoma. The Pueblo of Laguna expressed their concern that Douglas-fir be retained. However, this project does not propose to remove Douglas-fir. The project record contains a complete calendar of tribal consultation.

3.4.3 Environmental Consequences to Archaeological Resources

No Action (Alternative B)

Direct and Indirect Effects

The analysis area for this alternative is the entire watershed within the Forest boundary. To date, about 24% of the watershed has been inventoried for archeological resources. This alternative would not involve project impacts, such as from thinning, burning or temporary road construction. However, the No Action Alternative possesses the greatest potential for impacts to archeological resources from catastrophic wildland fires. Under this alternative no management actions would be undertaken to significantly reduce the danger of wildfire. Significant archeological resources are known to exist within the Bluewater project area that is currently at risk to catastrophic wildfire. Therefore, direct impacts resulting from a wildfire and from emergency suppression activities, as well as indirect, post-fire impacts (such as erosion) are predicted to be greatest if this alternative is chosen. To the extent possible, such impacts would be mitigated but the opportunity to do so and the effectiveness of the measures would be less than in the action alternatives because of the nature of wildfire situations.

Road density would not be changed, since existing temporary roads would not be decommissioned and therefore would be higher than post-treatment for the action alternatives**.** A higher road density, i.e., greater vehicular access, may increase the likelihood of vandalism, which is an indirect effect to archeological sites.

Cumulative Effects

In regard to the risk of wildfire, the effect of no action would be cumulative since no steps to reduce the threat of wildfire would occur and there would be continual fire suppression activity in this area on public as well as private lands. If successful fire suppression does takes place in the future, fuel loadings would not be reduced through low intensity wildfires and the potential for a catastrophic fire would continue to increase over time.

Direct and Indirect Effects Common to Both Action Alternatives

Not all proposed activities of the Bluewater Project have the potential to affect heritage resources as defined in the Southwestern Region's supplement to the Forest Service Manual. For example, thinning small diameter trees (< 5 inches diameter at beast height) using chainsaws and lopping and scattering limbs and leaving them on the ground (no burning) are not considered to have the potential to adversely impact heritage resources.

On the other hand, the Bluewater Project involves a number of activities that do have the potential to disturb or damage archeological resources, such as pile and broadcast burning, commercial tree harvesting, public and commercial gathering of fuelwood, improvement of system roads, and construction and decommissioning of temporary roads. Potential impacts from these activities can be direct or indirect. Examples of direct impacts are: damaging a scatter of chipped stone artifacts while blading to construct a road, or destroying a cabin during prescribed burning. Indirect impacts include such things as providing public access into a previously inaccessible area (an action that might lead to increased site vandalism), and removing vegetative cover, which might increase erosion on a site

Impacts assessed under an effects analysis are considered to be either beneficial or adverse to archeological resources. Adverse means that the effect will diminish the significant characteristics of the resource. Mitigation measures can lower the intensity of an adverse effect determination in order to reach a no adverse determination. An example of a beneficial effect is a treatment that provides for a natural fire regime. Such a treatment reduces the threat of a high-intensity fire and the need for suppression activities, both of which can impact archeological resources.

Both of the action alternatives would have beneficial affects on archeological resources in that the proposed treatments in the long-term would reduce the risk of wildfire and its associated direct and indirect impacts. Also, some existing temporary roads would be decommissioned thereby reducing road density and vehicular access and, consequently, the likelihood of the indirect effect of site vandalism.

Both action alternatives would provide for public fuelwood gathering areas. These areas would be considered as part of the District-wide fuelwood program. According to Southwestern Region's Supplement to the Forest Service Manual 2361.24 (1)(c)(10) a District-wide fuelwood program does not have the potential to affect heritage resources and does not require archaeological clearance. Public fuelwood programs over an area as large as a Ranger District have a low risk of affecting individual sites due to the dispersed nature of the activity. In the event there is an area that has a high archaeological site density and has available fuelwood, we would restrict fuelwood gathering to commercial contracts in order to eliminate potential effects to those sites, or transport fuelwood to roadsides or landings for public removal.

Without a complete archeological inventory of the entire area of each alternative, a statistical analysis of the effects cannot be assessed. Until a full survey is completed, certain parameters cannot be disclosed, such as the total number of sites, the types of sites, or the National Register status of sites for each of the alternatives. Even though a percentage of the project area has been surveyed (Table 5), these acres cannot be used to represent a statistically valid sample in order to predict the total numbers of significant sites. Because of this lack of survey data, a *Programmatic Agreement among the Forest Service, New Mexico State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding Bluewater Ecosystem Management Project (July, 2003)* (hereafter referred to as the Programmatic Agreement) has been prepared that would require full survey of areas potentially affected by a project activity before that activity is implemented.

Table 5. ***Percent of project or analysis areas surveyed for archaeological resources***

Alternative	Total Acres in Project/Analysis Area	Acres Surveyed to Date	% of Area Surveyed
Alternative A	23,925	13,445	56.2
Alternative B	114,419	26,845	23.5
Alternative C	31,190	16,769	53.8

Section 106 of the National Historic Preservation Act directs a federal agency to consider the effects of its actions on properties included in, eligible for inclusion in, or potentially eligible for inclusion in the National Register of Historic Places. In addition, the Advisory Council on Historic Preservation must be provided a reasonable opportunity to comment on any proposal. These requirements will be met for the Bluewater Ecosystem Area via a Programmatic Agreement (PA) that has been developed with the New Mexico State Historic Preservation Officer. That agreement has been incorporated into the project record and is available upon request.

The Record of Decision for the Bluewater Ecosystem Area FEIS will be signed before completion of the archeological clearance. The PA specifies how sites will be identified, evaluated and protected within a phased approach. Archeological clearance would be obtained and consultation with the SHPO would be completed before implementation of project activities.

Through implementation of the Programmatic Agreement, all project activity areas that can impact heritage resources will be inventoried according to the Agreement for the alternative chosen, prior to project implementation. Mitigation measures would be used where necessary to avoid adverse effects to significant heritage resources. The Programmatic Agreement is located in the project record and available upon request. Mitigation measures would vary with the type of site and its relationship to project activities. Mitigation could range from site avoidance to site excavation. The costs of mitigation for either action alternative cannot be determined until surveys are complete.

Proposed Action (Alternative A)

Alternative A would treat a total of 23,925 acres, of which approximately 56% has been archeologically inventoried. On those treated acres, fuel loadings would be lowered and the risk of impacts to sites from wildfire would be reduced. Commercial sawlog removal would occur in the ponderosa pine area, and commercial and/or personal fuelwood sales would take place in the PJ WUI, the fuelbreak and the ponderosa pine areas. This alternative would treat the slash in all project areas with prescribed broadcast burning. Burning would involve the construction of an estimated 304 miles of handline to provide fuelbreaks. A total of 33 miles of temporary roads would be constructed (and subsequently obliterated) to implement this alternative. An estimated 16.5 miles of existing temporary roads would also be obliterated following treatment activities. Commercial timber sales, commercial/personal use fuelwood sales, burning, construction of handline, and construction/obliteration of roads can cause direct and indirect impacts to heritage resources. If equipment, like the hydrobrush mower, is used in the Upland Meadow areas, that activity would also cause a risk of impacts to heritage sites.

With implementation of the mitigation, monitoring, and other stipulations specified in the Programmatic Agreement, there would be no direct and indirect effects to archeological resources under Alternative A. The entire project area would be surveyed prior to implementation. For sites that are eligible or potentially eligible to the National Register, they would either be flagged and avoided during implementation or impacts mitigated by measures listed in the Programmatic Agreement, such as excavation or detailed recording of significant information prior to implementation. A percentage of known sites would be monitored during and after project activities to ensure compliance with these mitigation measures.

Preferred Alternative (Alternative C)

Roughly 54% of the project area for Alternative C has been surveyed for archaeological resources. Alternative C would treat 7,265 acres more than Alternative A, and so would lower the risk of wildfire to sites over a larger area. However, project activities would also occur over a larger area and thus the risk of direct impacts to known or undiscovered sites during implementation would be increased. In this alternative, there would be an additional 3,570 acres treated with prescribed burning. Three factors that lower the risk of impacts to archeological resources in Alternative C as compared to Alternative A are: 1) the total miles of handline needed is reduced (18 miles versus 304 miles); 2) Alternative C would include pile burning in some areas as opposed to broadcast burning; and 3) Alternative C would not use prescribed burning practices in the piñon-juniper control units nor in about two-thirds of the Upland Meadow areas. Without the use of prescribed fire in these areas, there would be less impacts to sites since the type of thinning activities proposed do not have the potential to affect heritage resources. The use of pile burning has less of an effect since it is easier to control than broadcast burning, thus there is less of a chance for escape. Alternative C does not differ from Alternative A in regard to miles of temporary road construction or obliteration.

The same stipulations identified in the Programmatic Agreement as described above under Alternative A would also be applied under this alternative. Thus, there would be no direct or indirect effects to archeological resources from implementing Alternative C.

Cumulative Effects

To date minor amounts of site vandalism have been reported in the watershed on both private and NFS land. The planned future improvement of Forest Road 50 may increase public access and use of the watershed area. The proposed reroute of Forest Road 483 would allow vehicle access to the Cottonwood Creek and Lookout Mountain areas; which are currently not accessible by vehicles because of private land gates. It is not known if site vandalism would increase or not with the completion of these road projects, however, increased visitor use is expected as road conditions are improved. The potential for this impact to occur would be the same under any of the alternatives, including the no action alternative.

Activities such as timber harvesting and reforestation have taken place in the past within the analysis area. Projects on National Forest land over the past 30 years have followed regulations and procedures in regard to protecting heritage resources and so have not affected heritage sites. One of the recent past actions on private land has been timber harvesting. Private land owners are not required to protect heritage sites in accordance with Federal policy, thus impacts to heritage sites on private land are not known.

Neither of the two action alternatives would have any direct or indirect effects on archeological resources. Thus, there would be no cumulative effect on these resources under either Alternative A or Alternative C.

3.4.4 Environmental Consequences to Contemporary American Indian Uses

No Action (Alternative B)

This alternative would not involve ground-disturbing project impacts that have the potential to affect traditional cultural properties. However, this alternative possesses the potential to impact the traditional cultural property identified by the Zuni Pueblo due to increased risk of wildfire. When trees that are growing within structural features of an archaeological site are destroyed by fire, the heat can destroy subsurface artifacts and/or alter their dating potential. If a tree stump and its root system within a feature are completely consumed, the void filled by slumping soil will disturb the feature. When architectural stone is exposed to the heat of fire, certain stones can suffer flaking, cracking, and increased friability. The two-track dirt road that currently bisects the site would remain open to the public, and would remain unmaintained.

Direct, Indirect and Cumulative Effects Common to Both Action Alternatives

Potential affects to the traditional cultural property would be less because the overall reduction in fuel loading in the vicinity would reduce the risk of wildfire. As a result, there would be a reduced risk of fire burning through the site and potentially consuming larger trees growing within the structural features or heating the architectural stone. A portion of a known traditional cultural property is within a timber stand proposed for cutting and entirely within the area proposed for burning. Mitigation measures to protect this site were developed in consultation with the Pueblo of Zuni and included in Appendix C. A buffer area of at least 100 ft around the site would be established where no cutting would occur. The Pueblo expressed no concern with the use of fire to treat fuels within and around the traditional cultural property. However, due to the potential of fire to affect subsurface archaeological components in the event of burning trees or stumps, no burning would occur within the structural features of the site. A black line would be established around all structural features and burning would occur outward from those lines.

The two-track road that bisects the site would not be improved nor would it be used for accessing adjacent timber stands. Instead, other nearby roads would be utilized to access the timber stands. By using these mitigation measures, there would be direct or indirect effect to the traditional cultural property.

Overall, within the project area opportunities for traditional tribal activities such as fuelwood gathering would improve as a result of both action alternatives. Hunting opportunities may also be enhanced due to the stimulation of forage as a result of the broadcast burning.

Because there would be no direct or indirect effect to the traditional cultural property or traditional uses, there would be no cumulative effects as a result of implementing either action alternative.

3.5 Hydrology and Soil Resources

3.5.1 Location

The Bluewater Ecosystem Management Project is located on National Forest System (NFS) land in the Bluewater Hydrologic Unit (HU) Number 1302020702 (also referred to as a 5th code administrative watershed) west of Grants, NM, in the Zuni Mountain Division of the Mt. Taylor Ranger District, Cibola National Forest. The entire watershed is approximately 147,100 acres (230 square miles) in size. Within the watershed, there are approximately 99,400 acres of NFS land and 15,000 acres of non-NFS (land having other ownership) inside of the Cibola National Forest administrative boundary and 32,700 acres of non-NFS land outside of the Forest administrative boundary. The Bluewater analysis area, which includes parts of the Aqua Fria, Mount Sedgwick/Bluewater, Cottonwood/Las Tusas, Dent/Can Valley, El Muerto, Prewitt/ Six A, Wells Spring and Salitre Mesa allotments, falls either partly or entirely within the Bluewater fifth code watershed.

The Bluewater HU consists of two sub-watersheds, the Bluewater Creek sub-watershed and the Cottonwood Creek sub-watershed, which both drain into Bluewater Lake. The lake is a man-made reservoir formed by a concrete arch dam. Measured at Bluewater dam, the Cottonwood Creek sub-watershed has a drainage area of approximately 79,000 acres (123 square miles) and the Bluewater Creek sub-watershed has a drainage area of approximately

54,300 acres (84 square miles). The water in Bluewater Lake is owned is by both the New Mexico State Game and Fish Department and the Bluewater-Toltec Irrigation Company.

Two streams are the primary water sources for Bluewater Lake: Bluewater Creek and Cottonwood Creek. The flow regime for both drainages includes both intermittent and perennial reaches, with Bluewater Creek having the most perennial water. The annual peak flow for both drainages generally occurs during the spring snowmelt runoff period in March and April. The portions of Bluewater and Cottonwood Creek drainages considered for this analysis include NFS lands within the Bluewater HU.

There are numerous beneficial uses for Bluewater and Cottonwood Creeks and Bluewater Lake (Table 6). Natural or human processes that alter water yield, water quality, or biotic components may affect beneficial uses. Management practices are selected to minimize disturbances to natural processes and restore ecosystem functions in degraded areas.

Table 6 – *Beneficial uses of the Bluewater Hydrologic Unit*

Beneficial Use	Bluewater Creek	Cottonwood Creek	Bluewater Lake
Agriculture Supply			X
Cold Freshwater Habitat	X	X	X
Sport Fishing	X		X
Freshwater Replenishment	X	X	
Groundwater Recharge	X	X	X
Water Contact Recreation			X
Non-Contact Recreation	X		X
Spawning	X	X	X
Wildlife Habitat	X	X	X
Endangered Species Habitat (Potential/Existing)	X		

3.5.2 Watershed Description

Vegetation

The watershed has four predominant vegetation types. Mixed conifer forest exists on steep slopes, generally at the highest elevations such as the northeast side of Oso Ridge and on Mt. Sedgwick. Ponderosa pine covers the majority of the watershed. Piñon-juniper woodland dominates hot, dry exposures on the lower portions of Tusas and Salitre Mesas and on south and west facing step rocky breaks. Rabbitbrush and a variety of grasses dominate the alluvial terraces and bottoms along major drainages. Rabbitbrush is commonly found on the drier elevated terraces that have undergone dewatering due to streambed down cutting and gully migration. The lower terraces generally have more available water and support most of the grass species. Larger meadows like Post Office Flat, Rice Park and similar areas in the ponderosa pine, have large grassy expanses.

Morphometry

The elevation range within the watershed is 6,650 feet to 9,240 feet above mean sea level. Ground slope ranges from 0 to 140 percent with an average of 12 percent. Approximately three-fourths of the watershed has a slope in the range of 0 to 15 percent, 23 percent of the watershed has a slope in the range of 15 to 40 percent, and 3 percent of the watershed has a slope over 40 percent. Approximately 63 percent of the watershed has a northerly or easterly aspect, 33 percent of the watershed has a southerly or westerly aspect, and the remaining 4 percent of the watershed consists of flat terrain.

Meteorology

Mean annual precipitation ranges from approximately 12 inches at the lowest elevation to 23 inches at the higher elevations. The average mean annual precipitation for the watershed is approximately 18 inches. Mean annual temperature ranges from approximately 50 degrees F at the lowest elevation to 40 degrees F at the highest elevation. The average mean annual temperature for the watershed is approximately 44 degrees F. These ranges are based on linear estimation relationships between elevation and precipitation/temperature measurements recorded at 8 Western Regional Climate Center weather stations, located in the vicinity of the Zuni Mountains, during the 30-year period from1961 to 1990.

The majority of the precipitation in the project area occurs between the months of July and October, which coincide with the summer "monsoon" season in the Southwest U.S. This season is characterized by short-duration, high-intensity thunderstorms. During the months of November thru February, precipitation generally occurs as snowfall above 6,000 ft. As elevation increases, snowfall becomes a greater percentage of the total annual precipitation and snowmelt becomes a more significant component in surface runoff quantity and timing.

Potential evapotranspiration (PET) was also calculated for the 8 stations using both the Thornthwaite and Penman methods. A detailed discussion on how this methodology was used can be found in the Hydrology Report that is located in the project record and available upon request. Mean annual Thornthwaite PET ranges from approximately 22 inches at the lowest elevation to 16 inches at the highest elevation with an average of 19 inches. Mean annual Penman PET ranges from approximately 33 inches at the lowest elevation to 20 inches at the highest elevation, with an average of 26 inches.

Geology

The major geologic types exposed at the surface on NFS land within the watershed are undifferentiated Precambrian rocks, carbonate rocks, clastic sedimentary rocks, undifferentiated volcanic rocks, and unconsolidated alluvium.

The primary geologic formations (from youngest to oldest) within the watershed are identified in Table 7. below.

Table 7 – ***Geologic formations found within the Bluewater Watershed***

Geologic Unit	Description	Age
Qal – Alluvium	Surficial deposits, eolian deposits	Quaternary
Qb – Basalt	Undifferentiated flows, ash, cinder cones	Quaternary
TRc – Wingate Sandstone and Chinle Foramtion	Undifferentiated, fluvial siltstone, mudstone, sandstone, and bedded channel sandstones with some limestone in the upper part of the Chinle Formation	Triassic
Psa – San Andres Limestone	Marine fossiliferous limestone with some interbedded sandstone	Permian
Pg – Glorieta Sandstone	Massive-bedded, fine- to medium-grained, well-cemented intertidal sandstone	Permian
Py – Yeso Formation	Gypsiferous shale, siltstone, silty sandstone, with some thin-bedded limestone	Permian
Pa – Abo Formation	Reddish-brown sandstone and siltstone with some conglomerate in the lower part	Permian
PC – Precambrian rocks	Undifferentiated, composed of granite, gneiss, metarhyolite, schist, and quartzite	Precambrian

Soils

The major soil types within the national forest portion of the watershed are Alfisols, Mollisols, Entisols, Inceptisols, and Vertisols. The Hydrology Report in the project record provides a detailed description of each soil type. A summary of that information is provided below.

Alfisols are highly productive forest soils. These soils are present on older landscapes wherever ample supplies of primary minerals, layer lattice clays, and available plant nutrients are abundant in parent materials. Areas of transition between Alfisols and Mollisols are in ecotones between forest and grassland. Natural drainage conditions range from excessive on narrow hill crests and steep slopes to poorly drained on foot slopes and level plains.

Mollisols are soils with deep, dark, relatively fertile topsoil (mollic epipedon). These soils have been only slightly leached and the base status remains high. Nearly all are formed under grassland vegetation. These soils are typical of the Great Plains and mountain valleys.

Entisols are soils that have little or no evidence of horizon development. These are simple soils with a weakly developed A horizon and are typically featureless. Of first importance are the factors limiting soil horizon development in wetlands, alluvial lands, sandy lands, higher-lying rocky lands, and various unconsolidated deposits such as wind blown silt and mudflows.

Inceptisols are immature mineral soils having profile features more weakly expressed than mature soils and retaining close resemblances to the parent material, although they exhibit enough profile development to exclude them from Entisols (i.e. they typically have a recognizable A horizon, but only a weak B horizon). Features of settings where these soils occur include: 1) highly resistant parent material; 2) extreme landscape positions, i.e., steep lands and depressions; and 3) geomorphic surfaces so young as to limit soil development.

Vertisol are characterized by a seasonal drying of the soil profile. The typical situation for vertisols involves an annual wet-dry, monsoon type climate. These soils are formed by frequent churning caused by shrinking and swelling of the soil clays during seasonal changes in soil moisture. Vertisols are usually over 20 inches deep, having at least 30 percent or more clay material in all horizons down to a depth of 40 inches in some cases.

3.5.3 Watershed Condition

Historical Background

In a 1940 report, "Zuni Mountain Unit McKinley and Valencia Counties New Mexico," a description of the state of the Zuni Mountains in is outlined. It provides an important historic perspective relating to conditions in the Zuni Mountains today, including the Bluewater Watershed. This report is located in the project record and available upon request. The report describes landscape conditions during the turn of the century railroad logging days, and how once the trees had been removed, ranchers used the area to graze livestock. Each use had an affect on the landscape, and this report provides a description of what those affects were. This description helps to set in context the conditions found today within this watershed.

Water Quality

The following discussion involving water quality is based on information contained in the New Mexico State 305(b) Report for the year 2000.

Bluewater Creek

Bluewater Creek from USFS boundary to private inholdings (approx. 6.2 miles) was determined to be fully supporting designated uses (coldwater fishery) with impacts observed. Specific pollutants/threats are listed as stream bottom deposits. The probable sources are identified as livestock use, removal of riparian vegetation, recreational activities, and streambank modification/destabilization.

Bluewater Creek, portions on State Lands above Bluewater Reservoir and from private inholdings to the headwaters (approx. 10.2 mi) was determined to be not supporting designated uses (coldwater fisheries). Specific pollutants/threats include: metals, temperature, turbidity, and stream bottom deposits. The probable sources are identified as livestock use, silviculture practices (harvesting, residue management), road construction/maintenance, removal of riparian vegetation, and streambank modification/destabilization.

In the State of New Mexico Standards for Interstate and Intrastate Surface Waters, 20.6.4 NMAC (New Mexico Administrative Code, effective October 12, 2000, as amended through December 16, 2001), the designated uses for the perennial reaches of Bluewater Creek are identified as coldwater fishery, domestic water supply, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact. The water quality standards to meet the designated uses are:

1. In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20 degrees C (68 degrees F), total phosphorous (as P) shall not exceed 0.1 mg/L, and turbidity shall not exceed 25 NTU.

2. The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL.

Bluewater Lake

Bluewater Lake is monitored and determined to be fully supporting designated uses (high quality coldwater fishery) with impacts observed. Specific pollutants/threats identified as causing impacts are metals, turbidity, nutrients, temperature, conductivity, and siltation. The probable sources are identified as agriculture (rangeland use), silviculture activities, recreation activities and off-road vehicle use, road maintenance/runoff, removal of riparian vegetation, and streambank modification/destabilization.

Cottonwood Creek

To date Cottonwood Creek has not been assessed and designated uses have not been identified by the State.

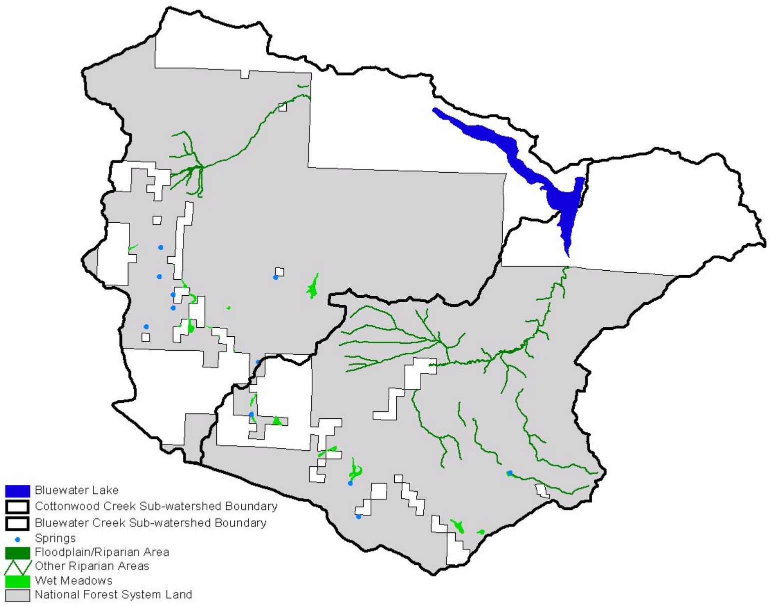
Water Quantity

The two major drainages within the Bluewater Watershed are Bluewater Creek and Cottonwood Creek. The Hydrology Report provides information regarding the discharge amounts for both drainages over the past 10 years.

Wetlands/Riparian Areas

The most significant riparian areas within the NFS portion of the Bluewater Watershed occur along the lower 3 to 4 miles of Bluewater and Cottonwood Creeks (i.e., the reaches upstream from the forest administrative boundary). Other isolated riparian areas exist along the tributaries to these drainages. Most of the wet meadows in the watershed occur in drainage bottoms adjacent to stream courses. There is an estimated 400 acres of riparian/wetland areas within this project area. There are also 11 known springs within the project area. Figure 6 shows the most important areas within the Bluewater HU.

Figure 6 – ***Riparian areas and wet meadow locations in the Bluewater Watershed***



The Forest Plan management goal for riparian area condition is that riparian areas in moderately high and high condition will be maintained or improved. Areas in low and moderately low condition will be treated. The anticipated results would be conditions similar to those set in the Southwestern Regional Guide regarding riparian areas. The applicable standards and guidelines for the project area, taken from the Forest Plan are listed in Appendix C. Additionally, the Forest Plan states that preferential consideration shall be given to resources dependent on riparian areas over other resources when there are unresolved conflicts among uses.

Riparian Areas that are in proper functioning condition would also meet the standards for riparian areas identified in the Forest Plan. In October 2001, a Proper Functioning Condition Analysis was conducted by the Cibola National Forest and Rocky Mountain Southwestern Research Station for a two-mile reach of Bluewater Creek. The results of the assessment indicated that the condition of the reach was Functional – at risk with an upward trend. Although this is the only stream reach that has been assessed, the results are more likely than not typical of other riparian areas within the watershed.

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Stream Health

Stream health is based on a stream's own capability defined in terms of diversity, stability, and productivity. Categories of stream health are defined in T-Walk Assessment protocols, which are available in the Hydrology Report. T-Walk assessments have not been completed for any stream within the watershed. However, personal observations indicate that the major streams (i.e. Bluewater and Cottonwood Creeks) and most of their tributaries where perennial water exists are most likely in diminished to impaired condition, if not worse. Few, if any of the streams within the watershed are in adequate or robust health.

Soil Quality and Condition

Soil quality is the capacity of the soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal health. Soil condition is assigned to one of three categories:

1) *Satisfactory* – Indicators signify that soil function is being sustained and soil is functioning properly and normally. The ability of soil to maintain resource values and sustain outputs is high.
2) *Impaired* – Indicators signify a reduction of soil function. The ability of soil to function properly has been reduced and/or there exists an increased vulnerability to degradation.
3) *Unsatisfactory* – Indicators signify that loss of soil function has occurred. Degradation of vital soil functions result in the inability of soil to maintain resource values, sustain outputs, and recover from impacts

Soil condition is an evaluation of soil quality based on an interpretation of factors that affect three primary soil functions: soil hydrology, soil stability, and nutrient cycling. A soil condition evaluation has not been done for the watershed.

Natural Erosion Potential

Costick (1966) described a model for evaluating the current condition of watersheds that produces a natural erosion potential index (NEPI) that is indicator of the current cumulative condition in watersheds. It is based on the premise that if a "healthy watershed is determined by the degree to which physical process and biological responses are at equilibrium, then excessive erosion suggests system instability and declining health." The model assumes that the risk of erosion is primarily a function of steep slopes, high soil detachability, and bare unprotected ground. The risk thresholds are defined as slopes in excess of 40% (calculated from USGS 30 meter Digital Elevation Models - DEM), soils detachability rating (RUSLE K-Factor) higher than 0.28 (obtained from Region 3 Terrestrial Ecosystem Survey for the Cibola National Forest), and areas with more than 40% bare soil or no surface cover (for this analysis, the cover factor was modified to include only those areas where vegetation cover is estimated to be less than 40 percent as determined by calculating the Normalized Difference Vegetation Index – NDVI - using Landsat imagery from September, 2000).

Costick (1966) based these threshold values on soil literature, from current U.S. Forest limits for tractor and cable yarding, and from California and Washington State Forest Practice rules. Given normal precipitation conditions for the Zuni Mountains, it is assumed that each parameter or risk factor has about the same probability of influencing erosion.

A parameter value may be 0 (none of three factors – slope, cover, K-Factor – exceed threshold values particular piece of ground), 1 (one factor applies), 2 (two factors apply), or 3 (all three factors apply). The methodology implies a current condition ranking on a "most-healthy to least-healthy" scale as determined by the percent of the watershed that exceeds each threshold value of one or above or combination of thresholds.

Table 8 shows the seven possible combinations of parameters, their corresponding values, and the number of acres of NFS land within the Bluewater HU (Watershed) for each combination of parameters.

Table 8 – *Possible Combinations of Parameters Over Threshold*

Parameter	Slope > 40%	K-Factor > 0.28	Cover < 40%	Slope + K-Factor	Cover + K-Factor	Slope + Cover	Slope + K-Factor + Cover
Parameter Value	1	1	1	2	2	2	3
NFS Acres In Watershed (% of WS)	3,556 (4)	18,972 (19)	22,918 (23)	521 (< 1)	5,463 (5)	865 (< 1)	23 (< 1)

The risk that soil eroded from a site would be transported to a watercourse and enter the drainage as non-point source (NPS) pollution (i.e., sedimentation) to is more likely to be higher in areas that are in close proximity to a watercourse and where vegetation is insufficient to trap and stabilize incoming sediments. In areas where multiple thresholds are exceeded, the potential for increased sedimentation to watercourses rises proportionately. Table 9 indicates that the Cover and K-Factor threshold values are each individually exceeded on about 20 percent of NFS land in the watershed and occur in combination on about 5 percent of the watershed.

Runoff from roads in these areas that have one or more parameters exceeding threshold values results in accelerated (i.e., above natural rates) sedimentation to the drainages. Future management activities that alter watershed characteristics (i.e., reduction in vegetation cover or change in K-Factor due to alteration of soil properties, such as structure due to compaction or reduction in surface organic matter content), especially in areas near drainages, may result in one or more parameter(s) crossing a threshold value thereby increasing the potential risk for accelerated runoff, soil erosion, and sedimentation to drainages – i.e., degraded watershed condition. The cumulative effects may or not be significant in terms of overall watershed condition and would need to be evaluated against the desired/expected results of the activities.

Natural Erosion Potential Index (NEPI)

Using Costick's model, the natural erosion potential index (NEPI) is an index of stability or resilience, predicting a watershed's ability to withstand erosion-causing events. When an area of ground (a 30 meter by 30 meter DEM or Landsat cell) exceeds a threshold value for any of the parameters (i.e., K-Factor > 0.28, slope > 40%, vegetation cover < 40%) the cell value is assigned a value of 1; conversely, if the parameter being assessed is less than the threshold, the cell value is assigned a value of 0. When two thresholds are exceeded for the same cell, the cell's value is 2 and when all three thresholds are exceeded in the same cell, the value of that cell is 3. Values are not duplicated when thresholds are combined.

The worst-case watershed is one where every cell has a value of three. To calculate the maximum potential NEPI, the total number of acres (each cell is equal to 0.22 acre) in a watershed is multiplied by three. The existing watershed value is generated by summing the total number of acres over threshold values (Figure 4). The total number of acres exceeding thresholds, divided by the maximum potential for the watershed (total acres multiplied by three), times 100, becomes the relative watershed score or % NEPI. Table 9 shows the calculated NEPI for existing conditions within the Bluewater Watershed (HU).

Table 9. ***Calculation of Existing NEPI for the Bluewater Watershed***

Parameter	NFS Acres Over Threshold
Cover < 40%	22,918
K-Factor > 0.28	18,972
Slope > 40%	3,556
Cover < 40% + K-Factor > 0.28	5,463
K-Factor > 0.28 + Slope > 40%	521
Cover < 40% + Slope > 40%	865
Cover < 40% + Slope > 40% + K-Factor > 0.28	23
Total acres over threshold	**52,318**

Maximum potential NEPI for Bluewater HU: (99,332 NFS acres in HU)(3) = 297,996
Existing NEPI for Bluewater HU: 52,318 / 297,996 = 0.1756 = 17.6%

The 17.6% value for the NEPI reflects the cumulative effects of past activities in the Bluewater HU. The same procedure can be used to derive the index at a future time and, when compared with the previous value, determine the change in overall watershed condition occurring over time An increase in the value would be indicative of a reduction in watershed condition an decrease in the value would indicate improvement in watershed condition. Parameters used in the to determine NEPI that may be altered as a result of natural occurrences (e.g., catastrophic wildfire) or management activities (timber harvesting) are cover and soil K-factor (slope is a constant). By estimating changes in these parameters resulting from natural or human-caused disturbances and applying the model, potential cumulative effects on watershed condition can be evaluated.

Past Watershed Assessments

In 1985 and 1986 a hydrologic function analysis was completed for the Bluewater Creek sub-watershed portion of the Bluewater HU (an analysis was not done for Cottonwood Creek sub-watershed). The analysis results indicated that while the uplands in the watershed generally exhibited satisfactory hydrologic function, localized problems still existed relating mainly to channels, gullies, roads, and riparian areas.

Assessment of Existing Hydrologic Function and Soil Quality

Watershed Condition is defined as the state of a watershed based upon physical and biological characteristics and processes affecting hydrologic and soil functions.

The watershed condition concept is based on the Organic Administration Act of 1897, the Weeks Law of 1911, the Multiple Use-Sustained Yield Act of 1960, and the National Forest Management Act of 1976. These laws contain the basic authority of watershed management on the national forests. They require the national forests to maintain favorable hydrologic function and preserve soil productivity. They define the basic land stewardship mission of the forest service. Watershed condition is assigned to one of three classes (FSM 2521.1, effective 05/25/2000):

1. *Class I Condition*: Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. The drainage network is generally stable. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are predominantly functional in terms of supporting beneficial uses.

2. *Class II Condition*: Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses.

3. *Class III Condition*: Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. A majority of the drainage network may be unstable. Physical, chemical, and biologic conditions suggest that soil, riparian, and aquatic systems do not support beneficial uses.

A general assessment of the Bluewater Watershed indicates that it is in Condition Class II. Aquatic and riparian ecosystems are impaired throughout the watershed and are either at risk in being able to support beneficial uses or do not fully support beneficial uses. Riparian areas, especially along the major drainages are categorized as “functional – at risk” and “nonfunctional". Aquatic habitat (stream health) is generally rated as "diminished to impaired" due to lack of riparian vegetation leading to elevated water temperatures, unstable channels, water turbidity, and deposition of fine sediments in stream bottoms. Soil condition varies from unsatisfactory to satisfactory throughout the watershed. The most significant degradation of soil function has occurred in valley/drainage bottoms where gully erosion and lowering of local water tables has resulted in the inability of soil to maintain resource values, sustain outputs, and recover from impacts. Magnitude and frequency of peak flows from storm events have undoubtedly increased as a result of these changes and streams that were once were able to maintain perennial flow (including Bluewater and Cottonwood Creeks) now flow only intermittently, or have perennial interrupted (perennial reaches separated by intermittent reaches) flow regimes.

Past activities occurring within the watershed are generally responsible for the deteriorated conditions. Changes in the types and intensity of management activities over the last 50 or so years have resulted in improved conditions throughout the watershed. Although recovery has and continues to occur, the soil, aquatic, and riparian systems are still at risk.

3.5.4 Environmental Consequences

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

Continuation of the current management of the Bluewater watershed would result in the steady increase in coniferous species throughout the watershed. Herbaceous vigor would continue to degrade due to the high percentage of canopy closure and meadows would continue to be invaded by ponderosa pine, piñon pine, and juniper species.

Ground cover would remain high in the forested areas due to a continued increase in litter deposition, as opposed to the desired herbaceous understory. Canopy cover and stand densities would remain high in the watershed, with most of the kinetic energy of rainfall intercepted, reducing short-term accelerated soil loss. The thick vegetation that currently exists intercepts virtually all of the kinetic energy of rainfall, which remains the critical and dominant role of vegetation in reducing soil erosion.

The risk of catastrophic forest fires remains the greatest threat under this action. Increases in fuel loads would continue to increase this risk. Catastrophic fires would result in the elimination of forest canopy and forest floor duff resulting in increased soil losses. Under the intensive heat of a catastrophic forest fire, soil glazing (crusting) causes decreased infiltration of precipitation and increased runoff.

Cumulatively, thinning activities on private land would not reduce the threat of catastrophic wildfire and the associated effects on water quality on NFS land, since most of the land (87%) within the watershed is under the jurisdiction of the Forest Service.

Proposed Action (Alternative A)

<u>Direct and Indirect Effects</u>

Thinning treatments are not expected to have any long-term adverse affects on soil loss or cause increases in soil loss in the fifth code watershed analyzed, provided herbaceous growth is established before prescribed burning is implemented. The burns are to be staggered, as proposed in this action, so cover would have the opportunity to be reestablished. Short-term increases in erosion may result but should recover within 2 to 5 years. A 50 foot buffer would be required around all springs and riparian areas located within the ponderosa pine treatment areas. Predicted rates of improved watershed and riparian condition would be slower under this alternative than compared to Alternative C.

Broadcast burning is anticipated over 23,925 acres of the treatment area or 21 percent of the watershed, under low intensity burn conditions. There are 475 acres of the treatment area designated as fuelbreak, and 885 acres as wildland urban interface, with heavy fuels reduction occurring in these areas. Approximately 304 miles of control lines are to be built within the project area. The construction of hand lines has the propensity for accelerated erosion by the removal of topsoil and herbaceous ground cover. There would likely be an increase in the local drainage systems and the loss of soil production in the areas disturbed by handlines. Best Management Practices (BMPs) would be used to lessen impacts to soil and water resources from prescribed burns. These measures are found in Appendix C.

Mitigation measures and BMPs prescribed for thinning treatments would reduce the detrimental effects of compaction or soil displacement within the watershed. Appendix C lists those thinning mitigation measures prescribed under this analysis. With the proposed thinning treatments, precipitation in all forms would have greater opportunity to infiltrate and replenish the groundwater table, thus increasing residence time of water in the watershed and increasing base flow water yields (to a lesser extent). A total of 19,460 acres would be patch cut through personal use and commercial fuelwood harvesting. Basal area on 23,925 acres would be reduced to 30 to 70 square feet per acre across most of the treatment area. A higher basal area of 70 to 110 square feet per acre is prescribed to meet goshawk habitat standards on 1,960 acres. Approximately 21 percent of the watershed would be pre-commercially thinned, creating more openings and opportunities for herbaceous vegetation to reestablish, thus greatly reducing the risk of catastrophic fire.

Indirect effects resulting from thinning would likely be an increase in the amount of surface water runoff. With less large vegetation left to intercept and use available moisture, more storm water recharge would occur during storm events. Short-term effects include greater surface water runoff, including sediment production, into the analysis area streams systems until herbaceous vegetation is established. Timing of vegetation treatments would be staggered as to reduce the possibility of accelerated erosion and has been considered in the proposed action.

In portions of the project areas that have limited herbaceous understory, after a prescribed burn has been implemented, little protective ground cover would remain. This creates portions of the watershed that lack the hydraulic roughness (grass and herbaceous vegetation) necessary to slow runoff process, allow infiltration, and reduce overland flow. Needle cast following the burn would help to reduce the potential for soil erosion by creating hydraulic roughness across the surface. The timing and use of moderate burn intensity would also help to mitigate effects.

Sufficient topsoil is critical in holding water and air in the soil pores, and these together with nutrients provide a medium for plants and soil fauna that are able to store, decompose, and return organic matter into the soil profile. The organic matter is also capable of holding nutrients in a form that makes them available for plant growth. Without a sufficient organic layer, re-growth of the desired herbaceous understory would be difficult.

Upland meadow treatments consist of removing conifer trees on approximately 1,900 acres. There are an estimated 400 acres of riparian/wetlands areas within the project area that would not be treated. In addition, springs within the ponderosa pine type would have a 50-foot no treatment buffer. This would allow more effective ground cover to grow in the riparian areas. Small increases in the alluvial water table are expected as conifer water utilization is decreased within treatment areas. Browse and grass conditions, including vigor, would improve due to the open canopy resulting from the use of prescribed fire and thinning treatments.

The transportation system described in this action includes the construction of 33 miles of temporary roads. This includes 32 miles of temporary roads in the ponderosa pine restoration treatment areas, one mile of temporary roads in the upland meadows and ½ mile in the WUI areas. Temporary roads built in areas of slope greater then 40% and on soils with a K value greater then 0.28 have the possibility of accelerated erosion. All roads would be obliterated after treatments are completed which would allow for rehabilitation of disturbed areas, and lessen further degradation by motorized vehicles on sensitive soils. The Hydrology/Soils Report, which is located in the project record and available upon request, has a summary of temporary roads to be built in sensitive areas. The construction of any road in these areas has the potential of increased runoff and accelerated erosion. The use of BMPs during construction and obliteration of these roads is critical for reducing the detrimental effects of road construction and obliteration.

The proposed action has a high likelihood of reducing catastrophic fire. It also has a high probability of temporarily increasing soil erosion from the construction of the temporary road system and hand lines planned for the vegetation treatment. The increase in soil erosion is believed to be short-term, 2 to 5 years, until vegetation is reestablished on the disturbed surfaces.

Preferred Alternative (Alternative C)

Direct and Indirect Effects

Soil losses due to thinning and prescribed burning activities in this alternative are expected to be similar to the proposed action, with no long-term adverse effects on soil losses provided treatments are staggered. The Preferred Alternative calls for an increase in the amount of treated area (27%) over the Proposed Action (21%). Short-term increases in erosion may result but should be recovered within 2 to 5 years. Mitigation measures and BMPs (as listed in Appendix C) would reduce the potential for effects to water quality and soil erosion.

Fuelbreaks are planned on 475 acres and WUIs on 885 acres, or approximately 1 percent of the analysis area. Heaviest fuel reduction would occur in these areas, with no change in the risk of catastrophic fire as described under the proposed action.

The transportation plan is the same as the Proposed Action, with the construction of approximately 33 miles of temporary roads.

The Preferred Alternative has the highest probability of reducing catastrophic fire. Low intensity, broadcast burns are anticipated over 13,825-acres or 12 percent of the watershed and pile burning over approximately 4,725 acres (4% of the watershed). The use of pile burns instead of broadcast burns would reduce the potential for erosion and decrease the risk of sedimentation moving into the drainage systems.

This alternative also has the lowest estimated amount of increased erosion from hand line construction. Approximately 18 miles of control lines are to be built; which is a significant reduction from the amount of handline proposed in Alternative A. The construction of handlines has the potential for accelerated erosion by the removal of topsoil and herbaceous ground cover. However, due to the reduced amount proposed for construction, the effects would be significantly less than those anticipated under the proposed action.

The increase in soil erosion from temporary road construction is expected to be temporary until vegetation is reestablished, within 2 to 5 years, on the disturbed surface.

Cumulative Effects

Cumulative effects are often assessed by watershed, or, as a portion of a specific watershed. This type of assessment addresses the incremental impacts of an action when added to other past, present, and foreseeable future actions, regardless of what entity is or has undertaken the action(s). A watershed cumulative impact can be defined as the total impact, positive or negative, on runoff, erosion, water yield, floods, and/or water quality that result from the incremental impact of a proposed action, when added to other past, present and reasonably foreseeable future actions occurring within the same natural drainage basin (watershed) (1978 CEQ definition of cumulative impacts).

Past Activities

Bluewater watershed has had many treatments in the last 25 years both by man and by nature. These activities and the resultant conditions are the context within which the analysis of cumulative effects is made.

During the past 50 years, only small, less then 2 acres, wildfires have burned in the Bluewater watershed. The areas of the older fires have been partially planted and natural regeneration has helped these fires recover over the last 25 years. Most of the fire areas are in need of pre-commercial thinning to reduce tree density, increase species diversity and provide wildlife and cattle forage.

Incorporation of soil and water conservation Best Management Practices (BMPs) have been required on all timber sale and other activities since 1991 as a result of a memorandum of understanding (MOU) between the Forest Service and the State of New Mexico. The MOU outlines the Forest Service's responsibilities to implement the Clean Water Act, which is accomplished through implementation and monitoring of BMPs as part of timber sale and other contract administration. The use of BMPs would help to reduce effects from future thinning and prescribed burning activities and maintain levels well below the established watershed threshold. The Hydrology/Soils Report provides a complete list of past timber sale activities over the past 37 years.

Livestock grazing in the analysis area has occurred over the past 100 plus years. In the past, overgrazing has resulted in reduction of watershed qualities. This is because of an increase in soil compaction and the reduction of herbaceous ground cover. Currently, there are eight grazing allotments within the treatment area of which, seven are actively managed under current ten-year term grazing permits. Watershed and riparian conditions are improving as a result of decreased livestock use. Upland watershed conditions are projected to continue improving.

The proposed treatments would have a positive effect on increasing the vigor of shrubs and other browse species by reducing canopy cover and increasing sunlight. The scheduled timing of treatment activities would provide for forage recovery before livestock are returned to an allotment.

Numerous public and private roads are found in the watershed. Studies have shown that roads can have the following effects within a watershed: alteration of stream flow quality, timing of peak flows, confine channels, encroachment on flood plains, and reduced diversity of aquatic habitats (Copestead 1997; and Johnson 1995). Haines (1993) further notes that roads cause an increase in water yield, increased runoff rates, a decrease in delivery time due to skid trails and roads directing flow into drainages or intercepting subsurface flow and delivering it to the channel, which results in increased sediment delivery, decreased water quality due to reduced ground cover and higher overland flow rates. Some roads are located in drainage bottoms, creating sediment problems for streams. Road compaction can lead to rapid run-off. Cumulative effects of roads have been evaluated as part of this environmental analysis process. Currently, there are 337 miles of Forest Service roads and 39 miles of private roads within the Bluewater watershed. A future Roads Analysis Process would assess which of the public roads could be obliterated and which ones should be kept open for public use.

3.6 Noxious Weeds

3.6.1 Known Weed Locations

Three species of noxious weeds are known to occur in the project area. A single infestation of Russian knapweed is found on Forest Road 178 just as it enters the NFS boundary, south of Bluewater village. Knapweed is usually spread when seed-bearing soil or plant parts are carried to new areas on vehicles, equipment, livestock, or wildlife.

Bull thistle is found along the lower stretch of Bluewater Creek from Section 1, Township (T) 11 N., Range (R) 13 W. to the NFS Boundary. This infestation is heaviest in Sections 20, 29, and 31 of Township (T) 12 N., Range (R) 12 W. A second infestation of bull thistle occurs along FR 480 between FR 50 and Post Office Flat. Musk thistle also occurs along Bluewater Creek in Section 29 of T. 12 N., R. 12 W., and Section 36 of T. 12 N., R13 W. This thistle is also found along tributaries to Bluewater Creek in Sections 33 and 34 of T. 12 N., R. 13 W., on private lands along Cottonwood Creek in Sections 8, 17, and 20, T. 12 N., R. 14 W., and as isolated patches in Section 7 of T. 11 N., R. 12 W., Section 33 of T. 12 N., R 12 W., and Section 31, T. 12 N., R. 14 W. Both bull and musk thistles produce abundant light seed that is carried on the wind. There are about 11 acres of bull thistle and 12 acres of musk thistle current infestation in the project area.

Other species of noxious weeds are known to occur along roadsides, in storage yards, and in areas of the Cibola and McKinley counties. Those of particular concern are camelthorn, Canada thistle, and spotted knapweed.

3.6.2 Environmental Consequences

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

Any activity that exposes mineral soil would leave a site vulnerable to noxious weed infestation. Since no soil disturbance would occur the No Action alternative would not increase the possibility of noxious weeds becoming established in the project area. Thus, there would be no direct, indirect, or cumulative effects on the spread of noxious weeds under this alternative.

Effects Common to Both Action Alternatives

Timber stands totaling over 15,000 acres are expected to experience some degree of mechanical soil disturbance under both action alternatives. Weed seeds brought into these areas, on commercial and recreational vehicles or carried by the wind, would have a good chance of establishing themselves in these scarified areas.

Entry into the project area by the public to collect fuelwood would increase the potential for weed seeds to be brought in on vehicles or equipment. Both action alternatives provide for the same amount of fuelwood to be removed, so there is no difference between alternatives. Public fuelwood collection sites would be monitored to determine if weeds were becoming established and measures taken to reduce spread.

Proposed Action (Alternative A)

Direct and Indirect Effects

In addition to mechanical scarification, Alternative A includes the use of broadcast burning across all treatment types to dispose of slash. Where these materials are heavy enough to burn to mineral soil, conditions could be created that promote the establishment of noxious weed infestations. The use of mitigation measures would be to reduce the potential for high intensity prescribed burns.

Preferred Alternative (Alternative C)

Direct and Indirect Effects

Under Alternative C, heavy slash in piñon-juniper areas would be piled and the majority of piles burned. Patches of mineral soil and ash would result from this activity, which can be prime sites for noxious weed invasion. Adherence to the noxious weed prevention guidelines contained in timber harvest contracts would greatly reduce the possibility of introduction of noxious weed seeds into the Forest by contractors. Monitoring by trained personnel would be required in order to spot infestations early when they are small and more easily controlled.

An estimated 4,725 acres of ponderosa pine slash would be pile burned under Alternative C. Pile burns leave a patch of exposed mineral soil mixed with ash and charcoal, sites extremely favorable to the introduction of invasive plants. As noted previously, seed sources for both musk and bull thistles and Russian knapweed occur within the project area. Infestations of other weeds of concern are found on rights-of-ways and vacant areas on adjacent non-Forest Service lands. Even with the precautions stipulated under contract provisions, mineral-soil patches scattered across 3,400 acres of project lands represent a significant risk for the introduction and spread of noxious weeds.

Mitigation measures outlined in Appendix C call for seeding of vulnerable areas to more rapidly establish a protective perennial cover. This precaution would reduce, although not eliminate, the probability of new noxious weed infestations appearing as a result of project activities.

3.7 Range Resources

3.7.1 Rangeland Management

The analysis area includes lands within eight grazing allotments. However, project activities (either cutting or prescribed fire) would cover only four allotments: the Agua Fría, Bluewater/Mount Sedgwick, Cottonwood/Las Tusas, and Salitre Mesa. The first three are currently leased under 10 year term permits with grazing scheduled to occur between May and October. The Salitre Mesa allotment is currently not grazed, however, plans are being made to possibly lease this allotment on an annual basis beginning in the summer of 2003 with use between June and October.

Rotational grazing systems are in effect on the three active allotments. The Bluewater/Mount Sedgwick system calls for two consecutive years of complete rest on each pasture (two pastures each year) during the 10-year term of the permit. The other two are grazed under deferred rotation systems where all pastures are grazed each year but the season of use changes for each from year to year. Table 10 shows current permitting levels and the number of pastures through which grazing is rotated.

Table 10. ***Summary of permitting on affected grazing allotments.***

Allotment	Season (# of months)	Permitted Number	Total Head Months	# of Pastures
Agua Fria	6	170	1020	5
Bluewater/Mount Sedgwick	5	127	635	8
Cottonwood/Las Tusas	5	292	1460	6
Salitre Mesa	5	57	285	1

A considerable number of range improvements, needed to facilitate livestock handling, grazing rotation, and to improve animal distribution are found on the project area. These include 74 miles of allotment boundary fence, 42 miles of interior fencing, 27 miles of private-land boundary fences, over 50 livestock water developments, a number of corrals, and a line cabin. These range improvements would need to be protected from damage during thinning and burning activities.

3.7.2 Livestock Forage

Forage species found in ponderosa pine stands includes: Arizona fescue, mountain muhly, spike muhly, pine dropseed, dryland sedges, and muttongrass. Native forage production in ponderosa pine units ranges from 0 to 1,000 pounds per acre in a "normal" precipitation year. Non-native grasses occur across the project area and can be dominant in old timber-sale units. These include: Kentucky bluegrass, crested wheatgrass, smooth brome, pubescent wheatgrass, hard fescue, and timothy. Production ranges from 500 to 1,500 pounds per acre in seeded areas.

Meadows and riparian areas support intermediate and slender wheatgrass, Kentucky bluegrass, sedges, rushes, redtop, and even cattails where year-round surface water occurs. The first three species account for the majority of production, which ranges from 1,200 to 3,000 pounds per acre per year under normal precipitation conditions.

The predominant forage species in the piñon-juniper treatment type (WUI, fuelbreaks, and control units) is blue grama, although squirreltail and June grass contribute measurably to production as well. Crested wheatgrass was commonly seeded in the control units. Annual forage production averages from 100 to 600 pounds per acre.

The forage production figures in this section are estimates drawn from local experience. Standardized production and condition studies have not been conducted in the project area since the 1970's.

3.7.3 Environmental Consequences

No Action (Alternative B)

This alternative would not remove commercial or non-commercial material from the Bluewater watershed nor would it allow for broadcast burning. By not taking any action there would be no effect on forage availability, livestock movement and management, or planned pasture rotations in the project area. Forage production increases that might be expected from overstory removal in all types would not be realized under this alternative.

Direct and Indirect Effects Common to Both Action Alternatives

Activities associated with removal of commercial and personal use materials under the two action alternatives are not expected to significantly affect livestock movement and management in piñon-juniper areas. In the long-term, changes in plant diversity and biomass should be expected in regards to forage availability. Forage productivity would likely increase under these two alternatives although perhaps marginally and at the expense of species diversity. Pieper (1990) studied the relationship between piñon-juniper canopy and understory production. He concluded that, "... decreasing overstory canopy of piñon -juniper woodlands in central New Mexico will tend to increase blue grama biomass, but decrease biomass of cool-season grasses such as New Mexico Muhly and piñon ricegrass." He further concluded that, "Increases in herbage production are relatively small unless canopy cover can be reduced substantially." In the control units, where crested wheatgrass was seeded, productivity increases would likely be more substantial.

Removal of the ponderosa pine overstory in historically open meadows, as described in both Alternatives A and C would be expected to increase forage production over time in these areas as well. Moore and Deiter (1992) note, that available studies show a strong correlation between forage and herbaceous production and the amount of ponderosa pine canopy closure. While working in northern Arizona they found an over six-fold difference in forage production between areas without trees and under the average canopy cover found in ponderosa pine stands.

Because of the acreage involved, activities described under the two action alternatives have the greatest potential to affect livestock management and pasture rotations in the ponderosa pine treatment areas. While cattle are most likely to eat pine needles when temperatures are very low, freshly felled pines might prove attractive to cattle at any time of the year. Poisoning of pregnant cows is possible, though unlikely, under both Alternatives A and C. Ingestion of pine needles by pregnant cows during the third trimester can cause an abortion. Up to 40% of cows are pregnant when placed on project area allotments with planned calving occurring as late as July.

With time, measurable increases in forage production in ponderosa pine stands are likely to result from implementation of either action alternatives. Mean basal area for all ponderosa pine stands to be treated (exclusive of upland meadows) is 66 square feet per acre. Although desired basal area after treatment ranges to 110 square feet, the great majority of stands have targets of 30 to 70. Material presented by Jameson (1967) suggests a one-third increase in herbage production at 50 square feet compared to 66 square feet basal areas.

A thinning and burning schedule, applicable to both action alternatives, has been developed to minimize impacts to range resources. This schedule would take advantage of planned two-year rest periods in the pasture rotation on the Bluewater/Mount Sedgwick Allotment. Therefore, burning would be followed by at least one, and more often two, years of rest from grazing for the majority of the pasture. On the Agua Fría and Cottonwood-Las Tusas Allotments, where deferred-rotation rather than rest-rotation is planned, burning would be scheduled so that cattle enter the affected pastures late in the year after the burning period. Strict salting instructions designed to draw livestock from vulnerable areas would be included in Annual Operating Instructions (which are given to a permittee at the beginning of the grazing season) to reduce use on burned areas. Negative impacts related to lack of forage and cattle grazing on newly burned areas would be minimized under both Alternatives A and C.

Proposed Action (Alternative A)

This alternative calls for broadcast burning of slash in all treatment units. Broadcast burning of slash would be conducted across 18,100 acres of ponderosa pine restoration areas. Concerns related to extensive use of broadcast burning include loss of standing forage crop, damage to re-growth should heavy grazing occur too soon after treatment, and burning to mineral soil where slash is very heavy. Because vegetation on recently burned areas is more palatable, grazing animals are attracted to and congregate on burns.

Removal of all slash is of particular concern in piñon-juniper areas where a moderate amount of slash is desirable to create micro-sites that protect newly established plants from the temperature and moisture extremes; common in these areas. This material also serves to reduce grazing pressure on young plants here and in other vegetation types. Burning of all slash could have several detrimental effects on forage plants in the piñon-juniper vegetation type. Removal of trees would open the soil surface to more sun, wind, high temperatures, and drying. Small limbs and branches that would have acted to moderate this effect would be removed at the same time that young plants are more palatable to grazing wildlife and livestock. Likely effects of Alternative A on rangeland resources in treated piñon-juniper areas, then, would be to lengthen the time needed to establish a robust perennial grass-forbs community and increase dominance of blue grama grass at the expense of cool-season perennial grasses.

The use of broadcast burning to treat slash can be problematic in meadows. The benefits of leaving some slash on the ground described under piñon-juniper above apply here as well. Forage re-growth on burned areas can be especially attractive to grazing animals, thus leaving these areas susceptible to over-use by elk, deer, and cattle when newly released forage plants are most vulnerable.

Seventeen pastures would be affected to a greater or lesser extent by planned broadcast burns under Alternative A.

Preferred Alternative (Alternative C)

Slash remaining on the ground under Alternative C would provide protection in piñon-juniper areas for grasses and forbs that were released as a result of increased sunlight. Development of the grass-forbs vegetation layer would be aided and accelerated due to the creation of micro-sites by remaining slash. However, a reduction in the contribution to productivity by cool season grasses would occur, as blue grama was favored in the warmer, dryer sites.

This alternative proposes to use broadcast burns on only one-third of the upland meadow units. The amount of area impacted would be significantly less because there would be a reduced chance for wildlife or livestock to overgraze the resource.

Thirteen pastures would be affected to a greater or lesser extent by prescribed burns under Alternative C. Approximately 13,825 acres of treated ponderosa stands would be broadcast burned and an additional 6,840 acres of un-thinned landscape would be broadcast burned. Another 4,725 acres would be pile burned in these stands.

Cumulative Effects

Allotment Management Plans for grazing allotments in the project area restrict forage utilization levels of 25% to 30% of the existing forage base. Holechek and Gault (2000) describe as "moderate" grazing on New Mexico mountain grasslands a 41% to 50% use (by weight) of forage and consider 31% to 40% use to be "conservative". Utilization levels are further reduced if the use is occurring within Northern goshawk habitat (20%) or Mexican spotted owl protected activity centers (25%).

Cumulative effects for the range program amount to factors that limit flexibility in grazing management and administration. Factors such as the presence of threatened, endangered, or sensitive species apply to all three alternatives. Under the two action alternatives, these concerns are compounded during project implementation but alleviated to some extent in the long-term as increased forage production enhances flexibility in grazing administration.

3.8 Recreation Resources

3.8.1 Developed Recreation

There are three developed sites within the Bluewater analysis area: Ojo Redondo Campground, Bluewater parking, and the Sawyer toilet. These developed sites are all located outside the proposed treatment areas.

3.8.2 Dispersed Recreation

Hunting and camping are the primary dispersed recreation uses within the Bluewater analysis area. Camping is primarily associated with hunting and occurs in the fall or early spring. Other activities that occur occasionally include: fishing, biking, hiking, wood gathering, picnicking, and equestrian travel.

Recreation Opportunity Spectrum (ROS) provides a formula for managing specific land settings for appropriate recreation uses and experiences. ROS is defined by six categories, three of these categories occur in the analysis area, which are: Roaded Natural (RN), Semi-primitive, Motorized (SPM), and Semi-primitive, Non-motorized (SPNM).

RN is a naturally appearing environment with low to moderate interaction between users. SPM is a natural appearing environment of large size with low interaction between users and a high degree of interaction with the natural environment. SPNM is a natural appearing environment of large size with low interaction between users and a high degree of interaction with the natural environment. Table 11 shows the distribution of each ROS within the analysis area and treatment area.

Table 11 – ***Recreation Opportunity Spectrum Class acres and treated acres.***

ROS Class	Acres in Analysis Area	Treated Acres
RN	24,664	723
SPM	78,867	1,284
SPNM	10,898	61
Totals	114,419	2,068

3.8.3 Environmental Consequences

No Action (Alternative B)

Direct Effects

There would be no direct effects to develop and dispersed recreation as described in the affected environment. Use of the developed sites and dispersed recreation would continue to occur. The ROS class would not change.

Indirect Effects

The indirect effects to the dispersed recreation activities would occur in the immediate area of where a wildfire occurs. This would result in decreased opportunities for hunting, camping, hiking, biking, picnicking, and equestrian travel. Big game hunting would increase the next 2 growing seasons because of the increase in forage availability. Since the interaction between users is low to moderate in a naturally appearing environment, the effects users would experience in each ROS class would be minimal. The developed sites would not be affected, unless the wildfire occurred in the immediate vicinity of the developed sites. The indirect effects of a wildfire would be a decrease in developed site use and dispersed recreational use because of results of a less desirable aesthetic burned landscape.

Cumulative Effects

The direct impacts of implementing of this project would be negligible when considered with other past, present, and expected future projects. Proposed Forest Road 50 upgrade and the current Forest Road 483 reroute would not have a cumulative effect on the ROS classes or the developed recreation sites. Private land logging would not have cumulative effects on existing ROS classes, the dispersed recreation, or the developed recreation sites. Public recreation is not permitted on private land; therefore activities on private land would not cumulatively affect recreation use on NFS land.

Direct and Indirect Effects Common to Both Action Alternatives

There would be no direct effects to develop recreation since the developed sites are outside the treatment areas under either Alternatives A or C. The indirect effects would be more fuelwood readily available to campers that use the developed sites from the treatment areas.

The action alternatives (proposed action and preferred alternative) would have minimal direct effects to dispersed recreation. Hunters and equestrian travelers would be directly affected immediately after treatment due to slash produced within the project area and during slash treatment. Dispersed recreation users would be affected during and immediately after the slash treatment.

Only 3 percent (approximately 700 acres) of the RN would be directly affected by treatment activities, such as thinning and prescribed burning (Table 12), by either the proposed action or the preferred alternative. However, those affects would be minimal because they are short-term in nature (two growing seasons) and the activities are within the ROS class standards. Most of the areas affected would be along Forest Roads 50, 178, 180, and 480. Similar treatments implemented in the past within this area indicate that forest visitors are not concerned with thinning and prescribed burning treatments. In the project area, resource modification and utilization practices are evident and treatments complement the natural environment. The indirect effects of treatments would be beneficial. Treatments would enhance the naturally appearing environment and continue the low to moderate interaction between users. Opportunities for both motorized and non-motorized forms of recreation would continue to occur. The ROS class would remain unchanged.

Only 2 percent (approximately 1300 acres) of the SPM would be directly affected. The direct effects of treatment in these areas would be minimal because they are short-term in nature (two growing seasons) and the activities are within the ROS class standards. The treatment areas are not easy accessible and in relatively remote locations. The areas affected by treatments occur mostly in the ponderosa pine restoration area in proximity of Post Office Flats with smaller portions in upland meadows, control units, and WUI located along the northern Forest Service boundary near Bluewater Lake. The indirect effects of treatment in these areas would be a continuation of low interaction between users and a high degree of interaction with the natural appearing environment. Opportunities for motorized use would still be available. The ROS class would remain unchanged.

Only 1 percent (approximately 60 acres) of the SPNM would be minimally affected by treatment because the treatment areas are in remote locations. A small portion of the Control Unit and the ponderosa pine restoration area is in this ROS class. The areas are located north of Cottonwood Canyon and the northern slopes of the Zuni Mountains; between Big Notch and Little Water Canyon. The SPNM, which is a natural appearing environment of large size with low interaction between users and a high degree of interaction with the natural environment, would not be indirectly affected. These areas are isolated in small pockets with limited access. The indirect effect is the ROS class would remain unchanged.

Table 12. ***Recreation Opportunity Spectrum Effects Summary***

ROS	Total Acres	Treated Acres	Percent Treated	Direct Effects	Indirect Effects
RN	24,664	723	3	Minimal	No Change in ROS Class
SPM	78,867	1,284	2	Minimal	No Change in ROS Class
SPNM	10,898	61	1	Minimal	No Change in ROS Class

Cumulative Effects

The cumulative effect of implementing either action alternative would be negligible when considered with other past, present, and reasonably foreseeable future projects. Proposed Forest Road 50 upgrade and the current Forest Road 483 reroute would not have a cumulative effect on the ROS classes or the developed recreation sites. Private land logging would not have cumulative effects on the ROS classes or the developed recreation sites.

3.9 Socio/Economic Factors

The Forest Plan requires an analysis of alternatives to determine cost efficiency by assessing project costs and benefits. Since not all project costs and benefits have a direct monetary value, project alternatives are usually evaluated by how well they maximize net public benefits (Cibola Forest Plan, 1985). Net public benefits are an overall expression of the value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs); whether they can be quantified or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index. Alternatives having a high benefit to cost ratio may not always provide the highest net public benefit when non-quantifiable benefits or costs are considered; such as catastrophic fire on a landscape level.

The areas most likely to be affected directly, indirectly, or cumulatively by the proposed action are the communities of Gallup, Grants, Bluewater Lake, and communities within the Navajo and Zuni Pueblos. Possible effects to the greater metropolitan area of Albuquerque would generally be so diffused and minor that they would not be measurable.

3.9.1 Social Factors

Social analyses are conducted by the Forest Service to discover what affect the agency has on local communities and the people using natural resources. A social impact is a change in social and/or cultural conditions which directly or indirectly results from a Forest Service action. A Social Impact Analysis estimates how Forest Service policies and actions affect the quality of people's lives and social well-being. It helps resource managers examine the human dimension of ecosystem management as part of the decision making process. It is the intent of this part of the analysis to describe the projected social impacts of the alternatives on the potentially affected interests.

Since the early 1960s, a relatively constant supply of timber from National Forest System lands supported lumber manufacturing and logging jobs in the area. Until around 1990, the number of jobs in the local timber industry had been fairly constant. In the early 1990's, the amount of commercial timber offered for sale from the Cibola National Forest dropped to virtually nothing for many reasons, including statewide lawsuits and the listing of threatened and endangered species under the Endangered Species Act. Since the 1990's, the timber industry has become non-existent in New Mexico with a few remnant lumber or specialty mills surviving in Arizona and Colorado.

Demographics

It is not anticipated that the proposed action would actually impact any demographic measures, but to help define the scope of the impacts the certain demographic features will be briefly described.

New Mexico has a population of 1,819,046 million (Census 2000) with a projected population of 2,112,957 million in the year 2010. This was an increase in population of 20.1% since the Census of 1990. Based on the Census 2000, New Mexico was the 12th fastest growing state in the nation and the 36th state ranked by population.

Currently, the population of New Mexico is comprised of: 45% White, 42% Hispanic, 2% African American, 9% Native American, 1% Asian/Pacific Islander, and 1% more than one race. By the year 2025, New Mexico's population is projected to be comprised of: 47.5% Hispanic, 39.7% White, 1.6% African American, 9.8% Native American, and 1.4% Asian/Pacific Islander.

Between 1990 and 1996, McKinley continued to experience low to moderate growth, but Cibola County suffered a dramatic decrease in population.

Cibola County has a population of 25,595 (Census 2000), which is a 7.6% increase since the Census of 1990. The current population is comprised of: 39% Native American, 33% Hispanic, 25% White, 1% African American, 1% more than one race, with the remaining 1% being Asian/Pacific Islander and other races. The population per square mile was reported at 5.6 with the number of households reported at 8,327 (Census 2000). Persons per household were reported at 2.9 (Census Bureau, Population Division).

McKinley County has a population of 74,798 (Census 2000), which is a 23.3% increase since the Census of 1990. The current population is comprised of: 73% Native American, 12% Hispanic, 12% White, 2% more than one race, with the remaining 1% being Asian/Pacific Islander, African American, and other races. The population per square mile was reported at 13.7 with the number of households reported at 21,476 (Census 2000). Persons per household were reported at 3.4 (Census Bureau, Population Division).

The Socio/Economic Report, located in the project record and available upon request, provides additional population statistics for these two counties.

Approximately 40 percent of the state population resides in the Albuquerque metro area. It is also one of the fastest growing areas in the state. The majority of this population is within two hours of the Bluewater Ecosystem Management Project Analysis area by automobile.

Communities

Geographically this region can be described as largely rural with large tracts of open lands and small communities that rely on a commercial center to augment their lifestyles. Recent population trends have moved the Southwest to be more urban-oriented. This trend has affected Cibola and McKinley counties, which are the two counties that encompass the analysis area.

Of particular interest to this proposal are the small local communities of Bluewater Lake and Thoreau. Bluewater Lake Community is located within the Cibola County and Thoreau is located within McKinley County. There is not much information published, written, or available via the Internet on these two small communities. Therefore, a majority of the information presented in this report is from the two counties of Cibola and McKinley. However, the large metropolitan area of Albuquerque is where the majority of recreation users reside. Local residents are actively pursuing economic development as it relates to tourism and recreation.

The Bluewater Village is located 11 miles northwest of Grants and its original Spanish name was "Agua Azul." This community was named after Bluewater Creek (Smith 2002). Many families who have deep-seeded roots in the land and are "descendants of original settlers" inhabit this area. (Grants Cibola County, Community Guide & Membership Directory)

The Bluewater Lake community (separate of the Bluewater Village) is an unincorporated community comprised of long-term residents, seasonal residents, and retired residents. The community is surrounded by National Forest lands that provide a multitude of recreational opportunities and provides for more traditional lifestyles. In communities that have a majority of seasonal or new residents (retirees), there are often differing views on issues compared to those of long-term residents. Particularly when one segment considers the natural resources as a commodity to derive their income and the other groups view the same environment strictly for recreational and aesthetic purposes.

Grants is the largest city and the county seat in Cibola County. It serves as the commercial hub for the residents of Cibola County. Grants is located 70 miles west of Albuquerque, which is about a one-hour drive from Albuquerque. Founded in the late 1870s, this area was mostly inhabited by cattle and sheep ranchers. In 1983, Grants began to have a decline in population due to the closure of mills and mines. The land area of Grants possesses majestic mountains, lakes, mesas, spectacular lava flows, and Indian ruins. (Grants Chamber of Commerce 2003)

Gallup is the largest city and the county seat in McKinley County. It serves as a commercial hub for the residents of McKinley County. Gallup is 140 miles west of Albuquerque and is located between the Navajo and Zuni reservations.

The Zuni Pueblo is located on Highway 602, 35 miles south from Gallup. This Pueblo has the closest proximity of any to the Bluewater Ecosystem Management Project. It is known to be the largest inhabited pueblo in the United States.

Lifestyles

Access to the National Forests is an important element of quality of life for local residents. Residents have access to its set of amenities and can take advantage of them more frequently and at less cost than if they lived elsewhere. The benefits realized from these amenities can increase the standard of living or well being of the local residents.

Farming and ranching continues to be a way of life for those who reside in the Cibola and McKinley Counties. In 2001, there were 166 farms in Cibola County and the average size farm was 10,237 acres. The commodities of these farms are cattle, calves, hay, silage, etc. In 2001, there were 224 farms in McKinley County and the average size farm was 14,094 acres. The commodities of these farms are cattle, calves, horses, and ponies. (New Mexico Economic Development Department 2003)

Attitudes, Beliefs, and Values

The Cibola National Forest is valued for it recreational purposes. Recreational opportunities are available year-round which caters to multiple users. These opportunities tie back into the high values held of the local and seasonal residents, and recreationists being able to access the National Forest lands.

Another value to the local communities is being able to utilize forest resources for their livelihood. Fuelwood is an important commodity to these residents. They use fuelwood to heat their homes, cook their meals, as a means of income if sold, and to create products for commercial retail. Some individuals use the forest to gather herbs and plants to make medicines for healing purposes.

Issues important to local Native Americans include a high demand for fuelwood, other natural resources, more recreational activities, and accessibility to the forest. Many Native American Tribes have ties on the Forest through their cultural and traditional beliefs. Issues and concerns regarding traditional and spiritual uses of the forest resources have and always will exist. (Mt. Taylor Ranger District Geographic Area Assessment 2000)

Employment

In 2001, New Mexico had a per capita income of $23,081 ranking it 48th in the United States in this category. The per capita income is only 76 percent of the national average and is growing at a much slower rate than the rest of the nation. The service industry is the largest sector in New Mexico, accounting for 27.5 percent of total earnings in 2001. State and local governments are the fastest growing sectors, which increased by 13 percent in 2001. Tourism, a component of the service industry is a large and growing sector of the State's economy. (Bureau of Economic Analysis 2003)

The per capita income in Cibola and McKinley counties were $16,163 and $13,896 respectively in 2001. This reflects a per capita income that is approximately 53 percent or less of the national average. Earnings of persons employed in the Cibola County increased by 8.7 percent and increased by 3.4 percent in the McKinley County. (Bureau of Economic Analysis 2003)

The school and the natural gas refinery at Thoreau and the power plant near Prewitt provide some sources for local employment to the small communities adjacent to the project area. There are several small supplemental type ranching operations within these communities and a few larger operations. However the majority of the population relies upon the larger service communities of Grants and Gallup for much of their economic contributions.

The largest employers within the Cibola County are: Lee Ranch Coal Company, McKinley Paper Company, Pueblo's of Acoma and Laguna, Cibola County Schools, CCA Women's Correctional Facility, Cibola County Corrections-CCA, and the NM State Highway Department (Grants Cibola County, Community Guide & Membership Directory 2003). Even though mills and mines closed, the mining industry continues to be an economic factor for the Cibola and McKinley Counties. The mining industry is still the highest paying employer in the Cibola and McKinley Counties. The largest industries in McKinley and Cibola County for 1999 were education (32.4 percent of earnings), and health and social services (27.4 percent of earnings).

Generally, unemployment is around 5% Statewide but was 6.1% in Cibola County and 9.2% in McKinley County in 2000 (Census Bureau, Population Division). McKinley County in 2000 had a median household income of $25,005 while Cibola County had a median household income of $27,774.

With the recent introduction of the President's Healthy Forests Initiative (Healthy Forests Initiative, President Bush, August 22, 2002) and the concept of ecological restoration of ponderosa pine stands in the Southwest (Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective, Allen et al. 2002) the Forest Service is prepared to ease the overcrowded stand conditions that are susceptible to catastrophic fires. However, the agency will need to demonstrate that it can produce a consistent supply of various wood products through restoration treatments to encourage forest product industries to invest and rebuild a smaller, more efficient woods product manufacturing sector in this area. Thus, the Southwest is shifting to non-traditional restoration treatments where some sawtimber would be removed but mostly small poles and biomass (trees less than 9" DBH) would be cut to lessen the threat of catastrophic stand replacement fires (Graham et al. 1999).

3.9.2 Environmental Consequences to Social Factors

Affects to people and to the functioning of their communities are complex and closely interrelated. Some affects, such as income and employment changes, are somewhat quantifiable. Affects to lifestyle, personal values, and attitudes are harder to quantify and evaluate. An area of concern to local residents, both seasonal and year-round, is the emphasis of maintaining a rural lifestyle. It should be noted that none of the alternatives propose any actions that would change this emphasis.

It is important to recognize that the social impacts associated with this analysis are generally indirect impacts and it is important to review impacts to other resources to determine if there is an indirect connection to a social aspect.

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

This Alternative would not restrict access to areas identified as having sense of place attachments. No restriction or denying of access would occur which could negatively affect the quality of life and culture of those people who have an attachment to these places.

Alternative B would not implement fuelbreaks on Forest Service lands adjacent to private property and residences along the northern portion of the project area. Communities would remain at elevated fire risks associated with fires starting on adjacent lands.

Since no active vegetation manipulation (timber harvesting, thinning, prescribed fire) would occur, forest users would not experience short-term impacts on local air quality from smoke and dust. Additionally, there would be no noise normally associated with these activities within the immediate area.

By implementing Alternative B, the risk of a catastrophic fire in the area would increase. The possible impacts from a large fire to the community of Bluewater and surrounding areas would have many short- and long-term effects. Short term effects from a large wildfire would be the visual loss of trees and scorched earth proceeded with local flooding events and localized mass erosion in areas that had a greater than 80% tree canopy loss the following winter. The community of Bluewater and surrounding rural area would experience an immediate loss of place as well as traditional rural lifestyle associated with a forested landscape. Forest use would decline in the short term but through time, natural succession would heal the project area and bring the aesthetic appeal of the project area slowly back to pre-fire levels.

Cumulatively, overall timber stand health within the project area would continue to decline due to annual forest growth rates and the trend towards ever increasing overcrowded timber stand conditions. This condition, which is prevalent throughout the Southwest, now threatens the remaining large trees through competition and by fueling increasingly extensive crown fires (Covington and Moore 1994).

By not treating overstocked timber stands under Alternative B through combinations of thinning and prescribed burning, timber stands within the project area would not achieve resiliency to natural disturbance events such as fires, insects, and regional drought and would become increasingly a higher risk to catastrophic fire events.

The debate over relative risks and trade-offs associated with different approaches to Southwestern ponderosa pine forests restoration continues. Past silvicultural activities in the project area focused on tree harvest and short term economics rather than an ecological sustainability approach with a focus on decreasing the high risk of stand replacement fires. Fire programs have been underway for decades. Concerns about excessive smoke and the risks of prescribed burning (highlighted by the Cerro Grande Fire of 2000) have constrained public support. However, large fires such as the 2001 Rodeo Chetiski Fire in Arizona have also swayed public opinion and highlighted the need to reduce fire risks in ponderosa pine stands through mechanical as well as prescribed fire treatments.

The higher frequency of public use within the project area has increased the potential risk of human caused fire starts. Much of this use comes from camping, hunting and firewood gathering activities. By implementing the No Action Alternative, much would remain the same in the short term. People would continue to use the project area with the current level of wildfire risk. However, long-term wildfire risk levels are expected to rise by an increase in forest users and the increase in wildfire potential caused by over stocked timber stands and forest fuel loading past acceptable levels.

Direct and Indirect Effects Common to Both Action Alternatives

Fuelwood has been used as a source for heating homes and cooking purposes for many years. An increase or decrease for fuelwood opportunities would have a direct impact on local residents. If fuelwood is made available for local residents, then it allows for the continual use of natural resources for their livelihood. If fuelwood is made available for commercial use, this can supplement and enhance the personal income of local residents. The Bluewater project area is anticipated to produce 18,981 cords of fuelwood. While much of this fuelwood would be sold in various sized commercial fuelwood sales (also available to the public), an estimated 18,100 areas would be opened for public fuelwood permits of 10 cords or less.

Many households in the surrounding area, for economic and traditional reasons depend on fuelwood for not only heat but also as a means of cooking food. This way of life is important to many rural users and is important in maintaining rural community values. Fuelwood users from larger communities such as Gallup and Grants generally burn fuelwood for heat and more traditional reasons.

Local business owners within proximity to the project area could be affected. Revenues generated by those who choose to recreate in the area can have an affect on small business income. If the project limits access into the Cibola National Forest or has a direct affect on the aesthetics or recreational opportunities of Bluewater Lake, then this could cause a decrease in the amount of recreationists in this area. However, the proposed project would not change the aesthetics or recreational opportunities of Bluewater Lake, nor would it change the recreational opportunities.

Areas of high public use that have special value within the Bluewater project area were intentionally left outside proposed treatment areas. These include all developed and many undeveloped camping areas, such as the Post Office Flat area and Ojo Redondo campground.

Both action alternatives would implement a 300-foot wide fuel break on Forest Service lands adjacent to private property and residences along the northern portion of the project area. Management activities within the fuel break would be readily visible from nearby residences. Fuelbreaks would be established not to stop fires, but to impede fires and give fire fighters a place to start control operations.

During periods of active vegetation manipulation (timber harvesting, thinning, prescribed fire), forest users are likely to experience short-term impacts on local air quality from smoke and dust. Additionally, noise associated with these activities would be audible in the immediate area.

Both alternatives continue to provide access to areas within the analysis area that were identified as having a sense of place attachments, such as developed recreational sites and frequently used dispersed sites.

Both action alternatives propose mechanical and fire treatments within many of the ponderosa pine stands with an emphasis on fuels reduction and to promote old growth characteristics in stands dominated by small diameter trees. These actions are anticipated to be received differently by various segments of the public depending upon their views and beliefs associated with large landscape level forest management including timber harvest. Currently, the only stands meeting old growth definitions are within the piñon-juniper stands.

Another area that probably is of concern to the local residents, both seasonal and year-round, is maintaining their rural lifestyle. A rural lifestyle was a highly rated outstanding quality for Bluewater Lake (Mt. Taylor Ranger District Geographic Area Assessment 2000). This proposed project would not change this lifestyle trait.

Proposed Action (Alternative A)

This alternative proposes vegetative and prescribed fire treatments that would be visible throughout portions of the project area. These treatments would result in some short-term impacts to users of the area. Approximately 23,925 acres under this Alternative would receive some type of vegetative or burn treatment. Commercial and non-commercial timber thinning would occur on approximately 23,925 acres. Public fuelwood access would occur on 19,460 acres.

Alternative A proposes the construction of 304 miles of handline to control the 23,925 acres of prescribed burning. The use of handlines for controlling the spread of fire has more risk than using wider features, such as roads or other geographical breaks. Thus, there is an increased risk of fire burning into areas not identified for a prescribed burn under this alternative.

It is expected that there would be an increase in short-term employment opportunities should Alternative A be selected over Alternative C. The Forest Service would offer a limited number of handline construction contracts to build the 304 miles of handline associated with this alternative.

This Alternative would not restrict access to areas identified as having sense of place attachments. The affects of broadcast burning fire would not be evident to the casual forest visitor after 2 to 4 years. No restriction or denying of access would occur which could negatively affect the quality of life and culture of those people who have an attachment to these places.

Preferred Alternative (Alternative C)

This alternative proposes vegetative and prescribed fire treatments that would be visible throughout portions of the project area. These treatments would result in some short-term impacts to users of the area. Approximately 31,190 acres under this Alternative would receive some type of vegetative or burn treatment. Commercial and non-commercial timber thinning would occur on approximately 24,350 acres. Public fuelwood access would occur on 19,460 acres.

As described in Alternative A, Alternative C would limit the number of handline construction to 18 miles while prescribed burning an additional 6,840 acres. While some scorching of trees is expected from prescribed burning operations within the untreated 6,840 acres (see fire section), tree kill is not expected to occur in trees >1" DBH. In addition, some acres would be piled and burned rather than broadcast burned.

It is expected that short-term employment opportunities as anticipated in Alternative A, would not exist if Alternative C should be selected. The Forest Service would more than likely prescribe burn the 6,840 acres and build the 18 miles of handline through use of Forest Service crews.

This Alternative would not restrict access to areas identified as having sense of place attachments. The effects of pile burning fire would be even less evident to the casual forest visitor than would a broadcast burn. No restriction or denying of access would occur which could negatively affect the quality of life and culture of those people who have an attachment to these places.

Cumulative Effects

Subdivision and development of private lands within the area is expected to continue with a trend of building homes within the heavily forested environment. Much of this development is occurring adjacent to National Forest System lands. This trend has resulted in additional homes being built in areas of higher fire danger due to dense vegetation with continuous canopy cover.

This increase in development and homes being built within a forested environment is creating an increase in the risk of these private properties being exposed to a catastrophic fire event. It is well documented on recent large landscape level fires that WUI areas are at risk of loss of life and property. The community of Bluewater and surrounding WUI areas are no exception. Both action alternatives present ways to treat fuel buildups within the project area to reduce the inherent risk that now exists.

Overall forest health and growth rates in overstocked ponderosa pine stands would continue to decline and be at risk of catastrophic stand replacement fires. Other forest resource values would continue to decline until a balance is achieved through restoration management activities or nature strikes a balance through insect infestation and fire.

3.9.3 Environmental Consequences to Economic Factors

Economic factors for all alternatives are based on the same indicator measures. Those measures are: 1) Present value of costs and benefits, and 2) Revenue/Cost Ratios.

In Table 13, the following assumptions were used in the economic analysis:

1. This analysis determines the net economic returns of both action alternatives based on amenity resources costs and benefits, which can be measured in monetary terms. Non-amenity resources (i.e. wildlife, water, air) are very difficult to quantify even though it is recognized that they do have a value. Thus, the costs of vegetation treatment related activities and the benefits realized from the incidental sale of wood products were the values used to determine the benefit costs of the Bluewater project.

2. All costs associated with "forest management" objectives were included even in areas that were to receive prescribed burn treatment only.

3. The predominance of small diameter trees within the project area would result in a substantially higher cost per acre for mechanical treatment. This combined with the relatively high cost per acre of broadcast and pile burning would result in an overall low benefit to cost ratio for this project.

4. The year 2003 was used as the base year for determining values. Project treatment schedules for each action alternative were distributed over the years 2004 through 2009.

5. Managing forests for non-timber objectives such as habitat for threatened or endangered species, water quality, recreational opportunities, aesthetic features, or fuels reduction need not preclude production of wood products. In fact, removal of some trees as wood products is often necessary to help offset costs associated with fuels reduction treatments and non-timber objectives.

Table 13. ***Economic Comparison of Alternatives***

	Alternative A	Alternative B	Alternative C
Total Temporary Road Costs 1/	$83,175	$0.00	$83,175
Total Mechanical Treatment Costs for Trees <9" DBH 2/	$2,590,800	$0.00	$2,593,200
Total Mechanical Treatment Costs for Trees >9" DBH 3/	$2,164,080	$0.00	$2,164,080
Total Prescribed Burning Costs 4/	$1,435,500	$0.00	$1,505,440
Total Cost of Handline Construction 5/	$188,143	$0.00	$11,140
Total Costs	**$6,461,698**	**$0.00**	**$6,357,035**
Fuelwood Revenues for Trees <9" DBH 6/	$98,930	$0.00	$98,930
Timber Revenues for Trees >9" DBH 7/	$1,094,034	$0.00	$1,094,034
Forest Management *Benefit to Cost Ratio* 8/	**0.17**	**0.00**	**0.17**

1/ 33.3 miles of temporary roads are proposed for treatment area access and closure under both Action Alternatives. Costs are Present Value.

2/ Costs are Midrange level costs experienced in Region 3. Costs are Present Value.

3/ Mechanical Treatment Costs include: stump to truck, truck to mill, contract administration, and road maintenance. Costs are Present Value.

4/ Costs include prescribed and pile burning. Costs are Present Value.

5/ Costs are based on 20 man Hotshot crew production levels. Costs are Present Value.

6/ Fuelwood Revenues are based on per cord values at the current Forest Standard Rate of $5.00 per cord. Revenues are Present Value.

7/ Timber Revenues are based on per CCF values at the current Forest Standard Rates for sawtimber. Revenues are Present Value.

8/ Benefit Cost Ratio represents costs of doing restoration management treatments and the recovery of benefits from sale of wood products from these treatments.

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

There are no direct economic benefits or costs associated with reducing fuels and fire risks to private property and other natural resources with this Alternative. However, the indirect consequences of not treating fuels are staggering and immeasurable. As experienced on adjacent Forests in the past 5 years, many millions of dollars have been spent in fire suppression and restoration activities. The loss of life and property is well documented. Although this economic analysis looks only at the quantifiable side of this proposal, the direct and indirect consequences of taking no action are significant.

As previously stated, large catastrophic stand replacement fires affect the environment at the landscape level. Loss of natural resources such as wildlife habitat, watershed and soil, timber and old growth values to name a few are a direct result of these large wildfires. Indirectly, there are job losses associated with tourism and manufacturing jobs related to fuelwood cutting when communities are affected by wildfire. Cumulatively, a local economy could be negatively affected by such a loss of revenue, thus changing how people make a living in this area.

Effects Common to Both Action Alternatives

Both alternatives propose using and maintaining the existing transportation system within the Project Area. Thirty-three miles of temporary road would be built under this Alternative for a direct cost of $83,175. This cost includes construction and decommissioning after treatments are completed. In addition, 16 miles of unauthorized two-track roads now in use would be removed at the end of the project. The primary users impacted by this action would be ATV users, because many of these roads currently are not physically accessible by other motorized vehicles. The majority of ATV use in the project area is for hunting access and pleasure riding, therefore only a small percentage of users would actually be affected.

The economic benefits associated with reducing fire risks to valuable forest resources and private property were not calculated for this project; as they would vary depending upon location and severity of wildfire. However, these benefits are considered significant due to the adjacent property values of homes and property within the area. The higher than normal risk and associated cost of large catastrophic stand replacement fires has been well documented within the last 5 years in the Southwest with dramatic effects. Loss of life, property, and valuable forest resources are a matter of record. Many millions of dollars have been spent in suppression and restoration costs on these large landscape level fires.

Proposed Action (Alternative A)

As previously noted, the overall cost of thinning small diameter trees and implementing prescribed burns is relatively high. As a result, the economic analysis for this alternative shows a low benefit/cost ratio of 0.17. However, the key consideration that must be kept in mind is the primary management objective of fuels reduction, not the sale of sawlogs under a series of timber sales. To meet the fuels reduction objective under this alternative, stand treatment costs would be greater due to the high costs associated with labor-intensive forestry work.

As shown in the table above, costs associated with mechanical treatment of timber stands and management access account for $4,838,055 or 75% of the overall project costs. Costs associated with prescribed burning accounts for approximately $1,623,643 or 25% of overall project costs. These costs are offset by $1,094,034 in revenues created by the sale of fuelwood and sawtimber. This accounts for approximately 16.9% in revenue offset or a benefit to cost ratio of 0.17.

The major differences in costs between Alternative A and C are based on type of prescribed burn treatments, number of acres designated for treatment, and the number of miles of handline required to control prescribed burning operations. These costs are shown in the Table 14 below.

In summary, the more significant cost differences are associated with prescribed burning treatments and number of acres designated for treatment. Alternative A prescribes broadcast burning at $60.00 per acre for a total of 23,925 acres and total cost of $1,420,240. Alternative C prescribes piling and burning at $40.00 per acre for a total of 23,925 acres and total cost of $1,435,500. Prescribed fire costs in association with acreage differences between Alternatives accounts for a total cost difference of $69,940. The number of miles of handline construction accounts for the other major cost difference between Alternative A and C. Alternative A proposes the construction of 304 miles of handline at $188,143 at $619 per mile versus 18 miles of handline for a total of $11,140 required by Alternative C. The total cost difference between Alternatives for prescribed fire is $107,063. For additional information, see Comparison of Alternatives.

Table 14. ***Cost of prescribed burn treatments for Alternatives A & C, within each treatment type***

Prescribed Fire Costs	Alt A WUI	Alt C WUI	Alt A Control Units	Alt C Control Units	Alt A Fuelbreak	Alt C Fuelbreak	Alt A Upland Meadow	Alt C Upland Meadow	Alt A PP	Alt C PP	Alt A Total	Alt C Total
Cost/acre of Prescribed Fire Treatments	$60	$40	$60	$0	$60	$40	$60	$40	$60	$60	------	------
Acres of Prescribed Fire Treatments	885	885	2565	0	475	475	1900	770	18100	25365	**23,925**	**27,495**
Total Cost of Prescribed Fire Treatments	$53,100	$35,400	$153,900	$0	$28,500	$19,000	$114,000	$30,800	$1,086,000	$1,420,240	**$1,435,500**	**$1,505,440**
Cost/mile of Proposed Handline Construction	$619	$0	$619	$0	$619	$0	$0	$0	$619	$619	------	------
Miles of Handline Construction	13	0	62	0	22	0	0	0	207	18	**304**	**18**
Total Cost of Handline Construction	$8,046	$0	$38,371	$0	$13,616	$0	$0	$0	$128,110	$11,140	**$188,143**	**$11,140**

Preferred Alternative (Alternative C)

The economic analysis for this Alternative shows a low benefit/cost ratio of 0.17. The economic benefit table above shows costs associated with mechanical treatment of timber stands and management access account for $4,840,455 or 76% of the overall project costs. Costs associated with prescribed burning accounts for approximately $1,516,580 or 24% of overall project costs. These costs are offset by $1,094,034 in revenues created by the sale of fuelwood and sawtimber. This accounts for approximately 16.9% in revenue offset or a benefit to cost ratio of 0.17.

The total prescribed fire cost difference of $107,063 between action alternatives is a result of a difference between acres to be treated, number of miles of handline to be constructed, and differences in costs relative to broadcast burning and pile burning. While the cost differences between acreage treated and broadcast burning versus pile burning tend to balance, it must be noted that there is a significant difference in number of miles of handline construction required between the two alternatives. The estimated costs for handline construction assumed a Forest Service 20 person Hotshot crew accomplishing the work. Although the cost is relative to the other prescribed burning costs, it is worth noting that handline construction costs may go up if the Hotshot crew is unavailable and the work has to be contracted out. Other considerations include timing in advance of prescribed burning operations, visual considerations (304 miles by 3.5 foot wide or 129 acres of construction), and longevity of construction (the annual needle shed of ponderosa pine may negate the effectiveness of handline construction after 1 to 2 years).

3.9.4 Environmental Justice

Executive Order 12898 (February 11, 1994) directs federal agencies to focus attention on the human health and environmental conditions in minority communities and low-income communities. The purpose of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

The population within the affected environment around Bluewater Lakes is relatively homogenous and predominately white non-Hispanic (91%). Minority populations within the area are well below the average for the State and County and would not meet criteria for "Minority Population" as defined by CEQ direction.

For this analysis, income levels at the community scale are based on the 2000 census data and may not reflect levels that would be found in those communities today. McKinley County had 36.1 percent of the population below the poverty level in 1999 compared to the States average of 18.4 percent. The per capita personal income was $9,872 in 1999, which was 43% below the State's average with 27,002 persons reported below the poverty level. Cibola County in contrast and more representative of the project area had 24.8 percent of the population below the poverty level in 1999, compared to the States average of 18.4 percent. The per capita personal income was $11,731 in 1999, which was 32.0% below the State's average with 6,348 persons reported below the poverty level.

The human health and environmental effects associated with the project are generally considered within acceptable norm for the area. None of the effects were deemed to be significant as employed by NEPA and specified in the CEQ Regulations on Environmental Justice. Thus, even if an independent community of low-income exists in the area it would not be considered disproportionately affected as defined by the Regulations.

3.10 Timber and Silviculture Resources

3.10.1 Vegetation Cover Types

There are seven major vegetation cover types in the analysis area. These are: mixed conifer, ponderosa pine, ponderosa pine-Gambel oak, piñon-juniper woodland, riparian, aspen, and grassland habitat (see Table 15 for acres and percentage). Each forest and woodland type has its own vertical and horizontal structural diversity, which includes riparian areas, inclusions of aspen and non-forested/grassland areas as well as a unique understory vegetation association (USDA 2000). Even though there is a mix of vegetation types, this geographic area still lacks good understory vegetation that is commonly associated with early- and mid-seral stages in all of the major forest habitat types.

Table 15. ***Acreage and percent of each cover type in the Bluewater analysis area.***

Vegetation Cover Type	Acres	% of Analysis Area
Mixed Conifer (Douglas-fir/Pine)	5,290	4.6
Ponderosa Pine	64,762	56.6
Ponderosa Pine-Gambel Oak	20,551	18
Piñon-Juniper Woodland	12,875	11.2
Oak Woodland	3,787	3.3
Quaking Aspen	540	<1
Grassland	5,390	4.7
Undetermined Timberland	1,296	1.1

Mixed Conifer

The mixed conifer forest type occurs on approximately 5,290 acres of the analysis area (3,579 acres on NFS land). This type is dominated by Douglas-fir, ponderosa pine, and Rocky Mountain juniper (USDA 2000). Mixed conifer is found primarily in the Oso Ridge and Diener Canyon areas with smaller patches located on the northeast side of Lookout Mountain. Some arboreal oaks occur in the drainages (USDA 2000). This vegetation type historically developed under a 5 to 25 year return interval fire regime (USDA 1998).

According to Hollenstein et al. (2001), “Total mortality over large areas was historically a rare fire pattern in…mixed conifer forests.”

In the Oso Ridge and Lookout Mountain areas, the mixed conifer stands are located on relatively moist slopes of 20 to 35 percent. These areas account for roughly 67 percent of the mixed conifer type on NFS lands in the watershed, and they were extensively logged in the past. The overstory is dominated by Douglas-fir and ponderosa pine, which typically occurs at high densities (700+ stems/acre – average 5 inches diameter). The primary VSS classification is young forest; VSS 3 (USDA 2000). The mixed conifer stands are predominately multi-storied with high densities of conifer seedlings and saplings in the understory.

About 33 percent of the mixed conifer type on NFS land is located within the Diener Canyon area. Most of the type is located on highly erosive, pre-Cambrian granitic soils and slope of 40 percent or greater. Little, if any, logging has occurred here and old growth (generally greater than 18 inch diameter) ponderosa pine and Douglas-fir are present. Diener Canyon supports a localized population (15 acres) of southwestern white pine (USDA 2000).

In the mixed conifer type, either Arizona fescue or Gambel oak dominate the understory. Arizona fescue occurs more frequently on the drier, upper slopes and ridges. Oak understories are primarily found in more moist areas. Disturbances in areas with oak understories tend to favor oak as the primary regenerating species (USDA 2000). Understory species within the mixed conifer type includes: meadowrue, jamesia, fringed broam, bahia, columbine, gentians, and pyrola. In general, herbaceous (grasses and forbs) vegetation is not diverse and is not abundant primarily due to the closed canopy conditions of the overstory (USDA 2000).

Ponderosa Pine and Ponderosa Pine/Gambel Oak

The ponderosa pine forest type occurs on 85,313 acres (75 percent) within the analysis area. About 13 percent constitutes private ownership. This type includes some Gambel oak (20,550 acres), Douglas-fir, aspen, and Rocky Mountain juniper in the more protected, moist drainages. One-seed and alligator juniper are also scattered throughout this type in relatively low densities (3 to 10 stems per acre). Research indicates that historic logging of ponderosa pine in the drier transition zone between piñon-juniper and ponderosa pine caused alligator juniper to increase in frequency. Blue spruce inclusions of 5 to 10 acres are found near Monighan canyon and Camp Two drainages (USDA 2000).

The ponderosa pine type historically developed under a frequent (2 to 10 year interval), low-intensity fire disturbance regime (Dick-Peddie 1993, USDA 1998, USDA 2000). This fire regime created multi-aged forests with diverse canopy structures and spatial distributions of trees (Hollenstein et al. 2001). “Except for climate, fire probably had the single largest impact in shaping the ecology of the Southwest prior to European settlement” (USDA 1997). Before the 1870’s, ponderosa forest landscapes were park-like with 20 to 40 trees per acre, primarily in the larger diameter classes with a dominant grass understory. Forest openings were frequent and varied greatly in size. Low intensity ground fires, carried by grass and light litter fuels, regularly consumed ground, surface, and ladder fuels; partially removed crown fuels; and killed most new tree regeneration established after previous fires. Trees that survived these fires were sustained through the next several centuries (Woolsey 1911, Dick-Peddie 1993, Blue Ridge 2000, USDA 2000, Hollenstein et al. 2001). Fallen trees were generally consumed by subsequent fires, creating a mineral soil seedbed and reducing grass competition, which favored establishment of ponderosa pine seedlings (Cooper 1960). According to Hollenstein et al. (2001), "Total mortality over large areas was historically a rare fire pattern in ponderosa pine…forests." Pearson (1949) noted that it was rare for the crown cover of ponderosa pine to reach more than 30 percent and it was usually not over 25 percent.

As a result of favorable topography and a relatively continuous pine forest, timber harvests in the early 1900s were heavy and widespread (Dick-Peddie 1993, USDA 2000). Ponderosa pine was almost totally removed from the Zuni Mountains during this time (Dick-Peddie 1993). Harvested timber was utilized to build railroads and towns. The Bluewater watershed has seen repeated harvest entries beginning with the railroad logging days, and continuing into the recent past with tractor yarding as the primary means of timber removal (USDA 2000).

The early 1900's also witnessed the beginning of fire suppression, which altered forest structure and fire regimes (Covington and Moore 1994). Heavy livestock grazing of the grass understory at the turn of the century gave a competitive advantage to pine seedlings. Timber harvests also stimulated regeneration that continued to grow. Fire suppression, heavy livestock grazing, and timber harvests have resulted in an increased density of small diameter trees, fewer older and larger trees, and reduced herbaceous production (Dick-Peddie 1993, Covington and Moore 1994, USDA 1997, USDA 1998). Associated with increases in tree densities are increases in canopy closure, vertical fuel continuity, and surface fuel loads all resulting in fire hazards. Increased tree density has also reduced tree health, which increases mortality from insects, disease, and drought (Covington and Moore 1992).

Today, the ponderosa pine type can be classified predominantly as young forest (5 to 12 inch DBH) with tree densities ranging from 37 to 1,190 trees per acre, with an average of 110 to 165 trees per acre (USDA 2000). Although 52 percent of the ponderosa type was determined to be uneven-aged, the majority of trees fall within the 5 to 12 inch size class. Seven to 15 percent of the total forest type is classified as seedling/sapling (1to 5 inches DBH) with densities averaging 400 to 700 stems per acre (USDA 2000). Regeneration in many of the stands is in excess of 1,000 trees per acre with Gambel oak regeneration dominant in many stands. About one-half of the ponderosa stands are multi-storied while the remaining half is single- or two-storied. Excess litter and fuels now dominate the forest floor. The ponderosa pine landscape is at a high risk to catastrophic fire (Blue Ridge 2000). According to Reggie Fletcher (2001), who was a noted Southwestern Regional Ecologist, visited the Bluewater watershed, "without fire as a regulating part of the Bluewater watershed, ponderosa pine regeneration can modify the structure of the forest and meadows. Pine densities can reach levels where catastrophic, stand replacement fires are ensured. Portions of the watershed already have these densities."

Overall, productivity within the ponderosa type is moderate to high. Understory associations are dominated by oak and Arizona fescue. Gambel oak densities range from 100 to 300 stems per acre (USDA 2000). Other understory species includes: Fendler ceanothus, Oregon grape, small soapweed, Arizona fescue, fringed brome, pine dropseed, mountain muhly, prairie junegrass, bottlebrush squirreltail, muttongrass, Ross sedge, bracken fern, American vetch, and manyflower gromwell (USDA 2000). Shrub and forb understories occur only in moderate amounts in this forest type due to competition and shading from a generally closed overstory canopy. Overall, the herbaceous component lacks diversity and is in decline (USDA 2000).

Piñon-Juniper Woodland

This woodland vegetation type occupies about 12,875 acres of the analysis area and consists of pure piñon or a combination of piñon and juniper. At the upper elevation range of this type, ponderosa pine is scattered in the transition zone. The majority of the woodland type is dominated by Colorado piñon pine and one-seed juniper. Canopy closures range from 50 to 90 percent with an associated 300 to 500 stems per acre, mostly averaging 7 to 10 inches diameter at root collar (DRC). The vegetation structural stage for this type is primarily mid-aged, mature, and uneven-aged forest; average DRC ≥ 9 inches (USDA 2000).

This vegetation type has expanded outside its historic range. Historically, fire on a 10 to 30 year return interval kept the piñon-juniper restricted to sites with shallow, rocky soils and rough topography (USDA 1998, USDA 2000). Fire suppression, logging practices, and livestock grazing over the past 100 to 200 years have allowed piñon-juniper to invade former grassland and ponderosa pine forest sites (USDA 2000). Stand density has also increased greatly producing a continuous canopy capable of supporting a crown fire.

Understory grass, forb, and shrub quantities and production in this type are extremely limited and declining as a result of tree canopy closure. Piñon-juniper understories east of the Continental Divide contain southwestern muhly species, wolftail, mullein, evening primrose, cholla, and 4-o'clock. Other understory species across the woodland type includes: sideoats grama, big bluestem, mountain mahogany, Lehman's lovegrass, Apache plume, Gambel and wavyleaf oak, bottlebrush squirreltail, needle-and-thread grass, pussytoes, biscuitroot, Indian paintbrush, pale wolfberry, nightshade, Datil yucca, fringed sage cliffrose, and winterfat (USDA 2000).

In 1968 and 1971, three groups of piñon-juniper stands were treated to enhance rangeland forage production. These areas are the Twin Tanks, Las Tuces, and Salitre Mesa units consisting of 2,565 acres. With the exception of numerous conifer stringers and clumps, all the woody vegetation was cut, windrowed, and then burned. There has been no maintenance of these "piñon-juniper control" units since the original treatment. As a result, piñon and juniper have regenerated and created a forest of trees up to 8 inches diameter and 1 to 15 feet tall.

Quaking Aspen

There are approximately 540 acres of quaking aspen within the Bluewater watershed. This cover type is found primarily as inclusions in the mixed conifer and ponderosa pine types. There are no large, distinct aspen clones present in the watershed (USDA 2000). Aspen is a disturbance-dependent, fire-adapted, early successional species. Due to fire suppression and subsequent conifer encroachment, aspen clones are deteriorating and becoming a minor and declining component of the mixed conifer and ponderosa pine types (USDA 2000). At the current time, almost 99 percent of the aspen are categorized as old growth with very little regeneration occurring.

Grasslands/Non-Forested Areas

About 5,390 acres of all the lands in the analysis area are considered non-forested/grasslands or areas which previously have not and which currently do not support more than 10 percent tree cover. Approximately 32 percent of the grasslands occur on private ownership. In the past, these natural openings were maintained by fire in the mixed conifer and ponderosa pine forest types. The openings are now less frequent and smaller due to encroachment by trees, primarily conifers. Encroachment into grassland sites has resulted from a combination of past livestock grazing and fire suppression. In addition, some of these sites were reforested with ponderosa pine in the 1980's even though the sites did not historically support conifers (USDA 2000). The reforestation trees have low productivity and have, in many locations, stagnated in growth.

Some of the openings are dry meadows dominated by grasses, such as western wheatgrass and muhly species. At higher elevations, these openings often retain snowmelt water and have saturated soils for much of the year. Plants such as iris, yarrow, and cinquefoil can be found in these areas. Other openings are wet meadows that hold water most of the year. These contain such species as mannagrass, saltgrass, and horsetail (Dick-Peddie 1993). The dry and wet meadow areas should produce very high amounts of forage and browse for wildlife use. In many cases, meadows are being invaded by conifers or contain large stands of Kentucky bluegrass, which tends to decrease diversity and successional development. All of these factors result in low production and poor nutrient levels in some meadow systems (USDA 2000).

3.10.2 Old Growth

The distribution of old growth on the landscape has been dramatically changed since pre-settlement times. Much of the remaining old growth pine forests have been relegated to less accessible areas and perhaps less productive sites (Kaufmann et al. 1992). These stands historically developed under a fire regime with more frequent fire return intervals (USDA 1998). Today high tree densities and fire suppression have left old growth stands susceptible to fire, drought, insects, and disease. Old growth trees that once survived the numerous pre-settlement fires now commonly succumb to high intensity crown fires (Harrington and Sackett 1992, Kaufmann et al. 1992). Silvicultural intervention where old growth is scarce may improve the quantity, quality, distribution, and duration of old growth forests on the landscape. It may be possible to enter forest stands and alter the structure, age distribution, and amount of coarse woody debris to favor the development of old growth characteristics (Kaufmann et al. 1992).

The Forest Plan states, "…allocate no less than 20 percent of each forested ecosystem management area on National Forest System lands to old growth" (USDA 1985). Within the Bluewater geographic area, the following potential old growth acreages have been set-aside (Tidwell 1997, USDA 2000):

Table 16. ***Potential old growth acres within the Bluewater analysis area.***

Vegetation Type	Potential Old Growth Acres (NFS land)	Total Acres (NFS land)	Percent
Mixed Conifer (Douglas-fir)	904	3,579	25.2
Ponderosa Pine	18,180	73,826	24.6
Piñon-Juniper Woodland	2,920	12,803	22.8
Quaking Aspen	533	538	99.0

The old growth acres were derived from Rocky Mountain Resource Information System (RMRIS) queries of existing data. Stands selected as potential old growth were either: 1) already allocated within the Mexican spotted owl recovery plan; 2) already identified as "potential" or "future" old growth; 3) identified as vegetation structural stages 4, 5, or 6; or 4) contained desirable structure, large trees, and other suitable old growth characteristics (Tidwell 1997). Although these acres have been set-aside as old growth, they have not been examined to determine whether they actually meet old growth criteria as stated in the Forest Plan. Therefore, they are only "potential" old growth stands. The minimum criteria for the structural attributes used to determine old growth is further defined in the Silvicultural report in the project record that is available upon request.

Most of the quaking aspen stands in the analysis area are in an old growth state. Stand modification may be necessary to reduce the number of large, decadent trees, in order to create a more balanced age distribution, which would create a more healthy, sustainable aspen ecosystem. These stands are lacking a seedling/sapling component that is critical for long-term sustainability. Without sufficient young age classes, as the decadent trees die out, they would be replaced with conifers due to encroachment.

3.10.3 Insects and Disease

Insect activity within the Bluewater analysis area has been very light over the last decade. While winter drought over the past 3 to 5 years has lead to epidemic levels of Ips in Arizona and parts of New Mexico (*Ips confuses*), no Ips beetle activity has been detected within the Zuni Mountains. Ips is a bark beetle that feeds on and breeds within green (moist) pine material 2 inches and greater in diameter. The 2001 and 2002 insect and disease aerial detection survey results revealed scattered pockets (5 to 10 trees) totaling 95 acres of western pine beetle (*Dendroctonus brevicomis*), as well as, western tent caterpillar infestations on the Mt. Taylor Ranger District. Very little other insect activity was detected during these surveys. Western pine beetle attack living pine trees that are greater than 6 inches diameter and generally stressed with low vigor. Western tent caterpillars are a major defoliating insect of deciduous trees that affects quaking aspen in the Bluewater watershed.

Historically, wildfires were a primary factor in determining the distribution and intensity of dwarf mistletoe (parasitic seed-producing plant) in coniferous forests. Fires opened forest canopies and created non-uniform, clumpy spacing, which reduced the effectiveness of seed spread from tree to tree. In addition, crown scorch often killed dwarf mistletoe plants within the lower portion of the crown. As a result of fire suppression, mistletoe infections have become widespread throughout the Southwestern Region (USDA 1998). Dwarf mistletoe affects an estimated 30 to 40 percent of the Bluewater watershed (USDA 2000), but at relatively low levels.

Tree ring studies in the Southwest prove that the last 30 years have been the most favorable for tree growth in the past 300 years. Thus, bark beetle-caused tree losses have remained at a relatively low level for over 40 years. The last major bark beetle outbreak cycle in the Southwestern Region occurred following a drought in the mid-1950's (USDA 2002). Insect outbreaks were a natural phenomenon, but their extent was often smaller, of shorter duration, and of less intensity than is the case today (USDA 1998).

Bark beetle activity within Region 3 began to increase in 2000 with most of the activity in the ponderosa pine type. Much of the recent mortality is thought to be the result of severe drought. Ponderosa pine mortality attributed to Ips beetles increased over 700 percent from 2000 to 2001. On the Cibola National Forest, approximately 1,650 acres were affected (USDA 2001). Piñon pine mortality from Ips beetles increased over 800 percent in the region, but has been very minor on the Cibola National Forest.

In 2002, the effects of the bark beetle outbreaks were very visible with millions of trees (ponderosa pine and piñon pine) killed throughout the region. Bark beetle populations are on the rise due to several years of extended drought. Even though conifer mortality has been reported on about 3/4 million acres across the region, the Cibola had only 1,200 acres affected in 2002. However, mortality within the ponderosa pine type is roughly six-fold from 2001 levels. Mortality in the piñon-juniper woodlands is estimated at 4,700 acre on the Cibola National Forest (USDA 2002). Overall, the Cibola National Forest is sustaining far less beetle-caused mortality than other forests in the Southwestern Region.

Adult Ips are known to attack small diameter trees and tops of larger trees, but their preferred host material is fresh pine slash. While reducing stand density and improving tree vigor would reduce insect susceptibility, large amounts of green material (slash) placed on the forest floor would place treated stands at risk for *Ips confuses* population build-ups. Ips can produce 3 to 4 generations within a single season. If there is not enough green slash present to support the existing population, surrounding standing live trees would be vulnerable to attack.

The best time to create slash is August through December (Allen-Reid 2002). There would be fewer beetles flying at this time and the slash would dry out sufficiently to render it unsuitable for breeding habitat. Beetle-induced tree mortality is a real possibility with harvest/thinning operations occurring from January through July (Allen-Reid 2002). In addition to timing, slash should be placed in open, sunny locations to further facilitate drying. Ips hazard increases if treatments are repeated annually in close proximity.

Several other management and slash treatment options are commonly used to reduce the risk of Ips population buildup, such as:

- Avoid creation of large, contiguous acres of slash in consecutive years (Kegley et al. 1997)
- Create a continuous supply of fresh slash during the flight period ("green chaining") (Kegley et al. 1997)
- Avoid damaging residual stand to reduce the risk of attracting beetles (Kegley et al. 1997)

3.10.4 Stand Structure

The stands within the Bluewater watershed are variable – from even-aged stands following past clearcutting practices to structurally diverse stands comprised of patchy mixtures of trees in different age classes. The distribution of pre-dominant diameter classes as described in the vegetation structural stage (VSS) classification system is used in this analysis to describe the existing diameter class distributions. This classification system is based on the tree diameter class most frequently represented in an even-aged stand. Even though this system has limited applicability for uneven-aged forest management, it has been used in this analysis to describe the existing condition because it provides the best representation of stand structure in the project area. Table 17 summarizes the habitat structural stage information as provided in the RMRIS database.

Table 17. ***Acres and average crown cover percent within each VSS type for the watershed based on available data.***

	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6	Uneven aged	Total Acres
Acres	3,132	5,568	27,752	12,291	5,085	423	895	55,146
Avg. Crown Cover (%)	12	44	44	37	34	40	<35	
Percent of Total Acres	5.7	10.1	50.3	22.2	9.2	.8	1.6	

VSS 1 - Seedlings (0-0.9" dbh)
VSS 2 - Saplings (1.0-4.9" dbh)
VSS 3 - Young Forest (5.0-11.9" dbh)
VSS 4 - Mid-Aged Forest (12.0-17.9" dbh)
VSS 5 - Mature Forest (18.0 – 23.9" dbh)
VSS 6 - Old Forest (24.0" + dbh)
Uneven-aged – multi-storied stand with no predominant diameter class

The above table does not contain information for the entire watershed since stand examinations were not completed for private land or for many stands within the watershed. However, it can be assumed that the forest structure is similar to that of the surrounding stands. Although no stand examinations have been completed to date on the piñon-juniper woodlands, field reconnaissance revealed that most of the vegetation type falls within the mid-aged and mature vegetation classes (VSS 4 and 5). The piñon-juniper control units can be classified primarily as saplings (VSS 2). Available stand exam data for the Douglas-fir (mixed conifer) forest type reveals that the majority (76%) of the forest type is within VSS class 3. Although the type is considered young forest, Douglas-fir's shade-tolerant characteristic would move the stand toward multiple canopy layers. Large blocks of riparian/grassland vegetation occur surrounding the western-most piñon-juniper control unit, in the northern Monighan area, and along Bluewater Creek. Most of the stand data available is for the ponderosa pine type.

3.10.5 Stand Density Index

Stand density index (SDI) is a relative measure of stand density based on average tree diameter and the number of trees per acre. SDI can be used in both even and uneven-aged stands. Although basal area is a widely used measure of stand density, SDI is a more descriptive means of expressing stand or group density and can be closely correlated to canopy closure. SDI in the Southwestern Region is calculated based on all live trees larger than 1inch in diameter. Ponderosa pine in the Southwest has a maximum SDI value of 450. This is the average maximum tree density that can be carried on a site. However, some stands may be capable of supporting a maximum value greater than 450 given specific site characteristics, therefore they have a SDI greater than this value.

Silviculturists and entomologists within the Southwestern Region of the Forest Service have developed some general relationships between the percent of maximum SDI and the health of stands (vigor of the trees). These relationships as described in Table 18, have been developed based primarily on field observations of insect and disease activity compared to measured SDI values (Cassidy 1998). These relationships correspond closely to those developed by Reineke (1933).

Table 18. ***Definition of stand density index values***

Percent of Maximum SDI	STAND DESCRIPTION
0-10	Little or no tree competition; Stand open and understocked; Optimal forage production.
10-25	Minimal tree competition; Adding additional trees does not reduce the growth and vigor of individual trees; Canopy closure occurs near 25% max SDI.
25-35	Onset of tree competition; Additional number of trees decreases individual tree growth and vigor, but stand growth and vigor is still increasing. Individual tree vigor may be declining.
35-50	Zone of full site occupancy; Stand vigor declining at upper limits; Insect and disease are becoming a primary factor in tree mortality due to loss of tree vigor; Stand begins to self-thin near 50% max SDI.
50+	Zone of density-induced tree mortality; Insects are a major concern; Between 60 and 100% SDI tree competition can directly cause tree mortality even without the presence of insects and diseases as trees compete for water and sunlight.

Many ecologists have determined that SDI values in ponderosa pine stands averaged 10 to 20 percent of the maximum SDI when fires were more frequent in the ecosystem. Values above 35 to 40 percent are of concern to most forest biologists and entomologists because of the increased risk of insect population growth. Optimum tree vigor for the Southwest is between 10 and 35 percent. The optimum SDI range for adequate forage production while maintaining optimum tree cover appears to be between 25 and 35 percent (Cassidy 1998). Preliminary studies indicate an SDI value of 25 percent of maximum would yield 40 percent canopy closure and 40 percent maximum SDI would yield a value near 60 percent canopy closure (Cassidy 1998).

The watershed currently has an average stand density index of 33 percent. Individual stands range from 7 to 143 percent of the maximum. Ponderosa pine stands within the watershed average 30 percent SDI (range 10 to 70) compared to 44 percent (range 15 to 99) in the Douglas-fir (mixed conifer) stands. The small number of piñon-juniper stands with data revealed an average 34 percent SDI with a range between 6 and 76.

3.10.6 Crown Closure

Fires within the ponderosa pine ecosystem historically were frequent, low-intensity ground fires that enabled the oldest, largest trees to survive. Today, wildfires frequently move from the ground to the tree crowns in little time. These types of fires can destroy the function and structure of the ecosystem. Reducing fuel density below a critical threshold can greatly reduce the spread of fire within the canopy. According to Hollenstein et al. (2001), managing stands below 40 percent canopy cover would create more fire resilient stands with less potential of fire spreading from crown to crown. In order to create a fire resilient stand, large trees that have formed a dense, continuous canopy may have to be removed along with smaller trees that have created ladder fuels reaching into those canopies. Deciding which trees should be removed is based on several factors, such as: stand structure, tree health, expanse of group, and the amount of ladder fuels. Fuel treatments are effective in reducing canopy closure only if larger diameter trees are also thinned where necessary (Blue Ridge 2000).

The average crown cover for all the stands in the watershed that contain data is 37 percent. Within the stands proposed for treatment, canopy cover also averages 37 percent. Using the VSS values from RMRIS, the number of acres with crown closures above and below 40 percent has been calculated. Because there is no crown closure value assigned to uneven-aged stands, SDI was used to determine approximate crown closure. Based on the silvicultural analysis, the watershed contains approximately 31,330 acres of stands with less than 40 percent crown closure, and about 25,680 acres with crown closure greater than or equal to 40 percent. Within the proposed treatment stands, 10,394 acres are less than 40 percent crown closure and 4,949 acres are greater than or equal to 40 percent.

Stand assessments utilized stand examinations, field observations, nearest neighbor determinations, and aerial photograph interpretation provided a general range of canopy cover values for each treatment type. Within the piñon-juniper control units, crown cover is between 5 and 10 percent. The piñon-juniper wildland urban interface units contain about 35 to 55 percent cover. The piñon-juniper within the fuelbreak is diverse in crown cover ranging from 15 to 55 percent. While portions of the upland meadow units contain minimal cover (5 to 10 percent), parts are covered with mature ponderosa pine that provide up to 55 percent cover. In the ponderosa pine type, about 68 percent of the treatment acres contain a canopy cover less than 40 percent.

3.10.7 Environmental Consequences

No Action (Alternative B)

Direct and Indirect Effects on Treatment Types

Wildland Urban Interface

Under this alternative, no harvesting of the piñon-juniper woodland would occur. Stand basal area would exceed 90 and canopy cover would exceed 35 to 55 percent. Where present, understory trees would range from 100 to 400 trees per acre. Under the current conditions, the understory grass and shrub component is lacking and would continue to decrease as stand density increases. Repeated freezing and thawing of soil throughout the late fall, winter, and early spring in Southwestern piñon-juniper ecosystems results in loose soil surfaces. This soil is especially vulnerable to erosion during intense early-season monsoonal thunderstorms. Without herbaceous understory vegetation and residual organic matter to provide physical barriers to sediment movement, erosion can be a common occurrence (Farmer 1995). Where significant understory vegetation loss leads to seedbank depletion, there can be a major setback in the re-establishment of native vegetation communities (Koniak and Everett 1982). High stand densities and close or interlocking crowns would increase the potential of fire spread should fire reach the woodland canopy.

The risk of a stand-replacing fire is also slightly higher than that of the action alternatives. If the existing seedbank is not adequate following a stand-replacing fire event, poor understory re-establishment may accelerate soil erosion from the exposed site.

Piñon-Juniper Control Units

With no treatment, the piñon and juniper seedlings and saplings would continue to grow. Seed dispersed from mature trees in the stringers and from off-site sources would continue to establish the site. With no disturbance, the site would become densely stocked with piñon and juniper. Ponderosa pine would continue to be scattered throughout the stands. As stand density and crown cover increase, the existing understory vegetation would decline. Similar effects of increased tree cover on soils and understory vegetation as discussed under the WUI section above, would occur within the control units.

Fuelbreaks

Under this alternative, no fuelbreak would be created near the forest boundary. Piñon-juniper woodlands with some scattered ponderosa pine would continue to increase in density. Canopy cover would continue to increase with stand density. Ladder fuels capable of carrying a fire into the canopy may or may not be present, depending on site-specific stand characteristics. As a result of not manipulating the forest vegetation, there would be no defensible space from which fire crews could make a stance against an advancing fire.

Upland Meadows

Under this alternative, none of the planted seedlings would be cut. Existing seedlings would continue to grow. However, because of site conditions a majority would either die or display stagnant growth. Some seedlings, however, were planted in more favorable sites and are growing adequately. These sites would become densely stocked if the seedlings/saplings were not thinned. This alternative would allow healthy trees to extend the forest/grassland ecotone into what once were grasslands. In addition, poor growing trees would remain on unfavorable sites further degrading the grassland/meadow component of the ecosystem.

Ponderosa Pine Restoration Areas

Under this alternative, no mechanical treatments or prescribed burning would occur to manipulate forest vegetation. Instead, the ponderosa pine ecosystem would be allowed to progress in a state outside the natural range of variability that existed over the past millennium (Allen et al. 2002). Unlike the historic, heterogeneous, ponderosa pine ecosystem, the Bluewater watershed would move closer to a homogeneous structure both at the local and landscape level. Dense stands of young trees would become even denser as regeneration of ponderosa pine and shade tolerant species increase. Fire susceptible piñon pine and juniper species would expand into ponderosa pine stands at lower elevations while Douglas-fir would move into higher elevations pine stands. Tree vigor and growth would be low and evapo-transpiration would be higher than historic levels. The resulting stand would be increasingly susceptible to insect attack. While other species move into ponderosa stands, ponderosa would further encroach into meadows and riparian areas further decreasing the grass, forbs, and shrub components. Few natural openings would occur throughout the landscape.

Densely stocked, small diameter trees would compete for available resources and threaten the vigor and life span of old, large diameter trees. In addition, the small trees serve as fuel ladders to bring surface fire into the canopy. The continuous canopy would create increasingly extensive crown fires leading to a stand-replacing event. Overstocked stands are also more susceptible to insect attack. During an insect population build-up, low vigor trees would be less likely to survive an attack. As mortality rates of old, large diameter trees increase as a result of the above, an important structural element is removed for the ponderosa pine ecosystem. Under dense stand conditions, the growth of large diameter trees would be a rare occurrence.

Understory herbaceous vegetation and shrubs are currently lacking within the Bluewater ecosystem. As stand density continues to increase, the productivity, abundance, and diversity of grasses, forbs, and shrubs would continue to decrease. Deep mats of slowly decomposing pine needles would replace herbaceous vegetation, an important ecosystem component. Nutrient cycling would be considerably slower than historic rates.

Densely stocked stands with both vertical and horizontal fuel continuity would increase the risk of a catastrophic, stand-replacing fire. These fires typically did not occur within healthy ponderosa pine ecosystems. Following a catastrophic fire event, early successional stages of grasses, forbs, and shrubs would persist for decades to centuries because ponderosa pine seed production and regeneration are erratic. In addition, the heavy, wingless seed only disperses 66 to 132 feet from the parent tree (Allen et al. 2002, USDA 1965). The historic, frequent, low-intensity fire regime that created and maintained healthy and resilient ponderosa pine stands would not be returned to the Bluewater watershed with this alternative. With the current soil cover/lack of herbaceous vegetation, a stand-replacing fire could cause serious erosion potential. Grass seed banks are low; therefore re-establishment of the herbaceous component could be slow or non-existent. Without duff or herbaceous plants in place, erosion could be rampant. Also the soil surface would be harsh for herbaceous seed germination.

Direct and Indirect Effects on Old Growth

Under this alternative, no management actions would be taken to improve current old growth stands or to move potential stands toward old growth characteristics. The stands identified as potential old growth in the Bluewater watershed during 1987 would retain their designation until some disturbance factor eliminates its qualifying characteristics or field validation determines they do not meet old growth standards.

Stand densities would continue to increase as existing trees grow and new trees become established. Seedlings, saplings, and pole-sized trees would continue to create fuel ladders and compete with existing large trees for resources. Increasing ladder fuels, stand densities, and canopy closures would increase the fire hazard near existing large, old trees and old growth stands. Where fires historically were frequent enough to help maintain old growth ponderosa pine conditions, a fire with the existing forest conditions could totally destroy the trees that were historically protected (Covington and Moore 1992; Harrington and Sackett 1992).

A catastrophic wildland fire, especially a crown fire, could significantly reduce the amount of potential and existing old growth within the Bluewater watershed. In addition, inter-tree competition with increasing stand densities would stress trees and leave them more susceptible to insect and disease damage and/or mortality.

Direct and Indirect Effects on Insects and Disease

Stand density index (SDI) is a good measure of relative stand density and the "stress" that trees within a stand are experiencing. At 25 percent, stand canopy closure occurs. At 35 percent, the site is fully stocked with trees, inter-tree competition for resources begins, and insects and disease become a factor. For each additional tree added to the fully stocked stand, individual tree growth and vigor is reduced. Once a stand reaches 60 percent, the stand is stressed and inter-tree competition causes tree mortality. Trees with low vigor are more susceptible to disease and insect attacks.

Western pine beetle populations may increase within the watershed when drought and disease are associated with the highly susceptible stand condition of dense stands. Maintaining the ponderosa pine type in a dense, non-vigorous, stressed state would increase the risk of a western pine beetle epidemic. Although western pine beetle would attack any trees greater than 6 inches diameter, they most commonly attack large, old trees. A western pine beetle epidemic would threaten the continued existence of the older structural stages within the watershed.

Endemic population levels of Ips or western pine beetle would kill widely scattered, individual trees across the watershed. However, overstocked stand conditions with low vigor trees coupled with drought could trigger population outbreaks leading to heavy tree mortality. The Cibola National Forest has had winter drought conditions for five of the last seven years (Rogers 2002). However, to date, the Zuni Mountains have had non-detectable levels of insect activity (Annual Insect Aerial Detection Surveys) either in the ponderosa pine or piñon-juniper cover types.

The average SDIs for the watershed and project area are 33 and 26 percent, respectively. However, individual stands range from 7 to 143 percent. With no forest management, the SDIs would continue to rise. Stands at or above 35 percent maximum SDI would continue to be susceptible to insect attacks. Some stands are currently below 35 percent, but stand growth and potential regeneration would move the stands toward higher SDI levels through time. Regardless of past insect trends, the watershed still has the potential of experiencing epidemic insect levels with its corresponding tree mortality.

Dwarf mistletoe infection levels would continue to rise within infected stands and spread to uninfected trees. The rate of spread would be approximately 1.2 feet per year in these dense stands (USDA 1974). Dense stands suppress seed production and shade out lower branches that are usually the most heavily infected. As a result of high canopy closures, dwarf mistletoe infections become latent (British Columbia Ministry of Forests 1995). The level of infection and rate of spread would be less with the No Action alternative than with the action alternatives (Alternatives A and C).

Direct and Indirect Effects on Stand Structure

Under the No Action Alternative, stand structure would remain as described in Table 17. VSS classes 2, 3, and 4 meet goshawk guidelines. However, the watershed contains an overabundance of stands in the VSS 3 class. VSS classes 1, 5, and 6 are lacking. Without a fire or other disturbance, stands would continue to become more dense and multi-storied. Multiple canopy layers would occur uniformly across the stand. Tree growth would slow and depending upon density, may stagnate. Stands would take longer to move into larger VSS classes. Larger VSS class stands would have an increased probability of being lost during a fire due to ladder fuels. Conifer encroachment into natural openings, meadows, and riparian areas would reduce the already low grass/forbs/shrub component. The longer the ponderosa pine ecosystem goes without a disturbance factor, the further it moves from resilient, historic conditions. Piñon-juniper woodlands would also increase in density and crown cover. The herbaceous understory would disappear. If a fire were to start in either forest type, a catastrophic, stand-replacing event could occur. Both systems would then revert back to a VSS 1 stage. The rate of re-establishment on these sites depends upon the area destroyed and the presence of an available seed source.

Direct and Indirect Effects on Stand Density Index (SDI)

Stand density index values would continue to increase across the Bluewater watershed. Stands currently near or beyond a maximum SDI of 60 would experience density-related mortality. SDI within these stands would remain stable or decrease slightly as mortality opens space for remaining trees. However, the remaining trees would increase in size, which would increase the SDI. Stands above 35 percent may begin to see a reduction in tree vigor and an increased risk of insect infestation. Any insect outbreaks resulting from high stand densities would create stand mortality and a reduction in SDI. Tree mortality resulting from the above high SDI values would increase fuel loading, especially over time as the material falls to the ground.

Direct and Indirect Effects on Crown Closure

As forest stands progress in their development, crown closure levels would continue to increase across the entire landscape. In the denser stands, close or interlocking crowns would enable fire to spread easily through the forest canopy. In the stands with currently low crown closure, crown fire hazard would be low. However, through time the crown fire hazard would increase across the landscape as stand density and crown closure increased. Regeneration would create ladder fuels and increased canopy cover. Conifer encroachment into meadows and forest openings would lead to a continuous canopy layer where the historic landscape had a highly discontinuous canopy. Stands capable of supporting Douglas-fir would, over time and without a fire disturbance event, experience in-growth of this more shade-tolerant species. Douglas-fir produces denser crowns and can grow at higher stand densities. Although the higher canopy covers would better meet goshawk habitat guidelines (crown cover between 40 and 70 percent), they would put forest stands at a higher risk for a catastrophic, stand-replacing fire.

Proposed Action (Alternative A)

<u>Direct and Indirect Effects on Treatment Types</u>

Wildland Urban Interface

The piñon-juniper woodland would be patch cut along the Wildland Urban Interface and all slash would be broadcast burned. This treatment would not mimic natural woodland conditions, but would disrupt the continuous fuels present along the interface while maintaining wildlife habitat components. Although reducing canopy closure should stimulate grass and shrub establishment and production, the actual outcome would depend upon the current seed bank and subsequent moisture patterns. Moisture following the treatment is necessary for the understory to respond. The moisture pattern would dictate how the understory responds through time. If the seed bank is lacking, understory vegetation may be at low levels for the short-term. This alternative proposes to broadcast burn slash 1 to 2 years following implementation of the treatment. The short-term retention of slash would provide physical barriers to soil movement and conserve nutrient and water resources. Slash retention, therefore, may enhance understory re-establishment. If understory re-establishment does not occur prior to broadcast burning, however, soil would be exposed to wind and water erosion.

Piñon-Juniper Control Units

Alternative A proposes to patch cut existing piñon and juniper trees while retaining additional areas for wildlife habitat. Five-acre patches and stringers of piñon, juniper, and ponderosa, where available, would be left to provide wildlife thermal and hiding cover. These patches and stringers would be retained throughout future clearing treatments in order to continue providing wildlife habitat. Material that is cut would then be lopped and scattered across the site. Approximately 1 to 2 years following the mechanical treatment, the area would be broadcast burned. Refer to the fuelbreak discussion below for effects of broadcast burning in the piñon-juniper woodland. If slash has accumulated at the base of residual trees, a broadcast burn could cause tree mortality since juniper and piñon pine are susceptible to fire (Paysen et al. 2000). Re-establishment of piñon and juniper would occur slowly after the fire as seeds are dispersed by birds and animals. Seedling establishment would be favored in the shade of live and dead vegetation. Periodic (10 to 15 years) mechanical treatments or prescribed burning would help maintain the desired early seral grass/shrub community. If the herbaceous community is re-established and grazing is managed properly, herbaceous plant competition would slow woodland re-establishment.

Fuelbreaks

Alternative A proposes to thin a 400-foot corridor through the existing piñon-juniper woodland. Some dog-hair ponderosa pine stands would also be thinned within the fuelbreak. This alternative is designed for fuel reduction and fire suppression purposes. The fuelbreak prescription would move approximately 475 acres of woodland toward its more historic savanna-like characteristics. This treatment would allow residual trees to increase in size and vigor. The area would be less likely to support a crown fire since canopy cover and ladder fuels would be reduced. Some of the down material would be removed under the personal use fuelwood program. However, the majority of material would be left on site and broadcast burned.

Broadcast burning releases nutrients, kills weed seeds and small trees left after mechanical treatment, and reduces fuel loading. Under heavy post-treatment fuel loadings, burning can remove barriers to seed germination by opening up the soil surface (Evans 1988) to more sunlight. There are disadvantages to broadcast burning in piñon-juniper woodland however. High intensity fires can bare the soil surface and create harsh seedbed conditions, thereby deterring natural plant establishment. Exposing the soil surface can also increase wind and water erosion. In order to minimize the potential deleterious effects of broadcast burning the piñon-juniper woodland, burning would occur under cool, moist conditions (Evans 1988). Follow-up treatments of burning or harvest would be necessary every 10 to 15 years to maintain the benefits and function of the fuelbreak.

Upland Meadows

A majority of the seedlings and saplings within the grassland/meadow community would be cut under this alternative. Material would be lopped, scattered, and broadcast burned 1 to 2 years following the treatment. This treatment would remove stagnant, mal-adapted trees from unfavorable sites (grassland/meadow communities with unfavorable soils for conifer growth). The treatment would mimic the natural fire regime that would have periodically removed seedlings and enhanced the grass/fords component. This alternative would restore the grassland/meadow communities within the Bluewater watershed. Burning the sites would stimulate nutrient cycling and grass production. Recurrent treatments of either mechanical removal, prescribed fire, or natural fire would be needed to prevent future conifer encroachment into the grasslands.

Ponderosa Pine Restoration Areas

Ponderosa pine stands included within the proposed action would be treated with a restoration silvicultural prescription. This prescription would reduce stand densities, create a multi-aged forest with even-age groups, create diverse canopy structure and spatial distribution, and restore ecological processes such that a more fire-resilient ecosystem is present. Reducing stand density through mechanical means or prescribed fire would increase forest resilience to natural disturbance events such as fire, insects, regional drought and the reduced risk of catastrophic fire events (Allen et al. 2002). A resilient stand or ecosystem is one that would quickly “bounce back” following a disturbance event. Under historic conditions, ponderosa pine was both resilient and resistant to disturbance factors. The restoration silvicultural prescription is designed to return ponderosa pine stands within the Bluewater watershed back to a more resilient and resistant condition. The desired structure may or may not be present immediately after treatment. However, in the long-term, the ponderosa system would contain the desired historic structure able to withstand fire, insects, and regional drought events. Use of frequent, low-intensity surface fires within the treated area would be essential to re-establish trends in forest processes that would move the stand toward historic structures (Allen et al. 2002).

Extensive stand-replacing fires naturally occurred in many western forest types (Agee 1993), but not the Southwestern ponderosa pine forests (Swetnam and Baisan 1996). Current forest conditions within the Bluewater watershed would be able to support crown and stand-replacing fires. Through implementation of this alternative, vertical and horizontal fuel continuity would be greatly reduced, thereby decreasing crown fire risk. Treatment areas outside northern goshawk post-family fledging areas and nest sites would reduce crown canopy closure below 40 percent. This has been demonstrated to be a threshold value for crown fire initiation (Hollenstein et al. 2001). Thinning from below would remove ladder fuels and open the canopy layer. Creation or maintenance of natural openings would further reduce fuel continuity. Although some of the larger crowns may be interlocking or close together in residual leave groups, adequate spacing around the trees should interrupt/discourage crown fire spread. A more open stand structure would stimulate tree growth and the creation of large diameter, thicker barked, more fire-resistant ponderosa pine. These trees would be able to survive reintroduction of a frequent, low-intensity fire regime.

In 2002, results from "A Strategic Assessment of Fire Hazard in New Mexico" (Fiedler et al. 2002) were published. The study included potential fire hazards in ponderosa pine/dry mixed conifer stands throughout New Mexico following three thinning treatments: 1) thin from below – remove all trees smaller than 9"; 2) diameter limit – reserve all trees >16", reserve <16" if necessary to meet 50 sqft/ac; and 3) comprehensive – ecologically based, reserve a target basal area of 40-50 sqft/ac, primarily comprised of larger trees. The study revealed that thinning from below moved only 29 percent of the treated stands to a low fire hazard category. After 30 years, most of the acres had to be thinned again and only 20 percent remained in the low hazard category. In contrast, the other treatments shifted 69 percent of the treated stands to a low hazard category with over one-half of the stands remaining in this category after 30 years. Although the diameter limit treatment produced similar long-range hazard reduction, the comprehensive treatment that considered density, structure, and species composition produced more ecological benefits (Fiedler et al. 2002).

Treatments designed to reduce catastrophic fire hazard would also benefit wildlife. Reducing stand density and opening the forest canopy would result in less evapo-transpiration from trees, increased sunlight to the forest floor, and the stimulation of a more abundant, diverse, and vigorous grass, forbs, and shrub components. Introduction of periodic low-intensity fire would also improve nutrient cycling. The restoration prescription is also designed to maintain structural complexity such as dense thickets of ponderosa pine, oaks, snags, large logs, deformed trees, and clumps of large diameter ponderosa with interlocking crowns. These features would be left throughout the treatment area at differing scales (sizes). The prescribed treatment would build upon existing forest structures; such as large trees and groups of trees with interlocking crowns. Within the homogenous single and two-storied stands, the post-treatment structure would be designed to "grow" these features. Under this alternative, a diverse array of even-age groups would be retained across the landscape for structural and genetic diversity.

Broadcast burning slash within treatment units at least one to two years following project implementation would serve to reduce fuel loading, increase nutrient cycling, and kill seedlings and saplings left after the mechanical treatment. The broadcast burn would be the first step in the re-introduction of low-intensity fires on the landscape. In order to maintain the treatment and facilitate further ecosystem restoration, prescribed or natural wildland fire would need to continue on a frequent return interval. Burning slash would release the high concentration of nutrients held within the needles, twigs, and branches. Residual trees would rapidly take up and utilize the readily available nutrients, thereby improving tree vigor and growth rates. Retention of coarse woody debris would facilitate the slow release of nutrients for future use. The burn would also remove much of the deep mat of pine needles that is inhibiting herbaceous and shrub establishment. However, removing too much ground cover may pose a potential threat of soil erosion following project implementation. Broadcast burning would kill many of the seedlings and saplings that were not removed during the mechanical treatment. In turn, it would create acceptable mineral soil seedbeds with little vegetation competition for new seedling establishment. Seedling establishment would be similar to that experienced under historic conditions. Future burns would serve to remove much of the regeneration so that ponderosa pine stand densities remain low. If no future burns occurred, stand densities would return to pre-treatment levels in the long-term.

Direct and Indirect Effects on Old Growth

This alternative proposes to treat about 6,500 acres of designated ponderosa pine old growth stands within the Bluewater watershed. Thirty-five percent of the ponderosa pine uneven-age management acres are designated as old growth. Three goshawk post-fledging family areas (PFA) and nesting areas are within the Bluewater project area's ponderosa pine forest and would be managed at levels consistent with old growth guidelines. These goshawk areas consist of 1,961 acres of ponderosa pine forest. About 1,127 acres (57%) of the goshawk PFA and nesting areas are currently listed as potential old growth. Treatments within the remaining 834 acres of goshawk habitat would be designed to "grow" the stand toward old growth characteristics.

With the restoration prescription, the approximately 11,600 acres not designated as old growth within the proposed action would be moved toward conditions better able to withstand fire occurrences. As a result of mechanical treatment and/or regular fires, these acres would "grow" toward old growth characteristics. Likewise, these characteristics would help stands withstand future fires resulting in additional old growth. Because of current stand conditions, it is not possible for all of the treated areas to contain old growth characteristics following initial treatment. However, stand variability in conjunction with this, as well as future treatments would facilitate old growth compositional, structural, and functional flow over time and across the Bluewater watershed. A "pipeline" of old growth stands would be created. Once the initial treatments were completed, future maintenance fires and mechanical treatments would be necessary to allow the forest ecosystem to become adapted and resilient to wildfires. Thinning or fire would also be necessary to reduce the amount of regeneration stimulated following treatments. Wildland fire should be allowed to return to its previous role in creating the desired, historic, and more old growth forest characteristics.

The restoration prescription would retain some of the dense, often stagnated thickets of seedlings, saplings, and pole-sized trees to create diversity and wildlife habitat. The majority of the stand would be thinned from below to remove ladder fuels, reduce crown fire risk, and stimulate the production of herbaceous understory vegetation. The prescription would enhance the characteristics of potential old growth stands and move other stands toward larger VSS classes through the removal of smaller vegetation. Although the focus would be to remove smaller vegetation, larger trees would also be removed when necessary to reduce inter-tree competition.

Treatment of the upland meadow stands would not change the present or future amount of old growth within the Bluewater watershed. However, treatment of these units could remove a fuel ladder source between the grassland and forested components adjacent to designated old growth stands. There would be no direct change in the amount of mixed conifer or aspen old growth under this alternative. Without treatment, many of the old aspen clones may be lost as a result of aspen's short life cycle, lack of disturbance processes such as fire, which clean and regenerate, and conifer encroachment.

There is only one 40 acre designated piñon-juniper old growth stand (#2197-0011, refer to Appendix D) identified within the proposed action treatment stands. This stand is within one of the piñon-juniper control blocks. Therefore, previous stand modification would have eliminated the old growth characteristic in all, but the leave-tree strips. The remaining old growth woodland stands are scattered throughout the piñon-juniper zone or adjacent to the proposed action's ponderosa pine stands.

Treatment within the woodland portions of the fuelbreak would create a more historic, savanna-like structure similar to old growth woodlands. However, because of the treatment's fuelbreak objective, the final stand may not meet the minimum criteria for structural attributes. Both the piñon-juniper control units and Wildland Urban Interface treatments would remove conifer vegetation within treatment blocks. The only remaining forest vegetation would be within the wildlife habitat clumps and stringers. Although these areas may contain some structural attributes of old growth, their size would reduce their effectiveness as old growth. With future management, these treatment units could be "grown" into woodland old growth. Overall, this alternative would not change the amount of designated piñon-juniper old growth within the Bluewater ecosystem.

Direct and Indirect Effects on Insects and Disease

Forest treatments of thinning from below would reduce stand density within the proposed treatment stands. Following the treatments, individual tree growth and vigor would increase as competition for resources decreases. Trees would be better able to defend themselves against low level insect attacks. Untreated stands with SDI levels greater than 35 percent would continue to be susceptible to insects. The proposed treatment stands constitute roughly 16 percent of the entire watershed. Although treated stands may be more resistant to insect attacks, population outbreaks within adjacent un-thinned stands could move into treated stands and cause mortality.

Thinning dense stands of ponderosa pine, so that the crowns are no longer touching, would relieve competitive stress among the remaining trees. Relieving tree stress would make the trees less susceptible to western pine beetle attack. Thinning stands to SDI levels at or below 25 percent (initiation of crown closure) would significantly improve a tree's ability to defend itself against the western pine beetle and other forest insects. Western pine beetle is rarely found in pine slash. Therefore, the proposed slash treatments would have little affect upon this insect. Alternative A would create stands less susceptible to western pine beetle attack than compared to the No Action Alternative because inter-tree competition would be reduced and trees would be more vigorous. However, scorched or dead residual trees as a result of prescribed burning may attract western pine beetle into the stand. The potential for insect damage depends upon the post-burn stand condition.

While reducing stand density and improving tree vigor would reduce insect susceptibility, green material (slash) placed on the forest floor would place treated stands at risk for Ips population build-ups. Ips can produce 3 to 4 generations within a single season. The beetles move from green material to green material. If the green slash present is insufficient to support the existing population, surrounding standing live trees would be vulnerable to attack.

The best time to create slash is August through December (Allen-Reid 2002). There will be fewer beetles flying at this time and the slash would dry out sufficiently to render it unsuitable for the beetle's first flight in March or April. Beetle-induced tree mortality is a real possibility with harvest/thinning operations occurring from January through July (Allen-Reid 2002). In addition to timing, slash should be placed in open, sunny locations to further facilitate drying. Ips hazard increases if treatments are repeated annually in close proximity.

Alternative A proposes to mechanically treat the same acres using the same silvicultural prescriptions as Alternative C with the exception of the Sawyer Mexican Spotted Owl Protected Activity Centers (MSO PAC). Several management and slash treatment options are available to reduce the risk of Ips population buildup. They are:

- Create slash from August through December (Allen-Reid 2002)
- Avoid creation of large, contiguous acres of slash in consecutive years (Kegley et al. 1997)
- Lop slash into smaller pieces and scatter in open, sunny locations (Kegley et al. 1997)

- Create a continuous supply of fresh slash during the flight period (“green chaining”) (Kegley et al. 1997)
- Avoid damaging residual stand to reduce the risk of attracting beetles (Kegley et al. 1997)

Ips should not be a problem in the piñon-juniper control units or the upland meadow treatment areas since the material would be lopped and scattered in predominantly open, sunny areas and should dry quickly. Almost all of the piñon and juniper cut within the WUI areas would be removed through firewood collection as soon as it is cut. The risk of Ips population build-ups in these treatment areas would be low. There is a chance that the fuelbreak would attract insects, but the fuelbreak implementation would create a “green chain” which reduces the potential for insects to attack residual trees.

The potential for creating high Ips population levels with this alternative exist for the following reasons:

- Slash would be created over large, contiguous acres of ponderosa pine in consecutive years.
- Slash could be created throughout the snow-free season to meet the proposed treatment schedule.
- Slash treatment through prescribed broadcast burning or pile burning would occur on treatment acres, but would not be implemented until 1 to 3 years following tree cutting.

Dwarf mistletoe infection would spread at about 1.7 feet per year in the thinned, more open stands (USDA 1974). Once stands are treated, latent mistletoe infections may become activated by the increased sunlight in the crown (British Columbia Ministry of Forests 1995). Infection levels would increase faster with the ponderosa pine thinning than the no action alternative since crown canopies would be opened. However, stand clumpiness would inhibit the continuous spread of mistletoe (Fletcher 2001). Dwarf mistletoe levels can be reduced if infected trees are removed from the stand during treatment. Dwarf mistletoe occurrence would be considered in all silvicultural prescriptions for stand treatment.

Direct and Indirect Effects on Stand Structure

Stands identified as seedlings (VSS 1) in the proposed treatment are within the Upland Meadow treatment areas and, although planned for treatment they would remain in the seedling category. There are no VSS 2 stands to be treated within this alternative. Therefore, there would be no change in this class. The grass/forbs/shrub stage is lacking slightly according to available data. However, large blocks of riparian/grassland vegetation do occur (as described above) that would increase the total acres to acceptable levels. In addition, some stands designated at the upper VSS classes actually contain a percentage of VSS 1 and 2 (Upland Meadow). Following treatment, these stands would also contribute to grass/forbs/shrub acres. Implementation of the ponderosa pine prescription would also create temporary VSS 1 openings throughout the landscape. Although these openings would gradually move into progressively higher VSS classes without future treatment, maintenance treatments (mechanical or fire) could retain these areas at the VSS 1 class where needed. Piñon-juniper Control Unit and WUI treatments would also create grass/forbs/shrub acres. The WUI acres would gradually move to higher VSS class, but the control units are designed for continued maintenance in VSS 1 status.

The majority of watershed acres reside in the VSS 3 class. Thinning from below would remove the smaller trees in VSS 3 and 4. As a result, the stands would move toward higher VSS classes in both the short- and long-term, depending upon existing stand conditions. Removal of smaller, competing trees would allow the residual stand to more rapidly increase in size and vigor and grow into VSS classes 5 and 6 in less time. Stands needing two entries to meet treatment objectives would take longer to move toward the larger VSS classes since complete treatment would be delayed. The ponderosa pine uneven-age management prescription objective is to create a more open, multi-aged forest condition with even-age clumps and a majority (at least 60%) of the biomass in VSS classes 4, 5, and 6. The Bluewater Ecosystem Management Project would not bring the watershed into the desired condition with a single treatment. Additional treatments within the watershed would be required in the future.

Direct and Indirect Effects on Stand Density Index (SDI)

The restoration prescriptions are designed to reduce SDI between 15 and 30 percent of maximum to produce healthy, vigorous, more open stands of ponderosa pine. The SDI in upland meadow treatment stands would change very little since the seedlings and saplings, at their current size and density, contribute only a small fraction to SDI. However, in the long-term, the upland meadow treatment would improve index values. The SDI within the fuelbreak and piñon-juniper control units would be reduced to less than 15 percent. These stands would essentially be open with minimal groupings of larger trees. With all of the treatments and lower SDI values, the treated stands would be more resistant to insects and disease and would produce higher growth rates.

Direct and Indirect Effects on Crown Closure

The proposed action was designed to reduce crown closure below 40 percent. Above this threshold value, fire could more easily spread through the forest canopy. The proposed action would achieve reduced crown fire hazard while achieving ecosystem restoration objectives. However, this action does not immediately achieve goshawk crown cover objectives. With the current average crown cover for the watershed and ponderosa pine already slightly below 40 percent, reducing cover with the proposed action would further reduce the watershed average in the short-term. The treatment proposes to thin from below (remove the smallest trees first) which would retain the larger VSS class tree that have the greatest crowns. The proposed treatment would reduce inter-tree competition and open up growing space so residual tree canopy densities could increase. Residual crown development would improve as competition for nutrients and water was decreased. Removing inter-tree competition would also allow the residual trees to grow more rapidly into VSS classes 4, 5, and 6 that support greater crown cover. Thinning from below would remove ladder fuels (smaller canopy trees) and potential for stand damage from wildfire. Reducing stand density would also improve tree resistance to insects and disease that could potentially lead to crown and tree mortality.

Preferred Alternative (Alternative C)

Direct and Indirect Effects on Treatment Types

Wildland Urban Interface

The piñon-juniper woodland would be patch cut along the WUI as described in Alternative A. Downed material that is not removed for fuelwood would be lopped and scattered. However, in areas where woody material exceeds 10 tons per acre, slash would be piled and burned. The results of this alternative's slash treatment would be the same as those described in the fuelbreak affects below.

Piñon -Juniper Control Units

Alternative C proposes to cut piñon and juniper trees as described in Alternative A. Material that is cut would be lopped and scattered. Any seedlings not removed mechanically would continue to grow and occupy the site. Re-establishment of the site would occur slowly as birds and animals disperse seeds and on-site seeds germinate. Scattered slash would provide microsites favorable to seedling establishment. The treatment would allow understory vegetation to increase as competition for moisture and light are reduced. The slash would provide soil protection and hold soil moisture longer on treated sites. Leaving conifer needles and twigs, which contain high amounts of nutrients, would benefit nutrient cycling and soil productivity. The effects of lopping and scattering slash are described in the fuelbreak section below. Periodic (10 to 15 years) mechanical treatments or prescribed burning would help maintain the desired early seral grass/shrub community. If the herbaceous community is re-established and grazing is managed properly, herbaceous plant competition would slow conifer encroachment.

Fuelbreak

Slash treatment is the only difference between the action alternatives. Under this alternative, pile burning would occur in areas where the fuel load exceeded 10 tons per acre after mechanical treatments. Burning large piles of slash has the potential for adverse impacts to soil productivity (USDA 1993). Therefore, if piling is necessary the piles should remain small.

According to the literature, lop and scatter is the preferred method of slash disposal in the woodland. Scattering residual logging slash across the harvested area would promote growth of herbaceous vegetation by providing partial shade, stabilizing the soil surface from erosion, and preventing close grazing by ungulates around re-vegetating areas (Loftin et al. 1995, USDA 1993, Brockway et al. 2002). Leaving slash on the ground to slowly decay provides a slow release of nutrients and soil cover. As the slash cover decays, soil cover actually would increase as live plant cover increases (Evans 1988). Research in New Mexico indicates the most desirable hydrologic response following a woodland treatment came from scattering slash. Hydrologic benefits included less runoff and sediment loss, high soil moisture, and high grass production (Wood and Javed 1992).

Upland Meadow

This treatment would produce the same results as those described under Alternative A. This treatment would mimic the natural fire regime that would have periodically killed seedlings and moved the ecotone back toward the forest. The only major difference between this alternative and Alternative A is that not all of the treated stands would be burned. Nutrient cycling would occur at a faster rate in the burned stands than in the unburned. Unburned slash would produce a slightly higher fire risk for 1 to 2 years after project implementation while fine flashy fuels exist. However, due to the current size of trees to be cut, this risk would be low.

Ponderosa Pine Restoration Areas

The effects of this alternative are the same as describe above in Alternative A. Within the Sawyer MSO PAC, standards and guidelines limit the amount of forest vegetation manipulation that can occur. As a result, only trees less than 9 inches DBH would be removed, such as ladder fuels that could carry a fire into the tree canopy. However, a continuous overstory canopy would still be present to carry a crown fire should one enter the PAC. Removing the smaller trees would reduce stand density and inter-tree competition and allow the residual trees to grow more rapidly into larger VSS classes desirable for the Mexican spotted owl. However, residual tree growth rates would be less than those experienced in the ponderosa pine restoration stands that would be treated without diameter cutting limits. Slash generated within the PAC, if it exceeded wildlife needs, would be piled and burned. Pile burning versus broadcast burning would reduce the potential of residual tree mortality since the burn is concentrated over fewer acres. However, many of the beneficial effects of broadcast burning would not occur.

The effects of broadcast burning in this alternative would be the same as those described under Alternative A. Some mechanically treated stands, however, are not part of the designated broadcast burn blocks and therefore slash would be piled and burned. Although pile burning reduces fuel loading, it fails to produce the same ecological benefits of broadcast burning. Within pile burn stands, there would be no removal of seedlings and saplings or creation of acceptable seedbeds. Pile burning would release nutrients held in the slash, but nutrients would be concentrated. Disturbance of the deep pine needle mat to facilitate herbaceous and shrub establishment would occur only in areas where mechanized harvest activities occurred. On the other hand, more short-term soil protection would occur with the retention of the needle mat. Soil protection under this alternative would be a combination of coarse woody debris and pine needle mat in the pile burned stands or coarse woody debris and live vegetation in the broadcast burned stands.

With this alternative, there would be approximately 6,840 acres of mechanically untreated stands that would undergo a low-intensity broadcast burn. The burning would remove the deep pine needle mat to facilitate herbaceous and shrub establishment, kill small diameter trees, reduce surface fuel loading, and release nutrients. Herbaceous and shrub establishment would tend to be lower in the untreated versus treated stands since the overstory canopy would still be dense. The heavy, often continuous canopy cover would still be available to carry a crown fire should one enter the stand. Nutrient release within the mechanically untreated stands would be less than in the treated stands since fewer nutrient-rich, fine materials would be burned.

It is assumed that some trees would torch and small groups of trees would be killed in the mechanically untreated stands due to stand characteristics and more intense fire behavior. This fire activity, however, would serve to open the canopy and create a more diverse stand structure than if the fire remained on the ground. If a crown fire were started as a result of the burn, thousands of acres of forest would be returned to an early successional grass, forbs, shrub, seedling stage. Although crown fires did not historically occur within the Southwestern ponderosa pine ecosystem (Swetnam and Baisan 1996), the resulting forest structure would add to structural and species diversity in this currently dense, homogenous landscape. Mitigation measures listed in Appendix C would be used to minimize the risk of high intensity crown fire during prescribed burning activities.

Direct and Indirect Effects on Old Growth

The effects of this alternative upon old growth would be similar to those described in Alternative A. This alternative proposes to treat about 6,645 acres of old growth. One hundred fifty-two acres of potential old growth within the MSO PAC are included in the above total. Because of the 9-inch upper diameter cutting restriction with a MSO PAC, the ability to create additional old growth conditions is limited. Large diameter trees would be released from small diameter, inter-tree competition. In addition, conifer ladder fuels would be reduced. Densities of large diameter trees would be greater than that typically evidenced in historic ponderosa pine stands. The MSO PAC acres would continue to contain old growth characteristics.

In Alternative C, prescribed burning would occur outside mechanically treated stands. Within the untreated portions of this alternative’s burn blocks there are 353 acres of ponderosa pine, 29 acres of mixed conifer, and 65 acres of piñon-juniper designated old growth. The stands are typically uneven-aged with variable stand densities. Although individual trees or portions of stands may be injured or killed during the prescribed burn, the loss would be within Forest Plan guidelines since potential old growth would still be greater than 20 percent for each forest type. Given the dense, often multi-storied nature of the untreated stands, there is a possibility for the understory burn to torch out individual trees or to move into the canopy. The existence of untreated ladder fuels would increase the possibility of torching and crowning. Stands within the untreated area may contain old growth characteristics essential for the creation of future replacement stands. Use of mitigation measures would reduce the risk of stand loss.

Direct and Indirect Effects on Insects and Disease

Direct and indirect effects under this alternative are similar to those described above under the Proposed Action. Alternative C proposes to broadcast burn through stands that have not been mechanically treated. Tree scorch in conjunction with the dense, stressed stand condition could attract western pine beetle. As long as the area of scorch is limited, the possibility of population build-ups should be low. However, if enough damage occurs to the residual stand, beetle populations could build and move into undamaged green trees.

Direct and Indirect Effects on Stand Structure

The effects of Alternative C upon stand structure would be similar to those described in Alternative A. Cutting only conifers less than 9 inches in diameter within the MSO PAC would increase the structural stage only slightly. Removing the smaller, competing trees would allow the residual stand to increase in growth and vigor. As a result, the MSO PAC stands would move toward higher VSS classes. However, the progression would not be as rapid as that in the ponderosa pine uneven-age management stands due to the diameter cutting limit; but it would be faster than under the No Action alternative.

Stand structure within the prescribed burn blocks outside treated areas may change depending upon fire behavior. With a low-intensity understory burn, only very small or individual trees would be killed. The VSS class most likely would not change. Mortality in pockets may change stand structure depending upon the size and frequency of pockets and the size of trees killed.

Direct and Indirect Effects on Stand Density Index (SDI)

The SDI information for Alternative A also applies to this alternative. The only difference would be within the MSO PAC. The SDI values within the MSO PAC stands are currently low, ranging from 9 to 36 percent. Because of the strict cutting limits (conifer less than 9 inches in diameter) and limited amount of material to remove, the SDI values would change only slightly. In general, the thinning treatment would reduce the SDI less than 5 percent given cutting restrictions and currently low values.

Prescribed burning and subsequent fire-caused mortality could reduce SDI in untreated stands. The amount of SDI reduction would depend upon the effects of the burn. However, a reduction in SDI would benefit the stand and watershed for the reasons described under Alternative A.

Direct and Indirect Effects on Crown Closure

The effects of Alternative C would be the same as those described above under Alternative A. Because only trees less than 9 inches in diameter would be removed from the Sawyer MSO PAC, crown closure for the PAC would only be reduced slightly and for the short-term. Residual tree canopy densities would increase with reduced inter-tree competition. Prescribed burning outside of treated stands could potentially reduce crown closure depending upon stand characteristics and burning conditions. There is a potential for individual tree or stand torching and/or crowning within untreated stands that would reduce crown closure.

Cumulative Effects

The past, present, and reasonably foreseeable actions that would be used to determine cumulative effects upon the forested vegetation have been listed within the Forested Vegetation Existing Condition report, which is available upon request. In addition to the actions listed in this report, activity on private land within the watershed was determined. A private landowner within the Monighan treatment block began a ponderosa pine overstory removal harvest project during the summer of 2002. The landowner proposes to harvest 2 to 4 sections (1,280 to 2,560 acres) of forested land leaving about 20 to 40 of the smaller diameter trees. The New Mexico State-issued permit for this activity expires at the end of 2003. However, State forestry officials anticipate that this will be an on-going project on the private land (T. Haines, personal communication).

Old Growth

During 2002, the Mt. Taylor Ranger District began analyzing a project that would protect large diameter ponderosa pine from the ensuing drought conditions (Large Diameter Tree Protection From Drought CE). That project proposes to thin understory and selected intra-group competitors to reduce basal area and canopy closure within identified groups. Heavy concentrations of needles, duff, and project-created slash would be removed from the bases of the larger trees. Upon approval of this project, localized protection would be implemented on designated potential old growth stands. The localized treatments most likely would not influence the behavior and effects of a catastrophic, stand-replacing, crown fire that could start in other locations within the watershed.

Implementation of this project within the Bluewater watershed, in addition to one of the action alternatives, would increase the number of acres with old growth characteristics treated to protect larger trees. This project would facilitate better growing conditions around large diameter trees and would provide some protection from fire. However, because the treatment would only be implemented within designated stands, no additional acres of old growth would be created other than those identified. Because the proposed project would remove ladder fuels from around large diameter trees, reduce the risk of large tree torching and crowning, and improve growing conditions, there would be no negative cumulative effects from the implementation of this treatment when combined with the Bluewater Ecosystem Management project.

In April 2003, approximately 2 acres of designated ponderosa pine old growth stand (stand 002326-0003), were mechanically treated by thinning from below to remove ladder fuels under the Ecological Restoration of Southwestern Ponderosa Pine Demonstration Unit project. Some trees up to 16 inches were removed to reduce interlocking crowns, open up the canopy, remove unhealthy trees, and reduce inter-tree competition. The treatment moved these 2 acres toward better old growth characteristics while reducing the risk of a crown fire.

The remaining 63 acres of this designated old growth stand would be treated under a similar prescription under either action alternative. No further cutting would occur within the previously treated section. However, slash treatment of the 2 acres would occur at the same time as the remainder of the stand. There are no cumulative effects from this treatment since the type of treatment is the same as proposed and the area is very small in size.

Vegetation Treatment Types

Piñon-Juniper Control Units

The piñon-juniper control units were established in 1968 and 1971 with the intent to create productive grassland where piñon-juniper woodland existed due to fire suppression activities and encroachment. Since the treatment was not maintained, the units reverted back to piñon-juniper woodland. Implementation of either action alternative would convert the units back to grasslands. Without continued mechanical and fire activities, the area would remain woodland. However, with continued maintenance the area would be changed back to its historic grassland conditions with minimal piñon and juniper scattered throughout. The cumulative effect of this treatment upon the past piñon-juniper control treatment is a loss in woodland acres with an increase in meadow acres. Herbaceous vegetation was able to establish adequately in some portions of the treatment units. Removal of woodland trees species would facilitate further establishment and expansion of the herbaceous vegetation.

Upland Meadows

In the mid to late 1980's, about 3,300 acres of forestland were disked and planted with ponderosa pine following timber sale activities. Some of the seedlings were planted in historic meadow/grassland systems (determined from soil information). The action alternatives propose to remove 1,900 acres of planted seedlings, thereby restoring meadow/grassland ecosystems. There would be no negative cumulative effects upon the soil resource since seedlings did not historically belong on these sites. In addition, burning in the meadow/grassland is a natural process that would have removed encroaching trees, released nutrients, and improved herbaceous vegetation quality and quantity. There would be no negative effects upon the forest resource since removal of these trees would have been part of the historic fire process.

Ponderosa Pine Forest

The cumulative effects of the Bluewater Ecosystem Management Project combined with other Forest Service restoration projects, as described above under the Old Growth Section, would not contribute to significant effects. Harvest activity on the private land in the Monighan treatment block would greatly change the forest characteristics on 1,280 to 2,560 acres. This activity would reduce the overall canopy cover, density, and vegetation structural stage for these acres. Because private land was not used to determine landscape canopy cover, the change in canopy cover would not alter the estimates described in the canopy cover section. The harvested acres, in addition to acres treated with either action alternative, would serve to move any possible crown fire to the ground.

Past Projects

Approximately 300 cords of fuelwood (dead and down material) are removed from the Mt. Taylor Ranger District annually. Although this activity removes coarse woody debris, the dispersed nature of the activity creates only minimal negative effects upon available nutrients, soil stabilizing structures, and wildlife habitat. Implementation of the action alternatives would create excessive amounts of coarse woody debris. Although approximately 19,500 acres would be open for fuelwood removal, this activity would have negligible effects since nutrient-rich fine fuels and sufficient quantities of coarse woody debris would remain on site.

Approximately 480 acres of thinning were completed within proposed treatment units. These treatments removed small diameter trees so that residual tree growth rates would improve. Previous thinning would result in beneficial effects for implementing the restoration prescription and achieving management goals. Thinning from below within these stands would be lighter since much of the small material was already removed. Overstory trees would be healthy, vigorous, windfirm, and growing into higher VSS classes. Treatment of these stands with a single entry would be more likely since the stands are closer to desired condition compared to untreated stands.

Within proposed treatment units, about 7,238 acres previously supported a timber sale. Based on past sale maps, it was determine that 1,112 and 16 acres were actually part of 2 and 3 timber sales, respectively. Available information stated that original sales occurred in 1968 with the second and third sales occurring in 1985 and 1991. Effects within the previously treated stands would be similar to those described above. Residual trees would be more healthy, vigorous, windfirm, and growing into higher VSS classes. The more open canopy would aid in the establishment of herbaceous vegetation. Stands that supported previous timber sales would be closer to desired stand conditions and would most likely require less intensive management than previously untreated stands. No information was available to determine how logging slash was treated following the timber sale. Therefore, the exact effects upon the soil resource cannot be determined. The multiple timber sale activities, however, could be compared to an uneven-aged silvicultural system that required continuous entries into stands. Soil disturbance (soil displacement, rutting, compaction, soil churning) within these stands occurred with each entry. Implementation of the action alternatives should utilize existing skid trails and roads to minimize further soil disturbance.

3.10.8 Terrestrial Ecosystem Surveys

Southwestern Region soil scientists have completed a Terrestrial Ecosystem Survey (TES) for the Zuni Mountains on the Mt. Taylor Ranger District, Cibola National Forest. The TES is a system of inventory, classification, mapping, and management interpretations for terrestrial ecosystems. The classification is based on ecological types that are a unique combination of soil, vegetation, climate, slope, geology, and geomorphology. Classification is based upon potential conditions as opposed to existing conditions. However, in many situations, the potential is also the existing. Many management actions have been rated for limitations based on restrictive soil properties. Based upon the limitations and restrictive features of a particular map unit, project design or mitigation measures can be prescribed.

The Silvicultural Report, located in the project record, contains a listing of all the TES map units within the Bluewater Ecosystem Management project area. The table also contains information concerning ratings for timber harvest, unsurfaced roads, windthrow hazard, and revegetation potential. The project treatment areas (WUI, control units, fuelbreaks, upland meadows, and ponderosa pine) within a map unit have also been denoted on the table. Timber harvest limitations are considered when evaluating the impact of timber harvest on soils with regard to maintenance of soil productivity. Limits relate to year-round or seasonal use of equipment. A moderate or severe rating directs the land manger to areas in which mitigation may or may not be economically or reasonable used to avoid impairment of soil productivity. Logging systems can be employed that adequately overcome many limitations.

Road limitations are associated with unsurfaced roads of low design standards. A moderate or severe rating alerts the land manager to potential limitation in the construction and maintenance of these roads. Mitigation measures are designed to minimize damage to the soil resource. Windthrow hazard is based on the probability of trees being uprooted by the wind as a result of insufficient depth and/or bearing strength of the soil when wet to give adequate root anchorage. This rating does not account for stand density and special topographic features such as ridges, windward slopes, etc. A moderate or severe rating alerts the forest land manager to windthrow susceptibility. It indicates the need for careful consideration when planning forest thinning projects. Revegetation potential refers to the probable success and ease in the establishment of native grasses.

A preliminary assessment of the Best Management Practices (BMPs) needed to mitigate potential soil damage and non-point source pollution related to silvicultural activities was completed and provided in Appendix C. Prior to silvicultural prescription completion and project implementation, the general BMPs would be made site-specific for each treatment unit. Standard timber sale contract C clauses would also cover many of the necessary BMPs (skid trail layout, log landing location, etc).

3.11 Transportation Systems

3.11.1 Existing Roads and Uses

The analysis area contains 301 miles of Forest Service roads. Of this mileage, 27 miles are maintenance level 3: passenger car roads; 203 miles are maintenance level 2: high clearance/ four-wheel drive roads; and 71 miles are unclassified roads that are not present in our roads database. The Comparison of Alternatives table, found in Chapter 2, lists the number of miles that occur on NFS land that would be used in this project. The majority of the use in the watershed area occurs on maintenance level 3 roads. The level 2 roads primarily receive use by fuelwood cutters and hunters.

Unclassified roads are roads on NFS lands that are not managed as part of the forest transportation system. These are unplanned roads, such as abandoned travel ways and off-road vehicle tracks that have not been designated and managed as a trail, and roads that were once authorized, but never decommissioned upon completion of the work.

Primary access roads into the Bluewater analysis area are National Forest Service Roads (NFSR) 180, 178, 480, 569 and 50. Table 19 denotes the maintenance levels and features of each road. The Federal Highway Administration has planned for NFSR 50 to be reconstructed into a double lane gravel road within the next 10 years. There are numerous other level 2 roads that provide recreational, hunting, and fuelwood access to the area.

Table 19 – *Primary access roads and their features within the Bluewater Project area.*

Road Number	Road Name	Maint. Level	Features	Location
NFSR 180	Pole Canyon	3	Single lane Gravel surface	Milan, NM to NFSR 178
NFSR 178	Diener Canyon	3	Double lane Gravel surface	Bluewater Lake to Post Office Flats
NFSR 480	Ojo Redondo	3	Single lane Gravel/cinder surface	County Rd. 49 to NFSR 178
NFSR 569	Tusas Mesa	3	Single lane Gravel surface	Bluewater Lake to Rice Park
NFSR 50	McGaffey	2	High clearance	Collector road that runs length of Zuni Mountains

There are several seasonally restricted areas and roads in the watershed. As an example, the Rice Park area is closed to all motorized vehicles from December 15 to March 31. The road through Rice Park is closed from May 15 to July 15 and December 15 to April 15. Other roads that are closed from December 15 to April 15 are NFSR 482, 569, and some roads at the end of NFSR 575 in the Salitre area. The last 4 miles of Bluewater Creek, before it leaves NFS land, is closed to all motorized vehicle use regardless of the time of year.

This project is predominately located in Management Area 8 and Management Area 14 as designated in the Forest Plan. The standards and guidelines recommend average road densities of 1.3 miles of road per square mile for these management areas. Current Forest Service road density for the entire watershed area is 1.68 miles of road per square mile of land. This project does not propose to construct or decommission any permanent system roads, although there is 16 miles of existing temporary roads that would be decommissioned once treatment activities were completed.

3.11.2 Environmental Consequences

No Action (Alternative B)

This Alternative would retain the "status quo" of existing roads. Although no new temporary roads would be built, a number of existing unauthorized 2 track roads would remain open. There would be no change in road density in the analysis area. All-terrain vehicle (ATV) users would not be impacted by this action and many of these roads would remain inaccessible by other types of motorized vehicles.

Direct, Indirect and Cumulative Effects Common to Both Action Alternatives

There is not a need to construct permanent new roads to access the areas for the proposed vegetation treatments. However, 33 miles of temporary roads would be constructed to access vegetative treatment units. All temporary roads constructed during project implementation would be decommissioned after use. In addition, 16 miles of existing temporary roads would be decommissioned after use, therefore decreasing in average road density in the analysis area. For a summary of existing and temporary miles of road in each treatment unit refer to the Comparisons of Alternatives table in Chapter 2.

All roads used during management activities would receive some level of maintenance. The degree of maintenance would range from routine blading, shaping and improved drainage, to heavy maintenance that involves the installation of drainage structures. All road maintenance proposed is within the scope of the Forest's regular maintenance schedule for Level 2 and Level 3 roads.

Access in the project area would be strictly controlled through contract administration during implementation. In the event any unauthorized roads were created during the time of project implementation that would not obliterate naturally, these roads would be decommissioned and reseeded with native vegetation.

Cumulatively, there are 39 miles of private land roads, which equates to a total road density of 1.90 miles of road per square mile of watershed. The addition of private land roads does not lead to a significant increase in road density, since the level is currently above Forest Plan standards and guidelines for Management Area 8.

A Roads Analysis will not be prepared for this document, since there is no proposal to construct any permanent system roads, reconstruct any permanent system roads, or decommission any permanent system roads. A separate decision will occur at a future date to address system road reconstruction and decommissioning for long-term access within this watershed, and to reduce road density in order to meet Forest Plan standards and guidelines.

3.12 Visual Resources

There are no overlooks points from any roads or recreation sites that provide views into the project area.

3.12.1 Visual Rating System

Visual Quality Objectives are used to measure the amount of visual contrast with the natural landscape caused by humans. These objectives are based on the physical characteristics of the land and also by how the land is viewed by people.

The proposed treatment areas within the Bluewater analysis fall into the following visual quality objective (VQO) levels: Partial Retention (PR), Modification (M), and Maximum Modification (MM). Table 21 list acres of VQO levels for each of the treatment types.

Management activities in Partial Retention are activities that are not readily apparent and appear natural. Any activities would be at a level similar to natural occurrences in the area. An example would be a trail or narrow road whose colors blend with the natural surroundings.

Under Modification, management activities may visually dominate the landscape, but still appear natural. An example would be a road that dominates the foreground, but incorporates color and texture from the surrounding landscape.

Under Maximum Modification, management activities are dominant, but appear natural when viewed from a distance. Several sections of tree clearings can be dominant when in close proximity, but appear natural when seen further away.

Table 20. ***Visual Quality Objective level acreage by treatment type***

Treatment Type	Partial Retention	Modification	Maximum Modification
Wildland Urban Interface (WUI)	0	886	0
Fuelbreak	0	206	269
P/J Control Unit	10	1,163	1,402
Upland Meadow	0	1,157	745
Ponderosa Pine	879	13,868	3,777
Total	***889***	***17,280***	***6,193***

Approximately 900 acres along Forest Road 50, 178, and 180 within the Rincon, Salitre Mesa, and Diener Canyon areas are classified as Partial Retention.

Approximately 17,300 acres found in the area between the Rincon and Kettner Canyon, the area between Salitre Mesa to the Serna Area, and the area along the northern boundary adjacent to Bluewater Lake are classified as Modification.

Approximately 6,200 acres between Lookout Mountain and Rice Park and a small area northwest of Ojo Redondo are classified as Maximum Modification.

3.12.2 Environmental Consequences

No Action (Alternative B)

Direct, Indirect and Cumulative Effects

The direct effect of a wildfire would be a decrease in visual quality as a result of burned landscape. The burned landscape would affect color, but the effects would be temporary. However, there would not be a change in the VQO levels within the analysis area. The indirect effects to the VQO levels would be affected in the immediate area of where a wildfire occurs. This would result in a decrease in recreation experience for those seeking natural settings.

Forest Road 50 upgrade and the Forest Road 483 reroute would not have a cumulative effect on the visual quality objective levels. Upgrading Forest Road 50 would not change the existing visual quality objective levels.

Private land logging may have cumulative effects on visual resources. After removing most of the overstory trees and as the sites begin to seed in with pine, these areas would have dog haired thickets within the units logged. This may cause a slight degradation in the visual integrity of the area. However, the Forest Service does not have any management jurisdiction on private lands.

Direct and Indirect Effects Common to Both Action Alternatives

Alternative A and C would directly affect the visual resources to all the visual quality objective levels (PR, M, MM) as a result of treatment activities. Direct affects to Partial Retention areas would be low even though it is in the viewshed of Forest Roads 178, 180, and 50. The treatments would remain visually subordinate to the visual strength of the characteristics landscape. Forest Roads 178 and 180 are classified as passenger car roads and have a higher potential of visibility. Similar treatments implemented in the past along these roads indicate that forest visitors are not concerned with vegetation treatment projects, such as thinning and prescribed burning. No visual concerns were raised during the scoping process.

The direct affects to Modification areas would also be low. The majority of the treatments areas are away from roaded areas. Treatments would remain visually subordinate to the natural characteristics of the landscape. Treatments activities would borrow from the natural landscape and at such a scale that its visual characteristics are similar to natural occurrences within the surrounding area. Under Modification, management activities may visually dominate the original characteristic landscape.

The direct affects to Maximum Modification areas would be low. Most of the treatments are not visible from Forest development roads and would occur in semi-remote areas. Treatments would remain visually subordinate to the natural characteristics of the landscape. Treatments activities would borrow from the natural landscape and at such a scale that its visual characteristics are similar to natural occurrences within the surrounding area

There would be no indirect effects to all the visual quality objective levels. The VQO levels would not change. Because treatments activities would borrow from naturally established form, line, color, or texture and at such a scale that it's visual characteristics are similar to natural occurrences within the surrounding area.

Cumulative Effects

Forest Road 50 upgrade and the Forest Road 483 re-route would not have a cumulative effect on the visual quality objective levels. Upgrading Forest Road 50 would not change the existing visual quality objective levels.

Private land logging may have cumulative effects on visual resources. After removing most of the overstory trees and as the sites begin to seed in with pine, these areas would have dog haired thickets within the units logged. This may cause a slight degradation in the visual integrity of the area. However, the Forest Service does not have any management jurisdiction on private lands.

3.13 Short-term Use and Long-term Productivity

Both action alternatives would be under the mandate of the Multiple Use and Sustained Yield Act of 1960, which requires the Forest Service to manage National Forest System lands for multiple uses, including: timber, recreation, wildlife, range, and watershed. All renewable resources are to be managed for availability of use by future generations. Harvesting of trees and use of prescribed fire to reduce stand densities can be considered a short-term use of a renewable resource. However, this resource can be re-established on the landscape in the future if there is no long-term loss of site productivity.

Both action alternatives would protect long-term site productivity in the project area through the use of Best Management Practices, Forest standards and guidelines, and mitigation measures. There would be direct, indirect, and cumulative effects on the biological and social environment from implementing thinning and prescribed burning activities.

Soil and water resources are two key factors in ecological productivity. These resources would be protected from significant environmental damage under both alternatives. It is expected that quantity of water flowing out of the project area would increase as stands were thinned. However, no long-term effects to water resources are expected to occur as a result of fuel reduction treatments. Soil and water resources could be impacted the most under the no action alternative if a catastrophic wildfire were to occur in the project area. A severe wildfire would remove the organic layer and create soil conditions that were highly susceptible to erosion forces. Without a protective cover to hold soil in place, there would be increased sediment eroding into stream channels and Bluewater Lake.

Wildlife habitat would be protected under both action alternatives. Thinning and prescribed burning activities would contribute to the maintenance of viable wildlife populations, even though individuals would be displaced during treatment. Management Indicator Species are used to represent habitat requirements of all wildlife species found within the project area. By managing habitats and populations of indicator species, other species associated with the same habitat would benefit. Both action alternatives include standards and guidelines, as well as, mitigation measures for maintaining long-term habitat and species productivity. Alternative C would provide additional protection to the Sawyer MSO PAC by removing ladder fuels that would contribute to a crown fire. Canopy cover would not be affected by the thinning, since only small diameter trees in the understory would be removed.

Thinning activities are not expected to affect long-term stand productivity since suppressed and intermediate trees would be the primary targets for harvest. Reducing stand density would improve growth rates for residual trees, thus contributing to a larger stand diameter over time. Mitigation measures would also be incorporated into treatment activities to ensure future availability of this renewable resource.

3.14 Unavoidable Adverse Effects

Implementation of either action alternative would result in some adverse environmental effects that cannot be entirely mitigated or avoided. The interdisciplinary process used to identify specific treatments was designed to eliminate or lessen any significant adverse impacts. In addition, Best Management Practices, Forest standards and guidelines, mitigation measures, and monitoring would be applied to further limit the extent, severity, and duration of these effects. Specific environmental effects were discussed earlier in this chapter. Even though the formulation of alternatives included avoidance of potentially adverse environmental effects, some adverse impacts may still occur.

The construction of temporary roads may lead to short-term soil erosion, which would affect soil and water resources. Once the roads were obliterated the potential for erosion would diminish. In addition, both action alternatives would decrease road density by obliterating some existing temporary roads that are currently contributing to sedimentation.

Air quality would be affected by smoke from prescribed burns. Alternative C would burn more acres over a longer period of time since burn blocks were expanded to include the use of existing roads for fire breaks. However, the use of pile burning and no burning in some treatment stands would reduce the total smoke produced during the burn treatments.

Individual wildlife species may be displaced during thinning and burning activities. This displacement would be short-term and there would not be any long-term population decline.

The use of broadcast burns without a prior thinning treatment would result in an estimated 5% mortality level in the ponderosa pine stands. However, the trees most affected would occur in the lower canopy, thus providing some reduction in fuel ladders.

There is a potential to introduce weed species into areas previously not infested. The use of mitigation measures during contract administration would reduce this potential of infestation. Even so, the expected increase in public travel to remove fuelwood would create a potential for weed introduction.

The natural landscape would appear altered by fuel reduction activities, particularly along major travel routes. The use of broadcast burning would create some scorching of tree stems and blackened vegetation. None of the activities proposed would significantly alter the landscape characteristics and re-growth of vegetation would reduce these effects.

The intensity and duration of these effects would depend on the alternative and mitigation measures applied to protect the resources. Most unavoidable effects are expected to be short-term, lasting anywhere from two to five years. Some adverse effects would be of a transitory type. For example, air quality may diminish on a recurring basis, as prescribed burns were implemented. However, these adverse effects would be temporary within the environment.

3.15 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments are decisions affecting non-renewable resources, such as soil, water, or cultural sites. Such commitments are considered irreversible if an action could damage the resource to the point that renewal would take a long period of time or require a large economic expense to restore.

Soil loss due to erosion is one example of an irreversible commitment of resource. However, by incorporating BMPs, Forest standards and guidelines, and project specific mitigation measures into the treatment activities, it is not anticipated that there would be any significant soil loss from erosion.

Damage to cultural sites would also create an irreversible commitment of resources. Such damage could be a result of acts of vandalism, accidental damage during contract administration, and undiscovered sites damaged during project implementation. A Programmatic Agreement has been prepared between the Forest Service and the State Historical Preservation Office, which would require full survey of areas potentially affected by a project before that activity could proceed. The standards and guidelines, survey methodology prior to activities, and mitigation measures specified in this document provide reasonable assurances that there would be no irreversible loss of cultural sites.

Irretrievable commitments of resources are commitments that result in the loss of productivity or use of a resource due to management decisions made based on the analysis. These are opportunities that are forgone for the period of time that the resource is not available.

Foregoing thinning activities at this time in certain areas due to resource or economic conditions would be an example or an irretrievable commitment of resources. That is because the value of that timber would not be realized at this time, but could be captured at a later date. Thus the commitment is irretrievable and not irreversible, because future thinning projects could harvest those areas if the need is still present. The areas identified for treatment represent sites that are in need of fuel reduction. The restoration of Southwest ponderosa pine stands to prior conditions that could withstand a catastrophic fire, before such an event happens, would not represent an irretrievable commitment of timber resources. Losing those resources to a catastrophic wildfire would represent such a commitment.

Changes to visual resources would also represent an irretrievable commitment of resources. Impacts from burning would typically recover over a period of a few years; therefore visual changes would not be as evident to the casual observer as time elapses. The proposed action (Alternative A) would implement broadcast burning over all treatment types. The preferred alternative (Alternative C) would utilize pile burning and a lop and scatter slash treatment method in certain treatment types. Thus, impacts from broadcast burning would be less under Alternative C. Visual quality would be significantly altered should a catastrophic wildfire occur in the Bluewater watershed. The no action alternative (Alternative B) would retain the stands in an overstocked condition, therefore making them more susceptible to wildfire.

CHAPTER 4:

CONSULTATION AND COORDINATION

4.0 Document Preparers

The following Forest Service personnel provided input into the Bluewater Ecosystem Management Project Environmental Impact Statement:

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John Burfiend	Fire and Fuels Resources, Air Quality
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4.1 Document Contributors

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this Environmental Impact Statement: Pueblo of Zuni, Pueblo of Hopi, Pueblo of Laguna, Pueblo of Acoma, Navajo Nation, US Fish & Wildlife Services, New Mexico State Forestry Office, State Historic Preservation Office, New Mexico Game and Fish Department, Dr. Peter Stacey from the University of New Mexico, and Dr. Julio Betancourt with the U.S. Geologic Survey.

4.2 List of Agencies, Organizations and Persons to Whom Copies of the DEIS were Sent

The Draft Environmental Impact Statement has been distributed to individuals who specifically requested a copy of the document. In addition, copies have been sent to the following Federal agencies, federally recognized tribes, State and local governments, and organizations representing a wide range of views regarding fuel reduction and restoration of ecological processes in the Bluewater Watershed:

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Casamcro Lake Chapter
Crownpoint Chapter
Mariano Lake Chapter
Ramah Navajo Chapter
Smith Lake Chapter
Thoreau Chapter
To'hajileehee Chapter
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McKinley County Commissioners
McKinley Soil & Water Conservation Dist.
Natural Resource Conservation District
US Fish & Wildlife Service
Bureau of Land Management
El Malpais National Monument
NM Dept of Game & Fish
NM State Forestry
NM State Land Office
Bluewater State Park
NM Environmental Dept of Surface Water

4.3 List of Agencies, Organizations and Persons to Whom Copies of the FEIS were Sent

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NM Senator Joseph Fidel
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Nm Senator Leonard Tsosie
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Casamcro Lake Chapter
Crownpoint Chapter
Mariano Lake Chapter
Ramah Navajo Chapter
Smith Lake Chapter
Thoreau Chapter
To'hajileehee Chapter
Cibola County Commissioner
McKinley County Commissioners
McKinley Soil & Water Conservation Dist.
Natural Resource Conservation District
US Fish & Wildlife Service
Bureau of Land Management
El Malpais National Monument
NM Dept of Game & Fish
NM State Forestry
NM State Land Office
Bluewater State Park
NM Environmental Dept of Surface Water

Reports Incorporated and Available Upon Request

USDA Forest Service. Cibola National Forest. 2003. Bluewater Ecosystem Management Project Archaeology Report.

USDA Forest Service. Cibola National Forest. 2003. Bluewater Ecosystem Management Project Hydrology/Soils Report.

USDA Forest Service. Cibola National Forest. 2003. Bluewater Ecosystem Management Project Social/Economic Report.

USDA Forest Service. Cibola National Forest. 2003. Bluewater Ecosystem Management Project Silvicultural Report.

USDA Forest Service. Cibola National Forest. 2003. Bluewater Ecosystem Management Project Forested Vegetation Existing Conditions Report.

USDA Forest Service, New Mexico State Historic Preservation Office, & the Advisory Council. July 2003. Historic Preservation regarding Bluewater Ecosystem Management Project.

Acronyms

ATV	All-Terrain Vehicle
BBS	Breeding Bird Survey
BMP	Best Management Practices
C	Celsius
CBH	Crown Base Height
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DBH	Diameter at Breast Height
DEM	Digital Evaluation Models
DRC	Diameter at Root Collar
EPA	Environmental Protection Agency
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FOFEM	First Order Fire Effects Model
FR	Forest Road
FSM	Forest Service Manual
GIS	Geographic Information Systems
HPA	Habitat Protection Area
HU	Hydrologic Unit
IDT	Interdisciplinary Team
MBF	Million Board Feet
MIS	Management Indicator Species
MOU	Memorandum of Understanding
MSO PAC	Mexican Spotted Owl Protected Activity Center
N	North
NAAQS	National Ambient Air Quality Standards
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Policy Act
NEPI	Natural Erosion Potential Index
NFS	National Forest System
NFSR	National Forest Service Roads
NMAC	New Mexico Administrative Code
NMBCP	New Mexico Bird Conservation Plan
NMDGF	New Mexico Department of Game and Fish
NMPIF	New Mexico Partners In Flight
NOI	Notice of Intent
NPS	Non-point Source
PA	Programmatic Agreement
PAC	Protected Activity Center
PET	Potential Evapotranspiration
PFA	Post-fledging Family Areas
PJ	Piñon-juniper
PM	Particulate Matter

R	Range
RAWS	Remote Automated Weather Station
RMRIS	Rocky Mountain Resource Information System
RN	Roaded Natural
ROS	Recreation Opportunity Spectrum
SDI	Stand Density Index
SHPO	State Historic Preservation Office
SPM	Semi-Primitive, Motorized
SPNM	Semi-Primitive, Non-Motorized
T	Township
TES	Terrestrial Ecosystem Survey
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
VQO	Visual Quality Objective
VSS	Vegetative Structural Stage
W	West
WUI	Wildland Urban Interface

Literature Cited

Agee, J.K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press. Covelo, CA.

Agee, J.K. 1996. The Influence of Forest Structure on Fire Behavior. *In*: Proceedings of 17th Forest Vegetation Management Conference. Redding, CA. 52-68 pp.

Albini, F.A. and J. Brown. 1978. Predicting Slash Depth for Fire Modeling. General Technical Report INT-206.

Alexander, M.E. 1988. Help With Making Crown Fire Hazard Assessments. *In*: Proceedings of the Symposium and Workshop of Protecting People and Homes from Wildfire in the Interior West. USDA Forest Service General Technical Report INT-251. 147-156 pp.

Allen, C.D., M. Savage, D.A. Falk, K.F. Suckling, T.W. Swetnam, T. Schulke, P.B. Stacey, P. Morgan, M. Hoffman, and J.T. Klingel. 2002. Ecological Restoration of Southwestern Ponderosa Pine Ecosystems: A Broad Perspective. Ecological Applications. 12(5):1418-1433.

Allen-Reid, D. 2002. Personal correspondence through memorandum.

Anderson, H.E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service General Technical Report INT-22. Intermountain Forest and Range Experimental Station. Odgen, UT.

Arno, S.F. and M.G. Harrington. 1999. Eighty-eight Years of Change in a Managed Ponderosa Pine Forest. USDA Forest Service General Technical Report RMRS-23.

Atzet, T. 1994. Applegate Adaptive Management Area Ecosystem Health Assessment. R6 USDA Forest Service.

Benedict, C. 1999. Notes from a Tribal Consultation Meeting with Baca/Haystack Navajo Chapter. On file at the Cibola National Forest, Forest Supervisor's Office.

Benedict, C. 1997. Notes from Tribal Consultation Meeting with the Pueblo of Acoma. On file at the Cibola National Forest, Forest Supervisor's Office.

Biswell, H.H. 1960. Danger of Wildfire Reduced by Prescribed Burning in Ponderosa Pine. California Agriculture. 14(10): 5-6.

Biswell, H.H., H.R. Kallander, R. Komarek, R.J. Vogel, and H. Weaver. 1973. Ponderosa Pine Management. Miscellaneous Publication 2. Tall Timbers Research Station. Tallahassee, FL. 49pp.

Biswell, HH. 1989. Prescribed Burning in California Wildland Vegetation Management. University of California. Berkley, CA. 253pp.

Blue Ridge Demonstration Project. 2000. Technical Committee Status Report to the Natural Resources Working Group. 7 pp.

British of Columbia Ministry of Forests. 1995. Dwarf mistletoe management guidebook. Forest Practices Code.

Brockway, D.G., R.G. Gatewood, and R.B. Paris. 2002. Restoring Grassland Savannas from Degraded Piñon-Juniper Woodlands: Effects of Mechanical Overstory Reduction and Slash Treatment Alternatives. Journal of Environmental Management. 64:179-197.

Brown, D.E. and K.P. Davis. 1973. Forest Fire: Control and Use. Second Edition. McGraw Hill. New York, NY. 686pp.

Bryan N., S. Young, and K. Shirley. 1978. Navajo Native Dyes: Their Preparation and Use. Filter Press. Palmer Lake, CO.

Cassidy, R. 1998. Appendix Report 2. Stand Density Index discussion for the Santa Fe watershed. Santa Fe Municipal Watershed Project Environmental Impact Statement Project Record. Santa Fe National Forest. Santa Fe, NM.

Cooper, C.F. 1960. Changes in Vegetation, Structure, and Growth of Southwestern Pine Forests since White Settlement. Ecological Monographs. 30(2): 129-164.

Copestead, R. 1997. Summary of Historical and Legal Context for Water/Road Interaction. USDA Forest Service, San Dimas Technology and Development Center. San Dimas, CA.

Costick, Larry A. 1966. Indexing Current Watershed Conditions Using Remote Sensing and GIS, Sierra Neveda Ecosystem Project: Final report to Congress, Volume III, Assessments and Scientific Basis for Management Options. Centers for Water and Wildland Resources, University of California. Davis, CA.

Covington, W.W. and M.M. Moore. 1992. Post-settlement Changes in Natural Fire Regimes: Implications for Restoration of Old Growth Ponderosa Pine Forest. *In*: Proceedings of a Workshop of Old Growth Forests in the Southwest and Rocky Mountain Regions. Portal, Arizona. Rocky Mountain Forest and Range Experiment Station General Technical Report RM-213.

Covington, W.W. and M.M. Moore. 1994. Southwestern Ponderosa Forest Structure: Changes Since Euro-American Settlement. Journal of Forestry. 2(1):39-47.

Dick-Peddie, W.A. 1993. New Mexico Vegetation Past Present and Future. First Edition. University of New Mexico Press. Albuquerque, NM. 244 pp.

Evans, R.A. 1988. Management of Piñon-Juniper Woodlands. USDA Forest Service General Technical Report, INT-249. Intermountain Research Station. Ogden, UT.

Farmer, M.E. 1995. The Effect of Anchor Chaining Pinyon-Juniper Woodland on Watershed Values and Big-game Animals in Central Utah. M.S. Thesis, Brigham Young University. Provo, UT. 47 pp.

Ferguson, T.J. and E. Richard Hart. 1985. A Zuni Atlas. University of Oklahoma Press. Norman, OK.

Fiedler, C.E., C.E. Keegan III, S.H. Robertson, T.A. Morgan, C.W. Woodall, and J.T. Chmelik. 2002. A Strategic Assessment of Fire Hazard in New Mexico. Final Report Submitted to the Joint Fire Sciences Program. 27 pp.

Fletcher, R. 1998. Cibola National Forest Range of Natural Variability. USDA Forest Service R3. Unpublished Report.

Fletcher, R. 2001. Notes on Discussion and Field Observation during the October 12, 2001 Field Day in the Bluewater Ecosystem Project Area.

Graham, R.T., A.E. Harvey, T.B. Jain, J.R. Tonn. 1999. The Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western forests. USDA Forest Service General Technical Report PNW-463. Pacific Northwest Research Station. Portland, OR. 27 pp.

Grants/Cibola Chamber of Commerce. 2003. Grants Cibola County Community Guide & Membership Directory. Available via Internet.

Haines, Toby. 1993. Watershed Condition Assessment of the Kehl, Leonard Canyon and Upper Willow Valley Subwatersheds of the East Clear Creek Drainage on the Apache-Sitgreaves and Coconino National Forest. Contract No. 43-8167-2-0500. Hydro Science. Davis, CA.

Hall, F.C. 1976. Fire and Vegetation in the Blue Mountain-Implications for Land Managers. *In*: Proceedings of the Tall Timbers Fire Ecology Conference. 15:155-163.

Harrington, M. and S. Sackett. 1990. Using Fire as a Management Tool in Southwestern Ponderosa Pine. USDA Forest Service General Technical Report RM-191. Rocky Mountain Forest and Range Experiment Station.

Harrington, M.G. 1987. Predicting Reduction of Natural Fuels by Prescribed Burning Under Ponderosa Pine in Southeastern Arizona. USDA Forest Service Research Note RM-472. 4pp.

Harrington, M.G. and S.S. Sackett. 1992. Past and Present Fire Influences of Southwestern Ponderosa Pine Old Growth. 44-50pp. *In*: Proceedings of a Workshop of Old Growth Forests in the Southwest and Rocky Mountain Regions. Portal, Arizona. Rocky Mountain Forest and Range Experiment Station General Technical Report RM-213. 201pp.

Hawksworth, F.G. 1995. Dwarf Mistletoes: Biology, Pathology, and Systematics. USDA Forest Service Agricultural Handbook 450.

Holechek, J.L., and D. Galt. 2000. Grazing Intensity Guidelines. Rangelands. 22(3):11-14.

Hollenstein, K, R.L Graham, and W.D. Shepperd. 2001. Biomass Flow in Western Forests; Simulating the Effects of Fuel Reduction and Pre-settlement Restoration Treatments. Journal of Forestry. 99(10): 12-19.

Holmes, B.E. 1989. American Indian Land Use of El Malpais. Prepared for the Bureau of Land Management. Office of Contract Archaeology, University of New Mexico. Albuquerque, NM.

Jameson, D. A. 1967. The Relationship of Tree Overstory and Herbaceous Understory Vegetation. Journal of Range Management. 20(4):247-249.

Johnson, S.R. 1995. Factors Supporting Road Removal and/or Obliteration. USDA Forest Service Document 2500. Copy in watershed section. Long Valley Ranger District, Coconino National Forest.

Kalabodkidis, K.D. and R.H. Wakimoto. 1992. Prescribed Burning in Uneven Aged Management of Ponderosa Pine/Doulgas-fir Forests. Journal of Environmental Management. 34(3): 221-235.

Kaufmann, M.R., W.H. Moir and W.W. Covington. 1992. Old-Growth Forests: What Do We Know About Their Ecology and Management in the Southwest and Rocky Mountain Regions? 1-11pp. *In*: Proceedings of a Workshop of Old Growth Forests in the Southwest and Rocky Mountain Regions. Portal, Arizona. USDA Forest Service General Technical Report RM-213. Rocky Mountain Forest and Range Experiment Station. 201pp.

Kegley, S.J., R.L. Livingston, and K.E. Gibson. 1997. Pine Engraver, Ips pini (Say), in the Western United States. Forest Insect & Disease Leaflet 122. USDA Forest Service.

Klopatek, C.C., L.F. Debano, and J.M. Klopatek. 1990. Impact of Fire on the Microbial Processes in Pinyon-Juniper Woodlands: Management implications. *In*: Effects of Fire Management of Southwestern Natural Resources 1988. Tucson, AZ. USDA Forest Service General Technical Report RM-191. Rocky Mountain Research Station. 197-205pp.

Koniak, S. and R.L. Everett. 1982. Seed Reserves in Soils of Succession Stages on Piñon-Juniper Woodlands. American Midland Naturalist. 102: 295-303.

Koonce, A.L. and L.F. Roth. 1980. The Effects of Prescribed Burning on Dwarf Mistletoe in Ponderosa Pine. *In*: Proceedings of the 6th Conference on Fire and Forest Ecology. Seattle WA. 197-203pp.

Leopold, A. 1924. Grass, Brush, Timber, and Fire in Southern Arizona. Journal of Forestry. 22(6): 1-10.

Leopold, L.B. 1951. Vegetation of Southwestern Watersheds in Nineteenth Century. Geographic Review. 41: 295-316.

Loftin, S.R., R. Aguilar, A.L. Chung-MacCoubrey, and W.A. Robbie. 1995. Desert Grassland and Shrubland Ecosystems. 80-94pp. *In*: Ecology, Diversity and Sustainability of the Middle Rio Grande Basin. USDA Forest Service General Technical Report RM-268. Rocky Mountain Forest and Range Experiment Station.

Mayer-Grission, H.D. 1995. Tree Ring Reconstruction of Climate and Fire History at El Malpais National Monument, New Mexico. Ph.D. dissertation, University of Arizona. Tucson, AZ.

Moore, M.M., and D.A. Deiter. 1992. Stand Density Index as a Predictor of Forage Production in Northern Arizona Pine Forests. Journal of Range Management. 45(3): 267-271.

Mutch, R.W. and W.A. Cook. 1996. Restoring Fire to Ecosystems: Methods Vary With Land Management Goals. USDA Forest Service General Technical Report INT-341. 9-11pp.

New Mexico Department of Game and Fish. 2002. Biota Information System of New Mexico – BISON-M.

New Mexico Economic Development Department. 2003. Available via Internet.

Paysen, T.E., R.J. Ansley, J.K. Brown, et al. 2000. Fire in Western Shrubland, Woodland, and Grassland Ecosystems. *In*: Wildland Fire in Ecosystems Effects of Fire on Flora.

Brown, J.K. and J.K. Smith. eds. USDA Forest Service General Technical Report RMRS-42. Rocky Mountain Research Station. 2:121-159.

Pearson, G.A. 1949. Management of Ponderosa Pine in the Southwest. USDA Agriculture Monograph No. 6.

Peiper, R.D. 1990. Overstory-Understory Relations in Piñon-Juniper Woodlands in New Mexico. Journal of Range Management. 43(5):413-415.

Peterson, D.L. and S.S. Sackett. 1994. The Effects of Repeated Prescribed Burning on *Pinus ponderosa* Growth. International Journal of Wildland Fire. 4(4):239-247.

President Bush, G.W. 2002. Healthy Forest Initiative: An Initiative for Wildfire Prevention and Stronger Communities.

Reineke, L.H. 1933. Perfecting a Stand-Density Index for Even-Aged Forests. Journal of Agricultural Research. 46:627-638.

Reinhardt, et al. 1991. Woody Fuel and Duff Consumption by Prescribed Fire in Northern Idaho Logging Slash. USDA Forest Service General Technical Report INT-443. 174pp.

Rogers, T. 2002. Personal communication.

Rothermel, R. 1991. Predicting Behavior and Size of Crown Fires in the Northern Rocky Mountains. USDA Forest Service General Technical Report INT-438.

Sackett, S.S. 1979. Natural Fuel Loadings in Ponderosa Pine and Mixed Conifer Forest of the Southwest. USDA Forest Service Research Paper RM-213. Forest Collins, CO.

Sackett, S.S. 1984. Observations on Natural Regeneration in Ponderosa Pine following a Prescribed Fire in Arizona. USDA Forest Service Research Note RM-435. 8pp.

Scott, J. 1998b. Reduce Fire Hazards in Ponderosa Pine by Thinning. Fire Management Notes. 58(1): 20-25.

Swetnam, T.W. and C.H. Baisan. 1996. Historical Fire Regime Patterns in the Southwestern United States since AD 1700. Allen, C.D. tech. ed. 11-32pp. *In*: Proceedings of the 2nd La Mesa Fire Symposium Fire Effects in Southwestern Forests. USDA Forest Service General Technical Report RM-286.

Tidwell, P. 1997. Existing/Potential Old Growth Management Areas by Geographic Area - Specialist Report. USDA Forest Service. Cibola National Forest, Mt. Taylor Ranger District.

Touchan, R. and R.W. Swetnam. 1991. Fire History in Northern New Mexico. Final Report to USDA Forest Service, Santa Fe National Forest and USDI National Park Service, Bandelier National Monument. 22pp.

U.S. Census Bureau. 2000 US Census Data. Available via Internet.

U.S. Census Bureau. 2000 US Census Data. Housing and Population Divisions. Available via Internet.

U.S. Department of Commerce, Bureau of Economic Analysis. 2003. Regional Economic Information System.

USDA Forest Service. 1965. Silvics of Forest Trees of the United States. Agriculture Handbook No. 271. 762 pp.

USDA Forest Service. 1974. Dwarf Mistletoe of Ponderosa Pine in the Southwest. Forest Insect & Disease Leaflet 19. Written by P.C. Lightle and M.J. Weiss.

USDA Forest Service. 1985. Cibola National Forest Land and Resource Management Plan.

USDA Forest Service. 1992. Management Recommendations for the Northern Goshawk in the Southwestern United States. General Technical Report RM-217.

USDA Forest Service. 1993. Watershed Management Practices for Piñon-Juniper Ecosystems. Southwestern Region. 41 pp.

USDA Forest Service. 1997. An Assessment of Forest Ecosystem Health in the Southwest. Dahms, C.W. and B.W. Geils. USDA Forest Service General Technical Report RM-295. Rocky Mountain Forest and Range Experimental Station.

USDA Forest Service. 1998. Cibola National Forest Range of Natural Variability. First Edition. Written by Reggie Fletcher. 177 pp.

USDA Forest Service. 2000. Bluewater Geographic Area Assessment. Cibola National Forest, Mt. Taylor Ranger District.

USDA Forest Service. 2000. Wildland Fire in Ecosystems Effects of Fire on Fauna. General Technical Report RMRS-42. Volume 1.

USDA Forest Service. 2002. Early Alert – Western Bark Beetle Activity. Southwestern Region.

USDA Forest Service. 2002. Forest Insect and Disease Conditions in the Southwestern Region, 2001. Southwestern Region, Forestry and Forest Health. R3-02-01. 21 pages.

USDA Forest Service. 2002. Draft Forest Insect and Disease Conditions in the Southwestern Region, 2002. Southwestern Region, Forestry and Forest Health. R3-03-01. 30 pages.

USDA Forest Service. Forest Service Handbook 2509.18 – Soil Management Handbook. Southwestern Region Supplement No. 2509.18-99-1.

USDI Fish and Wildlife Service. 1995. Mexican Spotted Owl Recovery Plan.

Van Valkenburgh, R. 1974. Navajo Sacred Places. In Navajo Indians III. On file at the Cibola National Forest, Supervisor's Office.

Van Wager, C.E. 1977. Prediction of Crown Fire Behavior in Two Stands of Jack Pine. Canadian Journal of Forest Research. 23:442-449.

Wagle, R.F. and T.W. Eakle. 1979. A Controlled Burn Reduces Impact of a Subsequent Wildfire in a Ponderosa Pine Vegetation Type. Forest Science. 25:123-129.

Weaver, H. 1951. Fire as an Ecological Factor in Southwestern Ponderosa Pine Forests. Journal of Forestry. 49(2): 93-98.

Weise, D.R. and S.S. Sackett. 1996. Rx Fire Research for Southwestern Forests. USDA Forest Service, Pacific Southwest Research Station Fire Management Notes. 56:2, 23-25.

Wood, M.K. and N. Javed. 1992. Hydrologic Responses to Fuelwood Harvest and Slash Disposal on a Piñon-Juniper Dominated Grassland Site in the Gila National Forest. 25-30pp. *In*: Proceedings of the 36th Annual New Mexico Water Conference 1991. New Mexico State University. Las Cruces, NM. NMWRRI Report No. 265.

Woolsey, T.S. 1911. Western Yellow Pine in Arizona and New Mexico. USDA Forest Service Bulletin 101.

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