

Final Decision Memo

BIG TIMBER CANYON VEGETATION TREATMENT PROJECT

USDA Forest Service
Gallatin National Forest
Big Timber Ranger District
Sweet Grass County, Montana

July 2007

PROPOSAL

The Big Timber Ranger District of the Gallatin National Forest is proposing a vegetation treatment project on approximately 180 acres in Big Timber Canyon, which is located approximately twenty miles northwest of Big Timber, Montana on the eastern slopes of the Crazy Mountains near Crazy Peak (See the attached Vicinity Map). The legal description for the proposal is T3N, R12E, Sections 2 & 4, Sweet Grass County, MT.. The proposal includes approximately 155 acres in Section 2 (Unit 1), approximately 25 acres in Section 4 (Unit 2), and consists of thinning densely stocked stands of Douglas-fir, to increase the health and vigor of the remaining trees and make them less susceptible to future Douglas-fir bark beetle attacks (See the attached Proposed Treatment Area Map).

DECISION

My decision is to implement vegetation treatment as described in the proposal. My decision also incorporates the identified mitigation as described on pp.11 through 13.

- There will be no permanent road construction. Access to Unit #1 will be obtained by utilizing a privately owned road, for which an access agreement has been verbally negotiated with the adjacent private landowner. A written agreement for access is being negotiated and will be finalized before work commences. Once the access agreement is finalized, approximately ½ mile of temporary road will be constructed connecting to the existing private road, providing an area on National Forest System lands to facilitate landings and harvest operations. This temporary

road will be permanently closed and rehabilitated within one year following the completion of project activities.

If the access agreement can not be finalized by the Forest Service, then the harvest method for Unit 1 would consist of helicopter logging the entire unit and flying materials to existing landings from past harvest units on NFS lands in Section 2.

Unit #2 is immediately adjacent to FS Road #197 and can be accessed by the Big Timber Canyon Road, so no new road construction would be necessary.

- Upon thorough review of the environmental analysis conducted and the specialists reports (located in the project file), I am comfortable that this project would not adversely affect any resource values including wetlands or floodplains; water quality; threatened, endangered, or sensitive species; archeological, cultural, prehistoric, historic, or scientific values.
- I find that this project will not have long term effects to the administration or public use of the area; and will not negatively affect the visual quality of the area.
- The project is consistent with the direction provided in the Gallatin Forest Plan for Management Area (MA) 9 (Forest Plan, pp.III-27 through III-29).
- The project is located outside of designated wilderness, wilderness study areas, Research Natural Areas, and inventoried roadless boundaries.

PURPOSE AND NEED

The main purpose and need for the project is to:

- Initiate insect control methods including commercial and non-commercial sanitation harvesting techniques as recommended by the Regional Entomologist to help control and prevent the spread of Douglas-fir bark beetles and improve the overall health and productivity of the forest community in Big Timber Canyon.

Other objectives associated with implementation of the proposed project include:

- Improve wildlife habitat/forage by increasing the abundance and diversity of shrubs and other understory plants within the forest community to help sustain a forage base for big game.
- Maintain and protect values that are consistent with sustaining visual quality objectives within the Big Timber Canyon corridor.
- Provide a sustained yield of timber products and improve the productivity of timber growing lands (FP. Pg. II-1).

- Create a more sustainable stand structure by removing diseased and insect damaged trees.



PROJECT BACKGROUND

The Big Timber Canyon Vegetation Treatment Project analysis area encompasses approximately 26,500 acres of forested and non-forested lands. The analysis area consists of timber Compartments 104 and 105, which range from 5,700 to 10,600 feet in elevation across a variety of aspects and have slopes ranging from 10 to 90 percent, with average slopes of approximately 30-50 percent.

Landtypes for the proposal area vary from 35-1C (Unit 1) to 34-1C and 35-1B (Unit 2). All of these landtypes consist of reasonably stable, productive soils that are capable of handling some disturbance, as long as Best Management Practices (BMPs) are utilized. The Forest Soil Scientist has completed on the ground reviews of both proposed units (See the soils report located in the Project File).

The Big Timber Canyon Vegetation Project analysis area is approximately 40 percent forested (almost 50 percent of this general area is rock/scree). This was determined by using Satellite Imagery Land Cover Classification System 3 (SILC3) data, which is a classification system developed by the Wildlife Spatial Analysis at the University of Montana, to create regional land cover type, tree size and tree canopy databases for Montana and Idaho. The forested areas are mainly composed of cool to moist Douglas-fir habitat types on the lower elevations, with cooler and moister subalpine fir habitat types at the higher elevations.

Several of the low elevation Douglas-fir dominated stands within the analysis area are densely stocked, having stand conditions that are especially conducive to supporting Douglas fir beetle outbreaks. The 2004 and 2005 Aerial Insect and Disease Detection Surveys noted scattered pockets of mortality from Douglas-fir bark beetles in stands throughout the Big Timber Canyon area. Much of the mortality is likely associated with the ongoing drought common throughout much of this part of the United States and the high tree densities (measured in basal area per acre) commonly found in moist Douglas-fir forests.

In September of 2005, Ken Gibson, the Forest Service Northern Region Entomologist visited the project area to assess the situation. Small groups (10-20) of beetle killed Douglas-fir were noted in a widely distributed pattern throughout the drainage, verifying the results of the annual aerial survey that was conducted in July of that year. Observations confirmed the presence of Douglas-fir beetles in the drainage, not at outbreak levels, but at a level to suggest that increasing beetle-caused mortality and populations of beetles are certainly possible, especially if any major stand disturbance (such as windthrow, insect defoliation, or wildfire) were to occur in the area.. The Regional Entomologist suggested that reducing the basal area to 80-100 per acre would be the optimum level for increasing stand vigor in order to reduce the likelihood of future Douglas-fir bark beetle epidemics in the treated areas (See the Regional Entomologist Trip Report located in the Project File).. Stand density reduction has been shown to be the most effective method of reducing beetle-caused mortality by reducing tree competition for moisture and exposing material to sunlight (USDA 1994, Leslie E. and Bradley, T. 2001).

Findings from Spring of 2006 field visits to Unit 1 indicate that additional mortality from Douglas-fir beetle has occurred in pockets throughout the stand. In addition, pockets of blown down Douglas Fir trees were discovered and identified to contain Red Ring Rot/White Pocket rot infections. These fungi are some of the most common wood rot organisms in coniferous forest of the western North America. Although they are mainly decomposers of dead and down timber, they have also been known to cause heart rot in living trees that weaken the trees, making them more susceptible to blow down and beetle attacks.

Approximately 1,550 acres or 26% of the forested area in Timber Stand Compartment 104 and 1,570 acres or 30% of the forested area in Timber Stand Compartment 105 is considered to be old growth as defined by Region 1 Guidelines (Green et. al.). Old growth stands were queried using ArcView, the Timber Stand Management Recordkeeping System (TSMRS), which is a Forest Service stand exam database and the SILC3 database, using ground-truthed data when it was available. The Forest Plan (page III-41) requires that we strive to maintain at least 10% old growth by timbered compartment. Presently, both compartments are well above the 10% standard (See the vegetation specialist's report located in the Project File).

The Crazy Mountains are somewhat unique having checkerboard ownership patterns, limited access to and within the Forest, as well as severe topography limiting public use and recreation opportunities on the National Forest System (NFS) lands. The Big Timber Canyon Road, #197 represents the only public access to NFS lands on the entire east side of the Crazies (including the Lewis and Clark National Forest). Due to this limited access, legal public recreation use is concentrated on those NFS lands immediately accessible from Big Timber Canyon and Big Timber Creek Trail, #119. Besides system trails, the only developed recreation facilities are located along the Big Timber Canyon Road. The Halfmoon area at the end of the road consists of the Halfmoon Campground and day use Picnic Area as well as the Big Timber Creek Trail Trailhead. The Big Timber Canyon Picnic Area near the Forest boundary also provides picnicking and dispersed camping opportunities adjacent to the Big Timber Canyon Road.

The project area is not located in an inventoried roadless area. The vast majority of the Crazy Mountains, located on the Big Timber Ranger District, are within the Crazy Mountain Roadless Area No.1-541. No Wilderness designation exists in the Crazies.

The Forest recognizes the outstanding scenic quality of the Crazy Mountains. The 1987 Gallatin National Forest Plan directs that the NFS lands in the vicinity of the proposed treatment units are to be managed as Partial Retention Visual Quality Objectives (VQOs). This means that management activities remain visually subordinate to the characteristic landscape. Historic cutting on private land below Half Moon Campground has been rather extensive but, does not dominate the viewshed. Past cutting that has occurred on NFS lands in the drainage is within the acceptable bounds of Forest Service visual objectives.

PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

A map of past timber-related activities is located in the vegetation specialist report in the Project File. The activities were queried from the TSMRS database for Compartments 104 and 105, which encompass the Big Timber Canyon Vegetation Project analysis area.

From 1969 through 1979 there were no recorded harvest activities on National Forest System (NFS) lands. In Compartment 104, from 1980 through 1989, approximately 50 acres were regeneration harvested and approximately 50 acres were partially-cut with shelterwood harvests on NFS lands. No additional harvests have occurred in this area after the 1980s on NFS lands.

On private lands in Compartment 104, about 150 acres were regeneration harvested in the 1960s, 70 acres in the 1980s, and 20 acres in the late 1990s. There were also approximately 90 acres of shelterwood harvests in the 1980s and 50 acres of shelterwood harvests in the late 1990s.

No harvest activities have occurred in Compartment 105 on USFS lands. In Compartment 105 approximately 300 acres were regeneration harvested in the 1980s on private lands. Timber stand improvement (TSI) activities may be conducted using hand treatment techniques, within previous regeneration harvest areas on approximately 50 acres. There are no other foreseeable harvest activities planned in the analysis area at this time.

After considering effects associated with the above-mentioned past, present, and reasonably foreseeable activities in conjunction with potential effects that could be associated with implementation of this project, I do not find that this project would create any significant cumulative effects (Effects worksheets concerning each resource can be found in the Project File).

PROPOSED ACTION

Overview of Proposal

The proposal will mechanically thin approximately 180 acres of mostly Douglas-fir forest, reducing stand densities to around 80 to 100 square feet of basal area per acre. These mechanically treated acres will have fuel treatments that combine lop and scatter, whole tree yarding, yarding unmerchantable material (YUM) with piling where down woody levels exceed 10 to 15 tons per acre in the greater than 3" diameter class or where material less than 3" in diameter exceeds 3' high X 10' wide. The proposed silvicultural treatments to meet management objectives will vary slightly between units. Table 1 provides a summary of treatment units.

Table 1 - Treatment Units and Objectives

Unit #	Location	Approx. Size (Acres)	Objective of Treatment
1	Section 2	155	Remove Douglas fir bark beetle infested trees, thin to a basal area of 80-100 to increase health and vigor of remaining stand, blend with adjacent private previously thinned land, increase species diversity of understory vegetation for wildlife forage
2	Section 4	25	Remove Douglas fir bark beetle infested trees, thin to a basal area of 80-100 to increase health and vigor of remaining stand, blend with adjacent previously thinned National Forest System (NFS) land.

Detailed Treatments by Unit

Unit 1

Unit 1 consists of approximately 155 acres located on NFS lands in Section 2 on the south side of Big Timber Creek (See attached map of Proposed Treatment Unit #1) and is adjacent to thinning that occurred on private lands in Section 1 in the late 1990s. The actual harvest acres proposed have been reduced in this unit to 155 acres as a result of the necessity to create a 40 acre buffer around an active goshawk nest that was discovered in the unit in the summer of 2006 (See Biological Evaluation in the project file). This proposal will create a less abrupt visual transition between private and NFS lands. Soils are highly productive and moderately fine textured with few rock fragments. The only evidence of past harvest activity is occasional stumps (>40 years old), near the northern boundary of the unit, which were likely harvested for local ranches. The Forest Soils Scientist completed an on the ground review of Unit 1 and found no evidence of past mechanical disturbance. By adhering to the required mitigation outlined on pp. 13-15, there would be minimal concerns for soil disturbance or productivity with either the ground-based mechanical or helicopter harvesting methods associated with this unit.

Helicopter logging is proposed for the southern 3/4ths of the unit, which has slopes >30%. Trees will be handfelled and whole-tree yarded (where necessary to accomplish fuels objectives of 10-15 tons per acre) to landings located on the bench on the northern edge of the unit. The northern 1/4 of the unit, which has slopes <30%, will likely be tractor logged. The northern boundary of the unit will be located on the bench, which is well outside of the riparian corridor for Big Timber Creek. The southern boundary of the unit near the ridge would be irregular to help meet visual concerns for the area.

Treatment will consist of thinning the existing stand to approximately 80 to 100 square feet of basal area per acre (presently this forested area has an average of around 250 to 290 square feet of basal area per acre). Based on this stand's current average stand diameter (of 9" - 13" dbh), such thinning will leave about 40 to 100 trees per acre (this equates to around 23' X 23' to 35' X 35' between boles if the spacing were uniform between leave trees). In order to create irregular spacing (a more natural appearance), distance between leave trees will be reduced to about 15' x 15' to 20' x 20' on about 20-25% of the unit. Trees to be left will include the largest and those with the best form (full-crowned, tall, straight, free of insect and disease) and the most likely to survive the longest. Fuels treatments will be as described in the above overview.

Verbal agreement has been obtained from adjacent private landowners to acquire temporary access utilizing their existing private road and stream ford in Section 1 to access Unit 1, which lies on the south side of Big Timber Creek in Section 2. A formal written agreement is also being negotiated for this access. The neighboring landowners have previously utilized this private road and ford to thin their adjacent land in Section 1. The private road will be utilized for hauling purposes only. In addition, approximately ½ mile of temporary road would be constructed on NFS lands, off the end of the existing private road (on the bench), to facilitate both helicopter and tractor harvesting operations. All landings will be located on NFS lands. The landings and temporary road would be recontoured and/or rehabilitated (restored to natural slope, drained, seeded and/or slashed to be minimally discernible) following completion of treatment activities.

Another harvest option for Unit 1 would be helicopter logging of this entire unit and flying materials to existing landings from past harvest units on NFS lands in Section 2. This would require flying logs over the adjacent private property. This option will need to be used if the temporary written access described in the preceding paragraph can not be finalized.

Unit 2

Unit 2 consists of approximately 25 acres in Section 4 on the north side of Big Timber Creek, adjacent to Half Moon Campground (See attached map of Proposed Treatment Unit #2). Soils are medium textured with many rock fragments. The Forest Soils Scientist has completed an on the ground review Unit 2 and found no evidence of recent harvest in the proposed treatment area. By adhering to the required mitigation outlined on pp. 13-15, there will be minimal concerns for soil productivity with the ground-based mechanical harvesting methods associated with this unit.

NFS lands adjacent to the north and east sides of Unit 2 were thinned in the mid 1980s. Thinning of Unit 2 will create a less abrupt visual transition between these areas, as well as remove the Douglas-fir mortality that is currently occurring in this previously unthinned area. No current Douglas-fir beetle attacks were noted in the thinned areas. Unit 2 is located on gentle slopes of <35% and will be tractor logged. The south edge of the unit would be located on the bench, outside of the riparian corridor of Big Timber Creek.

Treatment will consist of thinning to the same 80 to 100 square feet of basal area per acre as in Unit 1 and yarding trees to landings with ground-based equipment. Existing stand conditions consists of approximately 260 square feet of basal area per acre with average diameters of approximately 12" to 14". However, the spacing will vary from Unit 1 by leaving around 35 to 60 trees per acre (this equates to around 27' X 27' to 35' X 35' between boles if spacing were uniform between leave trees) to blend better with the adjacent thinned areas.. Fuels treatments will be as described in the above overview. Unit 2 can be easily accessed from Big Timber Canyon Forest Road No. 197.

Proposed Restoration Activities and Improvements

Ecosystem restoration activities that will be completed with revenues from implementation of proposal include road restoration work in past harvest units south of Half Moon campground in Section 4; picnic area improvements including 4-fire rings and picnic tables, a toilet replacement, installation of a bulletin board, hardening of the access road and parking area; trail work on Blue Lake Trail and Big Timber Creek trail above Twin Lakes (water bars); and rehabilitation work around Blue and Twin Lakes.

If additional funds are available once the above-mentioned activities are completed, other restoration activities would include replacing burned fences in the Derby Fire area.

Features Common to the Proposal

Woody Debris and Snags

The Forest Plan coarse woody debris standard is to retain a minimum of 10-15 tons per acre of 3 inch or larger material scattered across harvest units. The stands currently contain a range of volumes from 5-10 tons on steeper slopes up to 30-50 tons on benches and draws. The average coarse woody debris in the units is currently between 20-30 tons per acres. A minimum of 10-15 tons per acre of coarse woody debris would be retained in both treatment units. Along with existing woody debris, residual slash >3 inches in diameter will be retained to meet the 10-15 tons/acre standard. In addition, snags created from insect caused mortality would fall to the ground over time and continually replenish the coarse woody debris component. It is

also estimated that approximately 3 tons per acre of fine debris (needles and fine branches) would remain on the site following the mechanical treatment, along with scattered, large diameter (>15”), rotten butt-log pieces. This material has a high nutrient content (Daniel, T.W., Helms J. A. and Baker, F.S. 1979) that is important in these relatively infertile forest soils. Although it would be optimal to retain all of the fine debris to increase soil productivity, the high fuel loading and fire hazard associated with this action makes it undesirable to do so and it is not necessary to comply with the Forest Plan Standard for coarse woody debris.

Based on the Snag Management Direction in the Gallatin Forest Plan Amendment #15 (p. 1), all proposed units would leave at least 30 snags (greater than 18’ high and greater than 10” dbh, where they exist) per 10 acres. For safety reasons, these snags will be concentrated along the edges of openings and/ or clumped within the interior of the unit. If there are not sufficient dead trees meeting the size criteria, the largest available dead trees will be left as snags. Analyzing the number of snags (greater than 10” dbh) for the entire Crazy Mountain range using Forest Inventory Analysis (FIA) data reveals on average about 4.1 snags per acre (See the snag analysis in the Project File).

Old Growth

Of the 180 total acres to be thinned, approximately 25 acres are known to be old growth as defined by Region 1 guidelines as outlined by Green et al. This definition is as follows for Douglas fir forests in this area:

- 5 trees per acre 19 inches DBH or more,
- large trees 200 year old or more,
- basal area 60 square feet per acre or more,
- down log pieces (low to moderate probability of abundant material), and 3 to 29 snags per acre (Green et al. 1992).

In the remaining areas to be thinned, trees are approximately 140 to 160 years old and have less than 5 trees per acre that are 19 inches DBH and greater. All stands proposed in this proposal have been evaluated against the Green et al. old growth criteria (Region 1’s standard).

Approximately 25 acres (a portion of Unit 1 in Compartment 104) of identified old growth will be mechanically thinned under the proposed action. In Compartment 104 there is approximately 1,500 acres of old growth forest as defined by Region 1 Guidelines (Green et al.). The 25 acres to be thinned in Unit 1 are <.02% of the old growth identified in this compartment. The Forest Plan states that a least 10 percent of commercial forest land within each timber compartment meet old growth conditions. Currently Timber Compartments 104 and 105 meet the old growth requirement (as stated above, Compartment 104 has about 26% old growth and Compartment 105 has about 30% old growth) and will still remain well above Forest Plan old growth requirements after treatments.

Included in the Project File is a map for this analysis area with the forested stands identified as mature and older successional types. Old growth stands were queried using ArcView, the TSMRS database and the SILC3 database. Ground-truthed data was used when available. The Forest Plan (page III-41) requires that we strive to maintain at least 10% old growth by timbered compartment. Presently these two compartments are above the 10% standard. The analyses for both old growth and vegetative diversity were developed from data gathered from the Timber Stand Management Resource System (TSMRS) and SILC3. TSMRS stores practically all information related to individual forest stands delineated by human photo interpretation. Information such as slope, aspect, forested cover type, elevation, and activities completed (logging, precommercial thinning, stand exams, etc.) to name but a few are stored in this database. Based part on field exams and part from photo interpretation old growth and other forest successional types were identified.

Forest-wide on the Gallatin National Forest (using Forest Inventory Analysis (FIA) data) the amount of old growth calculated is approximately 28% with a confidence interval of 24% to 32% at the .90 confidence limit. For the Crazy Mountain Range (including the Lewis and Clark National Forest), old growth averages (using FIA data) 13% with a range at the .90 confidence limit of between 5% and 22 %". Many of the stands within the project area will eventually be old growth as defined by Green et al. However, it will take on average about 30 to 70 years for most of these stands to be defined as old growth (as per Region 1 guidelines).

Upland Meadows

No actions are planned in upland meadows.

Insects & Disease

Thinning activities associated with the proposed action will open up the existing stands and remove diseased and dying trees, individual tree stress would decrease, and tree health/vigor would increase. The amount of increased vigor will be dictated by the actual residual density around trees and future moisture availability. In addition, by reducing tree density, more open conditions would create an environment that is inhospitable to the beetle.

Reducing stand densities to around 80 to 100 square feet of basal area per acre will improve Douglas-fir tree vigor and resistance to Douglas-fir bark beetle. Additionally, although tree diameters will be within the susceptible size classes, reduced competition and improved vigor will increase the probability that individual trees could pitch-out or wall-off bark beetles to prevent mortality (See the Regional Entomologist Trip Report located in the Project File).

Soils

There is no significant previous harvest in either Units 1 or 2 (Table 2).

For Unit 1, the ground based harvest portion of the unit is estimated at a maximum of 39 acres (25% of the unit). There is approximately 500 feet of temporary road to be constructed (1/2) acre. This, applied to the ground-based area of the unit is 100 times (0.5 acre) divided by 39 acres = 1.2% disturbed area. This, when added to the potential 15% disturbance from ground operations would total 16.2% disturbed area. Helicopter harvesting will make up at least the remaining 116 acres, including a three acre detrimentally disturbed landing site. Total detrimental disturbance for the 116 acres of helicopter harvest is 100 times 1 acre divided by 116 acres = 0.9% disturbed area. Total detrimental disturbance from non-winter logging activities for Unit #1 is calculated by proportioning disturbance between the two methods (39 acres times 16.2% + 116 acres times 2.7% (helicopter landing) divided by 155 acres = 6.1% disturbed area). This will be the maximum amount of disturbed area. If fewer acres are ground-based harvested, disturbed area would be less.

If helicopter harvest methods only are utilized for Unit #1, the calculation is 155 acres times 2.7% (helicopter landing) divided by 155 acres = 2.7% detrimentally disturbed area (Table 2).

Calculations for Unit 2 assessed from previous studies within the Region have shown that detrimental disturbance from non-winter tractor harvest systems are within Regional standards (Farley, 2005 (<13% from 1997 and later sails); Dumrose, 2006 (55% of summer tractor plots had <15%); Svoboda, et. al., 2007 (14.5%); Shovic, 2005 (16.5%) including landings. Thus, for tractor units predicted detrimental soil disturbance from non-winter harvest is estimated at 15%.

Winter harvest is also an option for this project. If completed using the practices in the Gallatin Soil Quality Protection BMPs (Appendix A), predicted values of post-harvest detrimental soil disturbance would be less than displayed in Table 2. This is because winter ground-based activities would produce less than 7% detrimental disturbance, vs. the 15% non-winter disturbance.

Therefore, whether using winter or non-winter harvest methods, predicted post-harvest detrimental soil disturbance will be within Regional limits. The Gallatin Soil Quality Protection BMPs have been shown to be effective and are specified for the project. Pre and post-harvest soil monitoring would be conducted as described in the Soils Specialist Report (Located in the Project File).

Table 2 - Unit Acres, Harvest Method, and Detrimental Soil Disturbance by Unit

Unit	Acres	Harvest Methods	Previous Harvest (%) Detrimental Disturbance	Predicted (%) Detrimental Disturbance	Total (%) Detrimental Disturbance	Regional Soil Quality Standard (%)	Standard Met?
1	155	116 acres/ Helicopter 39 acres /Ground (non-winter)	0	6.1	6.1	15	yes
1	155	Helicopter	0	2.7	2.7	15	yes
2	25	Ground (non-winter)	0	15	15	15	yes

***It is important to note that the road restoration activities described on page 9 in the proposed improvements are not required to meet regional soils standards.**

Mitigation Identified for Proposal

- 1) Apply standard BT timber sale protection clauses to the commercial harvest activities to protect against soil erosion and sedimentation. Of particular importance are drainage and addition of slashing materials to the temporary road and skid trails upon unit completion and slashing to the Big Timber Creek ford approaches after use.
- 2) Apply BMP's for Forestry in Montana (DNRC, 2002) for all commercial thinning operations.
- 3) Coordinate with the Montana/Idaho Smoke Management Unit at <http://www.fs.fed.us/r1/fire/nrcc/smoke.html> for permitting and scheduling of pile burn operations.
- 4) Any temporary roads and/or landings would be re-contoured and/or rehabilitated cleared of chips and woody debris, seed bed prepared and seeded to native vegetation. within one year following completion of treatment activities
- 5) Spray access roads for noxious weeds prior to seed production each year during harvest and following sale closure noxious weed treatment and mapping needs to occur for up to 7 years on the access road, landings and any other disturbed areas.
- 6) Remove all mud, dirt, and plant parts from all off-road equipment before moving into the project area. Cleaning must occur off of national Forest lands. This does not apply to service vehicles that will stay on the main Big Timber Canyon roadway.
- 7) Any gravel or other surfacing/fill materials brought or moved on-site for project related activities must be from a weed seed free source. Any straw used for road stabilization and erosion control must be certified free of weed seeds.

- 8) Minimize the creation of sites suitable for weed establishment. Do not employ harvest practices such as scarification that result in disturbed soil. Identify and approve all skid trails prior to use.
- 9) Construct a temporary crossing by installing a series of small culverts (or similar mitigation devices that meet the same objective) in the crossing and covering with a washed gravel/cobble substrate. The culverts would need to be pulled prior to spring snowmelt runoff. This mitigation alternative is preferred by MFWP.
 - Monitor streambed stability at the ford crossing. If concerns arise, then cease hauling until the ford can be hardened, and or a temporary crossing structure can be built.
 - Monitor shelf ice formation along the channel margins at the ford crossing. If shelf ice becomes a problem, then cease hauling until a temporary crossing structure can be built.
 - Minimize disturbance at the riparian crossing site, since weeds located in riparian areas and on streambanks are especially difficult to treat. (this crossing will be used if temporary access is obtained).
- 10) Revegetate bare and disturbed soil, except the designated travel routes on surfaced roads, in a manner that optimizes plant establishment. Use native plant seed where appropriate. Use weed-free seed as tested by a certified seed laboratory.
- 11) Limit harvest duration to one year with reclamation, road restoration and other ground disturbing activities, etc. to be completed during the following year.
- 12) Whole tree yard portions of the units to keep remaining slash to a maximum of 10-15 tons to the acre, which is the Forest Plan coarse woody debris requirement.
- 13) Utilize fall/winter harvest operations to eliminate most potential direct impacts to wildlife species of concern. No harvest activities should occur from March 1-August 15.
- 14) Transect surveys for northern goshawks have been completed in May and June of this year and will be continued throughout harvest operations. Northern goshawks surveys were done using taped playback alarm calls to aid in identifying the presence of any active nesting birds. In addition, all nests/nest trees located during this survey will be marked for retention and buffering.
- 15) There will be no harvest of trees containing goshawk or any other raptor nests, whether they are active or inactive.
- 16) Leave a minimum 50 -foot diameter buffer around trees with other species of raptor nest trees.
- 18) An active goshawk nest was discovered in Unit 1 of the project in the summer of 2006. To meet disturbance thresholds during implementation of this project, no treatments or treatment-related disturbance will occur at any time in occupied nest areas to ensure 100% of the nest area (defined in Reynolds et al. 1992) is conserved. This will be achieved by placing a conservative 40-acre no harvest buffer around the known nest site, resulting in a contiguous no harvest area of 40 acres as per Region 1 direction (Brewer et. al. 2006). In addition, no ground disturbing activities will occur within the PFA from March 1 through August 15 to ensure that the goshawk family is adequately protected during the courtship, egg-laying, incubation, early nestling, and late fledgling periods (refer to

biological evaluation for more information). The same mitigation would apply to any newly discovered nest.

- 19) If it is determined through on-going surveys that the goshawk pair uses an alternate nest within the harvest units, No activity would be permitted within $\frac{1}{4}$ mile of the active goshawk nest between March 1 and August 15 and a 700 foot diameter buffer (40 acres) would be retained around the nest tree thereafter.
- 20) Marking along the east boundary on Unit 1 should blend with adjacent residual density and pattern in Section 1.
- 21) West edges of Unit 1 should be feathered and undulated over approximately 300 feet to reduce the contrast with adjacent private land (Section 3).
- 22) The uphill (south) edge of Unit 1 should also be feathered and undulated over a few hundred feet to avoid an obvious break of untreated conifers just below the ridge top.
- 23) The pattern of tree removal in both units should not leave uniform spacing, taking advantage of leaving larger trees with full crowns and include clumping to end up with patterns that are somewhat similar to the light patchiness visible on adjacent slopes.
- 24) For Unit 2, stumps that may be visually dominant within 50 ft of the Big Timber Canyon Road should be a maximum height of six inches with the cut face angled parallel to the slope.
- 25) Any temporary roads or skid trails that join the Big Timber Canyon Road should be rehabilitated to become minimally discernible from the surrounding area.
- 26) If the small road to the east of Halfmoon Campground is improved for equipment access, it should be returned to its fairly primitive condition within one year following completion of the project.
- 27) For Unit 2, staging areas and slash piles that might be discernible beyond one year after completion of the project should be located as much as possible out of sight of the Big Timber Canyon Road.
- 28) For Unit 2, all marking visible from the Big Timber Canyon Road should be removed within a year after completion of harvest activities (recommend cut tree mark).
- 29) If any historic or cultural sites are discovered during operations, they would be avoided and protected.
- 30) The Gallatin National Forest Soil Protection BMPs (Appendix A) will be used for all harvest ground based harvest operations.
- 31) Soil quality monitoring will be completed on activity areas within two years of completion of harvest related activities.

Economics

The timber value was estimated using the Northern Region Transaction Evidence Appraisal System. A financial analysis was completed for the different options using the (PNV) of revenues and costs anticipated during the life of the project. The direct costs for the timber harvest portion included the timber sale planning, preparation, implementation, administration, and post-sale treatments such as planting and fuel reduction on the acres where timber harvest would occur. In summary, the option with road right-of-way access through the private land and building ½ mile of temporary road off the end of the existing road is the most economically feasible. This is due to shorter flight distances and the potential to treat 75 acres with less costly tractor logging. See Table 3 below. The complete economic analysis is located in the Project File.

Table 3 Transaction Evidence Appraisal (TEA) System

Option	Approximate Advertised Value	Volume (CCF)
#1 (Approx. 40 Acres of Tractor Ground in Unit 1 with Spur access)	\$26,259.24	1800
#2 (No Tractor Ground in Unit 1 with no spur access)	\$2,150.63	1800

Option 1 is the most economically beneficial. The cost of Option 2 is higher due to the increased logging costs associated with longer flight distances for helicopter logging and less tractor logging.

CATEGORICAL EXCLUSION

Forest Service actions may be categorically excluded from documentation in an EA or EIS only if the action: (a) is within a category listed in Chapter 30 of FSH 1909.15, and (b) there are no extraordinary circumstances related to the action.

My decision qualifies under either provision of the Environmental Policy and Procedure Handbook (FSH 1909.15), W.O. Interim Directive No.: 1909.15-2003-1, dated June 5, 2003 as indicated below:

31.2 - Categories of Action for Which a Project or Case File and Decision Memo are Required.

14. Commercial and non-commercial sanitation harvest of trees to control insects or disease not to exceed 250 acres, requiring no more than ½ mile of temporary road construction, including removal of infested/infected trees and adjacent live uninfested/uninfected trees as determined necessary to control the spread of insects or disease.

This project:

- (a) Would be consistent with agency and Departmental procedures and the Gallatin National Forest Plan.
- (b) Would comply with all applicable Federal, Tribal, and State laws for the protection of the environment.
- (c) Would not be conducted in wilderness areas, wilderness study areas, national recreation areas, inventoried roadless areas, or other specified areas of significance..
- (d) Would not include the construction of new permanent roads or other permanent infrastructure.

Therefore, I have determined that these actions should be categorically excluded from documentation in an environmental impact statement (EIS) or an environmental assessment (EA).

CONSIDERATION OF EXTRAORDINARY CIRCUMSTANCES

An Interdisciplinary Team of resource specialists has reviewed the proposed action and submitted reports to the Project File. After considering their findings, I have decided that no extraordinary circumstances exist. I base this decision on the following findings:

➤ **Threatened, endangered, and proposed species or their critical habitat and Forest Service sensitive species.**

There is no critical habitat for threatened, endangered, proposed, or sensitive species within the project area. The grizzly bear is now considered a Forest sensitive species, since federal delisting of the Yellowstone population was completed in April of 2007. Even so, grizzly bears are not known to inhabit the Crazy Mountains. The Fish and Wildlife Service (FWS) does not require the Forest Service to analyze the effects of vegetation treatment to grizzly bears north of Interstate 90. Although reports of wolves have been reported in the Crazy Mountains, there has been no known verified occurrence of wolves in the project analysis area or recent occurrence on the east side of the Crazy Mountains. There may be some fall and winter usage of the project area by bald eagles, however the eagles are primarily found along the Yellowstone River. There is no evidence that individual eagle or potential eagle habitat would be impacted by implementation of this project. There are no known occurrences of lynx, or wolverine in the project area. Both the Canada lynx and the wolverine occupy large home ranges and may be rare and infrequently present in the analysis area. Canada lynx habitat has been mapped in the analysis and project area, but this species is not likely to be present because of limited snow depth in winter and the lack of appropriate foraging habitat and forage prey species. Wolverines are rare, having extremely large home ranges. The scale of this project is unlikely to affect the species even if it were present. Northern goshawks have been observed in the project area and are regularly present throughout the analysis area. A nesting pair of goshawks was discovered in the project area in the summer of 2006. Mitigation measures (pages 12 and 13) have been incorporated to minimize any potential impact to the species from proposed actions. Neo-tropical birds representing over 30 different species are present annually during the breeding season, but rely primarily on riparian habitat along Big Timber Creek. Migratory birds will have no direct impacts because they will not be present during proposed project activities. Some indirect impacts may occur that limit nesting of interior forest nesting species, although this would be offset by the abundance of interior forest nesting habitat available for these species within 1-3 miles of the proposed project area. Effects to threatened, endangered, or sensitive species are documented in a biological assessment/ evaluation that is located in the Project File.

➤ **Floodplains, wetlands, or municipal watersheds.**

There will be no negative impacts to floodplains, wetlands or municipal watersheds associated with the project. The Big Timber Canyon Vegetation Project is not located near any municipal watersheds. No timber harvest activities, including road or landing construction, will occur within riparian areas. The nearest harvest to Big Timber Creek is located a few hundred yards upslope from the stream and upslope from a topographic bench between the harvest area and the stream. Therefore, there is no potential for riparian harvest related effects. Harvest related activities will follow the Best Management Practices (BMPs) for Montana.

A total of approximately 65 acres in Units 1 and 2 would likely be harvested by tractor skidding. Helicopter logging is proposed for the majority of Unit 1, which significantly reduces the potential for harvest related sediment increases. The ½ mile of temporary road necessary to access Unit 1 is located on the bench above Big Timber Creek, so sediment delivery efficiency from that segment of road is minimal. The new temporary road would be re-contoured and rehabilitated following harvest. The R1/R4 sediment model estimates show that sediment yield for the Big Timber Creek drainage is currently 3.8% over natural, which accounts for all roads and previous harvest activities. This proposal is predicted to increase sediment yield 1.1% during harvest and would gradually return to current levels over the 4 years following treatment (Water and Air Resources Report). Existing and predicted increases are well below the 50% threshold guideline established for Gallatin National Forest streams of this type.

The primary source of potential sediment increase would occur at an existing stream ford on private land that would likely be used to access Unit 1. The ford was previously constructed by a private landowner to haul logs and access a harvest unit on private land. There is some potential to disturb the streambed at the ford crossing, which could release embedded sediments. However, streambed substrates at the ford are predominately large cobble and gravel and appear to be tightly packed and consolidated with low potential for rutting. The proposed fall/winter operating season would minimize potential impacts. These conditions would be closely monitored during hauling. See mitigation #9 and #10 and the fisheries report located in the Project File.

➤ **Congressionally designated areas, such as wilderness, wilderness study area, or National recreation areas.**

No wilderness designation, wilderness study areas, or national recreation areas exist within the analysis area for the proposal. There is no designated wilderness in the Crazy Mountains.

➤ **Inventoried roadless areas.**

The project area is not in an inventoried roadless area.

➤ **Research Natural Areas.**

There are no Research Natural Areas within or adjacent to the project area.

➤ **Native American religious or cultural sites, archaeological sites, or historic properties or areas.**

The Crazy Mountains are considered to be an area of religious and cultural importance to the Crow tribe, however, no Native American religious or cultural sites have been found in the proposed units. No comments or concerns regarding the proposal were received from the tribal representatives. No archeological sites have been found in the project area. If any cultural or archeological sites are found during implementation of the proposal they will be protected.

SCOPING AND PUBLIC INVOLVEMENT

In October of 2005, a project initiation letter for the Big Timber Canyon Vegetation Treatment Project (PF, 2-1) was sent to the Forest Service resource specialists on the interdisciplinary team for the project. A legal notice describing the proposed project was published in the Bozeman Daily Chronicle (the paper of record) on March 20, 2006 (PF, 2-3), stating that the Scoping/Draft Decision Memo was available for public review and comment. Copies of the Scoping/Draft Decision Memo (PF, 2-4) were mailed to 45 persons, groups, local governments, and agencies (PF, 2-5) that have been involved with, or expressed interest in similar projects, or live in the project area. A 30-day public review and comment period followed. A total of 3 comment letters pertaining to the project were received (PF, 3-2 through 3-4).

I signed the Final Decision Memo for the Big Timber Canyon Vegetation Treatment Project on February 7, 2007. A legal notice announcing the release of the decision was published in the newspaper of record, the Bozeman Chronicle, on February 8, 2007 (PF, 1-7). Letters responding to the comments were mailed out with the Final Decision Memo to the three commenters. Two appeals were received regarding the project. Upon further review of these appeals, I determined that, in lieu of recent court determinations regarding this level of decision, additional soils analysis was needed to clearly show compliance with Regional Soil Standard Guidelines. I withdrew the Decision until this analysis was completed.

I reissued the revised Draft Decision Memo, containing additional soils analysis, for another 30-day comment period and received one comment letter. I have considered these comments in making my final decision regarding this project. Responses to this comment letter can be found in Appendix A of this decision. Also attached are copies of the three comment response letters from the original scoping/comment period.

The Big Timber Canyon Vegetation Treatment Project is included in the summer and fall Quarters 2005, all quarters of 2006, and spring & summer quarters of 2007 proposed project listings for the Gallatin National Forest.

FINDINGS REQUIRED BY OTHER LAWS, REGULATIONS, AND FOREST PLAN DIRECTION

My decision is consistent with guidelines set forth in the Federal Land Policy and Management Act (FLPMA, P.L. 94-579, 10/21/76 as amended). This action does not violate any federal, state, or local laws or requirements imposed for the protection of the environment. Specialist input supporting consistency determinations can be found in the Project File.

Findings of Consistency with the Forest Plan and National Forest Management Act

Management direction appears in the Land and Resource Management Plan for the Gallatin National Forest approved in 1987. This project falls within Management Area (MA) 9 (FP, pp. III-27 through III-29), which consist of suitable timberlands that have high dispersed recreation value and are visually sensitive. The management goals for MA 9 include providing for a variety of dispersed recreation activities in a roaded setting, harvest of timber that is consistent with recreational activities, and meeting State water quality standards and maintaining stream channel stability.

Management of vegetation is possible as long the above goals are met or maintained. Specifically, even and uneven harvest can be used along with commercial and precommercial thinning that focuses on actively controlling tree damaging agents and providing a natural mix of conifer species and levels of stocking densities that improves the visual quality within the area. Visual quality objectives range from retention to partial retention with the shape and scale of even-aged openings to replicate natural openings. Mitigation actions identified with this project are consistent with MA 9 direction. The project is also consistent with MA9 visual quality objectives of retention to partial retention.

The Gallatin Forest Plan Forest Wide Standards applicable to this project for each resource and the findings of consistency include:

- ➔ **Visual Quality** – Forest-wide standards 4.1 and 4.2 (page II-16) require an analysis for landscape altering activities.
- ➔ **Cultural Resources** – The Gallatin Forest Plan incorporates the requirements under the following statutes: the National Historic Preservation Act (1966) and the American Indian Religious Freedom Act (1978). Forest Plan standards applicable to this project reflect the mandates under the above statues include inventory procedures, evaluation procedures, protection/preservation procedures, and coordination consultation procedures (see FP II-14 and II-17). The Big Timber Canyon Vegetation Project is consistent with the laws, regulations, and Forest Plan direction.
- ➔ **Wildlife and Fish** – Forest-wide standards 6.1, 6.7, 6.11, 6.12, 6.13, 6.14 and 6.15 pages II-17-19) provide for snag and downed woody debris management and protection of riparian habitat and cold-water fisheries.
- ➔ **Timber** –
MA Standards: **MA 9** (page III-27) ‘Classified as suitable for timber production.’
 - (page III-28) ‘Include even-aged and uneven-aged harvest method systems’.
 - (page III-28) ‘Shape and scale even-aged openings to replicate natural openings.’
 - (page III-28) ‘Permit commercial and pre-commercial thinning consistent with management goals’.
 - (page III-28) ‘Stocking density standards may be varied to add variety to the visual resource.’
 - (page III-28) ‘Actively control tree damaging agents.’

Appendix A. Criteria for Selecting Preferred Silvicultural System:

- (p. A-1) The system should develop stand conditions required to meet management area goals over the longest possible time.
- (p. A-4) The system should permit enough control of competing vegetation to allow establishment of an adequate number of trees growing at acceptable rates.
- (p. A-5) The system should promote stand structures, compositions and conditions that minimize damage from pest organisms, animals, wind and fire.

- **Water and Soils** – Forest-wide Standard 10.2 (page II-23) requires that Best Management Practices (BMP's) be used in all Forest watersheds in the planning and implementation of project activities. Use all necessary measures to minimize soil damage and soil erosion on project areas.
- **Fire** – Forest-wide Standards 14.3 (page II-28) provide for treatment of activity created dead and down woody debris to be reduced to a level commensurate with risk analysis.
- **Noxious Weeds** – Forest-wide Standard 15.1 (page II-28) states that an integrated weed management program would be implemented to confine present weed populations and prevent establishment of new areas of noxious weeds.

National Forest Management Act

The National Forest Management Act (NFMA) requires that Forest plans "preserve and enhance the diversity of plant and animal communities...so that it is at least as great as that which can be expected in the natural forest" (36 CFR 219.27). Furthermore, implementation regulations for the NFMA specify that, "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area".

There are three management indicator species (MIS) which may occur in the vicinity of the project. These are the pine marten, northern goshawk and hairy woodpecker. The project as designed does not occur in moist conifer or riparian habitat and will not affect old growth forest habitat, so the pine marten will not be affected. Regardless, all of the guidelines for pine marten habitat will be met following treatment. The northern goshawk is known to be present in the vicinity of the project. The Northern Region guidelines for the nest stand include canopy coverage of (45+%) and trees (≥ 9 in. dbh) based on Silc III, (Northern Goshawk Northern Region Overview, pp. 35 & 36) will remain after the project is completed. Adherence to the snag retention guidelines will also provide viable habitat for the hairy woodpecker.

There are currently 8 terrestrial species, 3 fish species, and 2 amphibian species identified as "Sensitive" that are known or suspected to occur on the Gallatin National Forest (USFS 2004). The grizzly bear is now considered a Forest sensitive species, since federal delisting of the Yellowstone population was completed in April of 2007. Even so, grizzly bears are not known to inhabit the Crazy Mountains. The northern goshawk was removed from the sensitive species list (Project Analysis in Region 1 letter from Regional Forester, July 17, 2007). There is no suitable habitat for the trumpeter swan, harlequin duck, flammulated owl, Townsend big-eared bat; northern leopard frog, western toad, arctic grayling, westslope cutthroat trout, or Yellowstone cutthroat trout, a "no impact" determination would be likely for these species.

Species for which habitat is suitable and was analyzed in the Biological Evaluation include the peregrine falcon, black-backed woodpecker, and wolverine. The analyses indicated there will be no impact to other sensitive species analyzed. The wildlife specialist report and Biological Assessment are in the Project File. A biological evaluation (BE) for the proposal has been completed and is located in the Project File.

Sensitive plants surveys have been completed for the two units within the treatment area with the results included in the biological evaluation and Project File. No sensitive plant occurrences were found. If any sensitive plants are found during project implementation, they will be protected.

Endangered Species Act

Under Section 7 of the Endangered Species Act, each Federal agency must ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any threatened or endangered species. A Biological Assessment has been prepared for the project. The project *may affect but is not likely to adversely affect* the Canada lynx, would have *no effect* on the bald eagle, and *would not be likely to jeopardize* the gray wolf. The U.S. Fish and Wildlife concurred with our findings in informal consultation. A copy of their concurrence letter is in the project file. The grizzly bear is now considered a Forest sensitive species, since federal delisting of the Yellowstone population was completed in April of 2007. Even so, grizzly bears are not known to inhabit the Crazy Mountains. There are no plants listed as threatened or endangered in the project area. The BA is located in the project file at the Big Timber Ranger District.

Montana State Water Quality Standards and Clean Water Act

State Laws: The State of Montana Water Quality Act requires the state to protect, maintain, and improve the quality of water for a variety of beneficial uses. Section 75-5-101, MCA established water quality standards based on beneficial uses. Big Timber Creek in the project area was characterized using the Level II classification scheme outlined by Rosgen (1996). Big Timber Creek is the only perennial stream within the proposed project area and there are no intermittent or ephemeral streams. The channel throughout the project area is generally characterized as a C3/C4 type (Rosgen 1996) with intermittent B3/B4 reaches where gradient increases and the channel has less access to its floodplain.). Sediment supply for C3 and C4 channels is generally low, unless the banks are in a highly erosive condition. B3 and B4 channel beds and banks are considered stable and contribute only small quantities of sediment during runoff events. Channel sensitivity to increased streamflow or sediment discharge is low for B3 and B4 channels. Streambank erosion potential is low and riparian vegetation has negligible controlling influence on streambank stability.

The 1991 Streamside Management Zone law and 1993 SMZ Rules of Montana apply to all commercial timber harvest treatments. The State of Montana Water Quality Act requires the state to protect, maintain, and improve the quality of water for a variety of beneficial uses. Section 75-5-101, MCA established water quality standards based on beneficial uses. No stream segments in the project area are on the Montana 303(d) list for TMDL development. The Montana 303(b) database lists 5.1 miles of Big Timber Creek from Swamp Creek to the mouth of the Yellowstone River as impaired from dewatering due to irrigation diversions <http://deq.mt.gov/CWAIC/default.aspx>. A TMDL is not required since no pollutant related use impairment is identified. The Big Timber Canyon Vegetation Treatment Project will not result in additional dewatering of Big Timber Creek.

Trout Unlimited Agreement

The goals, policies and objectives for aquatic resources outlined in the Forest Plan have been further defined within an agreement with the Madison-Gallatin Chapter of Trout Unlimited (TU) in 1990. One intent of the Agreement was to provide more specific direction on timber harvest in riparian areas. Forest Service Action #4 (outlined in the Agreement) states: “The Gallatin National Forest agrees that vegetative manipulation within riparian areas will occur only for the purpose of meeting riparian dependent resource objectives such as watershed, wildlife, or fisheries. Timber harvest activities designed to meet timber management objectives will not be scheduled in riparian areas. The Agreement further defines riparian areas as “the land and vegetation for approximately 100 feet from the edges of perennial streams, and intermittent streams of sufficient size, to include a distinct riparian vegetation community and rock substrate stream channel. This area should correspond to at least the recognizable area dominated by riparian vegetation.” No timber harvest activities, including road or landing construction, would occur within riparian areas. The nearest harvest to Big Timber Creek is located a few hundred yards upslope from the stream and upslope from a topographic bench between the harvest and the stream. Therefore, there is no potential for riparian harvest related effects. Mitigation measures outlined in the proposal are intended to protect riparian dependent resource objective including fish habitat.

Heritage Program Laws (National Historic Preservation Act (amended 1992), American Indian Religious Freedom Act, and Native American Graves and Repatriation Act)

The Forest Service is mandated to comply with the National Historic Preservation Act (as amended 1993) [Public Law 89-665], (36CFR800.1) on such undertakings that affect properties included in or eligible for inclusion to the National Register of Historic Places (NRHP). Historic properties are identified by a heritage resource inventory and are determined as either eligible or not eligible properties for the National Register. Eligibility is reviewed, and concurrence given by the Montana Historic Preservation Office (MTSHPO). Sites that are determined eligible are then

either protected in-place or adverse impacts must be mitigated. No historic sites have been located within the project area.

The Forest Service has obligations under the American Indian Religious Freedom Act (AIRFA) of 1978 to “protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian” [Public Law 95-442]. Executive Order 13007 of 1996 further directs federal agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting such sites.

No comments or concerns regarding the project have been received from the Crow Tribe. The Crazy Mountains are considered to be an area of religious and cultural importance to the tribe. No cultural sites have been located within the proposed units. There are no actions related to this project that are applicable to the intent of the Native American Graves and Repatriation Act.

Executive Order 12898 (Environmental Justice)

The Big Timber Canyon Vegetation Treatment project was assessed to determine whether it would disproportionately impact minority or low-income populations, in accordance with Executive Order 12898 (EA, page 3-119). No impacts to minority or low-income populations have been identified during the initial effects assessment.

Migratory Bird Treaty Act

On January 10, 2001, President Clinton signed an Executive Order outlining responsibilities of federal agencies to protect migratory birds. On January 17, 2001, the USDA Forest Service and the USDI Fish and Wildlife Service signed a Memorandum of Understanding to complement the Executive Order. Upon review of the information regarding neotropical migratory birds in the wildlife report, the Big Timber Canyon Vegetation Treatment Project will not result in significant loss of migratory bird habitat or be an extirpation threat to any migratory birds.

Clean Air Act

Activities to be implemented with the Big Timber Canyon Vegetation Treatment Project will be coordinated to meet the requirements of the State Implementation Plans, Smoke Management Plan, and Federal air quality requirements. Potential smoke emissions have been calculated using USFS R1 NEPA evaluation procedures for prescribed fire projects (Story and Dzomba 2005), which can be downloaded from USFS R1 air quality website at <http://www.fs.fed.us/r1/gallatin/air.index.shtml>. The Smoke Impact Spreadsheet (SIS) was utilized for the modeling as specified in the USFS R1 guidance. Results indicated the Big Timber Canyon Vegetation Project combined PM2.5 emissions of 7.1 tons, which will occur as slash piles from thinning and landings are burned. This level of emissions is much too low to pose violations of Montana air quality. During periods of pile burning concentrations of wood smoke will result in visible plumes in and near the units. No smoke concentration visibility

or health problems are anticipated near Forest Road #197, at Half Moon Campground or the private residences and ranches.

Land Use Strategy for WCT and YCT:

The Upper Missouri Short Term Strategy for Conserving Westslope Cutthroat Trout (UMWCT short term strategy) was finalized into a “Land Use Strategy” in April 2001. The Strategy calls for preventing habitat degradation and improving existing populations and their habitat until a long-term recovery strategy can be established and implemented. The Strategy ensures that land-use activities, like timber sales, will be implemented in a manner that results in a “beneficial impact” or “no impact” biological decision. Big Timber Creek has local significance as a recreational fishery with species composition consisting primarily of brook trout, with fewer rainbow and brown trout. Fishery surveys have been conducted. Neither Yellowstone or westslope cutthroat trout, sensitive fish species on the Gallatin NF, inhabit the stream. Thus, activities associated with the proposed action will meet the requirements of the Land Use Strategy.

Cooperative Conservation Agreement for Yellowstone Cutthroat trout within Montana.

This agreement establishes a framework of cooperation between the participating parties to work together for the conservation of YCT. The primary goal of the Agreement and accompanying Yellowstone Cutthroat Trout Conservation program is to ensure the persistence of the Yellowstone cutthroat trout subspecies within the historic range in Montana at levels and under conditions that provide protection and maintenance of both the intrinsic and recreational values associated with the subspecies. Fishery surveys have been conducted. No Yellowstone cutthroat trout, a sensitive fish species on the Gallatin NF, inhabit the stream.

Executive Order 12962 (June 1995)

Section 1. Federal Agencies shall, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by:

- b. identifying recreational fishing opportunities that are limited by water quality and habitat degradation and promoting restoration to support viable, healthy, and where feasible, self-sustaining recreational fisheries....
- h. evaluating the effects of federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries and document those effects relative to the purpose of this order...

Habitat surveys were completed in Big Timber Creek in 1998 in Section 4 above Halfmoon Campground where the stream is more incised, has higher gradient and has

a boulder dominated substrate. Habitat conditions were typical of high gradient mountain streams. Banks were 99.9% stable. Surveys were not conducted downstream through private property in Section 2 where gradient is less steep. However, based on visual observation, habitat conditions have not been degraded and are typical for C3/C4 channel types. The streambanks are stable and riparian vegetation has not been disturbed.

Big Timber Creek has local significance as a recreational fishery. Species composition consists primarily of brook trout, with fewer rainbow and brown trout. Yellowstone cutthroat trout, a sensitive fish species on the Gallatin NF, do not inhabit the stream. Trout populations are robust, especially brook trout, with several year classes represented. Recruitment success, or survival of incubating eggs, does not limit the numbers of adult fish in the population (personal communication, Jim Olsen MFWP).

With implementation of the proposed action, no timber harvest activities, including road or landing construction, will occur within riparian areas. The nearest harvest to Big Timber Creek is located a few hundred yards upslope from the stream and upslope from a topographic bench between the harvest and the stream. Therefore, there is no potential for riparian harvest related effects.

ADMINISTRATIVE REVIEW AND APPEAL OPPORTUNITIES

My decision is subject to appeal pursuant to 36 CFR 215, as clarified in the court order dated October 19, 2005 by the U.S. District Court for the Eastern District of California in Case No. CIV F-03-6386JKS. Individuals and organizations that submitted written or oral comments during the 30-day comment period for the June 2007 Draft Decision Memo may file an appeal. Comments received from an authorized representative(s) of an organization are considered those of the organization only, individual members of that organization do not meet appeal eligibility requirements solely on the basis of membership in an organization, the member must submit comments as an individual. A written appeal must be submitted within 45 days following the publication date of the legal notice of this decision in the Bozeman Chronicle, Bozeman, Montana (newspaper of record). It is the responsibility of the appellant to ensure their appeal is received in a timely manner. The publication date of the legal notice of the decision in the newspaper of record is the *exclusive* means for calculating the time to file an appeal. Appellants should not rely on date or timeframe information provided by any other source.

Paper appeals must be submitted to:

USDA Forest Service, Northern Region
ATTN: Appeal Deciding Officer
P.O. Box 7669
Missoula, MT 59807

Or

USDA Forest Service, Northern Region
ATTN: Appeal Deciding Officer
200 East Broadway
Missoula, MT 59802

Office hours: 7:30 a.m. to 4:00 p.m.

Electronic appeals must be submitted to:
appeals-northern-regional-office@fs.fed.us

In electronic appeals, the subject line should contain the name of the project being appealed. An automated response will confirm your electronic appeal has been received. Electronic appeals must be submitted in MS Word, Word Perfect, or Rich Text Format (RTF).

It is the appellant's responsibility to provide sufficient project or activity-specific evidence and rationale, focusing on the decision, to show why my decision should be reversed. The appeal must be filed with the Appeal Deciding Officer in writing. At a minimum, the appeal must meet the content requirements of 36 CFR 215.14, and include the following information:

- The appellant's name and address, with a telephone number, if available;
- A signature, or other verification of authorship upon request (a scanned signature for electronic mail may be filed with the appeal);
- When multiple names are listed on an appeal, identification of the lead appellant and verification of the identity of the lead appellant upon request;
- The name of the project or activity for which the decision was made, the name and title of the Responsible Official, and the date of the decision;
- The regulation under which the appeal is being filed, when there is an option to appeal under either 36 CFR 215 or 36 CFR 251, subpart C;
- Any specific change(s) in the decision that the appellant seeks and rationale for those changes;
- Any portion(s) of the decision with which the appellant disagrees, and explanation for the disagreement;
- Why the appellant believes the Responsible Official's decision failed to consider the substantive comments; and
- How the appellant believes the decision specifically violates law, regulation, or policy.

If an appeal is received on this project, there may be informal resolution meetings and/or conference calls between the Responsible Official and the appellant. These discussions would take place within 15 days after the closing date for filing an appeal. All such meetings are open to the public. If you are interested in attending any informal resolution discussions, please contact the Responsible Official or monitor the following website for postings about current appeals in the Northern Region of the Forest Service: http://www.fs.fed.us/r1/projects/appeal_index.shtml.”

IMPLEMENTATION DATE

If no appeals are filed within the 45-day time period, implementation of the decision may occur on, but not before, 5 business days from the close of the appeal filing period. When appeals are filed, implementation may occur on, but not before, the 15th business day following the date of the last appeal disposition.

Activities associated with the Big Timber Canyon Vegetation Treatment Project are anticipated to begin as early as the fall/winter of 2007/2008 and could continue for up to two years.

CONTACT PERSONS

For further information regarding this proposal, contact Bill Avey, District Ranger at the Big Timber Ranger District, (406) 932-5155 or Barbara Ping, Interdisciplinary Team Leader (406)-522-2558.

BILL AVEY
District Ranger

Date

APPENDIX A

RESPONSE TO COMMENTS

This appendix to the Big Timber Canyon Vegetation Treatment Decision Memo contains the agency's responses to questions and comments received during the 30-day public review and comment period for the June 2007 Draft Decision Memo. Public comments were due on July 16, 2007.

A total of 1 letter was received. Table A-1 below lists the letter number and commenter. Comments are grouped by subject matter or resource. Each comment is identified by letter number first and then by individual comment number after the hyphen (Example 1-1). The comments were transcribed as written in the comment letters with the agency response following the comment. Some comments are repetitive, so responses to these comments will refer to previous letters where that specific comment has already been addressed in this appendix. Identical comments have been grouped, showing the letter and comment numbers that apply.

Table A-1 Letters and Comments received in response to the June 2007 Draft Decision Memo

Letter Number	Commenter
1	Sara Jane Johnson-Native Ecosystem Council

Comment 1-1. Please identify the monitoring data and published research in peer-reviewed journals that identifies the effectiveness of a 40-acre no treatment buffer around a goshawk nest in maintaining continued use of this site by breeding goshawks.

Response: The "Northern Goshawk, Northern Region Overview, Key Findings and Project Considerations" (Brewer, Bush, Canfield, Dohmen, May 2007) reviewed all available literature pertaining to the goshawk and recommends a 40 acre minimum no activity buffer (p. 39) for projects within the Northern Region..

Comment 1-2: Please identify the specific wildlife species, based on monitoring and published peer-reviewed research, that will increase after logging and thereby improve and/or maintain goshawk foraging quality in comparison to existing conditions,

Response: The current conditions within the project area (mature forest with little understory vegetation) are not optimal for many prey species or for herbivores. If habitat is improved for herbivores by providing forage, predators that prey on these species will also utilize the project area. Further, there is abundant mature forest within the analysis area that will never be treated commercially or otherwise because it is within designated roadless and protected areas or is topographically inaccessible. Past logging activities have helped to maintain foraging habitat in the drainage as indicated by the presence of

breeding birds in the vicinity of these activities. This project will provide a similar mosaic of habitat.

Specific effects of forest management on prey populations and prey availability vary by species, and those effects, which could be positive or negative, are poorly documented (Squires and Kennedy 2006). Since the habitat of many prey species are linked to structural habitat components such as snags, downed wood, and vegetative diversity in the understory, as well as on a landscape scale, maintaining these components through silvicultural prescriptions (e.g. project design) may be important (Reynolds et al. 1992; USDI-FWS 1998). Species that rely on a mix of early successional stages and trees will utilize the project area. There are many studies that indicate this as well as the life history information available on these species. For instance, Young and Hutto (2002) consistently, over several years, found 5 bird species more abundant in uncut stands while they found 17 species more abundant in cut stands. Some of the 17 species that inhabit our Forest include the hairy woodpecker, northern flicker, dusky flycatcher, warbling vireo, mountain chickadee, ruby crowned kinglet, Townsend's solitaire, American robin, yellow-rumped warbler, MacGillivray's warbler, western tanager, chipping sparrow, dark-eyed junco, and a few others. Hutto and Young (1999) also noted American kestrel, Williamson's sapsuckers, olive-sided flycatcher, black-capped chickadee, house wrens and a number of other species to utilize these habitats more than other habitats. There is no doubt that many wildlife species use areas that have been partially harvested and that some species seem to prefer these habitats.

Hutto, R.L. and J.S. Young. 1999. Habitat relationships of landbirds in the Northern Region, USDA Forest Service. USDA Forest Service. Rocky Mountain Research Station. General Technical Report RMRS-GTR-32. 72 pp.

Young, J.S. and R.L. Hutto. 2002. Use of a landbird monitoring database to explore effects of partial-cut timber harvesting. *Forest Science* 48(2): 373-378.

Comment 1-3: Please identify why the Reynolds et al. (1992) or southwest goshawk guidelines are not considered suitable for management of the Big Timber Canyon goshawk breeding territory' including management of old-growth and a post-fledgling family area.

Response: See response to Comment 1-1 above. The guidelines used for the Big Timber Canyon project were based on analysis of the best available science. Specifically, the nesting buffer area for big timber canyon is larger than recommended by Reynolds et.al. and incorporates study results that are more specific to the Northern Region goshawk population, which can be found in the "Northern Goshawk, Northern Region Overview, Key Findings and Project Considerations" (Brewer, Bush, Canfield, Dohmen, May 2007)

Comment 1-4: Please identify the condition, including old growth and forested acres (both harvested and unharvested), that occur in intermingled private lands of the 2 affected timber compartments.

Response: The vegetative analysis completed for this area (Volume 1, page 5-5, 6-12C and 6-12D) shows (using SILC III data) the following forest types by timber compartment by each timber compartment ON FORESTED LANDS (excludes rock/grass/shrubs):

Private Acres in Compartment 104

FOREST TYPE	ACRES
OLD GROWTH	278
MATURE	794
POLE	281
SEEDLING/SAPLING	113

Private Acres in Compartment 105

FOREST TYPE	ACRES
OLD GROWTH	398
MATURE	930
POLE	294
SEEDLING/SAPLING	197

***Pole sized and seedling sapling stands include both harvested and un-harvested stands**

Comment 1-5: Please demonstrate that the forest inventory plot data that is being used for snags and old growth is based on a statistically valid sample. In the case of snags, these FIA plots were used to justify a lack of site-specific snag inventory, so the former should have a very low error potential.

Response: Snag numbers and old growth amounts were generated using Forest Inventory and Analysis (FIA) plot data for the forested lands within the Gallatin National Forest and the Crazy Mountains. The national FIA program provides a congressionally mandated, statistically-based, continuous inventory of the forest resources of the United States (see pages in volume 1 section 6).

Comment 1-6: Please identify what information is currently available to show that the current snag direction for the Gallatin Forest Plan will maintain viable populations of associated species and therefore can be used as a measure of project significance in the Big Timber Canyon Vegetation Project.

Response:

The 1987 Gallatin Forest Plan was amended for snag management direction in 1993. This standard is to designate to leave an average of 30 live snag replacement trees per 10

acres with harvest units where broadcast burning is not scheduled. This is doubled in Doug fir and subalpine fir on shallow or rocky soils. A snag is defined as greater than 18 feet high and 10 inch DBH. Snags may be left in clumps or islands. This standard was based on some information available at that time including Thomas et al 1979. This continues to be a reasonable standard for green tree harvests because these snag densities are those that are supposed to provide the maximum potential population (p. 69 and pp. 388-391, *Ibid*) and would thus retain viable populations. Thomas (et al. 1979) is the classic work on snags upon which many following studies and research are based. According to the FIA data, 4.1 snags/acre are what is found in this area on average, and 3 snags/acre is only slightly below that. Most recent research on the topic of snag densities for wildlife has focused on fire salvage harvest, and not retention of snags in live stands after harvest. A recent review of the literature did not indicate that our current snag direction is incorrect for harvest of green trees, however, the Forest may revisit the snag direction for post-fire salvage.

In this project, only 180 acres are proposed for harvest in which this snag standard will be met. In addition, this sale area is an island within a large amount of area that has not been harvested and is not planned for future harvest. There will also be a large 40 acre island left within the sale area of unharvested trees that should include a higher density of snags than the harvested area. In addition, this area is somewhat patchy in forest cover due to soils and geology. If it is found that too few snags remain post harvest, snags can be created by topping or girdling.

Thomas, J.W. editor. 1979. Wildlife habitats in management forests: the Blue Mountains of Oregon and Washington. USDA Forest Service. Ag. Handbook No. 553.

Comment 1-7: Please identify specifically how 3 snags per acre will be maintained in the proposed thinning units in both the short and long term.

Response: After thinning, this area will have around 80 to 100 square feet of basal per acre of mostly Douglas-fir trees. Presently the basal area is around 175 to 290 square feet per acre. The leave basal area per acre equates to around 145 to 285 trees per acre. Where snags exist and are deemed safe to leave for logging operations, at least 3 snags per one acre will be left in clumps or 30 snags per 10 acres. Additional snags will be left untouched within the 40 acre goshawk buffer. Over the long term, there will be adequate snags per acre present as natural mortality (from various insects and disease) occurs within the stand. If needed, snags can be created in the area by topping or girdling.

Comment 1-8: How will snag recruitment change from existing to post-logging conditions on the treated acres, and how will this affect snag availability?

Response: The number of snags likely to occur into the future as a result of the thinning operation will be lower within the actual thinning area because we intend to leave the healthiest larger trees within the proposed harvest unit (approximately 145 to 285 trees per acre will be left after thinning).. If it is found that too few snags remain post harvest, additional snags can be created by topping or girdling.

With this project, only 180 acres are proposed for harvest. The project area is an island within a large amount of area that has not been harvested and is not planned for future harvest, much of which is designated roadless. There will also be a large 40 acre island of unharvested trees (goshawk buffer) left within Unit 1 that should include a higher density of snags than the harvested area.

Comment 1-9: What will happen to red squirrel after logging, and how will this affect predators as the boreal owl, goshawk, and pine marten?

Response: The red squirrel population, along with other prey species should remain healthy within the project area. Retention of some mature trees coupled with areas within the units that will be left untreated will provide good habitat for squirrels and other species. In addition, areas adjacent to the proposed treatment units and located throughout the analysis area provide abundant habitat for these species. As a result, predator species such as boreal owl, goshawk, and pine marten should have more than sufficient prey base in the short-term and during the various successional forest stages. There is no evidence in the literature or from practical observation and experience that a project of this scale (<200 acres) will result in permanent detrimental impacts to prey species or predator species in question. In fact, Reynolds et al (1992) and Graham et al (1997) have suggested that the use of controlled fire and/or thinning may improve habitat for goshawks by creating favorable conditions for goshawks and their prey (i.e. promoting diameter growth in overstory trees, creating open understories, or downed wood). Specific effects of forest management on prey populations and prey availability vary by species, and those effects, which could be positive or negative, are poorly documented (Squires and Kennedy 2006).

Comment 1-10: The Draft DM notes that logging will improve wildlife habitat, including forage for big game. Please define how this was determined, and provide the supporting documentation that forage is currently limiting and that after logging big game populations will increase.

Response: If we manage the entire landscape for one successional stage (mature timber), then we will have abundant hiding and security cover but little or no foraging habitat. Therefore, big game species will not utilize these habitats. If we manage for variable aged stands at different stages of successional development, then we will provide a good mix of foraging habitat (more open stands with forb, shrub and sapling food sources), hiding and security cover (mature and canopied forest with good visual and environmental protections). The Big Timber Canyon project proposes to manage a small area (<200 acres) within a much larger landscape. Post project, there will still be good distribution of forested stands of varying age class and successional development distributed throughout the canyon and the analysis area. Furthermore, management of the stand will address the purpose and need of the project, which is to protect this stand and surrounding mature forest stands from potential Douglas-fir beetle infestation and mortality.

Comment 1-11: The lynx is identified as a threatened species for the Gallatin Forest. Please identify the specific surveys that have been done in the Big Timber Canyon area that demonstrate there is no current lynx use.

Response: The Canada lynx is a wide ranging species that has a large home range size. Although, habitat conditions within the Crazy Mountains would provide good habitat for this species, historical trapping records and project area surveys have not detected this species in the project area or the eastern aspect of the range. Project area surveys were conducted after snowfall events during the winters of 2005 and 2006 between December and March. No confirmed lynx tracks were identified during these surveys. However, both mountain lion and bobcat tracks were found in the project area. In addition, local trappers have been very successful trapping bobcats in and around the project area, but have never encountered or trapped lynx from trapping sites within Big Timber Canyon.

Comment 1-12: We would like to have a summary provided of goshawk monitoring done on the Gallatin Forest in regards to the impact of past timber harvest on goshawk density and productivity. This type of monitoring is essential in order for the Forest to estimate the impact of the currently proposed project, the Big Timber Canyon Vegetation Project, on the active goshawk nest that will be impacted. Please don't just list any studies that have been done. We want to know specifically how monitoring relates to the currently-proposed project in regards to logging impacts on goshawks and their prey species.

Response: No specific analyses of goshawk surveys in relation to past timber harvest has been compiled for the Gallatin National Forest. However, surveys were conducted throughout the Northern Region on all National Forests in 2005 in accessible areas, many of which had past timber harvest (Northern Goshawk, Northern Region Overview, Key Findings and Project Considerations, Brewer, Bush, Canfield, Dohmen, May 2007, pp. 29 & 30). These surveys determined that goshawks were widely distributed throughout the Region and established a baseline for documenting goshawk presence. The northern goshawk was removed from the sensitive species list (Project Analysis in Region 1 letter from Regional Forester Tidwell, July 17, 2007). Specific to the proposed project, there has been both recent (within the past 10 years) and historical (within the past 25 years) timber harvest in the vicinity of the proposed project on both private and Forest Service ground and goshawks are still occupying the area and reproducing. There are over seven other drainages on the east side of the Crazy Mountains that offer virtually the same habitat characteristics, aspect and elevation. The Forest does not have legal access to any of these drainages and commercial harvest will never occur in these areas. By applying basic modeling principles, we can predict that some of these areas are likely already occupied by nesting pairs of goshawks and/or would adequately meet the needs of any nesting pair of goshawks on the eastern aspect of the Crazy Mountains.

APPENDIX B

Soil and Water Conservation Best Management Practice (BMP) (version of 052907)

BMP for Soil Protection using Guidelines for the Gallatin National Forest

Practice 15.26

OBJECTIVE: to protect soil productivity in tractor harvest operations on the Gallatin National Forest

EFFECTIVENESS: High

IMPLEMENTATION

Most soil disturbance in cutting units results from ground-based harvesting systems. Little detrimental disturbance occurs under helicopter or skyline harvest areas. Road construction effectively removes soils from productivity. Road obliteration does not restore soil to a productive state unless the road bed is re-contoured and topsoil re-spread to a natural surface contour. For calculations involving area removed from production for roads, road width plus highly disturbed area averages 40 feet in width.

- Require a systematic skid trail pattern during logging.
- Use ground-based harvest systems only on slopes having sustained grades less than 30 percent.
- Maintain an average of at least 100 feet between skid trails, and allow no ground-based equipment off these trails at any time, with the exception of designated landings and system roads.
- Scarify all skid trails with a 3-4 tooth scarifier to a depth of 6 inches and with tooth spacing about 12 inches. This will reduce compaction on designated skid trails.
- The above direction does not apply if operating on soils with at least 8 inches of snow cover, or over soils frozen to at least 4 inches in depth. Winter logging has a negligible effect on soil or vegetation cover.
- Allow no mechanical site preparation or harvesting equipment off established skid roads unless the soil is frozen or snow-covered as discussed above, or where a continuous slash mat is at least 12 inches deep.

- Site preparation for fuels will consist of broadcast burn; hand lop and scatter; trample over dry soil with at least 12 inches of slash between the machine and soil surface; or other similar measures that minimize soil disturbance. Operators will be encouraged to trample only where there is sufficient slash to protect the soil surface. Burning will be considered strongly before the latter two options are specified.
- No mechanical site preparation will be specified other than for the fuels and cone preparation purposes as specified above over at least 12 inches of slash. This will help assure productivity guidelines are met, as scarification for natural regeneration site preparation results in excessive detrimental soil disturbance.

REFERENCES

- Anderson, Hal E., 1982. Aids to Determining Fuels Models for Estimating Fire Behavior, General Tech. Report INT-122, Intermountain Forest and Range Experiment Station Ogden, UT 84401
- Brewer L. T., J. Canfield, A. R. Dohmen, S. Kowalski, D. Lockman, David J. Roberts, K. S. Swisher. 2006. Draft Northern Goshawk Overview and Multi-level analyses, Northern Region. Missoula, MT 35 pp.
- Cline, R., Cole, G., Megahan, W., Patten, R., and J. Potyondy, 1981. Guide for Predicting Sediment Yields from Forested Watersheds. USFS/USDA, Region 1 and Region 4, Missoula, Montana.
- Daniel, T.W., Helms, J.A. and Baker, F.S. 1979. Principles of Silviculture. McGraw-Hill Book Company. Pages 229-232.
- Davis, C. E. and H. F. Shovic. 1996. Soil Survey of Gallatin Forest, Montana. Gallatin National Forest and NRCS, Bozeman, MT.
- Fischer, William C. and Clayton, B.D. 1983. Fire ecology of Montana Forest Habitat Types East of the Continental Divide. Gen. Tech. Rep. INT-141. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experimental Station. 83 p.
- Graham, R.T.; Harvey, A.E.; Jurgensen, M.F.; Jain, T.B.; Tonn, J.R.; and Page-Dumroese, D.S. 1994. Managing coarse woody debris in forest of the Rocky Mountains. USDA Forest Service, Intermountain Research Station, Research Paper INT-RP-477. 12 p.
- Green, P.; Joy, J.; Sirucek, D.; Hann, W.; Zack, A.; and Naumann, B. 1992. Old-growth forest types of the Northern region. R-1 SES April 1992; USDA Forest Service, Northern Region. Pages 2-7, 10.
- Leslie, E. and Bradley, T. 2001. Brief literature review of the Douglas-fir Bark Beetle. Silva Ecosystem Consultants Ltd. Pages 1-12.
- Montana DEQ. 2004. Montana 2002 Impaired Waters Database. Retrieved 11/30/04 <http://maps2.nris.state.mt.us/scripts/esrimap.dll?name=TMDL2002&Cmd=INST>
- NOAA, 1973. Precipitation frequency Atlas of the Western United States. USDC, NWS. Silver Spring, MD.
- Ramsey, B. 1978. Geologic Overview of the Gallatin National Forest. Bozeman, MT.

Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce, Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the Northern Goshawk in the southwestern United States. USDA For. Serv. Gen. Tech. Rep. RM-217. 90pp.

Rosgen, D. I. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Story, M. and T. Dzomba, 2005. Smoke NEPA Guidance. USFS R1/R4. Missoula, MT.

Timber Stand Management Record System. Version 2.30. USDA Forest Service.

USDA. 1994. Forest insect and disease identification and management. USDA, Forest Service, Region 1; Idaho Department of Lands; and Montana Department of Lands. Pages 4.4.1-4.4.12, 4.5.1-4.5.5, 4.12.1-4.12.2.

USDA. 2005. Big Timber Canyon project initiation letter. USDA, Forest Service, Gallatin National Forest, Big Timber Ranger District.

