CHAPTER 3
AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter presents both the existing environmental conditions of the project area and potential consequences to that environment by implementing the action alternatives presented in Chapter 2. The consequences of no action are also presented. Discussions of the current condition describe the physical, biological, social, and economic environment for each potentially affected resource. Discussions of environmental consequences form the scientific and analytical basis for comparing the alternatives. All direct, indirect, and cumulative effects are disclosed. The means by which potential adverse effects would be reduced or mitigated are also described (also see Chapter 2).

The Proposed Action and its alternatives are limited to the specific timber harvest, fuel treatments, and reforestation activities on NFS land in the Sheppard Creek Post-Fire Project area, although the geographic extent of some areas used to analyze different components (i.e., fisheries, old growth, wildlife home ranges) may extend beyond the project area. The analysis of effects disclosed in this document includes those occurring from the entire "scope" of the decision. Scope is defined in 40 CFR 1508.25 as the range of actions, alternatives, and impacts to be considered in an environmental analysis document. Any new information that develops after the Decision is made would be considered prior to implementation.

The discussions of resources and potential effects take advantage of existing information included in the Forest Plan, other project documents, project-specific resource reports and related information, and other sources as indicated. Where applicable, such information is briefly summarized and referenced to minimize duplication. The Project Record for the Sheppard Creek Project includes all project-specific information, including resource reports and results of field investigations.

Affected Environment Analysis

The resource information provided in the Affected Environment narratives includes the effects of past actions in that they are now assessed as part of the existing condition of the landscape. Specific past actions considered in the Affected Environment analysis are summarized in Table 3-1 below. A decade by decade description of the amount and type of past timber harvest and reforestation site preparation is presented in Tables 3-2 and 3-3. The Project Record provides additional information for these actions. The list of past actions is not necessarily exhaustive, as records may not exist for all past activities (by project). This is particularly true for those actions that predate the passage of the NEPA in 1970. Nevertheless, the effects of such past actions are fully accounted for in the assessments of existing conditions to the extent they are still affecting the particular resource considered.

Environmental Consequences Analysis

Environmental consequences are the effects of implementing an alternative on the physical, biological, social, and economic environment. The Council on Environmental Quality (CEQ) regulations implementing the NEPA includes a number of specific categories to use for the analysis of environmental consequences. Several are applicable to the analysis of the proposed project and alternatives, and form the basis of much of the analysis which follows. They are explained briefly here.

Connected Actions - Those actions that are closely related and therefore should be discussed in the same environmental impact statement are connected actions. Actions are connected if they:

- automatically trigger other actions which may require environmental analysis,
- cannot or will not proceed unless other actions are taken previously or simultaneously, or
- are independent parts of a larger action and depend on the larger actions for their justification.

The Proposed Action includes those activities necessary to fulfill the identified Purpose and Need as well as all connected actions identified in the alternatives described in Chapter 2. Connected actions include:

- √ Noxious weed control as outlined in the Flathead National Forest Noxious and Invasive Weed Control Environmental Assessment and Decision Notice would take place in and near the project area. A description of weed control treatments is provided in the table below.
- √ Temporary road construction, maintenance, and restoration would occur to gain temporary access to harvest units.
- √ Best Management Practices (BMPs) would take place on all haul routes associated with salvage operations. BMPs include road work to improve surface drainage, stabilize slopes, and reduce erosion and stream sedimentation.
- √ Reforestation would consist of both planting and natural regeneration after harvest activities. No site preparation for reforestation would be necessary.
- √ Monitoring of activities would take place as outlined in Appendix E.

Similar Actions **–** Similar actions are those actions that have enough similarity in timing or geography as the Proposed Action that the effects of these similar actions should be considered in the same environmental analysis as the Proposed Action and its alternatives. This Proposed Action does not have any similar actions.

Direct, Indirect, and Cumulative Actions **-** *Direct effects* are those occurring at the same time and place as the initial cause or action. *Indirect effects* are those that occur later in time or are spatially removed from the activity, but would be significant in the foreseeable future.

Cumulative effects result from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time.

Cumulative actions are those actions, which when viewed with past actions, other present actions, and reasonably foreseeable actions, may have cumulatively significant impacts and therefore should be discussed in the same environmental analysis document. Past, present, and reasonably foreseeable actions are activities that have already occurred, are currently occurring, or are likely to occur in the vicinity of the project area and may contribute cumulative effects. The past and present activities and natural events have contributed to creating the existing condition, as described in the Affected Environment sections of this chapter. These activities, as well as reasonably foreseeable activities, may produce environmental effects on issues or resources relevant to the proposal. Therefore, the past, present, and reasonably foreseeable activities described in the following tables have been considered in the cumulative effects analysis for each resource area or documentation in the project file.

The evaluation of direct, indirect, and cumulative effects in the following resource sections used the most recent and available information, as well as data related to past, present, and reasonably foreseeable events that have occurred or may occur in the individual analysis areas. The listed events that are not specifically analyzed or mentioned in the following discussion were considered to have no potential effect on the individual resource. These determinations are documented in the "Cumulative Effects Worksheets" found in each resource section of the project file.

Table 3-1. Cumulative Effects Summary by Ownership. Actions spanning each column are relevant to past, present and reasonably foreseeable actions.

Actions on All Ownerships	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
Wildland Fire Suppression	There is evidence of extensive wildland fire in and near the project area over the last several hundred years. Most recently, large fires burned approximately 3191 acres in 1889 burned in the project area, 150 acres in 1991, 1994 acres in 1994, and 214 acres in 2000. During the Brush Creek Fire, 5676 acres of the previously listed large fires reburned. Since the late 1930s, wildland fires have been actively suppressed by the Forest Service and other agencies. Wildland fires would continue to be suppressed. Wildland fires have typically been less than one acre and were suppressed using hand crews and occasionally heavy equipment. A few fires have been over one acre and may have utilized aerially applied chemical retardant. The Flathead National Forest portion of the Brush Creek Fire employed approximately 40.8 miles of mechanical/dozer fire line, 3.6 miles of control line on unmaintained roads, 16.2 miles of control line on maintained roads, 11.5 miles and 174 acres of shaded fuel break, 0.8 miles of hand-constructed line, 1.6 miles of fire line constructed using a mechanical masticator, and 53 acres of safety zone construction on 35 different safety zones. An undetermined amount of aerially applied fire retardant was applied in this effort. A map showing the location of these suppression activities is found in Exhibit U-5. Please see the glossary for an explanation of these terms. The USDA Forest Service has been assigned wildland fire protection responsibilities for the entire project area, however all suppression agencies would participate if necessary.		
Hunting and Trapping	These activities have been and continue to be popular uses of National Forest System land and other ownerships. Some species, such as grizzly bear, were hunted and		

Actions on All Ownerships	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
	trapped in the past.		
Fishing	Fishing on Sylvia Lake is a popular activity and is anticipated to remain popular. Fishing in analysis area streams is less popular.		
Firewood and Other Miscellaneous Forest Product Gathering	Firewood gathering has occurred and would continue in the future; higher than historic energy costs may increase the public's desire to obtain firewood but air quality concerns may also reduce reliance on this source of fuel in the future. Other products gathered in small quantities in the area include posts and poles, berries, and Christmas trees.		
Mushroom Harvest	Commercial and personal use harvest of mushrooms would be occurring in the burned environment and took place in the Little Wolf fire area in the mid 1990s.		
Snowmobiling	A minor amount of this activity currently takes place and is expected to slightly increase in the future.		
Camping/Boating	There is one semi-developed campground in the project area that receives a high level of use. This campground (Sylvia Lake) has limited amenities. Dispersed camping is popular and would continue. The only boating opportunities are on Sylvia Lake. These activities are expected to increase in popularity.		
Driving	Driving, sightseeing, and wildlife viewing on open Forest and private roads would continue.		
Hiking, Mountain Biking, and Horseback Riding	These activities have occurred and would continue to occur on both trails and roadways. All trails and roadways are available to each of these three activities.		
Road Maintenance and BMPs	Roads on all ownerships would be maintained for use either by all users or for just the individual landowners. Roads used for the transport of forest products are generally maintained to meet Montana Best Management Practices (BMP). Road work to improve surface drainage, stabilize slopes, and reduce erosion and stream sedimentation has occurred primarily on roads used by timber companies since the early 1990s.		
Motorcycle and ATV Riding	Many trails on NFS land in the project area have been and would continue to be open to motorcycles. No trails on NFS lands are currently open to ATV use, but this is occurring on private property. These activities are expected to increase in popularity.		
Fish Stocking	Sylvia Lake is regularly stocked by the Montana Department of Fish, Wildlife, and Parks for recreational arctic grayling and cutthroat trout. Montana FWP intends to continue to manage Sylvia Lake in this manner. Robertson Creek was stocked with transplanted cutthroat trout from Good Creek in 2001.		
Precommercial Thinning	Approximately 620 acres of sapling-sized stands have been thinned on National Forest System land in the project area. Some of these stands originated from wildland fire and others from timber harvest activities. A small quantity of land may have been precommercially thinned on private property. Most of this precommercial thinning took place in the 1980s and 1990s.		
Predator Control	Some predator populations, such as wolves and coyotes, were reduced in numbers from the project area in the early part of the last century.	A limited amount of coyote population control may be occurring and may take place in the future, particularly on and near private property.	
Beaver Control	Trapping of beavers and	Trapping of beavers may take place on private	

Actions on All Ownerships	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
	destruction of beaver dams occurred up to the 1990s on all ownerships.	property. Destruction of beaver dams may take place on all ownerships.	
Mineral extraction	There are five historic mines located within the analysis area. Each of these mines occupies small areas less than one acre. None of these mines are currently active.		

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
Burned Area Emergency Restoration	BAER activities in the Brush Creek post-fire environment would be completed in 2008. Please refer to Exhibit U-4 for a description of activities. Specific activities associated with BAER work include: - Spray noxious weeds on 147 acres, mostly along the highest priority roads. These roads already have weeds present that may rapidly spread into adjacent burned or disturbed areas. - Monitor 260 acres for weed establishment (includes roads, dozer lines, and safety zones). - Place approximately 140 pheromone pouches on lodgepole pine trees at Sylvia Lake Campground. - Clean culverts and ditches along approximately 137 miles of road that are at risk of plugging. - Replace 8 undersized culverts. - Construct water bars and other erosion control structures on 8.8 miles of trail within or adjacent to moderate or high burn severity on steep slopes greater than 20 percent. - Remove hazard trees at dispersed campsite near Sylvia Lake. - Install warning signs on roads and trails that alert the public of hazards associated with burned conditions (i.e. flooding, falling trees, etc.). BAER activities similar to the above list were accomplished for the Little Wolf Fire of 1994 and the Elk Mountain Fire of 2000.		
Road Maintenance	Roads open for motorized use by the public are maintained with safety as a high priority. This primarily involves repairing drainage features and clearing live and down vegetation. Some roads have been closed year-long or seasonally and are maintained at a lower level. There are approximately 96 miles of road under USFS jurisdiction; 33 miles of which are open year-long and receive a higher level of maintenance. Approximately 28 miles of USFS roads are closed year-long and 35 miles are closed seasonally. A reasonably foreseeable activity is the repaving of the Griffin Creek road (Forest Road 538). A decision to repave this road was made in 2005 and is awaiting appropriation of funds.		
Road Reclamation	Road reclamation involving the removal of a road from active maintenance and use		Road reclamation in the project area is planned to occur in 2009 and 2010.

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
	has occurred in the past. Approximately 26.6 miles of road have been water barred, scarified, seeded, and had culverts removed. This activity was primarily planned under the Sheppard-Griffin Decision Notice of 1996.		Approximately 19.3 miles of road would be water barred, scarified, seeded, and have culverts removed. This activity was primarily planned under the Sheppard-Griffin Decision Notice of 1996.
Road Closure Orders	Orders by the Forest Supervisor to close roads to public use have been periodically issued in the project area for the past 25 years. Several of these orders are still in place for the roads currently closed.		
Trail Maintenance	Trail maintenance is accomplished annually on the Tally Lake Ranger District. This primarily involves repairing drainage features and clearing live and down vegetation.		
Outfitter and Guiding	Special use permits have been issued for guided hiking, biking, horse, dog sledding, and motorized use, primarily on roads and trails in the project area. These permits are typically for one or two short-duration events occurring in only one year.	No outfitter/guide permits are currently issued in the Sheppard Creek Project area.	Special use permits are expected to be available again in 2009. The amount and type of such permits is not known.
Road Access/ Utilities Special Use Permits	There are five road access special use permits in effect in the analysis area. The total length of permitted use is approximately one-half mile. Please see Exhibit U-6 for a map of these special use permits within the project area. There are no utility corridor special use permits issued for this area.		
Noxious Weed Control	Since 1997, noxious weed treatments have emphasized the control and containment of tansy ragwort. Aerial spraying for control of tansy in the Little Wolf Fire area occurred in 1997 and 1999. In addition, chemical and biological treatments have continued annually in this area. These controls have demonstrated a decline in total acres of tansy on this area, as indicated by reduced yearly acres treated. In 1997, approximately 1093 acres were treated. By 2005, only 1.5 acres were collectively treated within a 15,000 acre area. A public use closure order of the Little Wolf Fire area also assisted in the	Noxious weed control as outlined in the 2001 Flathead National Forest Noxious and Invasive Weed Control Environmental Assessment and Decision Notice would continue to take place in the project area. Specific areas to be treated include along non-haul route roads near possible timber harvest areas in 2008 and spot treatments of infestations near roads. The Brush Creek Fire Salvage Project on the Kootenai National Forest is also planning possible timber haul on	Noxious weed control as outlined in the 2001 Flathead National Forest Noxious and Invasive Weed Control Environ-mental Assessment and Decision Notice would continue to take place in the project area. Projects would emphasize the roadside vegetation seeding, herbicide applications, and biologi-cal control of tansy ragwort and species of hawkweed.

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
	containment of this species. This closure order went into effect in 1997 and was rescinded in 2007.	Flathead National Forest roads. The primary route would be the Sheppard Creek Road #113 from Brush Creek Divide to the beginning of the pavement in Section 11. This route would be treated for weeds prior to log haul in the summer of 2008 using prescriptions written by Flathead National Forest personnel.	
Timber Harvest (see Table 3-2)	Approximately 12,467 acres of timber have been harvested on National Forest System land in the project area since the 1950s. This is approximately 56 percent of all NFS land within the project area. The majority of the treatments were accomplished in the 1970s, 1980s, and 1990s. Table 3-2 below details the acreage of timber harvest by decade and treatment type. The most recent timber harvest projects are depicted in Table 3-3 below.	The Gregg-Plume Timber Sale is located to the northeast of the project area. This timber sale was planned with the Good Creek Resource Management Project Final EIS and Record of Decision in 2000. Approximately 40 percent of the acreage of this timber sale was affected by the Brush Creek Fire. Salvage of this portion of the sale began in the winter of 2007/2008. The unburned portion of the sale would be harvested in the next one to three years. Information regarding changes made in the implementation of this timber sale as a result of the Brush Creek Fire are in the implementation file for the Good Creek ROD.	The Kootenai National Forest is proposing to salvage harvest approximately 600 acres of timber burned in the Brush Creek Fire of 2007. This project is called the Brush Creek Fire Salvage Project. Timber hauling could occur on the Sheppard Creek road down to the paved county portion of the Star Meadow Road. Weed control measures and BMPs would be implemented on the unpaved portion of this haul route if the purchaser of the timber sale chooses to use this route. Information regarding this planning effort is located on the Kootenai National Forest's internet web site.
Site Preparation and Reforestation	Areas that had experienced past timber harvesting or wildland fire were reforested using different site preparation and reforestation methods. Table 3-4 below describes these activities by decade.		
Insect Control		Use of trap trees and pheromone traps would begin	

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
		in the summer of 2008 and continue for several years.	
Road-side Harvest of Hazard Trees		Approximately 1820 acres of timber was felled near roads for the purpose of protecting public safety. This felling was typically within two tree lengths of the road. Some of the commercial-sized material was sold in a timber sale in the fall of 2007. Timber removal was usually with cable equipment that pulled logs to the road. This harvest would be completed in 2008. A map showing the roads where hazard tree removal took place is located in Exhibit U-6.	
Prescribed Burning	The prescribed burn in the vicinity of Elk Mountain accomplished 70 acres of whitebark pine and elk winter range restoration in 1999. The prescribed burn in Good Creek EIS unit 208 accomplished 30 acres of fuel reduction in 2002.		
Cattle Grazing	The Swaney Allotment is primarily located in the area between Sheppard Creek and Swaney Ridge. Currently, 80 cow-calf pairs are permitted. The Island Meadows/Lemonade Springs Allotments are located in the upper reaches of the Griffin Creek drainage. Currently, 140 cow-calf pairs are permitted. Cattle have been grazed on these allotments for many years and the allotments were active in 2007.	An administrative decision to suspend grazing on the burned portion of the Swaney Allotment for two years has been made to minimize the spread of weeds and sediment to streams. Grazing would occur on the Island Meadows/Lemonade Springs Allotments.	After two years, consultation with the forest weeds coordinator and district hydrologist would occur to assess the appropriateness of resuming grazing on the Swaney Allotment. Grazing would continue on the Island Meadows/Lemonade Springs Allotments.
Road Construction	Approximately 126.6 miles of road have been built on federal land in the project area. This total includes		

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
	National Forest System Roads, Flathead County roads, and private roads under permit. The roads are in varying levels of use, ranging from the highly used Star Meadow Road to roads that have been closed and are no longer drivable. The majority of roads built on federal lands were completed between 1950 to the mid-1980s. The most recent system road construction projects in the project area are shown in Table 3-5 below.		
Trail Construction	Nearly all trail construction in the project area took place prior to 1990. The most recent trail construction took place in 2007 on the Ingalls Mountain trail (Trail #460).	Regular maintenance and clearing is scheduled for Trails 258, 252, 460, and 171 in the project area for 2008 and into the future.	
Campground Construction and Improvements	A small campground on Sylvia Lake has been maintained for many years. Recent improvements include installation of new picnic tables, a vault toilet, and a boat launch.		
Stream Habitat Restoration	Approximately ten log structures were constructed to create pools in the late 1980s in the lowest four miles of Gregg Creek. Large logs were placed in a one-mile stretch of Good Creek in Sec. 14 in T31N, R26W in 2002 to improve stream bank stability and trap bedload.		Two culverts on an unnamed tributary to Sheppard Creek in Sec. 19 of T30N, R25W are acting as barriers to fish migration. These culverts are approved to be removed but implementation is dependent on funding becoming available. A culvert on Gregg Creek at the intersection of Road 60A in Sec. 28 in T31N, T25W would be replaced to allow for fish passage. A section of Gregg Creek above this culvert would also have in-stream log structures constructed to improve fish habitat. Two sections of Plume Creek in Sec. 30 and 32 in T31N, T25W would also

Actions on National Forest System land only	Past	Present (Fall 2007 – Fall 2008)	Reasonably Foreseeable
			have in-stream log structures constructed. A total of approximately 200 small logs would be used to construct these structures in both Gregg and Plume Creeks.
Mineral Extraction	Rock products primarily used for road construction and maintenance have been quarried from several sources throughout the project area. The primary quarries are the Listle Quarry, Gregg Quarry, Dunsire Quarry, and Sylvia Quarry. These quarries range in size from one to three acres. The location of these quarries is in Exhibit M-1.	A project to extract rock products from the Bowen Quarry to reconstruct the Going-to-the-Sun Road in Glacier National Park was approved in 2006. Activities to quarry, shape, and haul the material are expected to begin in the summer of 2008 and continue for several years.	
Cabin Rental	The Star Meadow Guard Station located in Sec. 12 of T30N, R25W has been on the cabin rental program for several years. This action is expected to continue.		

Actions on State and Private Ownership Only	Past	Present (Fall 2006 – Fall 2007)	Reasonably Foreseeable
Livestock Grazing	Grazing of cattle, sheep, and other livestock has occurred and would continue to occur on private land.		
Private Land Development	The construction of buildings and other improvements on private land near the project area has been occurring for decades and would continue. All of the development has occurred on individual lots without multi-lot planning. The rate of development on private land has been recently increasing. The majority of this development near the project area has occurred in the Star Meadow and Good Creek communities.		
Noxious Weed Control	Noxious weed control on state and private ownership would continue to take place in and near the project area and is expected to increase in the future. Some weed control along county roads would continue to be performed by Flathead County and individual landowners would continue to control weeds with primarily spot applications on their property.		
Road Construction	Roads have been constructed, are being constructed, and would continue to be constructed on private land within and near the project area. Most of these roads are used to access private residences but other roads are used for forested land resource management. Most of the roads constructed and maintained on state and industrial timber lands meet Best Management Practices. Miles of road on private lands are difficult to quantify.		
Timber Harvest	Timber harvest has occurred in the past on private property in the project area. Plum Creek Timber Company lands located at the head of the Sheppard Creek	Timber salvage harvest may be occurring on Plum Creek Timber Company Land in the project area on some	

Actions on State and Private Ownership Only	Past	Present (Fall 2006 – Fall 2007)	Reasonably Foreseeable
	drainage has had an estimated 250 acres, or 75 percent of non- Forest Service lands, with regeneration harvest over the past 40 years. Seven acres of other private property on the east side of the project area does not appear to have experienced timber harvest in the past 40 years.	or all of the estimated remaining 80 acres not previously harvested prior to the fire. Ongoing harvest is not expected on the other ownership.	
Treatments Specific to Forest Fuels Reduction	Removal of live and dead vegetation for the purpose of reducing wildland fire intensity has been accomplished on private property near the project area. This activity is expected to continue. The extent of fuel reduction on private property is not known but is primarily limited to areas immediately adjacent to structures.		
Agriculture	Land on private property near the project area that is not owned by timber companies has been used and would continue to be used for agricultural purposes. Much of the agriculture is devoted to growing feed for livestock. Most of this activity is in the Star Meadow area.		

Table 3-2. Past Timber Harvest Activity Acres on National Forest System Land.

Harvest Type	1950s	1960s	1970s	1980s	1990s	2000s	Total
Regeneration	192	1574	2221	4832	1779	395	10,993
Intermediate	5	47	688	66	641	27	1474
Totals	197	1621	2909	4898	2420	422	12,467

Table 3-3. Most Recent Timber Sale Projects on NFS Land in the Project Area.

Project Name	Year Project was Most Active	Acres of Timber Harvest
Big Wolf Fire Salvage	1997	157
Dunn Tepee Salvage	1988	282
East Griffin Bugs	1999	287
Gregg Creek	1988	204
Hand to Mouth	1991	373
Help Creek Salvage	1999	1021
Plume Creek	1992	205
Riffin Salvage	1998	149
Spruce Bark Beetles	1997	104
Spruced Up Salvage	1997	364
Star Sheppard	1987	148
Sylvia	1989	189
Tepee	2003	118
Small Timber Sale Projects	1987-1990	561
Totals		**4162**

Table 3-4. Past Site Prep and Reforestation Activity Acres on National Forest System Land.

Activity	1950s	1960s	1970s	1980s	1990s	2000s	Total
Direct Seeding	0	190	326	0	5	0	521
Planting	0	54	0	1158	568	295	2075
Natural Regeneration	0	243	939	1361	873	1083	4499
Sapling Slashing	0	0	0	30	44	221	295
Burning Site Prep	0	0	0	112	14	0	126
Mechanical Site Prep	0	284	448	1001	596	209	2538
Manual Site Prep	0	0	0	115	0	0	115

Table 3-5. Most Recent System Road Construction in the Project Area.

Project Name	Years Project was Active	Miles of Road Constructed
Sylvia Timber Sale	1987	0.7
Plume Creek Timber Sale	1987-1988	5.4
Elk Bowen Salvage Timber Sale	1994	0.2
Help Creek Timber Sale	1998	1.3
Small Timber Sale Projects	1988-1990	0.7
Totals		**8.3**

VEGETATION

Introduction

This section describes existing vegetation conditions in the Brush Creek Fire area, and how the Proposed Action and its alternatives would affect vegetation and timber resource components. Specifically it displays the condition and effects on the following components:

- Vegetation species composition, structural stage distribution, and general conditions before and after salvage harvest.
- Timber resources, including acres and volume harvested, acres reforested, and acres capable of meeting forest plan management direction for timber production in the future.

The three resource sections following this one describe the existing situation and effects of the Proposed Action and its alternatives for these vegetation-related components:

- Spruce and Douglas-fir bark beetle hazards
- Sensitive plants
- Noxious weeds

Refer to the *Fire and Fuels*, *Old Growth*, *Riparian*, and *Snag and Downed Wood* wildlife habitat sections for further information on how vegetation affects those resources.

Analysis Area

The analysis area used for the vegetation resource is the portion of the Brush Creek Fire area within the Flathead National Forest boundary (analysis area). It includes both Forest Service and private lands and totals approximately 25,366 acres (see Figure 3-1). The analysis includes the area directly, indirectly, and cumulatively affected by the Proposed Action and its alternatives and focuses on proposed treatments that could have measurable effects to vegetation structure, composition, or pattern. The stands proposed for treatment are in Management Areas 2C, 7, 12, 15, and 17 as described in the Forest Plan. The time frame for this analysis focuses on the period during and immediately after implementation of activities. Immediate effects are described as lasting until shrubs and trees are established as a canopy layer in areas disturbed by treatments, approximately 20 years. However, some effects of treatments may last up to 100 years, until the next stand altering disturbance, such as thinning, timber harvest, or wildland fire.

Information Sources

Existing vegetation data that were used to characterize the affected environment within the analysis area includes past stand examinations, satellite imagery, geographic information systems (GIS), modeling, and recent past experience with large wildland fires on the forest.

The Forest Service Natural Resource Information System (NRIS), specifically the FSVeg database, was used to describe existing vegetation conditions on National Forest System lands. It contains information such as stand age, species composition, and average diameter for stands that have had field inventories (stand exams). Field reconnaissance surveys were conducted in September through November 2007 to gather data specific to resource issues, such as post-fire insect potential and activity, riparian boundaries, reforestation potential, and vegetation conditions (Exhibit P-10). A set of randomly-located Common Stand Exam plots were sampled in October and November 2007 to help determine the distribution of large trees for snag and live tree retention and bark beetle hazard (Exhibits P-11, 12, and 13). Aerial photos taken in 2003 (pre-fire) and September 2007 (post-fire) were used to classify vegetation in stands without exam data, to verify or update field data, and to determine fire severity.

R1-VMap (Northern Region Vegetation Map) (Brewer, et al. 2004; Berglund, et al. 2007) was used to determine vegetation conditions on private lands, update and verify older stand exam data, and validate aerial photo interpretation. It is a satellite image classified to provide information about species composition, stand size class, and canopy cover.

Both FSVeg and R1-VMap provide consistent baseline data with accuracy assessments for vegetation conditions.

Affected Environment

Fire Severities and Interpretation Related to Vegetation

The fire burned with varying intensity (British Thermal Units, or BTUs) across the landscape. Intensity corresponded to fire behavior that ranged from creeping and smoldering to fast moving crown fires. Temperature, humidity, wind, topography, and fuel moistures can all influence how intensely a fire burns (DeBano, et al. 1998). Walk-through exams, plots, satellite imagery, and aerial photography taken after the fires burned were analyzed to determine the effect of the fire on vegetation. The four categories used to classify the immediate effects (vegetation fire severity) were: high-crown fire severity, high-underburn fire severity, moderate fire severity, and low fire severity. Definitions are adapted from Ryan and Noste 1985, Ryan 1982, West Side Reservoir Post-Fire Project fire severity metadata (Flathead National Forest), and field observations in the analysis area gathered in the fall of 2007 (Exhibit P-1).

High-crown fire severity resulted in understory vegetation being burned and blackened or consumed. Greater than 80 percent of the trees in this severity class have black and deeply charred boles and their foliage was consumed. Estimated tree mortality from fire is at least 80 percent.

High-underburn fire severity resulted in understory vegetation being burned and blackened or consumed. Greater than 80 percent of the tree boles in this severity class are black and deeply charred, while foliage may be scorched or green. Greater than 20 percent of the overstory trees have green foliage. Estimated tree mortality from fire is at least 80 percent.

Moderate fire severity resulted in understory vegetation being mostly burned. There may be variable amounts of mortality depending upon tree species. Tree stems are predominately blackened with light to moderate bole char and some tree foliage is scorched. There may be areas of both high and low severity mixed within an area classified as moderate. Estimated tree mortality from fire is between 30 to 80 percent.

Low fire severity resulted in understory vegetation being scorched with few blackened stems. Small amounts of green vegetation are evident. Less than 30 percent of the trees in this severity class have their foliage scorched (brown) or consumed and some have light bole char. Many of the fire-killed trees retained their small branches, twigs, and needles. Estimated tree mortality from fire is less than 30 percent.

Aerial photography from September 10, 2007 and satellite imagery from September 4, 2007 (Exhibit P-3; USDA 2007a) indicated that some areas remain unburned and large areas had low severity underburning within the fire perimeter. However, some underburning went undetected and high severity underburning was underestimated due to the remaining green canopy in the overstory. Field surveys were used to verify and update the remote sensing data. Additional mortality to trees, especially thin-barked species such as spruce, subalpine fir, and lodgepole pine, can be expected along the margins of areas characterized as *unburned* or *low fire severity*.

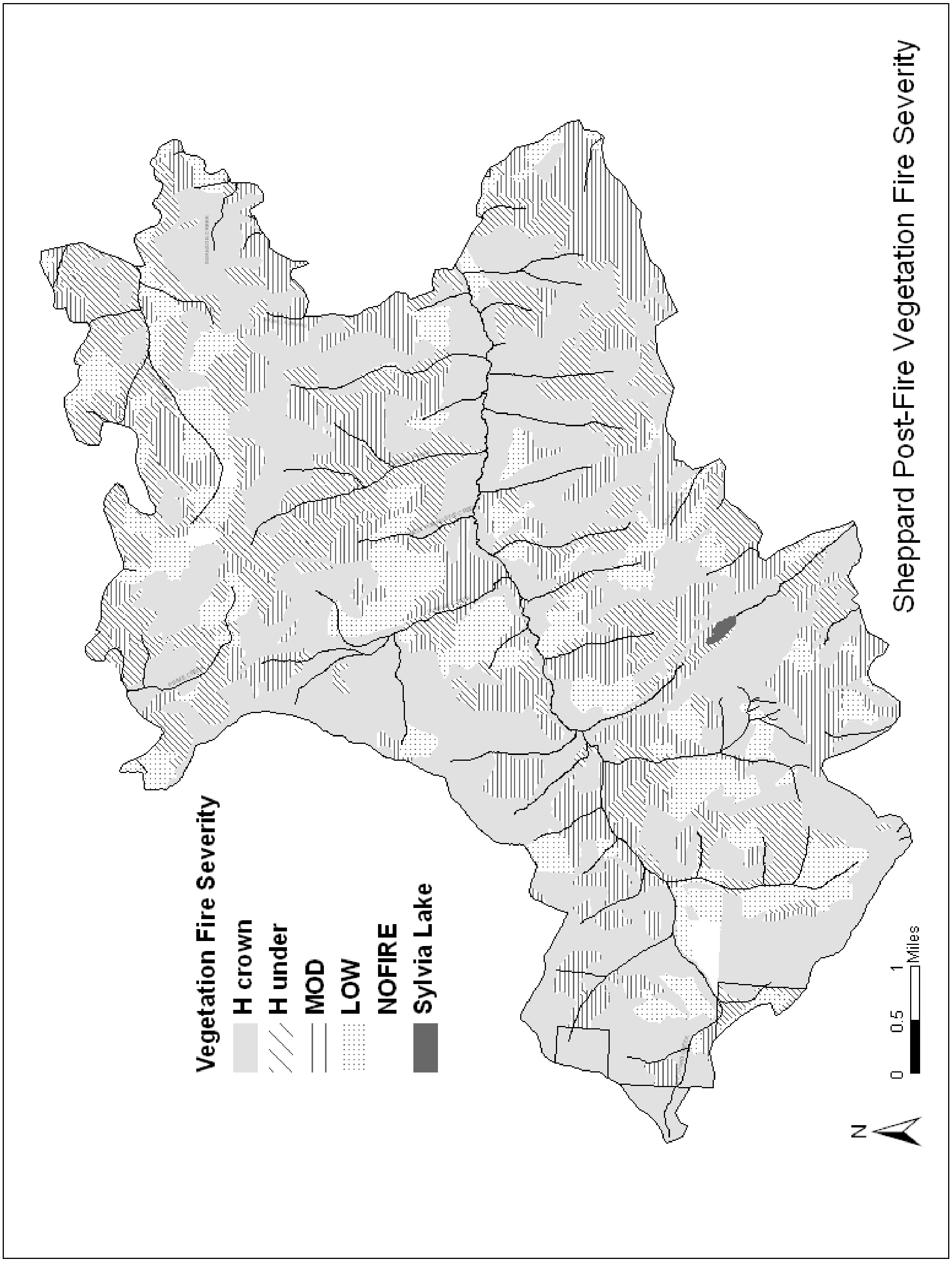
Table 3-6 and Figure 3-1 below display acres by vegetation fire severity within the analysis area (Exhibit P-1 and P-4).

Table 3-6. Vegetation Fire Severities within the Flathead National Forest Portion of the Brush Creek Fire.

Fire Severity	*Acres Affected	Percent of Fire Area
High-Crown	11,400	44.9%
High-Underburn	4926	19.4%
Moderate	5258	20.7%
Low	3617	14.3%
Unburned	142	0.6%
Water	23	0.1%
Total	**25,366**	**100%**

*Numbers are approximate due to GIS/satellite data processing and interpretation, rounding, water and rock.

Figure 3-1. Vegetation Burn Severity Map of Flathead National Forest Portion of the Brush Creek Fire.



Potential Vegetation Groups

Forest vegetation develops through continually changing ecological processes involving soils, weather, disturbance patterns, and type of current vegetation community. The Brush Creek post-fire landscape and processes at work can be classified using a system that describes the potential vegetation that would occupy the site at the late successional stage in the absence of disturbance (Pfister, et al. 1977). Potential Vegetation Groups (PVGs) display similarity in potential natural vegetation, nutrient cycling, successional change, productivity, and fire behavior. PVGs help define the fire regime for areas of a forest (Fischer and Bradley 1987, Brown 2000, Christensen 1989). PVGs were mapped for the analysis area using the groups described in Forest Plan Appendix I. Table 3-7 below displays acres by potential vegetation group (PVG) within the analysis area (Exhibit P-22).

Table 3-7. Acres of Potential Vegetation Groups by Vegetation Fire Severity within the Flathead National Forest Portion of the Brush Creek Fire.*

Potential Vegetation Group (PVG)	High-Crown	High-Underburn	Moderate	Low	Unburned	Total Acres	% of Fire Area
Cold Dry PVG	294	183	278	254	86	1094	4%
Cold Moist PVG	5910	1871	2537	1266	27	11,611	46%
Cool Moist and Riparian PVGs	4509	2678	2112	1998	29	11,327	45%
Warm Dry PVG	425	129	269	59		882	3.5%
Aquatic habitats			61			61	0.2%
Water					23	23	0.1%
Private Lands	262	65		40		367	1.4%
Total Acres	11,400	4926	5258	3617	165		

*Numbers are approximate due to GIS/satellite data processing and interpretation, rounding, water and rock.

Cool and cold PVGs cover about 95 percent of the analysis area. Based on PVGs and cover types, most of this area is in a lethal fire regime with an 80 to 200 year fire return interval. Cool and cold, moist vegetation types support very high levels of biomass, forming a continuous fuel load (Fischer and Bradley 1987). Long intervals between fires allow large amounts of fuel to accumulate. Under a lethal fire regime, fires burn into tree canopies and can kill most of the overstory trees. Mortality can vary depending on time of day when the fire burned through an area, fuel conditions, fire intensities (how hot the fire is burning), terrain, and weather. A smaller portion of this PVG is classified in a mixed-severity fire regime with a less frequent fire return interval.

The warm dry PVG comprises about 880 acres (3.5 percent) of the fire (Exhibit P-2), mostly on drier south and west aspects with Douglas-fir cover types. This type would normally have low intensity fires with a frequency of 5 to 25 years rather than stand replacement fires. Fire exclusion in many western forests has moved these communities toward a long-interval stand-replacement fire regime (Arno 2000). However, these patches of dry PVG are often surrounded by moist PVGs, as is the case in the Sheppard Creek Project area. At low elevations, Douglas-fir habitat types often surround the mixed-severity classes in the dry PVGs. A lethal fire occurring in the larger landscape would easily consume these dry PVG patches as well. This results in a high probability that ponderosa pine and western white pine would be lost as a component on these habitat types in the high and moderate burn areas due to a lack of natural seed sources. See the *Fire and Fuels* section for more detail on fire regimes and departures from historic conditions.

In all PVGs in the Brush Creek Fire area, extended drought, high amounts of fuel, and deep surface litter resulted in high severity fire effects. Approximately 20 percent of the area had high severity underburning that deeply charred the root collars yet did not scorch the crowns. In moist PVGs where fuel accumulations tend to be higher, the proportion of high severity underburn is 25 to 30 percent of the PVG. In dry PVGs where stands are generally more open with slow growth rates, high severity underburn occurred on about 15 percent of the PVG.

Species Composition

Tree species found within the analysis area include lodgepole pine, subalpine fir, Douglas-fir, western larch, Engelmann spruce, grand fir, ponderosa pine, western white pine, black cottonwood, quaking aspen, and paper birch. Ponderosa pine, western white pine, and grand fir occur in small, scattered amounts within the fire. Western white pine is susceptible to blister rust, but some resistance is evident. This watershed contains a minor amount of habitat suitable for the development of ponderosa pine and western white pine cover types. Birch, cottonwood, and aspen are in some high groundwater riparian areas. Common shrubs include Sitka alder, red osier dogwood, serviceberry, Rocky Mountain maple, white spiraea, and several species of low shrubs.

Before the 2007 fire, the proportion of forest cover types within the fire area was generally within the range of expected historical conditions, though the subalpine fir/ Engelmann spruce forest type was probably near the high end of its range (over 70 percent of the analysis area). This reflects the lack of major fires over the past 100 to 250 plus years across most of the analysis area (refer to *Fire and Fuels* section), the preponderance of cool/moist habitats, local climatic conditions which trend towards high snowfall, and associated shorter growing seasons. Early and mid seral communities, dominated by lodgepole pine, larch and Douglas-fir, comprised over half of the fire area prior to 2007, primarily where there had been past timber harvest. Table 3-8 displays the cover groups affected by the fire (Exhibit P-4).

Engelmann spruce, subalpine fir, and lodgepole pine have low resistance to fire damage and generally experience high mortality, even with low and moderate burn severities. Western larch and Douglas-fir can withstand higher fire severity and individuals of these species may survive even high burn severity. An estimate of post-fire cover types shows that most stands that were dominated by spruce, subalpine fir, or lodgepole pine were either completely killed by the fire or changed to western larch or Douglas-fir types. Table 3-9 displays the Cover groups after the fire (Exhibit P-4).

Table 3-8. Acres by Pre-Fire Forest Cover Type Affected by Fire Severity*

Cover Type	High-Crown	High-Underburn	Moderate	Low	Unburned	Total Acres	% of Fire Area
Larch	636	269	584	584	1	2073	8.2%
Larch/Douglas-fir			31			31	0.1%
Larch/ Mix	82		5			87	0.3%
Douglas-fir	1016	361	804	283		2463	9.7%
Douglas-fir/Larch			21			21	0.1%
Douglas-fir/Mix	211	56	79	34		380	1.5%
Other Mix[#]	8314	3853	3132	2690	141	18,131	71.5%
Other Mix/Larch	548	211	40	5		804	3.2%
Other Mix/Douglas-fir	324	51	51	20		446	1.8%
Mix (no distinct type)	270	125	511			907	3.6%
Water					23	23	<0.1%
Total Acres	11,400	4919	5258	3617	165		

[#] Other mix includes Subalpine fir, grand fir, Engelmann spruce, and lodgepole pine.
*Numbers are approximate due to GIS/satellite data processing and interpretation, rounding, water and rock (non-forest).

Table 3-9. Acres by Post-fire Forest Cover Type Affected by Fire Severity

Cover Type	High-Crown	High-Underburn	Moderate	Low	Unburned	Total Acres	% of Fire Area
Larch	636	269	660	584	1	2150	8.5%
Larch/Douglas-fir			703			703	2.8%
Larch/ Mix	82		997			1078	4.3%
Douglas-fir	1016	361	649	338		2363	9.3%
Douglas-fir/ Larch						0	0%
Douglas-fir/Mix	211	56				267	1%
Other Mix[#]	8314	3853	2027	2690	141	17,026	67.1%
Other Mix/Larch	548	211		5		764	3%
Other Mix/Douglas-fir	324	51				375	1.5%
Mix (no distinct type)	270	125	222			510	2.4%
Water					23	23	<0.1%
Total Acres	11,400	4926	5258	3617	165	25,366	

Forest Structure

Disturbance processes alter the successional pathways of forest vegetation. Fire is a disturbance process that affects forest structure. The range of fire severities experienced in the analysis area set back the successional and structural stages in many stands. Structure type is based on size classes for deadwood retention in the Forest Plan and size classes defined by the Region 1 Forest and Range Management staff (Brewer, et al. 2005; Berglund, et al. 2008). Structural stages are also described following Oliver and Larsen (1996).

The change in structure is a function of fire severity and cover type. A severe fire, with total mortality or consumption of all live vegetation, will set a forest habitat back to the grass/forb/conifer seedling stage of succession, or stand initiation stage (Oliver and Larsen 1996). A less severe fire, in which some trees survived, may change a dense forest to a more open one of the same or larger size class. This results in the understory reinitiation stage, in which some live trees exist in the overstory, but the mid- and understory trees have been killed. Nutrients, water, and sunlight become available to allow a new generation of trees to become established under the overstory trees. The late seral, or old forest stage, can develop as the stand ages. In the cool/moist forest types within the fire areas, the late seral stage is typically characterized by multiple tree canopy layers and ages, usually densely stocked, and with a component of older trees (generally greater than 150 years) in the upper canopy.

The Brush Creek Fire, in combination with past harvest activities and natural disturbances, has created a mosaic of stand structures across the landscape. Acres harvested in the last five decades were in the stem exclusion (dense sapling), understory reinitiation (thinned sapling/small tree), or the stand initiation (seedling) stages at the time of the fires.

The following tables and figures show the amount of structure type affected by fire severity and the existing, post-fire structure types.

Table 3-10. Acreage of Pre-Fire Size Class Affected by Fire Severity Level within the Flathead National Forest Portion of the Brush Creek Fire.*

Structure	High-Crown	High-Underburn	Moderate	Low	Un-burned	Total Acres	% of Fire Area
Seedling/Sapling (<5' dbh)	3569	992	2562	1724	32	8879	35%
Small (5-9" dbh)	1411	512	948	1536	87	4486	18%
Medium (9-12" dbh)	3301	1285	683	221	0	5491	22%
Large (12-20" dbh)	3112	2122	1065	144	22	6466	25%
Very Large (>=20" dbh)	6	14	0	0	0	21	0.1%

*Numbers are approximate due to GIS/satellite data processing and interpretation, rounding, water and rock.

Table 3-11. Existing Structure Classes across the Flathead National Forest Portion of the Brush Creek Fire.

Structure	Acres post-fire	% of Area
Seedling/Sapling	20643	81%
Small	2552	10%
Medium	418	2%
Large	1423	6%
Very Large	307	1%

Figure 3-2. Pre-Fire Forest Structure within the Flathead National Forest Portion of Brush Creek Fire.

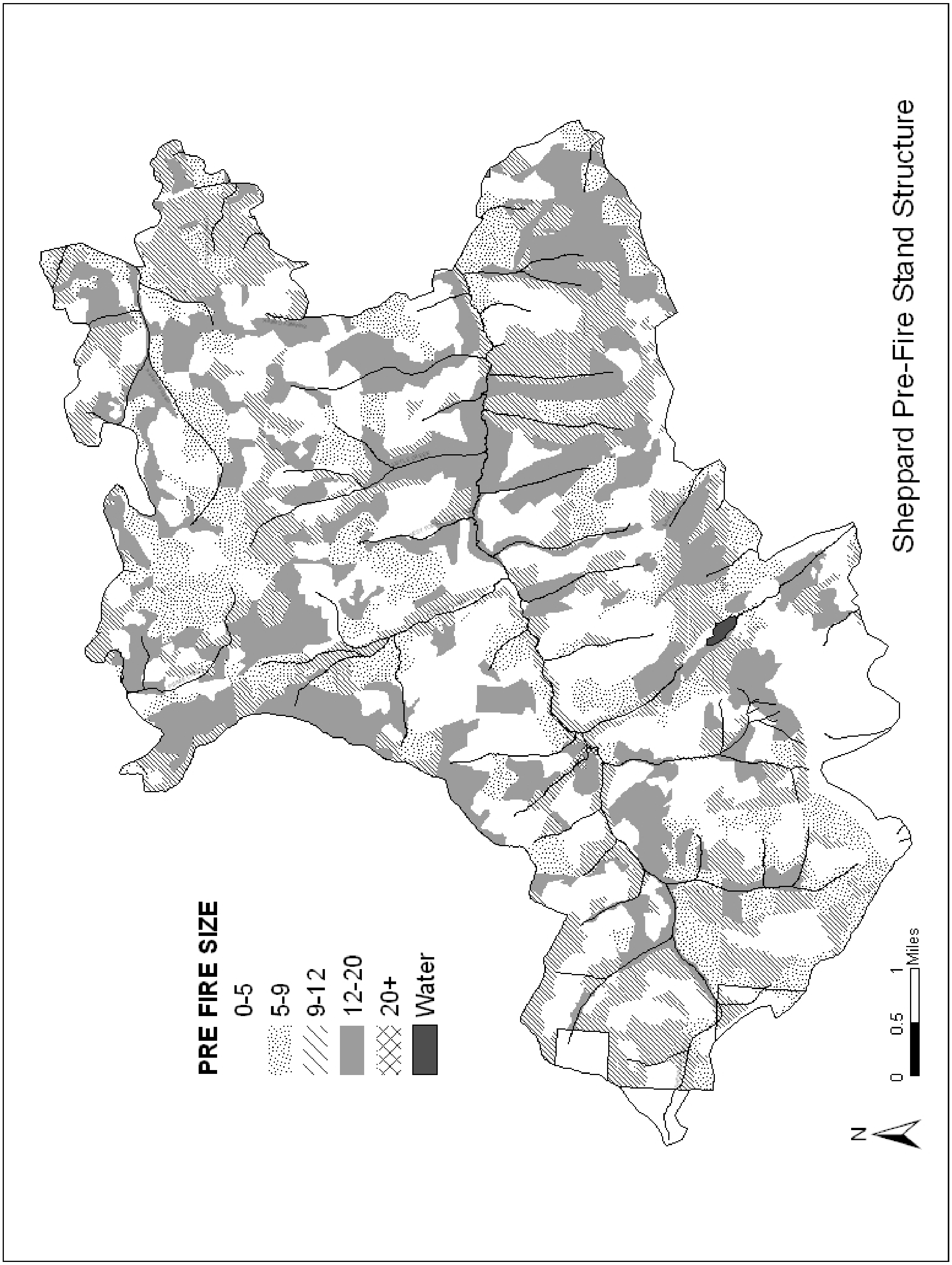
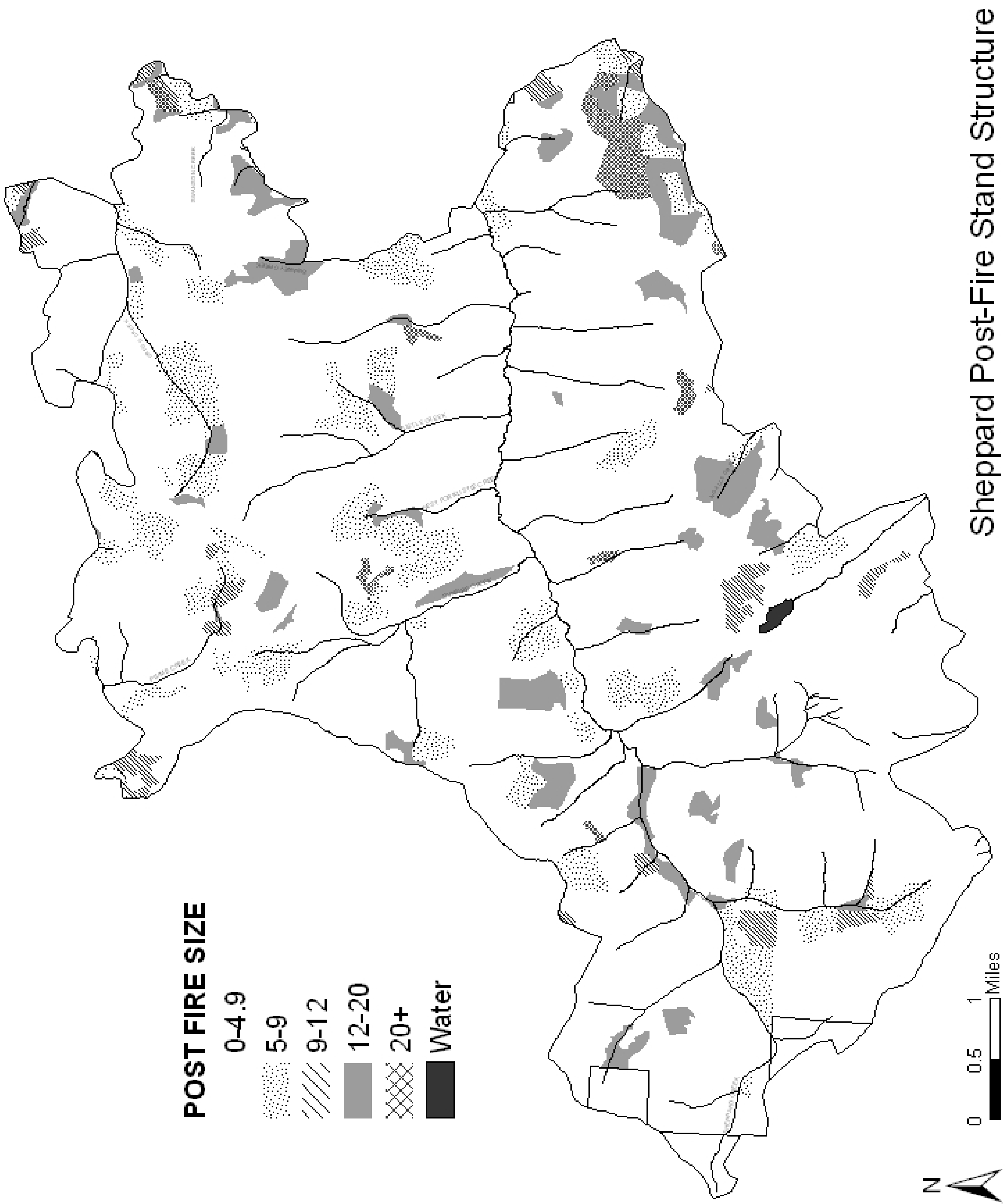


Figure 3-3. Post-Fire Forest Structure within the Flathead National Forest Portion of Brush Creek Fire.



The Brush Creek Fire altered structure substantially. About 11,764 acres, or 46 percent of the fire area, reverted from mid to late seral to stand initiation stage with standing stems (snags) retaining some vertical structure (Exhibit P-4).

About 35 percent of the fire area was in an early seral or stand initiation stage prior to 2007, mostly a result of regeneration timber harvesting during and after a large mountain pine beetle outbreak in the early 1980s. In addition, some of the 1994 Little Wolf Fire area reburned in the Brush Creek Fire. The seedling/sapling size classes depict this structural stage; characterized by grass, shrubs, forbs, and small trees becoming established in the growing space created by a disturbance. There is full light reaching the forest floor, providing a suitable environment for seedling establishment and high plant diversity.

Over 40 percent of the fire area was in a mid seral or stem exclusion stage prior to 2007, mostly because of regeneration timber harvesting in the 1960s and early 1970s and fires in 1889, 1919, and 1994. This structural stage includes the small (5 to 12 inch DBH) size classes characterized by trees of similar size and age, with closed canopy, and occupying all of the growing space. This condition allows little or no light to reach the forest floor, creating a difficult environment for seedling establishment (Oliver & Larson 1996). More than 5500 acres within the analysis area burned in the 1889 and 1910 fires. Much of this area regenerated to dense stands of lodgepole pine or spruce and subalpine fir, often with Douglas-fir and larch. These stands were largely in this mid seral stage prior to the Brush Creek Fire. Most of these small and medium tree size stands were unmanaged at the time of the Brush Creek Fire. Many of them had high mortality during the mountain pine beetle outbreak in the early 1980s and provided a continuous fuel matrix. High mortality from the Brush Creek Fire returned these stands primarily to stand initiation stage of successional development.

Spruce and subalpine fir stands would experience nearly complete mortality from low to moderate severity burns and return to stand initiation, whereas older western larch and Douglas-fir stands experiencing the same fire intensity may lose the understory but few overstory trees. Douglas-fir and larch stands that experienced moderate or low fire severity generally retained their size class and would be considered as understory reinitiation stage due to the new available growing space. These stands may have some live overstory trees remaining, though all mid- and understory tree canopy layers have been killed by the fire.

Late Seral/Old Forest

Before the fire, more than 6500 acres, or 25 percent, of the analysis area was in a late seral stage of development. This includes the large, very large, and some of the medium size classes. More than 80 percent of the acres in late seral structures experienced high severity burns and were changed to early seral structures or stand initiation stage. The late seral stage now comprises about seven percent of the area. Some late seral stands retained their character and function if they experienced a light ground-fire and were mainly comprised of fire-resistant species such as western larch. Late seral stands containing spruce, subalpine fir, or lodgepole pine were changed by low and moderate severity fire to understory reinitiation, due to those species' susceptibility to girdling by fire (Exhibit P-4).

The natural variability for late seral/old forest within Griffin, Sheppard, and Upper Good Creeks could be expected to range from about one percent up to more than 65 percent of the area. This is due to the natural disturbance regime typical of the cool, moist PVGs and forest types in this area characterized by large, stand-replacing wildland fires with long fire-free intervals (150+ years) (Exhibit O-5). This disturbance regime results in large patches of burned forest converting many, if not most, of the older forests to a seedling/sapling stage of development. Some of this eventually develops into an old forest structure again with larger-diameter trees and multi-storied canopies. Refer to the *Old Growth Habitat* section under Wildlife for more detail on late seral forest and old growth habitats.

Snags and Downed Wood

The Brush Creek Fire created approximately 13,000 acres of snags and downed wood in areas that were not previously harvested in the analysis area. The size of the snags differ greatly between areas that have had regeneration harvest and site preparation in the last 50 years, areas that experienced one or more fires during the last 150 years, and other areas that have not burned for 250 years or more. Refer to the *Snags and Downed Wood* section in Chapter 3 for detail.

Windthrow

Blowdown of the standing dead trees is a natural consequence after fires. Fall down rates vary by species and diameter (Everett, et al. 1999). Fall down rates are lowest for western larch and subalpine fir (USDA 2000). Five years after the 2001 Moose Fire on the Glacier View Ranger District (30 miles northeast of the Brush Creek Fire), no larch had fallen due to natural causes and 11 percent had broken tops (Jackson 2006). Douglas-fir fall rates increase after five years, as the volume of decay increases in the lower stem. On the 1961 Sleeping Child burn in Montana, only 28 percent of lodgepole pine trees were still standing after ten years (Lyon 1977). Research has shown that 75 to 80 percent of ponderosa pine trees that die in the first post-burn year would fall within ten years (Harrington 1996). Riparian areas within the fire area have already experienced a great deal of blowdown, primarily among the mature spruce trees. Trees with extended use as snags would be those with moderate to low crown scorch that remain alive for at least two years after injury (*ibid*). Although a majority of trees would fall the first 10 to 20 years, the trees that remain standing after that time may do so for a long time (e.g. 50 to 70 years).

Deterioration of Fire-killed/Fire-damaged Timber

Relatively rapid deterioration of fire-killed or fire-damaged trees can be expected, causing a decline in its commercial value. Factors affecting the rate of deterioration are tree species, species characteristics, tree diameter, growth rate, age, site conditions, fire severity, and time of year. The agents affecting deterioration are insects, stand and decay fungi, and weather. Rates of staining (2 to 50 percent volume affected), cracking (5 to 60 percent volume affected), and sapwood decay (5 to 40 percent volume affected) are high the first five years (USDA 2000, Jackson 2006). Rates of staining reduce over time as the sapwood decays.

Cracking allows the sapwood to dry out, retarding or arresting decay. This is more common in thin-barked species such as Engelmann spruce, subalpine fir, and lodgepole pine.

Patch Sizes

Immediately before the Brush Creek Fire, the average "patch" size of forest of similar size and structure in the Griffin, Sheppard, and Upper Good Creek drainages ranged from 100 to 300 acres (Exhibit P-6). The larger average patch sizes were in the late seral structural stage. Early seral structural stage mean patch sizes of about 80 to 200 acres is largely the result of timber harvesting with harvest unit sizes of less than 40 acres. Historically, patch sizes averaged 40 to 700 acres. The current (pre-fire) mean patch sizes are smaller than historic for all structural stages, except for closed canopy, mid seral.

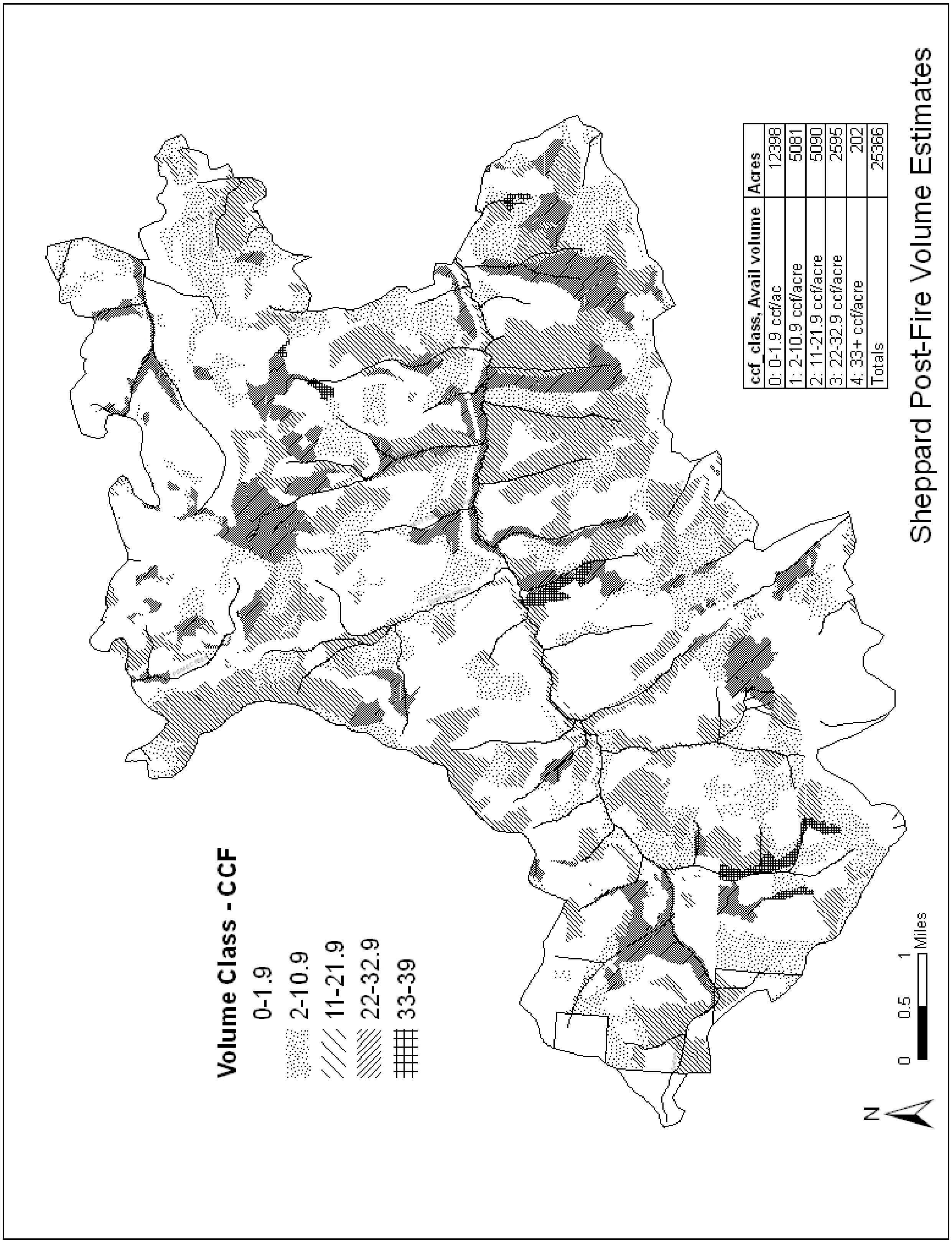
The high severity fire in 2007 reverted many acres back to the stand initiation stage. The 25,000 acres of Brush Creek Fire on the Flathead National Forest is now the largest patch on the Tally Lake Ranger District. The shape is irregular and contains a mosaic of vegetation islands with varying structure and fire severities (Exhibit P-6).

Timber Volume

Timber volume estimates across the fire area range from none to about 39 hundred cubic feet (CCF) per acre. Most of the previously harvested and regenerated stands have no available volume. Some of the shelterwood stands with high burn severities have some overstory trees that could be harvested and still retain adequate numbers of snags and snag recruits. The volume estimates displayed here are based on pre-fire stand data, walk-thru exam estimates, and photo-interpretation. They have been adjusted to account for burn severity and do not include trees less than nine inches in diameter (Exhibit P-14). They do not account for reductions for snag retention nor cull and breakage, which would increase over time. To convert CCF to thousand board feet (MBF), multiply CCF by 0.4545.

The following figure displays the distribution of available volume by classes:

Figure 3-4. Post-Fire Volume Estimates within the Flathead National Forest Portion of Brush Creek Fire.



Conifer Regeneration and Reforestation

Regeneration in Previously Managed Stands

Within the fire boundary, timber harvest dating from about the mid-1950s to 2008 had occurred on about 12,570 acres, or about 50 percent of the 25,366 acres burned by the Brush Creek Fire (Exhibit P-7). Not all of those acres were treated with regeneration harvest. Many regenerated harvest areas within the fire area were severely impacted by the fire. About 2640 acres that had regeneration harvest since 1991 were moderately to severely burned. Another 5560 acres that were harvested between 1955 and 1990 were moderately to severely burned. Over 1900 acres are planned for planting of conifer seedlings in 2008 through 2010 (Exhibit P-8). Reforestation in areas previously harvested, and subsequently burned by the Brush Creek Fire, is a high priority to meet the provisions of the National Forest Management Act. Seedling planting is planned in the first to fifth post-fire years before competition from pine grass and shrubs preclude successful tree establishment. Planting would be dependent upon seed availability and funding. White pine genetically resistant to blister rust was planted in some harvested areas prior to the fire. Where possible, white pine would be replanted in these same and additional areas.

Regeneration in Other Areas

There is a large body of data on post-fire regeneration based on local research conducted at the Miller Creek Demonstration Forest (Exhibit P-9). The research consists of short and long-term projects (up to 35 years). From these local data, we can predict fire effects for the Brush Creek Fire. The initial community establishing in the fire area is expected to be grasses and shrubs. Their source will be from one of three components: survivor, residual colonizer, or offsite colonizer (Stickney 1990). Trees become established on a disturbed site in a number of ways, such as residual seed in the soil, from cones on trees that survived the fire, from seed that blows in from off-site, or from animal transport. Diverse natural conifer regeneration may be delayed or below desirable levels in some areas due to lack of seed source. It is likely that much of the fire area has surviving residual lodgepole pine seed in the soil or unburned cones. Other species such as western larch will not become established unless a cone crop coincides with the first few post-fire years when the germination substrate is favorable (Shearer 1975). Some of the area with less than desirable regeneration may occur in the center of larger burn areas with complete mortality, or at upper elevations and south facing aspects where there are thin soils.

The length of time for natural revegetation on dry PVGs is expected to be slow and spatially discontinuous. Immediate post-fire species composition is largely dependent on seed dispersal from adjacent unburned areas, persisted through the fire, or resprouted from plant parts surviving the fire (DeBano, et al. 1998). Native grasses and shrubs will colonize the burned areas (Noste and Bushey 1987). Although the tree component would be influenced by competition, generally the community that was present before the fire is the community that will return through succession (Stickney 1986).

The *Northern Region Overview Summary* (USDA 1998) and *Integrated Restoration and Protection Strategy in the Northern Region* (USDA 2007) categorize the forest and rangeland species at risk for the Northern Rockies Zone as aspen, western white pine, whitebark pine, western larch, ponderosa pine, and upland grasses/shrubs. They are considered most at risk in this zone due to "past and potential future loss in the aerial extent of the cover type; substantial changes in landscape level heterogeneity (fragmentation); substantial changes in structure (both density and change in distribution of structural stages); and susceptibility to spread of identified exotic plants."

The probability for natural regeneration of western white pine is low due to the scarcity of white pine in the area, severity of the burn, and lack of surviving seed source. Many areas have 90 percent mortality of the overstory, and very few white pine cones were observed during field reconnaissance. Some white pine would be planted in previously harvested and severely burned unharvested areas.

In some areas within the fire, a few western larch, Douglas-fir, Engelmann spruce, and lodgepole pine survived. A recently burned soil substrate is a very favorable condition for tree seedlings, especially western larch, to become established; however, an abundant cone crop must occur within two or three years of the fire for larch to gain a foothold on a site. Good larch cone crops are produced at about five year intervals. Larch is an early seral species, highly shade intolerant. If larch gets a late start on a site, it is often out-competed and shaded by shrubs and other conifer species (Schmidt, et al. 1976).

There are a few areas of high severity burn where distance to the seed wall exceeds 3000 feet. These areas may have lodgepole pine seed in the soil or already regenerating from cones opened by the heat of the fire, but species diversity would be lacking as these patches regenerate without other seed sources.

The majority of the area burned by the fires occurred on lands classified in the Forest Plan as Management Area 15 (79 percent), emphasizing cost-efficient production of timber while protecting the productive capacity of the land and timber resources. Vegetation treatments are appropriate and expected on MA 15 lands. Planting may be necessary on some MA 15 lands to restore the productive capacity of the land in a timely manner. Between years 2008 and 2010, tree planting on about 1400 acres outside of previously or planned harvest units is planned.

Forest Plan resource goals include designing treatments to encourage development of diverse vegetation native to the site. Western larch was historically a dominant species throughout the fire area. Timber harvest in the 1960s, 1970s, and 1980s removed much of the mature larch. Encouraging larch regeneration before lodgepole pine, Douglas-fir, and other species out-compete it would contribute to restoring the Sheppard, Griffin, and Good Creek drainages to historical conditions.

Access for Forest Management

The existing system of roads open yearlong, open seasonally, or closed with gates allow reasonable access (within 0.5 mile of a road) to 24,990 acres of national forest lands within the analysis area.

Environmental Consequences

The analysis of direct, indirect, and cumulative effects on vegetation is limited to the vegetation analysis area previously described. The potential effects described below represent the result of analysis based on research, experience, and monitoring to date and best professional judgment of the silviculturist, fuels management specialist, wildlife biologist, regional entomologist, other interdisciplinary team members, and others in the professional community.

The direct, indirect, and cumulative effects of the Proposed Action or its alternatives would result mainly from the vegetation management activities described in Chapter 2. These activities consist of salvage harvest of fire-affected trees and regeneration of the harvest units to mixed conifer stands. The effects would vary among alternatives based on the acreage, size, and spatial distribution of the units treated. Significant issues related to vegetation include old growth, snag and down wood retention, untreated "reserve areas," helicopter yarding, salvage in riparian areas, and bark beetles (refer to Chapter 2). These are analyzed in the *Wildlife, Socio-Economics, Hydrology, Fisheries,* or *Bark Beetle* sections. The following effects indicators were used to focus the vegetation analysis and disclose relevant environmental effects:

- Acres of salvage harvest,
- Harvest volume,
- Acres of reforestation,
- Acres of natural successional development, and
- Salvage harvest by structural stage (acres).

Other impacts addressed in the vegetation effects analysis include late seral forests, blowdown, dead wood, and remaining unharvested areas. Access for timber management would not change with any alternative, so it will not be discussed (see Affected Environment section, above).

The following vegetation effects indicators will be addressed in detail in separate sections:

- Potential for tree mortality caused by bark beetles,
- Sensitive Plants, and
- Noxious weeds

Direct and Indirect Effects

<u>Alternative A (No action)</u>

Timber Resource

There would be no salvage or tree planting with the No Action Alternative. Deterioration of dead timber would be most noticeable within two years of the fire. Drying and splitting of the heartwood (checking) is a major cause of deterioration. Wood that dries rapidly is subject to checking. This is expected to occur in areas with high burn severities, especially high crown fire. Checking would increase because of long periods of dry weather. Insect attack usually precedes fungal attack and provides the mechanism for introducing microorganisms that accelerate sapwood deterioration. Many variables influence deterioration, and volume and value lost vary by species (USDA 2000). Blue stain appears in pines within the first year. By the second year, some of the sapwood would be decayed. After three years, the sapwood of most softwood species would have deteriorated beyond practical use. Fifty percent of the volume may be lost in Douglas-fir trees 11 to 20 inches DBH by year three (Lowell, et al. 1992). Western larch in western Montana may lose up to 20 percent of sapwood volume to decay and stain by year five (Jackson 2006).

Natural Successional Development

In this alternative, no vegetation management actions would be taken. Species and community biodiversity would return through succession, natural revegetation, and recolonization processes. In the burned area, beargrass and some grasses and sedges were already resprouting in the autumn of 2007. Revegetation of shrubs can be expected in about six years (Stickney 1986 and 1990).

Establishing seral species of trees is important to maintain ecosystem stability and to prevent type conversion to noxious weeds, shrub fields, or climax species. Where needed, planting seedlings in areas that had been harvested prior to the fire would occur regardless of this proposal or its alternatives. Of the approximately 11,200 acres (44 percent of the fire area) that had previous regeneration harvest, approximately 8200 acres were moderately to severely burned (Exhibit P-7). Over 1900 acres are planned for planting of conifer seedlings in 2008 through 2010 (Exhibit P-8).

On most of the area not previously harvested and regenerated (56 percent of fire area), the early successional stage of vegetation (stand initiation) would consist of shrubs, perennial herbs, and grasses that resprout. Germination can be expected from plants, including conifers, whose seeds survived the fire or disseminated from offsite sources. In areas with high burn severity where conifer seed sources are limited, shrubs may out-compete conifers if no artificial regeneration occurs. On south-facing slopes, pinegrass could quickly become established and out-compete seedlings. High-intensity fires in pure lodgepole pine stands usually result in a new stand of pure lodgepole pine. The high biotic potential in seed stored in serotinous cones is important in the establishment of extensive areas of pure, dense, lodgepole pine (Lotan, et al.1984; Volland 1984). Although most of the lodgepole pine stands in the Sheppard Creek area had some trees other species, such as subalpine fir, spruce, or larch, they would regenerate primarily with lodgepole pine. Without artificial reintroduction of other species on these sites, overstocked stagnated stands of lodgepole pine is often the result, as occurred after the nearby 1988 Red Bench, 1994 Little Wolf, and 2001 Moose fires.

In most of the fire area, tree species would return through germination of seeds in the soil and/or from trees in unburned or adjacent areas, and some species would resprout. In general, conifers produce seed at irregular intervals, which varies by species. The Brush Creek Fire, in conjunction with past harvesting, left extensive areas without seed trees, and natural regeneration is expected to be a slow process. Regeneration is greatly increased in areas where dead trees are left standing to provide shade (Shearer 1976). The time required for the area to return to a forested ecosystem depends on many factors including, but not limited to:

- Site conditions and productivity,
- Burn severity,

- Future fires and their extent and intensity,
- Weather patterns,
- Proximity of seed sources, and
- Seed dispersal events.

Stands that experienced a high-severity fire, or even a moderate-severity fire, now provide growing space for plants. Western larch favors a germination substrate where fire has reduced both the duff layer and sprouting potential of competing vegetation (Shearer 1975). However, in the first four or five years, shrubs and herbs would dominate the site. Common species include fireweed, spiraea, beargrass, and grass species. Eventually, the growing space is completely occupied by plants. In about 15 to 25 years after the disturbance, the more competitive plants and tree species exclude others from colonizing and take over the growing space of the less competitive species. As development progresses, in 80 to 100 years, overstory trees may dominate the site completely (stem exclusion). Shrubs and trees that invade the understory grow very slowly in height for many years and form advanced regeneration (understory reinitiation).

The next successional stage may occur after about 150 years, provided it is not altered by another major disturbance. This stage (understory reinitiation or young forest multi-story), characterized by two or more layers of trees, but not dominated by large, old trees, may last many decades. Barring large partial or stand-replacement disturbances, the forest continues to grow until gradually the overstory trees begin to die. As they die, understory trees often grow to become the overstory. The result may be a stand structure with many layers of foliage, a diversity of tree sizes but dominated by large older trees, large snags and downed woody material. As tree diameters increase and senescence begins, the stand develops into late seral or “old growth.”

In low fire-severity stands, the fire directly killed a portion of the vegetation. Initially there is the appearance of greater survival, but due to the susceptibility of Engelmann spruce and subalpine fir (very thin bark) to heat, subsequent mortality is impending (Miller 2000). In the next year, crown canopy would decline and continue at a reduced rate for the next four or five years. This may be described as a partial disturbance. In this case, patches of growing space are available, and newly established species such as Douglas-fir, subalpine fir, spruce, and lesser amounts of shade-intolerant larch and lodgepole pine undergo similar changes to those described above for stands with complete disturbance. The invading individuals compete with other plants and trees that survived the fire. The species composition of conifers would be greatly influenced by site factors (Shearer 1976). These low fire severity stands would progress in a manner similar to the slightly more open grown stands.

Forest Structure

With Alternative A (No Action), the area in all of the structural classes, and all burn severities, would remain the same as described in the vegetation affected environment section. Blowdown is inevitable over time. In a study in similar upper montane subalpine forest types, 85 percent of the snags fell in the first 13 years, and 93 percent had fallen in 21 years (Lyon 1984). However, in this study, the majority of species were lodgepole pine. In a study in the Moose Fire, no western larch had fallen within five years after the fire, but 11 percent had broken tops (Jackson 2006). There is a variety of species in the fire area, as described earlier in the affected environment section. In terms of standing trees, the vertical structure in high fire severity classes would change dramatically over the next 10 to 20 years because most trees are dead and would fall. In stands near ridge tops with predominantly subalpine fir, spruce, and lodgepole pine; and where the average diameter is less than 10 inches DBH; blowdown can be expected in 10 years rather than 20. In low fire severity classes, low and delayed mortality would allow trees to stand longer and retain some vertical structure. However, in twenty years the majority of dead trees in these areas would have blown down, especially spruce.

Snags and Downed Woody Material

All dead wood would be left on site providing for ecological integrity and ecosystem function by leaving the community of soil and decomposer microorganisms intact. Additional blow-down is anticipated over time (see Forest Structure, above). The large number of snags and subsequent woody debris recruitment remaining after the fire would contribute to stream health, wildlife habitat, and soil productivity (Harvey, et al. 1987). Personal-use firewood cutting is not possible to quantify, but would remove some of the dead wood within about 200 feet of open roads. This topic is covered in depth in the *Snags and Woody Debris* section of this DEIS.

Effects Common to All Action Alternatives

Timber Resource

All action alternatives were designed to salvage and recover the value of fire-killed trees while leaving snags and woody debris sufficient to maintain ecological processes that protect ecosystem function. All salvage areas have been determined to be physically and economically feasible to salvage. Wildlife snag prescriptions would leave snags at variable densities dispersed across the salvage harvest units. All alternatives would remove primarily dead trees and trees likely to die because of severe fire injury or bark beetle infestation, following the direction within Post-Fire Mortality Guidelines (Exhibit P-15) and snag retention prescriptions. Incidental removal of live trees may occur where trees are smaller than specified diameters and landings, skid trails, or temporary road locations are needed to facilitate logging operations. See Chapter 2 for a full description of treatments for each alternative.

Harvest operations are anticipated to take two years. If harvest operations extend to the third year, substantial loss of value of timber products can be anticipated due to deterioration. Deterioration would be greatest in spruce, subalpine fir, and lodgepole pine trees less than 10” DBH. Should harvest extend into the third year, an estimated 30 to 60 percent of the volume not yet harvested would be affected by checking and decay (USDA 2000).

Minimal or no post-salvage slash treatments are anticipated. Most slash treatment would be accomplished through whole tree yarding and burning or chipping the landing piles. Some additional fuel reduction may be necessary in units where accumulations of woody debris would inhibit regeneration or create a fuel hazard. If required, fuel reduction treatments would be applied only where impacts on soil could be minimal. The intent is to balance the objective of leaving remnants of the fire while reducing the hazard if another fire should start.

Harvest Systems

As shown in the following table and in Table 3-12, the majority of acres proposed for harvest in all alternatives would be salvaged using ground-based systems of tractor, cable, and tractor swing (54 to 62 percent). Skyline is proposed for 25 to 35 percent and helicopter for 0 to 20 percent of the acres.

Table 3-12. Acres and Percent of Total Acres by Harvest System by Alternative

Harvest system	Alt. B (6346 acres)				Alt. C (3902 acres)				Alt. D (7465 acres)			
	All Year		Winter only		All Year		Winter only		All Year		Winter only	
Ground-based (skidder/tractor)	878	14%	2331	37%	411	10.5%	1860	48%	1720	23%	1802	24%
Cable	39	0.5%	37	0.5%	11	<0.5%	19	0.5%	209	3%	0	0
Skyline	2079	33%	0	0	1391	36%	73	1.5%	1977	26%	0	0
Skyline-Tractor Swing	0	0	276	4%	0	0	137	3.5%	185	2.5%	108	1.5%
Helicopter	706	11%	0	0	0	0	0	0	1464	20%	0	0

Most of the ground-based logging would occur during the winter to minimize any adverse effects on soil and seedlings, except in Alternative D. In Alternative D, about half the ground-based acres would be summer logged in order to recover bark beetle infested downed logs that would be buried under snow in winter. In units that may be summer logged with ground-based methods, the equipment would operate on a mat of slash. This would protect the soil, but may damage newly germinated seedlings in the skid trails.

Hand falling and helicopter yarding is the least impactive method of salvaging trees. No heavy equipment would be on the ground, nor would trees be dragged across the soil, which would limit the potential damage to new seedlings. However, more snags may need to be felled for safety and this method is the most costly. Helicopter yarding is proposed in areas that have no road access or where slopes are too broken for skyline or tractor and have adequate volume to support the cost.

Unmerchantable material would be left standing where possible and practical, although harvest operations can be expected to push some smaller dead trees over.

Volume Estimates

Volumes were estimated for all stands in the fire area, as described in the affected environment section above. Those estimates were applied to the proposed harvest units and reduced to account for cull, breakage, and snag retention (Exhibit P-14).

Table 3-13 displays the estimated amount of volume that would be harvested with each action alternative. Although Alternative D would harvest the most volume, approximately 10,000 CCF of that is in units that would be harvested only if increased bark beetle populations are detected.

Table 3-13. Summary of Volume Available by Alternative

	Alternative B	Alternative C	Alternative D
Total CCF	59,056	37,353	69,812
Average CCF/Acre	9	10	9
Total MBF	26,840	16,975	31,730
Average MBF/Acre	4	4.5	4

MBF = CCF x .4545, CCF = MBF x 2.2

Natural Successional Development

Natural successional development (not supplemented by planting conifers) would occur in about 30 percent of the salvaged acres under all action alternatives. It is important to note that the lightning-caused fire of 2007 was the disturbance that initiated a new, early seral stage of succession. Some late seral stands received enough mortality that they are now in early succession, or seedling stage. The high severity ground fire that occurred over most of the area provided site preparation and a germination substrate for natural regeneration. Germination of lodgepole pine, larch, and Douglas-fir has a high potential for success due to the bare soil and ash seedbed created by the fire, if adequate cone crops exist (Schmidt, et al. 1976; Miller 2000). These species regenerate best with direct contact between the seeds and soil, abundant sunlight, low competition from other plants, and nutrients provided by ash.

Salvage treatments would not change the successional stage because primarily dead and dying trees are proposed for harvest (Exhibit P-15). Removing dead and dying trees would not keep natural succession from occurring, especially where helicopter, skyline, or winter ground-based logging methods are required because little damage to new seedlings would be expected. Some loss of new seedlings would occur with summer ground-based logging methods. The action alternatives affect succession to the extent that planting conifers in harvest areas hastens the revegetation process and affects the mix of tree species. Planting seedlings does not inhibit natural regeneration. If regeneration surveys show that natural regeneration is inadequate to meet stocking guidelines, planting would augment these areas. Long-term site productivity would not be adversely affected due to the abundance of coarse woody debris prescribed for all units.

Forest Structure

Direct and indirect effects of the action alternatives on vegetation diversity and ecological processes are evaluated through quantifying the amount of various communities and their characteristics (structure and fire severity classes) across the landscape. The analysis focuses on the condition of the forest communities, burned or unburned, that would result from the proposed activities and the effect they would have on future forests. It is important to remember that remnants of the pre-fire condition are present in the vertical arrangement of the burned vegetation (structure).

In stands with low to moderate fire severity, the distribution of mortality is highly variable. Consequently, harvesting dead trees would leave stands with irregular forest structures. Small openings would be interspersed with live trees of sapling, pole, and mature size classes. Residual canopy cover would be greater than in stands with high fire severity. Cone-bearing trees would provide a seed source for natural regeneration in less intensely burned stands.

The relevance of examining structure, with regard to burned forest, lies in the precept that ecosystem function is a consequence of structure. If the Sheppard Creek Project landscape is to function as burned landscapes have in the past, then a substantial proportion of the burn should remain undisturbed. The degree to which alternatives provide for a fully functioning ecosystem is a measure of how well overall ecological integrity might be maintained. Varying amounts and distributions of structure are left as legacies across the landscape in each alternative. Remaining live and dead trees of all sizes would leave some structure in harvested areas, both standing and as downed wood. It is acknowledged that some trees that would be removed would otherwise live and some trees that would be left may die. Some live trees may be damaged (bark skinning) during harvest operations. Skid trails and skyline corridors would be located to minimize damage to live trees.

Table 3-15a displays the acres treated by vegetation fire severity with the action alternatives (Exhibit P-4 and P-19). The majority of the burned areas would remain unaffected by the proposed salvage harvesting.

Table 3-15a. Salvage Harvest Acres by Vegetation Fire Severity for Action Alternatives.

Vegetation Fire Severity	Total Acres	% of Area	HARVEST ACRES AND % OF FIRE SEVERITY CLASS TREATED		
			Alternative B	Alternative C	Alternative D
High Crown	11,400	45%	3808 (33%)	2663 (23%)	4206 (37%)
High Underburn	4926	19%	1748 (35%)	1082 (22%)	2162 (44%)
Moderate	5258	21%	736 (14%)	156 (3%)	1004 (19%)
Low	3617	14%	54 (1.5%)	0	93 (2.5%)
Unburned and Water	165	1%	0	0	0
Totals	25,366		6346 acres (25%)	3902 acres (15%)	7465 acres (29%)

Table 3-15b displays the amount of existing forest structural stages that are treated under the alternatives (Exhibit P-4).

Past timber harvest has affected structure to varying degrees in about 50 percent of the burned area outside of proposed salvage units. For example, in past regeneration harvest, all of the small and most of the large diameter trees and woody material were removed. This may affect the post-fire environment, thus the successional development on that site, such as by reducing potential post-fire conifer seed sources. In addition, low amounts of down wood in past harvest stands affected the fire behavior and burn severity resulting in low mortality in many seedling, sapling, and pole-sized stands. Therefore, another way to assess the effect of salvage harvest on the overall functioning of the ecosystem at the landscape scale is to determine how much of the burned area would remain in a fully undisturbed condition. These areas developed without past harvest, have no salvage proposed, and would remain largely unaltered by direct human influence. Table 3-16 below provides a summary of the undisturbed areas by alternative.

Table 3-15b. Salvage Harvest Acres by Post-Fire Structural Stage (size class) for Action Alternatives.

Structure / Size Class	Acres post-fire	% of Area	HARVEST ACRES AND % OF POST-FIRE STRUCTURE TREATED		
			Alternative B	Alternative C	Alternative D
Seedling/Sapling (<5' dbh)	20,643	81%	5734 (28%)	3760 (18%)	6555 (32%)
Small (5-9" dbh)	2552	10%	42 (2%)	41 (2%)	48 (2%)
Medium (9-12" dbh)	418	2%	28 (7%)	28 (7%)	34 (7%)
Large (12-20" dbh)	1423	6%	405 (28%)	70 (5%)	662 (47%)
Very Large (>=20" dbh)	307	1%	137 (45%)	0	167 (54%)
Totals	25,366		6346 acres (25%)	3902 acres (15%)	7465 acres (29%)

Table 3-16. Summary of "Undisturbed" Area Without Past or Proposed Timber Harvest by Alternative

	Alternative A	Alternative B	Alternative C	Alternative D
Past harvest acres	12,870	12,870	12,870	12,870
Proposed salvage acres	0	6346	3902	7465
Human influenced acres	12,870	18,720	16,542	19,637
"Undisturbed" acres	12,496	6646	8824	5729
"Undisturbed" area percent of fire area	49%	26%	35%	23%

Note: some proposed salvage units are in areas with past harvest, so those acres do not add to "acres with human influence."

A mix of forest structural classes exists within these undisturbed areas. The stand initiation stage dominates on more then 80 percent of the acreage, where the fire killed all, or most of the trees. Around 14 percent is in the understory reinitiation stage (9 to 20 inch size classes), where some overstory trees survived. Between 0.4 percent (Alternative D) and two percent (Alternative C) is in a late seral stage where most of the overstory trees survived. The mid-seral stage comprises one to two percent of the area (Exhibit P-4).

Late Seral/Old Forest

Areas mapped and confirmed as existing, functioning old growth would not be treated under any action alternative. The fire altered the functioning structure of most stands that were late seral or old forest prior to the fire. Most of these stands reverted to earlier stages of succession, such as the stand initiation or understory reinitiation. Ground-truthing in the fall of 2007 revealed tree mortality ranging from 10 to 100 percent in mixed conifer stands. Units and portions of units considered in this draft EIS will be dropped from the final proposal if surveys in the summer of 2008 find they have a enough live trees remaining to still function as old growth or recruitment old growth (late seral/old forest). Refer to the *Old Growth Habitat and Old Growth Associated Wildlife Species* section in Chapter 3 for more detail.

Snags, Downed Woody Material, and Windthrow

Snag retention prescriptions vary across the fire depending on the dominant species, size class, and burn severity of a stand. For a full discussion of snag guidelines, see *Snag and Downed Woody Habitat* analysis under the Wildlife section.

Larger snags and live snag recruits would be left within salvage areas in all action alternatives to serve a variety of ecological functions, including wildlife habitat, woody debris recruitment for nutrient cycling and long-term site productivity, and a degree of structural integrity. These would usually be the larger wind-firm western larch or Douglas-fir. Unmerchantable trees with deep char and those less than 10 inches DBH would be left, unless the purchaser opts to use them as pulp. Some trees may be felled during harvest operations for logging access or operations safety. Residual trees would be distributed throughout the harvested units in clumps or as isolated trees. See Chapter 2 alternative descriptions for more detail on the snag retention prescriptions.

Blowdown potential is a function of species, diameter, landtypes/soils, elevation, and wind patterns. Shallow-rooted species including spruce, subalpine fir and lodgepole pine and smaller-diameter trees left in the harvested stands and in adjacent unharvested stands are most susceptible to blowdown and would likely remain standing for five to ten years. Large diameter larch and Douglas-fir have the potential to remain standing for a considerably longer time, depending on the degree of stem char. Residual trees in harvest units can be expected to come down sooner than those in unmanaged stands because of increased exposure to wind and root damage from logging. However, most of the trees and snags to be retained are deep-rooted western larch, and Douglas-fir. The edge created by harvest would contribute to blowdown in the adjacent unharvested areas, but would be mitigated somewhat by residual standing snags, live trees, and unmerchantable dead trees in the harvested area. Trees that have developed together in dense stands mutually protect and support each other and do not have strong roots and boles to withstand exposure to wind if opened drastically. Residual live trees may develop more wind firmness over time. Delayed mortality would occur due to cumulative stress from the fire and climatic conditions and those trees would contribute to future down wood. Predicting when and which residual trees would blow down is difficult. As stated earlier, research (Lyon 1977, Harrington 1996) has shown that most fire-killed trees fall within ten to twenty years regardless of adjacency to salvaged areas. Therefore, blowdown patterns are not greatly influenced over the long term by salvage.

Size of Openings

The National Forest Management Act requires that openings created in the forest by even-aged silviculture shall be less than 40 acres except in areas harvested as a result of natural catastrophic conditions such as fire, insect and disease, or windstorm (36 CFR 219.27,d,iii). The Brush Creek Fire satisfies the “catastrophic” condition. Salvage units in high fire severity areas would result in even-aged stands because the fire caused more than 80 percent mortality and all new trees would be one age. Units in low severity fire areas would result in two age classes because residual green trees would provide one age class and newly regenerated trees would be a distinctly younger age. Moderate severity fire areas would result in a mixture of both, because delayed mortality to trees is expected in many areas that presently display green crowns but have fatal root and/or bole scorch.

Artificial Reforestation

Prompt reforestation would minimize the time before burned stands are adequately stocked. It would also maintain or improve species diversity with higher proportions of desired species than are expected naturally. The logging operations would accomplish site preparation for reforestation in addition to that provided by the fire. Regeneration activities are expected to provide fully stocked stands within five years. A variety of conifer species would be planted to add to the diversity of the vegetative community, including larch, Douglas-fir, rust-resistant western white pine, lodgepole pine, spruce, and ponderosa pine. Each unit would have a site-specific prescription for species and spacing, based on the site conditions and remaining live trees. Future generations may then have options for wood fiber, wildlife habitats, and soil and water protection, as expressed in the National Forest Management Act (NFMA).

Tree planting is planned on about 70 percent of the salvaged acres. These are mostly in units that were severely burned with no live seed trees nearby.

The following table displays the number of acres of planting and natural regeneration proposed by alternative.

Table 3-14. Reforestation by Alternative

Reforestation Method	Alt. B	Alt. C	Alt. D
Acres of Full Plant	1844	1198	2159
Acres of Interplant (species diversity)	2337	1654	2978
Acres of Natural Regeneration	2165	1050	2328

Seedlings planted on national forest lands, including the Sheppard Creek Post-Fire Project, come from native seed sources adapted to the planting site.

<u>Alternative B- Proposed Action</u>

Alternative B, the Proposed Action, was designed to meet the purpose and need for salvage of merchantable wood while complying with Forest Plan direction. Refer to Chapter 2 for a full description of the elements of Alternative B.

Timber Resource and Natural Successional Development

Alternative B would recover the value of dead and dying trees across 6346 acres. Approximately 59,000 hundred cubic feet (27 MBF) of timber volume would be harvested.

Conifer seedlings would be planted on approximately 4180 acres (66 percent) of the salvaged area. Natural regeneration is expected on the remaining 2165 acres of salvage harvest.

<u>Alternative C</u>

Alternative C is based on the Proposed Action and is designed to respond to issues and concerns regarding wildlife habitat, temporary road construction, sensitive soils, old growth and recruitment old growth habitats, and helicopter logging costs. Units and temporary roads were eliminated or modified from the Proposed Action to respond to these resource concerns. The prescriptions for salvage treatment and snag retention are the same as in Alternative B. Refer to Chapter 2 for a full description of the features of this alternative.

Timber Resource and Natural Successional Development

Alternative C would recover the value of dead and dying trees across 3902 acres. Approximately 37,000 hundred cubic feet (17 MBF) of timber volume would be harvested.

Regeneration through planting would occur on approximately 2852 acres, or 23 percent of the salvaged area. This would leave 1050 acres regenerate naturally, without the influence of planted conifers.

<u>Alternative D</u>

Alternative C is based on the Proposed Action and designed to respond to issues regarding potential bark beetle outbreaks. Helicopter yarding replaces ground-based systems in the Proposed Action units that were removed from Alternative C. The prescriptions for salvage treatment and snag retention are the same as in Alternative B. Refer to Chapter 2 for a full description of the features of this alternative.

Timber Resource and Natural Successional Development

This alternative would recover merchantable, burned trees, across about 7465 acres. Approximately 70,000 hundred cubic feet (32 MBF) of timber volume would be harvested.

Regeneration through planting would occur on approximately 5137 acres, or 69 percent of the salvaged area. This would leave 2328 acres to regenerate naturally, without the influence of planted conifers.

Cumulative Effects

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. Past, present, and reasonably foreseeable actions, as described in the introduction to this chapter, are not expected to greatly influence succession, structure, or species distribution for vegetation when combined with salvaging fire-killed trees or in conjunction with the No Action Alternative.

Fire and past regeneration harvests were the primary disturbance in the analysis area. Salvage of dead and imminently dead trees would not affect the ability of vegetation to continue to function as it has since the glaciers receded. Artificial regeneration would promote species diversity in areas that would otherwise be expected to develop slowly into spruce, subalpine fir, or lodgepole pine monocultures. Disturbances to vegetation, either naturally occurring such as wind, fire, or flood, or through past harvest, are all relatively short-term. Habitat types in northwestern Montana are generally highly productive for vegetative biomass. The climate provides adequate moisture and seed dispersal from adjacent live trees, shrubs, grasses, bird and animal droppings, and residual seed in the soil aids in renewal. The soils severely affected by fire would be slower to recover, but would in time (see *Soils* section later in this chapter). Rates of blowdown of fire-damaged or fire-killed trees may increase because of existing and proposed harvest openings.

Past, Present, and Reasonably Foreseeable, Actions Considered for Cumulative Effects

Past Activities

Past regeneration harvest occurred on about 11,200 acres (44 percent) of lands within the Flathead National Forest portion of the Brush Creek Fire boundary. Harvested areas were regenerated and in various stages of growth at the time of the fire, as described earlier in this section. Approximately 8200 acres were moderately to severely burned (Exhibit P-7). Approximately 3000 acres that had past regeneration harvest burned with low severity, largely because past harvest and site preparation removed most of the dead wood from these areas. The proposed harvest, in conjunction with the fire and past regeneration harvest, would further reduce the amount of dead wood across the landscape that would be available for ecosystem functions, such as soil and nutrient replacement, wildlife habitats, and substrates for mycorrhizae, fungi, lichen, and insects. However, the young stands that survived the fire are expected to develop into mature stands sooner than those that would regenerate after the fire and/or salvage harvest. In the absence of future fire or other disturbance, these young stands would provide landscape diversity and may become old growth in 100 to 200 years.

Precommercial thinning in the project area selected dominant trees of preferred species, such as larch, Douglas-fir, and white pine. Many of the thinned stands were burned and would be evaluated for re-planting. Some had grown large enough to be considered in this salvage proposal. The thinning seemed to have little effect on fire behavior and therefore no cumulative effect with salvage on the vegetation condition.

Suppression tactics used to control the 2007 and previous fires directly affected some vegetation resources. Similar effects are expected when future fires occur in the area. Documented impacts to vegetation resulted from:

a) Construction of dozer lines along previously closed road systems and on previously undisturbed sites;
b) Creation of “safety zones”, staging areas, and drop points within and outside the fire perimeter;
c) Removal of hazard trees during line construction activities and along open roads;
d) Reduction of fuels and vegetation ahead of the fire-front by backfire operations; and
e) Construction of “shaded fuel breaks” along roads.

These activities resulted in changing the forest structures on about 320 acres to primarily non-stocked with no residual live or dead trees.

Rehabilitation of the above items was undertaken at the end of the fire. Waterbars and woody debris were placed in dozer lines. Disturbed ground was seeded with native grass species, which should not persist more than several growing seasons, allowing native species to become established.

Removal of felled hazard trees (non-windfirm snags) along roads, and outside of riparian buffers, is expected to be completed in the spring of 2008. Adequate woody debris and residual snags remain in these areas for soil nutrient cycling.

These past activities, taken in consideration with the proposed salvage of dead and dying trees, should not result in long-term detrimental effects to the vegetation resource in the project area.

Present and On-Going Activities

Special forest products gathering for personal use are likely to continue, particularly in areas unaffected by fire. Products include berries, firewood, Christmas trees, evergreen boughs, and cones, and others. Christmas tree and bough harvesting affect a miniscule proportion of trees in the drainage and can serve to prune and thin along roads on a small scale.

Mushroom harvesting occurred during the summer of 1995 in the Little Wolf Fire area with no measurable effect to vegetation. Commercial and personal use mushroom harvesting is planned in the spring of 2008 throughout the fire area. Based on observations from Little Wolf, Moose, and the 2003 fires on Hungry Horse and Glacier View Ranger Districts, the harvesters have little overall effect on regeneration. Although, people walked on nearly all acres of the fires, and tender seedlings undoubtedly were stepped on, post-fire natural regeneration of western larch, lodgepole pine, and Douglas-fir is so abundant, the trampling had little effect. Walk-through surveys after the mushroom harvest found abundant tree seedlings throughout the fire areas. Only minor amounts of mushroom harvesting activity are expected in future years as green plants become established and conditions for the flush of fungi are diminished.

Noxious weed treatments have and would occur during the summers of 2008, 2009, and beyond. Reducing weeds along the roads and site-specifically off-roads would benefit native plants by maintaining the natural diversity in the vegetation community.

Snowmobiling is a popular recreation activity on roads in and near the Sheppard Creek Project area. If snowmobiles travel over areas with young trees that are not adequately covered by snow, the tops of some of the trees can be damaged. As the fire areas regenerate and trees emerge above the snow, there could be some adverse affects to individual trees. This would be minor because, generally, snowmobilers would find other play areas as the trees impede their travel.

Reasonably Foreseeable Actions

Replanting of previously harvested units where regeneration was consumed by the fire is planned during the spring and early summer of 2008 through 2010. Tree planting is planned on over 1900 acres of regenerated stands that were severely burned. In addition, tree planting is planned on approximately 1400 acres outside of past and proposed harvest units. As discussed earlier, this would recover full stocking and allow for species diversity.

Natural regeneration or continued growth of surviving seedlings would occur on the remaining 9300 acres of past regeneration harvest and unplanted areas outside proposed harvest units. Therefore, natural succession without the influence of planted conifers, would occur on 19,286 acres (76 percent) of the approximately 25,366 acres in the Flathead National Forest portion of the fire area with Alternative B, 20,614 acres (81 percent) with Alternative C, or 18,329 acres (72 percent) with Alternative D.

Cattle grazing could damage seedlings, especially Douglas-fir and ponderosa pine, by trampling and browsing. However, grasses and forbs are preferred forage most of the year. Minimal effects to vegetation are expected if grazing is managed and cattle are released to the allotment in late spring or early summer when grasses are abundant.

The network of roads in a forest facilitates economic management of forest resources. There are presently about 125 miles of road in the Sheppard Creek Project area, with access ranging from open yearlong to closed and naturally revegetated. Road closures and reclamation have been implemented in the drainage for many years and more is planned. However, the Sheppard Creek Project does not propose any changes to road management. Reduced road access would increase costs of implementing and monitoring vegetation treatments and forest management activities would be reduced in the future.

According to Perry and Amaranthus (1997), management systems can be devised that sustain productivity and biological diversity. Design criteria for this project include consideration for soils, woody debris for nutrient cycling, and conifer regeneration, ensuring that any of the action alternatives would protect biological diversity and soil integrity on this landscape. The action alternatives contain plans for the future through regeneration of the forest with diversity of species. Future generations may then have options for forest management.

REGULATORY FRAMEWORK AND CONSISTENCY

Vegetation

The National Forest Management Act (NFMA) (16 USC 1604) requires that Forest plans "reserve 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). Additional direction states that "management prescriptions, where appropriate and the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which could be expected in a natural forest and the diversity of tree species is similar to that existing in the planning area." The NFMA further requires that "timber will be harvested from National Forest System lands only where there is assurance that such lands can be restocked within five years of harvest."

All units are proposed in previously forested areas that are suitable for timber management. The alternatives were designed to ensure regeneration within five years after salvage harvest by prescribing tree planting in units that may not adequately regenerate naturally. Planting is also proposed in units that are expected to naturally regenerate with low species diversity. Determination of adequate stocking would be based on regeneration surveys conducted one, three, and five years following tree planting or site preparation for natural regeneration. Numbers of trees per acre and stocking percentages would be calculated from these surveys, and compared to the minimum and desired stocking levels identified in the harvest prescription for each particular stand.

Flathead National Forest Plan goals include maintaining a diversity of vegetation and habitats across the forest to meet the needs of a variety of wildlife species and providing a sustained yield of timber products that is cost-effective, responsive to the needs of the local economy, and is consistent with other Forest Management goals (page II-5). Forest-wide timber and vegetation management objectives, on pages II-8 to II-9, describe scheduled outputs. Forest Plan standards on pages II 47-49 and in Appendix I provide direction for protection and improvement of the timber and vegetation resources.

Salvaging dead and dying trees after wildland fire contributes to achieving Forest Plan goals for cost-effective timber management and sustained yield. Planting trees helps maintain a diversity of vegetation and habitats. Harvest and reforestation prescriptions would be based on vegetation burn severity, tree dominance types, and potential vegetation groups, as described in Forest Plan Appendix I. Therefore, all alternatives are consistent with Forest Plan direction and its amendments concerning vegetation.

Old Growth Habitat (Late Seral)

Forest Plan direction related to old growth forests (Amendment 21) has goals to “maintain and recruit old growth forests to an amount and distribution that is within the 75 percent range around the median of the historical range of variability” and "ensure that Forest Service actions do not contribute to the loss of viability of native species.” For species associated with old growth forests, there are objectives to "maintain ecological processes and provide for natural patch size distribution" and to "manage landscape patterns to develop larger old growth patch sizes where needed to satisfy wildlife habitat requirements.” At the landscape scale, standards state that "sufficient retention of forest structure (large-diameter live trees, snags, and coarse woody debris)" should be left to provide for future wildlife movement through the matrix surrounding old growth forests; "treatments within existing old growth may be appropriate where current insect and disease conditions pose a major and immediate threat to other stands"; and vegetation treatments should be modified "as needed to meet habitat needs of old growth associated species.”

As described earlier in this chapter, no salvage harvest would occur in old growth habitat or stands that could become old growth over the next 20 to 100 years. See the *Snag and Downed Woody Habitat* and *Old Growth Habitat* sections for discussion of regulatory consistency in regards to deadwood and old growth retention.

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BARK BEETLES

Introduction

Many insects and pathogens capitalize on the changed forest conditions after fire. In the Flathead National Forest portion of the Brush Creek Fire, spruce and Douglas-fir bark beetles are of primary concern to land managers. They have the potential to develop large populations within the fire area, spread into live trees within and outside the fire area, and produce adverse effects on other resource values. Wood boring beetles are also of some concern. Although they usually do not kill trees, they have caused mortality in western larch and Douglas-fir in past years (Exhibit PB-18). Their boring galleries can affect the value of lumber milled from all species of salvaged logs. Western balsam bark beetle has been active in the fire area with minor amounts of subalpine fir killed near Sheppard Mountain, Elk Mountain, and above Bowen Creek Drainage in 2006 (USDA 2006).

Disturbances such as insects, disease, and fire are a natural part of the ecosystem. Wildlife, vegetation, and other components of the ecosystem have evolved and responded to the influence of these processes for thousands of years. Bark beetle populations are usually "endemic" in the forest, with typically low annual tree mortality. However, periods of high beetle population levels occur, usually in response to disturbances that stress and weaken host trees (such as drought, fire, and blowdown). These insects have evolved to take advantage of disturbances, such as the Brush Creek Fire, where thousands of fire-killed and stressed trees provide suitable brood-producing habitat. A bark beetle outbreak in and around the fire area would be normal and natural from an ecological context. However, high tree mortality in much of this area may conflict with management objectives and create undesirable consequences.

Several conditions must exist for bark beetles to take advantage of fire-damaged hosts (USDA 2000, USDA 2003a, and Exhibit Pb-20). These include the following:

First, the fire area must have sufficient numbers of host trees with undamaged inner bark (phloem) in which beetles feed and lay eggs. Stand-replacing fires, or fires in thin-barked tree species, may render the inner bark unusable to beetles. However, within the burned area, many Douglas-fir and large spruce still have viable, moist inner bark. The dead, large-diameter (greater than16 inches) Douglas-fir and spruce trees are capable of attracting and supporting bark beetles for up to one year, before the inner bark dries out. Fewer beetles would be produced in trees with severe char that extends up the bole than in those still alive or less charred.

Second, fires must occur at a time when beetles are able to capitalize on the new feeding and breeding habitat. Fires in late summer or early fall may occur after adult beetles have flown, and a burned tree's inner bark may become too dry, or in some cases "sour," before the next year's flight season. Most of the Brush Creek Fire occurred after the bark beetle flights in 2007. The fire killed many spruce and Douglas-fir trees, though the inner bark on many is still moist and able to support a new generation of beetles (Exhibit Pb-20 and 21). Much of the fire mortally charred the root collars and shallow roots, but left the boles and crowns unaffected. Many other trees, not directly killed by the fire, experienced crown scorch or bole char and are highly stressed. These trees are the most susceptible to beetle infestation and able to produce high numbers of new adult beetles in subsequent years. Flat- and round-headed woodborers can apparently fly later in the season than bark beetles. Their larvae were found in western larch in the 2003 Robert Fire during the winter following the fire. No surveys have been conducted to confirm populations of woodborers in the Brush Creek Fire area.

Third, there must be a population of beetles within a reasonable distance to take advantage of weakened trees. While Douglas-fir beetle infestations in western Montana have declined to the lowest levels since 1998, populations remain higher than normal (USDA 2006). Following extremely dry conditions in 2007, a rebound of beetle populations is a distinct possibility that could continue for a few years more (Exhibit Pb-20). Spruce beetles are currently at endemic population levels in Northwest Montana, but expected to be capable of exploiting the new, highly desirable feeding and breeding sites in the analysis area (USDA 2006, and Exhibits Pb-6, 7, 20, 21, and 22).

Historically, bark beetle outbreaks on the Flathead National Forest are common. Within the past 30 years there were large outbreaks of mountain pine beetle in lodgepole pine stands (McGregor, et al. 1983) and spruce beetle in Engelmann spruce stands (Gibson 1984). Small, Douglas-fir beetle outbreaks are scattered in mature Douglas-fir stands throughout the Flathead National Forest, notably in Logan Creek on the Tally Lake Ranger District and parts of Glacier View and Hungry Horse Ranger Districts (USDA 2006). Bark beetle outbreaks in the Northern Region precipitated by fire-damaged stands are well-documented (Amman and Ryan 1991; Gibson and Oakes 1993, 1994; Gibson, et al. 1999; USDA 2004).

Predicting bark beetle infestations is not an exact science. “Impact” models are useful for predicting beetle-caused mortality in stands of certain characteristics (Cole and McGregor 1983; Negron, et al. 1999). Our best efforts are directed towards risk and hazard reduction – recognizing when “outbreak conditions” are present, considering potential effects on various resources should an outbreak be realized, and implementing strategies to prevent or lessen the effects of an outbreak if management objectives deem that a prudent course of action. That is the strategy of this analysis.

The greatest benefits in dealing with actual or potential Douglas-fir or spruce beetle infestations are derived from efforts aimed at preventing outbreaks rather than suppressing them (Schmitz and Gibson 1996). This involves modifying live susceptible stands to make them less vulnerable before a stand disturbance that may trigger an outbreak. Actions may include altering tree densities and species compositions. Once disturbances occur (common ones are blowdown, fire and drought), removal of bark beetle susceptible trees before they are infested is the most effective action to prevent an outbreak or influence beetle populations. Removing as many infested trees as feasible before the adult beetles emerge, and spread to live trees in the vicinity, can reduce the risk of a large-scale bark beetle infestation (Holsten, et al. 1999; Exhibits Pb-8, 17, and 20). Alternatives include use of pheromones to either trap or repel beetles, burning or peeling infested logs to destroy brood, and using trap trees to attract beetles then removing the attacked trees. All these methods have utility and are applicable in specific situations (Exhibits Pb-9 and 20). A variety of methods may be used to deal with a potential bark beetle outbreak in the Brush Creek Fire area.

Information Sources

Stand conditions, susceptibility, and potential effects are based on information from stand exams stored in the FSVeg database, photo interpretation, field observations, satellite imagery, insect and disease aerial detection surveys, and various GIS data filed in the Flathead National Forest and Sheppard Creek Post-Fire Project electronic libraries.

Field reconnaissance surveys were conducted in September through November 2007 to gather data specific to resource issues, such as post-fire insect potential and activity, riparian boundaries, reforestation potential, and vegetation conditions (Exhibit P-10). A set of randomly-located Common Stand Exam plots were sampled in October and November 2007 to help determine the distribution of large trees for snag and live tree retention and bark beetle hazard (Exhibits P-11, 12, 13). Aerial photos taken in 2003 (pre-fire) and September 2007 (post-fire) were used to classify vegetation in stands without exam data, to verify or update field data, and to determine fire severity.

R1-VMap (Northern Region Vegetation Map) (Brewer, et al. 2004; Berglund, et al. 2007) was used to model bark beetle hazard in and near the fire area. It is a satellite image classified to provide information about species composition, stand size class, and canopy cover.

Analysis Area

The area affected directly by spruce and Douglas-fir bark beetles is the Flathead National Forest portion of the Brush Creek Fire perimeter (Figure 3-1). For evaluating indirect and cumulative impacts of bark beetles, the area affected includes all lands within a five-mile radius of the fire area (Exhibits Pb-3 and Pb-5). This distance is based on our knowledge that bark beetles will only fly as far as necessary to find a suitable host. Flight tests indicate few beetles can fly more than seven miles nonstop (Chansler 1960). Therefore, it is reasonable to assume beetles produced in the fire area might fly up to five miles from where they developed.

Table 3-17 below displays land ownerships and acreages within the five-mile zone, including the fire area, which may be directly or indirectly affected by bark beetle activity. It also shows the estimate of acres susceptible to spruce and Douglas-fir beetles (see descriptions of hazard ratings in the Affected Environment section below).

Table 3-17. Acres by Land Ownership and Bark Beetle Hazard within Five Miles of the Flathead National Forest Portion of the Brush Creek Fire.

Ownership	Acres*	Percent of Total Area	Spruce Beetle Hazard[(2)]		DF Beetle Hazard[(3)]	
			Acres*	Percent of Ownership	Acres*	Percent of Ownership
Flathead National Forest	108,033	63	73,921	68	63,865	59
Kootenai National Forest	20,638	12	9,610	46	8,268	40
Small Private	6,300	4	3,000	48	1,496	24
State of Montana	870	<1	435	50	203	23
Plum Creek Timber	36,766	21	7,937	22	7,830	21
TOTALS	**172,607**[(1)]		**94,903**	55	**81,725**	

*Numbers are approximate due to GIS/satellite data processing and interpretation, rounding, water and rock.
[(1)] 142,687 acres outside the fire area. 16,668 acres are Plum Creek and Kootenai NF assumed no or low hazard without data for hazard rating.
[(2)] High or Medium hazard.
[(3)] Very High, High, Moderate, Low, or Very Low hazard.

Affected Environment

Spruce Beetle

Description, Life History, and Host Interactions

Spruce beetle (*Dendroctonus rufipennis* [Kirby]) is the major natural mortality agent of mature spruce in this area and the most important biotic disturbance agent affecting post-fire, spruce-fir forests in the Intermountain West (Veblen, et al. 1994; Jenkins, et al. 1998). At endemic population levels, spruce beetles usually live in wind-thrown trees, scattered individual trees, and groups of low-vigor trees (Schmid 1981). Outbreaks normally occur after a stand disturbance, such as a windstorm, that results in abundant feeding and breeding habitat for the beetle. Beetle populations can increase dramatically in these situations and spread into larger-diameter, standing live spruce in surrounding regions, causing extensive mortality of these trees. Outbreaks during the last two decades in Alaska and Utah spread over more than 2.3 million acres and 122,000 acres respectively (USDA 1999c). In Utah, mortality exceeded 1.5 million spruce trees and the loss of over 90 percent of the large spruce (Dymerski, et al. 2001; Keyes, et al. 2003; USDA 2005a).

The normal life cycle for spruce beetle is two years. Adult beetles fly and attack host trees mostly in early summer. The female finds a suitable breeding site and releases a pheromone (chemical) that attracts male beetles. Males then attract both male and female beetles, initiating a mass attack on the tree. A thousand or more beetles may infest a single tree and in turn produce two to five times that number of beetles in the next generation. Once mated, the female constructs an egg gallery in the inner bark of the tree and lays her eggs. Eggs hatch the same summer laid. Larvae tunnel at right angles to the egg gallery and feed, eventually killing the tree by girdling (Schmid and Frye 1997).

Spruce beetles typically overwinter as larvae and pupate by late the following summer. These new adults overwinter again in the same tree, with the majority emerging from their original pupal sites, moving to the base of the tree, and boring back into the bark near the litter line. This may be an adaptation to reduce predation by woodpeckers and reduce winter mortality from extreme cold. The spring and summer of their second year, the adult beetles emerge from the tree to seek mates and new breeding sites. Beetles developing in downed logs remain in place after maturity, emerging the following spring.

Spruce beetles are able to fly several miles in search of suitable breeding sites. Being non-aggressive, they prefer to attack wind thrown, weakened trees. If these trees are not available, they attack live, healthier trees where they may or may not be successful. Larger-diameter trees (greater than 18 inches DBH) are usually attacked first, but with high and persisting populations, smaller-diameter trees may be attacked as well.

Natural enemies of the beetle include birds, insect predators, and parasites. When beetles are at lower populations, these organisms can effectively keep population levels in check. During outbreaks, their influence is much less effective.

Past and Present Spruce Beetle Activity in and around the Project Area

Spruce is, and has historically been, a common species throughout the Tally Lake Ranger District. Spruce beetle activity undoubtedly fluctuated through time and was probably always a common cause of mortality in larger-diameter spruce. Periodic epidemics occurred in response to events such as fire or windstorms, depending upon the condition of the stands.

A major spruce beetle epidemic occurred in northwest Montana and northern Idaho following a severe windstorm of hurricane force in 1949. Hundreds of thousands of acres of blowdown resulted. Following this, spruce beetles infested and killed millions of spruce trees through the 1950s. Harvesting throughout the higher elevations on the Flathead and Kootenai National Forests (in the 1950s and 60s) was conducted to slow the epidemic and salvage the value of the dead and highly susceptible spruce trees.

More recently, a spruce beetle outbreak occurred after the 1994 Little Wolf fire that burned on the south edge of the Brush Creek Fire area. Immediately after the fire, the Forest Service salvaged dead trees, mostly lodgepole pine and subalpine fir, from upland sites. This project avoided harvest in or near riparian areas dominated by spruce. Monitoring in 1995 and 1996 revealed spruce beetle populations increasing on about 2000 acres, mostly in and near riparian areas. Additional salvage was planned. In 1997 and 1998, a combination of salvaging infested trees, trapping emerging beetles, and removing trap trees successfully reduced spruce beetle populations and averted a widespread epidemic (Gibson, et al. 1999).

Except for the Little Wolf post-fire outbreak, spruce beetles have been at endemic levels in and around the project area for the past 40 years. Aerial surveys have detected scattered spruce beetle-caused mortality ranging from less than one to about 30 acres per year within five miles of the fire since 1968 (the first year of aerial surveys). The highest activity levels occurred in the late 1990s and the lowest in the 1970s (Exhibit Pb-7).

Spruce Beetle Hazard Rating for Habitat Conditions in and around the Project Area

All stands within the fire area (29,921 acres), and within five miles from the fire boundary, were evaluated for susceptibility or "hazard" of spruce beetle infestation. Hazard was estimated based on a rating system developed over 30 years ago. Criteria to determine hazard include average diameter of spruce over 10 inches DBH; proportion of spruce in the canopy; basal area (density) of the stand; and physiographic location (i.e. creek bottoms vs. lower productivity sites) (Schmid and Frye 1976). R1 VMap was the primary information source because it provides current and consistent vegetation data across all ownerships (Brewer, et al. 2004; Berglund, et al. 2007). Additional information from past field inventories, photo interpretation, satellite imagery, and field knowledge helped validate and refine the R1VMap data (Exhibit Pb-1).

Hazard ratings identify stands with conditions that would support a beetle outbreak and stands that could experience considerable mortality once an outbreak occurs. Hazard ratings do not predict when, or if, beetles would be active or cause mortality in a certain stand nor do they predict actual stand losses from beetles.

High hazard stands are those that could support large numbers of beetles and have high mortality once a disturbance (such as fire) occurs. The high-hazard stands are typically well-stocked stands on productive sites, with medium to large diameter (greater than 16 inches DBH) trees where spruce often comprises over 65 percent in the canopy. Given a beetle population in the area, these stands would experience the greatest net losses and would be able to support and contribute substantially to beetle population buildup.

Medium hazard stands are generally similar to high hazard stands except with smaller diameter (greater than 12 inches DBH) trees, with spruce comprising less than 60 percent of the overstory. Given high beetle populations, spruce in these stands would also have high mortality and be able to support and contribute to beetle population buildup.

Low hazard stands are typically those where larger (greater than 16 inches DBH) spruce are present, but at low numbers or the spruce are relatively small (less than 12 inches DBH). Individual trees may be infested and killed by spruce beetle, but the stand as a whole does not provide abundant beetle habitat.

Medium and low hazard stands may experience less beetle-caused mortality, but large (greater than 16 inches DBH) trees might still be killed in these stands. Net losses would be lower than in high hazard stands, because there are fewer susceptible trees. In addition, medium and low hazard stands become more vulnerable when high hazard stands nearby are infested.

Based on field observations and knowledge of stand conditions both inside and outside the fire area, the rating appears to overestimate the hazard. This is probably because the stands were rated using data derived from satellite and aerial photo imagery from which it is difficult to determine the proportion of spruce in a stand (Exhibit Pb-1).

Current Spruce Beetle Conditions within the Fire Perimeter

For post-fire stands, vegetation fire severity was integrated with the detailed hazard ratings described above. Information from past and immediately post-fire field inventories, and photo interpretation were used to refine the ratings (Exhibit Pb-1).

Over 14,600 acres, or about 58 percent of the fire area, was rated with medium or high levels of spruce beetle susceptibility. Most of these acres are in moist, productive riparian zones or in mid- to high-elevation stands dominated by spruce and subalpine fir. Some of the stands are mixed species with mature spruce as a minor component. These areas were underburned, where the fire stayed on the ground and burned through the vegetation on the forest floor, killing or damaging spruce and other trees. These sites have the highest number of larger-diameter, fire-affected spruce, some over 20 inches DBH, and many already wind thrown, creating even more desirable beetle habitat. Table 3-18 displays the estimated acres within the fire areas that are susceptible to spruce beetle (Exhibits Pb-1 and Pb-3).

Table 3-18. Estimated Acres and Spruce Beetle Hazard Rating for Stands within the Flathead National Forest Portion of the Brush Creek Fire.

Spruce Beetle Hazard Rating	Acres	Percent of Total Acres
High	470	2
Medium	14,150	56
Low	8,607	34
None	2,127	8
Total	25,354	100

Spruce has thin bark. A high severity fire that chars the bole along most of its length kills the inner bark, rendering the trees useless to spruce beetles as habitat. These areas were classified as “high crown” vegetation fire severity. Underburns char only the lowest part of the bole or the root crowns and the foliage is usually still green, creating ideal beetle habitat. The inner bark was damaged in the charred regions of the bole, highly stressing the trees. In most cases, these trees were killed by the girdling effect of the fire itself. They still contain abundant moist inner bark in which beetles may successfully develop. These areas were classified as “high underburn,” “moderate,” and “low” vegetation fire severities. See the *Vegetation* section for estimates of fire severity on vegetation.

Field surveys in 2007 were too soon after the fire to detect spruce beetles. Therefore, population levels are not known. Surveys are planned in 2008 to determine the level of hazard and where, if any, additional treatments should be implemented.

Current Spruce Beetle Habitat Conditions outside the Fire Perimeter

Table 3-19 displays the estimated acres of spruce stands on National Forest System Lands outside the fire area and their hazard ratings for spruce beetle (Exhibits Pb-1 and Pb-3). The majority (54 percent) of the stands within five miles of the fire boundary are rated medium to high hazard for spruce beetle infestation. This is consistent with the cool, moist habitats and lack of stand replacing fire for over 150 years in most of the analysis area, especially along streams, on north-facing slopes, and at the higher elevations. Shade tolerant forests of spruce and either subalpine fir or Douglas-fir are the dominant forest cover in these areas.

Table 3-19. Estimated Acres and Spruce Beetle Hazard Rating for Stands on all Ownerships within Five Miles and Outside of the Flathead National Forest Portion of the Brush Creek Fire.

Spruce Beetle Hazard Rating	Acres	Percent of Total Acres
High	4,895	3
Medium	75,388	51
Low	30,372	21
None	36,597	25
Total	147,252	100

National Forest System Lands

The Flathead National Forest administers 83,500 acres within five miles of the fire. As described above and in the “Vegetation” section, several forest types that include spruce occur throughout the National Forest. Approximately 49,000 acres (60 percent) of these national forest lands have spruce trees that are susceptible to spruce beetle, based on the hazard rating process. Approximately 3800 acres (90 percent) of the 4300 acres of old growth habitat outside the fire area are rated high or moderate hazard to spruce beetle and would be at risk if a population outbreak develops in the fire area.

The Kootenai National Forest administers about 20,600 acres within five miles of the Sheppard Creek Project area including 3600 acres that burned in the Brush Creek Fire. About 9600 acres have some spruce trees that are susceptible to spruce beetles. According to the Brush Creek Fire Environmental Assessment (EA) (USDA 2008a), about half the burned area had high vegetation fire severity, the other half had low, moderate, or high severity under-burns. The majority of the burned area was mature forest stands of mixed conifers on cool moist and cool dry habitat types. Species composition in most stands included Douglas-fir, lodgepole pine, western larch, and subalpine fir. Spruce was a minor stand component along streams, at higher elevations, and on north-facing slopes. Even if the Kootenai National Forest does not salvage any burned trees, the EA concludes, “there is little food available in adjacent areas” for bark beetles. Most of the area surrounding the fire was previously harvested and regenerated with ponderosa pine.

Private Forest Lands

The 42,700 acres of private lands in the five-mile zone outside the fire area are mostly Plum Creek Timber Company land on the west side of the fire. Small private holdings are in the Star Meadow and Good Creek areas east and north of the fire. Most of the Plum Creek lands have been harvested over the last 50 years and have mixed stands of second growth Douglas-fir, ponderosa pine, larch, and lodgepole pine with some spruce. About half of the small private lands are meadow or cleared forest, now supporting pasture and residential areas. There are few large forested areas dominated by spruce forest, although susceptible spruce trees exist along streams and wetlands and in mixed species forest. These susceptible stands on small private lands are estimated to total less than 3000 acres. Based on the hazard rating process, conditions in adjacent national forest lands, and photo interpretation, large spruce are likely to be a component in the these stands. If an epidemic occurs because of beetle infestation in the Brush Creek Fire area, these spruce would be vulnerable to spruce beetle infestation and mortality.

State Forest Lands

State Forest lands within five miles of the Brush Creek fire are at lower elevations in and near Star Meadow and along Evers Creek. These 870 acres have a mix of medium, low, and no hazard. About half of these acres are meadow, wetland, or previously harvested. Based on the hazard rating, the mature stands are mostly mixed species bordering streams and wetlands with a high percentage of spruce. Therefore, a reasonable estimate is 200 to 400 acres with some hazard.

Douglas-fir Bark Beetle

Description, Life History, and Host Interactions

Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopkins*)* infests and kills Douglas-fir throughout most of its range in western North America. Normally, at endemic population levels, beetles infest scattered trees, especially those weakened by such factors as defoliation, root disease, fire-scorch, or windfall. When and where such susceptible trees become abundant, beetle populations can build rapidly and spread to adjacent green, standing trees. During outbreaks, they commonly kill groups of 100 trees or more. Outbreaks frequently last from two to four years, with those of longest duration coinciding with periods of drought (Schmitz and Gibson 1996).

Douglas-fir beetle has a one-year life cycle. In this area, adult beetle flight season lasts from mid-April through June, with occasional late season flights in late August through September. Adult beetles are strong fliers, capable of flying for several miles in search of mates and breeding sites. Once a female beetle finds a suitable host tree, she emits a pheromone attracting male beetles that then attract beetles of both sexes. A thousand or so beetles can be attracted to one tree, initiating a mass attack. Once mated, the females bore into the moist inner bark layer and lay eggs. The larvae that hatch bore outward from the egg galleries, feed on the inner bark, and kill the tree by girdling. Later in the year, the larvae pupate and develop into adults that overwinter in the tree. The following spring, this new generation of adults emerges to begin the cycle again.

Beetles usually attack trees over about eight inches DBH, because they need sufficiently thick inner bark to support the brood. They preferentially attack stressed and weakened trees, such as those recently damaged or killed by fire, drought, other insects, or diseases. If dead or stressed trees are not available, they attack live, more healthy trees, even stands normally considered to be low hazard (such as those with trees of smaller diameter or low numbers of larger diameter Douglas-fir). Beetle brood success in these types of stands depends on tree vigor and number of attacking beetles.

As many as 1200 to 1500 male and female beetles may attack a typical 20 inch diameter tree and produce about 7500 beetles, assuming a five percent brood survival rate. Generally, at high population levels, one infested tree can produce enough beetles to kill an additional five trees (Gibson 2004, personal communication).

Natural enemies of the beetle include an array of bird species (woodpeckers and other insect-eating birds), insect predators, and parasites. These organisms can have an impact on beetle populations and brood success when beetles are at lower population levels. During outbreak conditions, their effect is much reduced, simply because of the very large numbers of beetles.

Past and Present Douglas-Fir Beetle Activity in and around the Project Area

Historically, forests dominated by Douglas-fir and mixed species forests with a Douglas-fir component were widespread within the cool, moist and warm sites in the Sheppard Creek area. They were common on all but the cold, higher elevation sites that support spruce, subalpine fir, and lodgepole pine. Douglas-fir beetles would have had periodic influence on these Douglas-fir forests, particularly after a triggering event such as blowdown or fire, with effects ranging from small to large, depending upon stand conditions at the time.

Western Montana has experienced a Douglas-fir beetle outbreak over the last 10 years, although it has declined since 2006. In 2003, the Lolo and Bitterroot National Forests experienced sharp increases after large fires in 2000 (FHP 2004). Douglas-fir beetles have been very active within five miles of the fire since 1998. They have affected an overall area of about 4300 acres. The highest population level was in 2005 with over 1500 acres affected (Exhibit Pb-7, Gibson 2005, USDA 2006a). Douglas-fir beetles and associated agents (mainly root disease and drought) have killed small patches of mature and older Douglas-fir stands throughout the analysis area, most are less than five acres. Most of the activity has been on the drier south and west aspects on the east side of the fire area (Exhibits Pb-7 and 20). Within the fire area, Douglas-fir beetles killed only about 30 trees in 2007, before the fires began (Exhibit Pb-7).

Douglas-Fir beetle Hazard Rating for Habitat Conditions in and around the Project Area

After the fire, stand hazard for Douglas-fir beetle was determined for the forest acres within the fire and within five miles of the fire perimeters. Information used included field surveys (pre and post-fire), photo interpretation, and satellite imagery (R1VMP).

Criteria for the rating include stand density and the size, age, and proportion of Douglas-fir in the stand (Weatherby and Thier 1993; Negron, et al. 1999; Steele, et al. 1996; Randall and Tensmeyer 1999). This rating was integrated with fire severity and its effects on Douglas-fir trees within the stand. Douglas-fir trees severely affected by the fire, but perhaps not directly killed (i.e. scorched crowns, charred boles, charred root crowns, or large surface roots) were considered more vulnerable to beetle attack and mortality than they were before the fire (Jenkins 1990; Hood and Bentz 2007; Hood, et al. 2007). Stands were rated a lower hazard where average tree size was smaller, where Douglas-fir was a more minor stand component, and/or where fire severity was particularly high, damaging the cambium layers of the tree. Maps and tables displaying the beetle hazard analysis and potential for population buildup are in Exhibits Pb-5, Pb-6, and Pb-7.

As explained in the spruce beetle section, hazard ratings identify stands with conditions that would support a population of beetles, and the level of beetle-caused mortality that may be expected. Refer to Exhibit Pb-2 for a discussion of the hazard rating process.

Current Douglas-Fir Bark Beetle Conditions within the Fire Perimeter

About 14,000 acres, or 55 percent of the fire area, was identified as susceptible to Douglas-fir bark beetle. These stands are scattered throughout the fire and are more concentrated at low elevations and on south-facing slopes. Almost one-half of the susceptible stands were rated moderate or higher (Exhibit Pb-2). Table 3-20 displays the estimated acres within the fire area that are susceptible to Douglas-fir beetle (Exhibit Pb-3, Pb-5).

Table 3-20. Estimated Acres and Douglas-Fir Beetle hazard Rating for Stands within the Flathead National Forest Portion of the Brush Creek Fire.

Douglas-fir Beetle Hazard Rating	Acres	Percent of Total Acres
Very High	2,998	12
High	584	2
Medium	3,049	12
Low	89	<1
Very Low	7,230	29
Extremely Low (None)	(11,387)	(45)
Total Susceptible	13,950	100

Current Douglas-Fir Bark Beetle Habitat Conditions outside the Fire Perimeter

Although nearly 68,000 acres are susceptible to Douglas-fir beetle, about half of the stands rated as “very low” to “low” hazard. This is due to either a low proportion of larger Douglas-fir or a low number of trees overall within these stands. Most of these stands are mixed species, where Douglas-fir comprises a relatively small proportion of the total overstory stocking. In other low hazard stands, Douglas-fir may be a dominant species, but the stand is relatively young and not yet at the size and age that makes it highly susceptible to Douglas-fir beetle. However, even these stands may experience beetle mortality during an epidemic.

About 29,000 acres within the five-mile zone are considered “moderate” to “very high” hazard for Douglas-fir beetle. In these stands, larger diameter, older Douglas-fir comprise a large portion of the stand stocking, providing beetles with abundant breeding habitat. Table 3-21 displays the acres susceptible to Douglas-fir beetle within five miles and outside the fire area (Exhibits Pb-3 and Pb-5).

Table 3-21. Estimated Acres and Douglas-Fir Beetle Hazard Rating for Stands on all Ownerships within Five Miles and Outside of the Flathead National Forest Portion of the Brush Creek Fire.

Douglas-fir Beetle Hazard Rating	Acres	Percent of Total Acres
Very high	5,200	4
High	22,683	15
Moderate	1,351	1
Low	8,125	6
Very low	30,416	21
Extremely Low (or None)	62,828	42
Unknown level – No data	16,637	11
Total Susceptible (Very Low-Very High)	**67,775**	**100**
TOTAL	**147,240 acres**	

National Forest System Lands

The Flathead National Forest administers 83,500 acres within five miles of the fire. As described above and in the *Vegetation* section, several forest types that include Douglas-fir occur throughout the National Forest. Over 49,000 acres (60 percent) of these national forest lands have Douglas-fir trees that are susceptible to bark beetle, based on the hazard rating process. Approximately 3000 acres (70 percent) of the 4300 acres of old growth habitat outside the fire area are rated high or moderate hazard for Douglas-fir beetle and would be at risk if a population outbreak develops in the fire area.

The Kootenai National Forest administers about 20,600 acres within five miles of the Sheppard Creek Project area including 3600 acres that burned in the Brush Creek fire. About 8000 acres have Douglas-fir trees that are susceptible to bark beetles. As stated above under the discussion of spruce beetle, the Brush Creek Fire Environmental Assessment (EA) (USDA 2008a) concluded that even if the Kootenai National Forest does not salvage any burned trees, “there is little food available in adjacent areas” for bark beetles.

Private Forest Lands

As stated under the section on spruce beetle, the 42,700 acres of private lands in the five-mile zone outside the fire area are mostly Plum Creek timber company lands that have sapling and small trees and private lands in the Star Meadow and Good Creek areas. About one-half of the small private lands are meadow, cleared forest/pasture, and residential areas. There are no large areas of Douglas-fir dominated forest, although small stands of susceptible trees exist adjacent to Star Meadow and Evers Creek, especially on south and west facing slopes. These susceptible stands on small private lands are estimated to cover less than 1500 acres. Large Douglas-fir that are present in these stands would be vulnerable to beetle-caused mortality if an epidemic occurs because of beetle infestation in the Brush Creek Fire.

State Forest Lands

State Forest lands within five miles of the Brush Creek Fire are at low elevations in and near Star Meadow and along Evers Creek. These 870 acres have a mix of stand conditions and Douglas-fir beetle hazards. About 203 acres have some level of Douglas-fir beetle hazard in mixed species stands with scattered Douglas-fir or stands dominated by Douglas-fir.

Environmental Consequences

Bark beetle activity in forest stands, and its resulting consequences, is a normal and natural part of the ecosystem that has been occurring for thousands of years. Beetle outbreaks after disturbance events, such as fire, are not a certainty, but they are not unprecedented (USDA 2000). As described under "Affected Environment," there may be situations where the consequences of beetle activity conflicts with management objectives for a variety of resources, potentially affecting wildlife habitat, old forest, riparian and stream stability, timber productivity, private property, or other values. The purpose of this section of Chapter 3 is to disclose the possible effects from a beetle outbreak on these resource values.

Scoping for this project identified an issue related to bark beetles. Alternative D was designed to address the possibility of a bark beetle outbreak, especially spruce beetle (refer to Chapter 2). The following quantitative Effects Indicators were used to focus the beetle analysis and disclose relevant environmental effects (numeric predictions are best used as a relative comparison of potential hazards and effects between alternatives):

- Salvage treatments in areas susceptible to spruce beetle (acres).
- Salvage treatments in areas susceptible to Douglas-fir beetle (acres).

Outbreak Characteristics and Analysis Assumptions

To assess outbreak effects it is helpful to review past and ongoing epidemics (Furniss, et al. 1979; Amman and Ryan 1991; Gibson, et al. 1999; Dymerski 2001; USDA 2005a). When we refer to an acre being infested with bark beetles, it does not necessarily mean every tree has been attacked and killed by beetles. Trees killed per acre can vary widely. During a spruce beetle outbreak in 1995 through 1997 in the Little Wolf fire area, surveys showed from one to twenty infested trees per acre (Gibson, et al. 1999). Douglas-fir beetle outbreaks in Region 1 averaged about 1.5 trees per acre killed in 2001. However, field data collected in the early 2000s show that up to 50 trees per acre killed in heavily infested stands is not uncommon (Exhibit Pb-15). One northern Idaho Douglas-fir beetle-infested stand had 90 of 152 trees killed in one year in the early 1970s (Furniss, et al. 1979). Data collected in 2001 on the areas affected by the 2000 fires on the Bitterroot National Forest show new Douglas-fir beetle attacks averaged 23 trees per acre for 12 plot areas, but one was as high as 46 trees per acre

(Exhibit Pb-15). These examples illustrate the extent that extreme levels of bark beetle populations may affect stands.

The typical pattern of infestation and mortality, especially with Douglas-fir beetles, begins with beetles attacking small groups of trees scattered across a stand. Emerging adult beetles then spread to neighboring susceptible trees, and these relatively small pockets of infestation grow year by year, depending upon individual stand conditions and other factors, such as favorable weather. Beetle populations and associated tree mortality can grow exponentially, and these infestation "cells" can eventually join, creating larger areas of infestation.

Based on many years of observation and data collection, we can anticipate that in a "typical" Douglas-fir or spruce beetle outbreak, 60 to 80 percent of the trees over 14 to16 inches DBH could die before the outbreak naturally subsides in two to six years (Exhibit Pb-15). In an epidemic, one could also reasonably assume a 3:1 annual increase in area infested by bark beetles. For example, if Douglas-fir beetles infest the 3000 acres in the fire area rated "Very High" in the first year, there could be as much as 9000 acres infested in the second year. Under very high population levels, beetles may attack and kill many trees that would normally not be susceptible, such as younger or smaller trees.

Monitoring in the summers of 2008 and 2009 is planned to provide site-specific information on location and extent of spruce and Douglas-fir bark beetle infestations. If outbreak levels are detected or predicted, a management plan may be implemented that could include some or all of the following actions:

1. Use of "trap trees" in selected locations,
2. Use of the anti-attractant pheromone MCH to protect high-value areas of live Douglas-fir, and
3. Use of pheromone-baited beetle funnel traps to trap out small populations of spruce or Douglas-fir beetles.

Without salvage, these methods may or may not be effective or efficient, depending upon the extent and pattern of beetle infestation. These treatments are not proposed or analyzed in this project and could be implemented regardless of the salvage proposed in any alternative.

Direct and Indirect Effects

<u>Alternative A- No Action</u>

No additional fire-affected trees would be salvaged under this alternative. Ongoing roadside hazard tree removal, salvage of fire-affected trees in the Gregg-Plume timber sale, and possible use of beetle traps and dispersing pheromones might influence beetle populations.

Effects of Spruce Beetle Activity

If spruce beetles are present within about five miles of the fire area, it is reasonable to expect spruce beetles would attack trees on up to 5000 acres (30 percent) of susceptible stands within the project area in the spring and summer of 2008. These are spruce stands where a low, moderate, or high severity ground-fire occurred, damaging and killing the spruce by girdling them at the root collar, but leaving their crowns and large portions of their bole undamaged. This is ideal spruce beetle habitat. In addition, many of the spruce have blown down, improving habitat conditions for beetles even more. Additional trees that survived the fire in unburned and low severity fire areas would be attacked in 2009.

The beetles would complete their two-year life cycle in these trees, with a new generation of adults emerging in the spring and summers of 2010 and 2011. There would be very few live spruce left within the fire area for these adults to infest because few actually survived the fire. The adult beetles would instead spread outside the fire area in search of breeding habitat.

Effects of Douglas-fir Beetle Activity

Using the information described in the Outbreak Characteristics section above, and observations that confirm Douglas-fir beetles have been active in the fire area since 1998, beetles could potentially infest Douglas-fir trees on up to 7000 acres (50 percent of the susceptible stands) within the project area in the spring and summer of 2008. These are mostly in stands where high severity fire damaged or killed the Douglas-fir by girdling them at the root collar and, in some cases, scorching the crown, but leaving large portions of their bole undamaged. The beetles would complete their one-year life cycle within these trees. Adults emerging in the spring of 2009 could feasibly infest trees on up to all 14,000 susceptible acres. Most of these acres would "overlap" with those infested in the previous year, with emerging beetles attacking live trees that are scattered throughout the fire area. In succeeding years, assuming favorable beetle conditions, up to 30,000 acres could possibly become infested. Again, many of these acres would be the same as those in previous years. However, most would be outside, and within a few miles of the fire boundary. Not all trees on these acres would be attacked and killed, with anywhere from two to dozens of trees infested per acre.

Live overstory Douglas-fir trees exist across an estimated 3800 acres of the fire area, where the fire burned at lower severities. Loss of high numbers of these Douglas-fir trees that survived the fire would reduce the future forest structural diversity of this area, possibly affect future old forest and wildlife habitat values, and decrease potential seed sources for tree regeneration. Remaining thermal cover within the fire area would be reduced with mortality of the live Douglas-fir. The trees that die would contribute to the large diameter snag component, which though important and valuable for wildlife habitat and forest structure, already exists in relative abundance across this landscape compared to live overstory trees.

Effects Common to all Action Alternatives

All action alternatives propose to treat some of the stands susceptible to both Douglas-fir and spruce bark beetle within the analysis area. They vary in area proposed for salvage harvest that could influence beetle populations. Assuming that beetle attacks would be concentrated in the higher hazard stands as expected, the effectiveness of treatments can be measured by the proportion of susceptible areas harvested, season of harvest, and proximity to other high or moderate hazard areas that would not be harvested.

Acres Susceptible to Spruce Beetle Infestation with No Proposed Treatments

A total of about 8700 acres (about 60 percent of the total susceptible) within the fire area that rated as susceptible to spruce beetles would go untreated under all action alternatives. These stands are scattered through the fire area and were not identified as high priority for salvage because they are either mostly alive, have low volume, difficult access, or less susceptible spruce than indicated by the rating process. Some are in old growth and late seral stands that survived the fire or have a high proportion of trees that survived. Some are past seed tree or shelterwood harvest with spruce leave trees or regeneration that is large enough to support beetles. Many had high crown vegetation fire severity and have few, if any, susceptible trees left; but were identified as medium hazard because of other stand characteristics. If spruce beetles are attracted to the fire area, they are likely to infest some of these areas, possibly up to 4000 acres. The density of susceptible trees is relatively low in most of these stands. However, they could produce or sustain beetle populations, especially with the amount of blowdown and trees felled for hazard reduction during the fire. Beetles are expected to begin infesting these trees in 2008 and 2009 and could contribute to the potential beetle population in the project area. In addition, some of these stands are near the edge of the fire area and could contribute to beetles spreading into riparian and late seral stands outside the fire, especially in the upper Good Creek drainages.

Acres Susceptible to Douglas-Fir Beetle Infestation with No Proposed Treatments

Areas susceptible to Douglas-fir bark beetle infestation that are not proposed for salvage total an estimated 8000 to 10000 acres (58 to 70 percent of the total acres susceptible) scattered throughout the fire area. They were not identified as high priority for salvage because they are either mostly alive, have low volume, or difficult access. Some are within riparian, old growth, and late seral stands that have a high proportion of trees that survived. Some are past seed tree or shelterwood harvest with Douglas-fir leave trees. Many rated “very low” for Douglas-fir beetle hazard because they had high crown fire severity, small trees, or few Douglas-fir trees. Although very low hazard, these stands do have some susceptible Douglas-fir. Beetles are likely to infest some or all of these acres in 2008 and would therefore contribute to the potential beetle population in the project area. However, the density of susceptible trees is relatively low in most of these stands. With the proposed salvage of nearby trees, they are not likely to produce or sustain high beetle populations, except in small areas.

Timing of Salvage Treatments

Under all action alternatives, timing of treatments is important in minimizing the effects of bark beetles. The most effective method to reduce beetle populations in fire areas is to salvage beetle-infested trees before the adults emerge (Exhibit Pb-20). Spruce beetles remain within the same tree for the duration of their two-year life cycle. In all action alternatives, it should be possible to complete proposed salvage in the acres infested with spruce beetle within two years (by spring of 2010). However, it is unlikely all the salvage would be completed before the fall of 2010. This would allow beetles to spread if they have survived in the burned trees.

Douglas-fir beetles infesting trees the first year after the fire (2008) will emerge as adults starting in the spring of 2009. Many of the units with Douglas-fir beetle infestations would not be harvested by the spring of 2009 meaning adult beetles emerging that spring could spread to live trees both within and outside the fire area.

Field surveys in 2007 found evidence of recent and older Douglas-fir beetle activity in many of the stands with Douglas-fir trees throughout the fire area. The population levels are not known because the surveys were not focused on bark beetles and it was too soon after the fire for beetles to have infested the burned trees (Exhibits P-17, P-18, Pb-20, and Pb-21). More detailed surveys in the summer of 2008 would provide site-specific information on location and extent of spruce and Douglas-fir beetle infestations to determine if and where outbreak levels are developing. If outbreak levels are detected or predicted, treatment may be prioritized to salvage the units with highest hazard or levels of infestation first.

Acres Susceptible to Spruce Beetle Infestation with Proposed Salvage Treatments

If an outbreak occurs, up to 80 percent of susceptible spruce could be killed over two to four years (Exhibit Pb-20). Not all the susceptible, larger diameter trees on any one site would be infested. Considering the high number of susceptible trees across the spruce stands within the fire area, this equates to about 10 to 20 spruce trees per acre in high and moderate hazard stands that could be attacked by beetles in 2008 and 2009. Table 3-22 displays the acres with trees that are susceptible to spruce beetle where proposed harvest would reduce or eliminate the potential for a population build-up.

Table 3-22. Acres Susceptible to Spruce Beetle Proposed for Treatment with Salvage Harvest.

	Total Acres to be Treated	Susceptible Acres Treated	% of Treated Acres That Are Susceptible	% of Total Susceptible Acres*
Alt. B	6346	4890	77	33
Alt. C	3902	2830	73	19
Alt. D	7465	5885	79	40

*14,600 total susceptible acres in fire

All of the susceptible spruce stands are within the suitable timber base, or management areas, where salvage could be used as a tool for beetle management. Most of the proposed salvage is in areas with high crown burn severity where the cambium is either already charred, or would likely dry out before beetles can successfully develop. Therefore, except with Alternative D, most of the beetle activity is expected outside of stands proposed for salvage.

All actions alternatives require winter logging in areas that have potential for either soil damage or weed spread. Winter logging in spruce stands would only partially reduce the potential for spruce beetle populations to build in those stands. As discussed earlier, the most desirable habitat for beetles is recently downed trees. It is likely that if spruce beetles move into the fire area in 2008, spruce blowdown would be infested first. Logging in deep snow would preclude removing these downed trees. The trees under the snow, in winter-logged units, along with those outside of harvest units, would contain developing beetles that could emerge and infest nearby live trees in 2010. Riparian areas and old growth stands are areas most at risk should this occur. However, any susceptible and infested trees that are removed would reduce the numbers of beetles that can emerge and contribute to an outbreak.

Acres Susceptible to Douglas-Fir Beetle Infestation with Proposed Salvage Treatments

The effectiveness of the salvage action alternatives on influencing Douglas-fir beetle populations is proportional to the amount of infested trees removed from the site. Removing one infested tree removes enough beetles to theoretically save five or more live trees from attack and mortality. Generally, the number of infested trees removed can be estimated by comparing beetle-susceptible acres treated by alternative as displayed in Table 3-23.

Table 3-23. Acres within the Fire Susceptible to Douglas-Fir Beetle* and Acres Proposed for Treatment with Salvage Harvest.

	Total Acres to be Treated	Susceptible Acres Treated	% of Treated Acres That Are Susceptible	% of Total Susceptible Acres
Alt. B	6346	5065	80	36
Alt. C	3902	3060	78	22
Alt. D	7465	5860	79	42

*14,000 total susceptible acres in fire

All of the susceptible Douglas-fir stands are within the suitable timber base or management areas where salvage could be used as a tool for beetle management. The action alternatives salvage 30 to 34 percent of these acres or 22 to 42 percent of all susceptible acres. Most of the proposed salvage is in areas with high and moderate burn severity where the cambium is currently ideal for attracting beetles, but may dry out in the severely burned trees before they can successful develop.

Treatments within many units would not remove all susceptible or invested Douglas-fir. Some trees would be retained in order to leave individual and patches of snags/live trees across the area for forest structural diversity, large snag and downed wood habitat, and address soil and water concerns. The numbers, sizes, and species of trees retained vary by the pre-fire stand type. In most units, Douglas-firs greater than 25 inches DBH would be left. In predominantly larch stands, no Douglas-fir would be left. In stands dominated by spruce, subalpine fir, or lodgepole pine, all larch and Douglas-fir would be left. These retention guidelines would result in one to four Douglas-fir trees per acre averaged across all the units. See the *Snag and Downed Wood Management Proposals* sections the alternative descriptions in Chapter 2. Based on large trees per acre left, their distribution across the units, and the susceptible acres salvaged, Alternative D removes the most and Alternative C removes the fewest Douglas-fir.

Winter logging in Douglas-fir stands would decrease the potential for a Douglas-fir population buildup. Unlike spruce, Douglas-fir are relatively windfirm and will remain standing for at least a year or two, allowing harvest in deep snow. Harvesting Douglas-fir trees in winter would remove many overwintering beetles before they emerge in the spring.

Logging operations within beetle-infested stands would not be completed before the spring of 2009, when the beetles would emerge, even with some required winter logging. Flexibility in location of salvage, selection of leave trees, and the opportunity for winter logging in 2008/2009 would provide the greatest possible effectiveness to manage beetle populations.

Many dying trees are expected to remain susceptible through 2009. All susceptible and infested trees that are removed would reduce the numbers of beetles that can emerge and contribute to an outbreak. The salvage activity in any of the actions alternatives would reduce the potential for Douglas-fir beetle population buildup within the fire areas and the subsequent contribution to a renewed beetle outbreak outside the fire area.

<u>Alternative B</u>

Spruce Beetle

Alternative B would substantially reduce the potential for spruce beetle populations to buildup in the fire area and spread outside the fire area. It would treat 33 percent of all acres rated as susceptible. However, this alternative would avoid Riparian Habitat Conservation Areas (RHCA), which is where most of the highest hazard stands occur. RHCAs are productive sites often dominated by large spruce. The stands with high hazard for spruce beetle had fire severities that created ideal habitat. Winter logging is required on 563 acres that have high potential for spruce bark beetles.

Douglas-fir Beetle

Alternative B would also substantially reduce the potential for Douglas-fir beetle populations to build in the fire area and spread outside the fire area. It would treat 36 percent of all acres rated as susceptible. It treats the majority of the high and moderate stands, except for a few in RHCAs, and in some areas with poor access and low volume.

<u>Alternative C</u>

Spruce Beetle

Alternative C would treat less than 20 percent of all acres rated as susceptible to spruce beetle. It is the least likely of the three action alternatives to reduce the potential for spruce beetle populations to buildup in the fire area and spread outside the fire area. Like Alternative B, this alternative would avoid RHCAs, which is where most of the highest hazard stands occur. RHCAs are productive sites often dominated by large spruce. In addition, salvage would not occur in stands needing access by helicopter or temporary roads that have soil or water concerns. Some high hazard stands on north-facing slopes would be left as well as many throughout the fire with medium hazard. The stands with high hazard for spruce beetle that would be left had fire severities that created ideal habitat for spruce beetles. Stands with moderate hazard ratings had a mix of fire severities. Most of these stands have spruce that would attract beetles; some of the trees would maintain enough moist cambium to support a brood and contribute to a population buildup. Winter logging is required on 396 acres that have high potential for spruce bark beetles.

Douglas-Fir Beetle

Alternative C would treat only 22 percent of all acres rated as susceptible to Douglas-fir beetle. It is the least likely of the three action alternatives to reduce the potential for beetle populations to buildup in the fire area and spread outside the fire area. Like Alternative B, this alternative would avoid RHCAs where some high hazard stands occur. In addition, salvage would not occur in stands needing access by helicopter or temporary roads that have soil or water concerns, or in some areas retained for natural ecological processes and wildlife habitat. Several high hazard stands in the Hand Creek, Dunsire Creek, Griffin Creek, and some unnamed drainages would be left as well as many throughout the fire with medium hazard. The stands with high and moderate hazard for Douglas-fir beetle that would be left had fire severities that created ideal habitat for bark beetles. Stands with lower hazard ratings generally had high crown fire severities.

<u>Alternative D</u>

Spruce Beetle

Alternative D has the highest probability of minimizing a potential spruce beetle population buildup in the fire area and maintaining the currently low beetle population levels outside the fire area. It would treat 40 percent of all acres rated as susceptible. In addition to the units in Alternative B, Alternative D would remove spruce from RHCAs where most of the highest hazard stands occur and additional upland stands with high and moderate hazard for bark beetles. The stands with high hazard for spruce beetle had burn severities that created ideal habitat. Spruce trees would only be harvested from these additional stands if surveys in 2008 and/or 2009 show that beetle populations are increasing toward epidemic levels. Some mortality of live spruce outside but near the fire area may still occur. Winter logging is required on 576 acres that have high potential for spruce bark beetles.

Douglas-Fir Beetle

Alternative D also has the highest probability of minimizing a potential Douglas-fir beetle population buildup in the fire area and maintaining the currently low beetle population levels outside the fire area. It would treat 42 percent of all acres rated as susceptible. In addition to the units in Alternative B, Alternative D would remove Douglas-fir from some stands in RHCAs and additional upland stands with high and moderate hazard for Douglas-fir beetles. Douglas-fir trees would only be harvested from these additional stands if surveys in 2008 and/or 2009 show that beetle populations are increasing toward epidemic levels. Some mortality of live Douglas-fir outside but near the fire area may still occur.

Cumulative Effects

The following section discusses past, ongoing, or foreseeable actions that, in combination with the proposed Sheppard Creek Post-Fire Project alternatives, may have a cumulative impact on bark beetle activities within and around the fire areas and on potential for outbreak conditions to develop.

Potential Beetle Activity in Future Years and to Forested Stands Several Miles from the Project Area

As described in earlier sections, it appears conditions are present at this time that make both spruce and Douglas-fir bark beetle outbreak development within the analysis area possible, though not certain. To evaluate the cumulative effects of a "worst-case scenario," the area within five miles from the fire boundaries was evaluated for potential effects resulting from prolonged epidemic levels of beetle activity. It is difficult to predict beetle population growth and spread into the future (four-plus years) because of unpredictable and uncontrollable factors (local climatic conditions being a major factor). If large beetle populations do develop in the fire area, and conditions continue to be favorable for beetle survival over the next several years, breeding sites in and near the fires would become increasingly scarce and areas farther outside the fire area could become increasingly vulnerable to attacking beetles. It is likely to be several years before areas further from the fire experience any mortality from an outbreak initiated within the fires.

For spruce beetle, the probability of widespread epidemic conditions that originate from the fires is believed to be low to moderate. Susceptible stands are fragmented although widespread, the duration of and pattern noted in recent past epidemics has been short and localized, and spruce beetle populations in surrounding areas currently appear to be low. However, highly favorable beetle breeding conditions will probably continue for several years outside the fire.

The probability of Douglas-fir beetle developing widespread epidemic conditions from the fire alone is moderate and much more likely than with spruce beetle. Although fragmented, there are many stands vulnerable to Douglas-fir beetles in this area, the duration of and pattern of the current declining epidemic was long and widespread, and Douglas-fir beetle populations are already high near the fire area.

Past Harvesting on National Forest System Lands

Past harvesting activity is described under the general vegetation section of this chapter. Harvesting in the 1970s and 1980s occurred in response to a large mountain pine beetle epidemic in lodgepole pine. As a result of high mortality in those stands and widespread harvest activity, many acres were converted to young, early seral seedling and sapling forests. Spruce and Douglas-fir were often harvested along with the lodgepole pine and the sapling stands now create a diversity of structure and species. As a result, the amount, quality, and distribution of potential spruce and Douglas-fir beetle host material has been reduced somewhat from pre-1970 conditions in the local area, and the overall vulnerability of the landscape to spruce beetle is lower. The Brush Creek Fire burned over many of these past harvest areas, and if harvesting had not been conducted, there could potentially be far more stands at high hazard of bark beetle infestation than currently exists.

Road-side and trail-side hazard trees were removed from approximately 320 acres during and after the fire. Most of the trees were subalpine fir, spruce, and lodgepole pine; some were Douglas-fir, larch and other species. The trees were felled during the fires and many are not expected to be removed until the summer of 2008. It is likely the spruce and Douglas-fir that are removed after the spring 2008 beetle flight season will serve as trap trees and contribute to reducing the available adults in 2009 and 2010.

Past Wildfires and Fire Suppression Activities on National Forest System Lands

Past wildfire activity and suppression efforts in the project area and surrounding lands is described under the *Fire and Fuels* section of this chapter. Past wildfires influenced the conditions and pattern of forests in the fire areas and surrounding lands, introducing diversity in forest age, size classes, and species composition. This in turn has an influence on the potential activity of bark beetles, which require certain habitat and host conditions. Wildfire suppression activities can alter this natural disturbance pattern within an area, thus also influencing forest patterns and conditions, and the actions of associated pathogens.

The majority of the Flathead National Forest portion of the Brush Creek Fire had not experienced a large-scale or stand-replacing fire for over 200 years. The long fire interval and resulting extensive area of mature forest type created a landscape of relatively high vulnerability to effects from disturbances such as fire or bark beetles. The large mountain pine beetle epidemic in the Sheppard and Griffin Creek areas in the early 1980s, the subsequent blowdown of beetle-killed lodgepole pine, then the high severity fire in 2007, illustrate this process. These were natural events considering the fire regimes within the area, the long fire-free interval, and the forest conditions across the landscape. Because of the size, maturity, density, and species composition of these forests before the Brush Creek Fire, we now are experiencing post-fire conditions in this area favorable to both spruce and Douglas-fir bark beetles.

Proposed Reforestation Activities within the Fire Area

Depending upon the alternative, about 2800 to 5000 acres are proposed for planting following salvage activities. An additional 1000 to 1900 acres of burned regeneration is scheduled for planting. Species planted would include western larch, Douglas-fir, western white pine, ponderosa pine, and possibly spruce and lodgepole pine. The rest of the fire area, both in and out of proposed salvage units, is expected to regenerate naturally. The combination of planting and natural regeneration would help maintain the diversity of species within the future forest, which increases the resilience of these areas to the potential future effects of insect, disease, or fire events (refer to analysis under the *Vegetation* section earlier in this chapter).

Potential Treatments, such as Pheromone Treatments and use of Trap Trees

Pheromones and funnel traps may be used in 2008 and 2009. These treatments, in addition to the proposed salvage, would help protect the few late seral stands that survived the fire, especially those near the edge of the fire area. However, it is difficult to predict at this time if and where beetle treatments farther into the future may occur (i.e. five or more years from now) and how effective they would be. Monitoring beetle populations and brood survival within the fire areas and in surrounding forests, over the next few years, would provide information needed to ascertain whether additional actions to manage beetle populations are needed. If so, the appropriate analysis and assessment of effects would occur before implementation.

REGULATORY FRAMEWORK AND CONSISTENCY

Flathead National Forest Plan direction specifies that landscapes should be managed to reduce the risk of undesirable fire, insect, and pathogen disturbances, and to apply an understanding of natural disturbance regimes, landscape patterns, and dynamics to management of the forest (page II-5-9). Forest Plan standards for insect and disease (page II-65) specify that integrated pest management strategies should be considered in project analysis design and that "project silvicultural prescriptions would emphasize treatments that reduce losses due to insects and/or disease." In accordance with this direction, the area has been analyzed and it has been determined that all action alternatives are within the standards of, and consistent with, the Forest Plan.

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INVASIVE PLANT SPECIES: NOXIOUS WEEDS

Introduction

Invasive, non-native plants species can inhabit and negatively alter native plant communities. A number of invasive species are recognized as noxious, meaning laws have been developed to restrict their spread and effect on the environment. Dry vegetation types and areas affected by road development, grazing, logging, fire, or other disturbances are most susceptible to weed invasion. Typically, invasive species have the ability to spread rapidly and reproduce in high numbers which enables them to effectively crowd out native plant populations. Some can pose serious threats to the composition, structure, and function of native plant communities. Field observations, road surveys, and weed treatment records indicate that the presence and extent of invasive plant populations is established and has a high potential to spread within the Sheppard Creek Post-Fire Project area.

Information Sources

The Montana State noxious weed list was consulted and invasive species of concern were identified. In addition, a recent weed risk assessment (WRA) project in the Forest Service's Northern Region (USDA Forest Service 2003) identified additional species that pose a threat to native vegetation. Noxious weed surveys and treatments were conducted along major road corridors and within the project area as part of the tansy ragwort treatments in the Little Wolf Fire area.

Weed inventories are documented in a Forest Service national weeds database, NRIS TERRA Invasive Plants Database (Natural Resource Inventory System). Population of this database began in 2005.

This assessment of non-native and noxious weeds incorporates by reference the Flathead National Forest's Noxious and Invasive Weed Control (NIWC) Decision Notice and Environmental Assessment of March 2001. The objective of the Forest-wide project is to implement an adaptive, integrated pest management strategy to control and reduce the presence of noxious and invasive weeds on NFS lands.

Analysis Area

The spatial bounds of the Sheppard Creek Project noxious weeds analysis area is based on the area of the project's influence/impacts on the potential introduction and spread of noxious weeds within the project area. Because ground disturbance increases the potential for weed establishment and spread, the analysis area includes all treatment units and road systems with activity related to this proposed project.

The temporal bounds are up to 50 years after the 2007 Brush Creek Fire. Following the fire, vegetation conditions would take approximately 10 to 50 years to return to a closed overstory and understory tree and shrub canopy cover. These conditions would shade out and compete with shade-intolerant noxious weeds established after the fire and activities proposed in this document. During this recovery time, opening of the canopy from the existing conditions resulting from the Brush Creek Fire and increased soil disturbance from salvage activities would increase the potential for weed establishment. Regenerated stands consisting of primarily lodgepole pine would create a closed tree canopy approximately ten years following the fire to cover shade-intolerant weeds and allow for native plants to more successfully compete. All other conifer stands may take up to 50 years for understory tree and shrub cover to establish conditions unfavorable for shade-intolerant weed persistence within the stands. Shade-tolerant weeds, such as hawkweed, may persist indefinitely even after the canopy closes. It is expected that after a 50-year period the rate of new infestations due to the disturbance would be at a minimum.

Affected Environment

Historic Condition

In the late 1800s, exotic plant species rapidly became established in North America due to the introduction of species for agricultural and experimental purposes. This introduction rate dropped in the mid-1900s because of the depression, wars, and decreased travel abroad. A dramatic increase in global travel and trade introduced many more species, and their distribution is rapidly expanding. Some of these species are spreading at an exponential rate. Locally, establishment and rate of spread may have been influenced by timber harvest, road building, and to some degree grazing; all vectors for the spread of weeds. Most of these activities began in the 1960s on the Flathead National Forest. Some unroaded areas remain relatively weed free because of healthy, undisturbed native plant communities where few vectors exist for the spread of weeds.

The Flathead National Forest has been less affected than many other public lands because most invaders are best adapted to grasslands, shrub lands, and warmer/drier forest types than exist here. Regardless, exotic invaders adapted to our climate have substantially altered native species composition locally.

Pre-Burned Conditions

There is a concern in the project area that invasive plants may spread into treatment areas and undisturbed native habitats, especially where susceptible conditions exist. Weed invasion and expansion has been observed in areas of past timber management projects. Noxious weeds may alter organic matter distribution and nutrient flux. For example, spotted knapweed has greater ability to uptake phosphorus over some native species in grasslands (Thorpe, et al. 2006). In addition, noxious weeds may influence species richness and displacement of resident species by reducing native seedling establishment (Yurkonis, et al. 2005).

Invasive species considered for this analysis are those listed as noxious by the State of Montana, as well as other exotic species determined to be highly invasive. They are displayed below in Table 3-24. Of the 1062 vascular plant species known on the Flathead National Forest, about 110 are classified as exotic. Of these, over 42 species are classified as invasive. Within the project and adjacent areas, ten noxious weed species and four undesirable weed species of concern have been observed as shown in Table 3-24.

Table 3-24. Noxious Weed Species of Concern within the Sheppard Creek Project Area.

Scientific Name[a]	Common Name	Known from the Project Area	Potential invader to the Project Area
Category 1 – Widespread established[b]			
Acroptilon repens (*C. repens*)	Russian knapweed		X
Cardaria draba	hoary cress		X
Centaurea biebersteinii (C. maculosa)	spotted knapweed	**X**	
Centaurea diffusa	diffuse knapweed		X
Cirsium arvense	Canadian thistle	**X**	
Convolvulus arvensis	field bindweed		X
Cynoglossum officinale	hound's-tongue	**X**	
Euphorbia esula	leafy spurge		X
Hypericum perforatum	St. John's-wort	**X**	
Leucanthemum vulgare	ox-eye daisy	**X**	
Linaria dalmatica	Dalmatian toadflax		X
Linaria vulgaris	yellow toadflax		X
Potentilla recta	sulfur cinquefoil	**X**	
Tanacetum vulgare	common tansy	**X**	
Category 2 – Recently established, rapidly spreading[b]			
Hieracium aurantiacum	orange hawkweed	**X**	
Hieracium caespitosum, H. floribundum, H. piloselloides, H. pretense	yellow hawkweed complex	**X**	X
Lepidium latifolium	perennial pepperweed		X
Lythrum salicaria	purple loosestrife		X
Lythrum virgatum	wandlike loosestrife		X
Ranunculus acris	tall buttercup		X
Senecio jacobaea	tansy ragwort	**X**	
Tamarix spp.	salt cedar or tamarisk		X
Category 3 – Not yet detected or small occurrence[b]			
Centaurea solstitialis	yellow starthistle		X
Chondrilla juncea	rush skeletonweed		X
Crupina vulgaris	common crupina		X
Iris pseudacorus	yellowflag iris		X
Isatis tinctoria	dyer's woad		X
Myriophyllum spicatum	Eurasian water milfoil		X
Additional Invasives of Concern for the Flathead National Forest			
Achillea nobilis	noble yarrow	**X**	
Artemisia absinthium	absinthium	**X**	
Bromus tectorum	cheatgrass		X
Campanula rapunculoides (undesirable)	creeping bellflower		X
Carduus nutans	musk thistle		X
Chorispora tenella	purple mustard		X
Cirsium vulgare	bull thistle	**X**	
Elymus repens	quackgrass		X
Euphorbia species (cautionary)	spurge (all)		X

Scientific Name[a]	Common Name	Known from the Project Area	Potential invader to the Project Area
Phalaris arundinacea	reed canarygrass		X
Potentilla argentea	silvery cinquefoil		X
Sonchus spp.	perennial sowthistle		X
Tragopogon dubius	goat's bear/salsify	**X**	
Tripleurospermum perforata (Matricaria inodora, M. perforata) (undesirable)	scentless chamomile		X
Veronica officinalis	common speedwell		X

[a] Nomenclature follows the USDA Plants Database: USDA, NRCS 1999. The PLANTS database (http://plants.usda.gov/plants). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
[b] Montana Department of Agriculture Noxious weed categories.
Category 1 is defined as noxious weeds that are currently established in the State and generally widespread in many counties of the state. Management criteria include awareness and education, containment and suppression of existing infestations, and prevention of new infestations. These weeds are capable of rapid spread and render land unfit or greatly limit beneficial uses.
Category 2 is defined as noxious weeds that have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds are capable of rapid spread and invasion of lands, rendering lands unfit for beneficial uses. Management criteria include awareness and education, monitoring and containment of known infestations and eradication where possible.
Category 3 is defined as noxious weeds that have not been detected in the state or may be found only in small, scattered, localized infestations. Management criteria include awareness and education, early detection, and immediate action to eradicate infestations. These weeds are known pests in nearby states and are capable of rapid spread and render land unfit for beneficial uses.

Inventories for various projects (e.g., timber stand exams, sensitive plant surveys, and post-fire Burned Area Emergency Response assessments) within the project area have occurred through the years. In addition, approximately 95 miles of road (240 acres) have been surveyed for noxious weeds (2004 and 2006) within the project area and vicinity. Table 3-25 summarizes results from those surveys.

Approximately 175 acres (70 miles) were surveyed for invasive plants. Twelve invasive species were mapped during 2004 and 2006 surveys. The most abundant and widely-distributed noxious weed species in the project area are spotted knapweed (*Centaurea biebersteinii*), Canadian thistle (*Cirsium arvense*), orange hawkweed (*Hieracium* aurantiacum), oxeye daisy (*Leucanthemum vulgare*), sulfur cinquefoil (*Potentilla recta*), and tansy ragwort (*Senecio jacobaea*).

Spotted knapweed, sulfur cinquefoil, common tansy, and oxeye daisy are roadside species and generally have not invaded into understory forested habitats. These species do, however, have potential for expansion into open canopies and natural occurring forest openings such as grasslands, open rock outcrops, and other open areas created by fire. Canadian thistle is a generalist and can invade in almost any habitat from dry to wet disturbed areas with canopy openings.

Table 3-25. Acres Infested of Weed Species of Concern Along 95 Miles of Major Roads within the Sheppard Creek Project Area.

State Category	Species	Common Name	Acres Occupied within Surveyed Areas*
State Noxious Weed Species			
1	*Centaurea biebersteinii*	spotted knapweed	82
1	*Cirsium arvense*	Canadian thistle	81
1	*Tanacetum vulgare*	common tansy	56
1	*Leucanthemum vulgare*	oxeye daisy	31
2	*Senecio jacobaea*	tansy ragwort	30**
1	*Potentilla recta*	sulfur cinquefoil	25
2	*Hieracium aurantiacum*	orange hawkweed	10
1	*Hypericum perforatum*	common St. John' s wort	7
2	*Hieracium sp.*	yellow hawkweed	4
1	*Cynoglossum officinale*	hounds tongue	6' x 6' spot
Other Exotic Species of Concern			
NA	*Cirsium vulgare*	bull thistle	26
NA	*Tragopogon dubius*	yellow salsify	2

* From 2004 and 2006 surveys.
** Does not include point data of tansy ragwort.

Two state-listed Category 2 noxious weeds species, orange hawkweed and tansy ragwort (*Senecio jacobaea*), are of greatest concern in the area. These species are recently established (within the last five to ten years) and are rapidly expanding in established areas. Tansy ragwort spread rapidly following the Little Wolf Fire of 1994. Chemical and biological treatments in the last ten years have reduced the total acres of this species in the Little Wolf Fire area; however, isolated populations still occur there. In addition, this weed has spread along roads and open areas to the north of the Little Wolf Fire area into the proposed Sheppard Creek Project area. In 2006, tansy ragwort was documented on almost every system road within the project area, with the highest concentrations on roads 113 (Brush Pass), 538B (Sylvia Lake), 2973 (S. Fork Sheppard Ck), 2885 (Sheppard Ck.), 538 (Griffin Ck.), and 2908 (Dunsire Ck.).

The amount and distribution of the above invasive plants is highly variable within the project area, ranging from scattered isolated individuals to small dense groups. These species occur along portions of many of the roads, gravel pits, and other disturbed sites. Invader weed species tend to be shade-intolerant, with the exception of orange and yellow hawkweed (personal observation). Invasive plants establish in disturbed areas where other plants are slow to establish and recover. These areas are mostly associated with road right-of-ways, landing sites for timber harvesting, gravel pits, mechanically piled slash burn piles, skid roads, mechanical site preparation treatment on well drained or shallow soils, power line corridors, and mines. Most of the area outside of these more heavily disturbed sites has experienced limited invasive plant establishment.

Post-Burn Conditions

As a disturbance process, fire has the potential to greatly exacerbate infestations of certain noxious weed species, depending on burn severity and habitat type (Fire Effects Information

System 2004). Soil disturbance such as that resulting from high and moderate burn severities from a wildfire and fire suppression related disturbances (dozer lines, fire camps, drop spots, etc.) provide optimum conditions for noxious weed invasion. Dry site vegetation types and road corridors are also extremely vulnerable, especially where recent ground disturbance has occurred, because many of our noxious weed species have evolved in dry Mediterranean climates and are highly competitive under these similar site conditions (USDA Forest Service 2003). Approximately 79 miles of roads were modified during suppression activities with several of these roads containing known occurrences of orange and yellow hawkweed and other noxious weeds species.

Non-native invasive plants have a high potential to establish and spread into the burned areas within the project area, especially where optimum conditions exist as described above. Inventories of historic fires on the FNF (e.g. Moose 2001, Little Wolf 1994) indicate that fire and related suppression efforts may favor weed invasions and population expansion. Weed invasion and expansion has also been observed in areas of past timber management projects. In addition, unburned areas within the Brush Creek Fire, harboring weed populations, would act as sources for weed spread into the burned fire areas.

Vegetation recovery of the burned areas is largely dependant on the degree of soil burn severity from the fire. In areas of moderate to high soil burn severity, plant root mortality is higher, potentially decreasing the recovery rate of both native and non-native plant species. Non-native plants typically have a higher potential for expansion into severely disturbed areas than natives; therefore these high burn severities are at greater risk to invasion. Severely burned sites can have altered soil structure and reduced organic matter content, creating a favorable germination substrate for weed seeds. Conversely, in areas where soil burn severity is low, root mortality would be lower with greater potential for native and non-native plants to re-establish following the fire. Low burn severity areas have a higher potential for natives to out-compete non-natives than higher burn severities. Nearly 13 percent of the soils in the analysis area were subjected to burn at this low severity level (Table 3-26).

Table 3-26. Soil Burn Severity Acres for the Brush Creek Fire. [a]

Soil Burn Severity	Acres	Percent of Burned Area
High	5629	12
Moderate	29937	62
Low	6227	13
Unburned	6570	13

[a] See Exhibit U-4 for BEAR documentation.

Plant response to fire depends on many factors. Each species must be assessed individually due to the great degree of variation in life history, morphology, phenology, ecology, and reproductive biology. The following are summarized notes on response to fire for the key species (widespread invaders) in the burned area taken from the USDA Forest Service's Fire Effects Information Database (2004) and from The Nature Conservancy's Stewardship abstracts database. Some site-specific information about these weeds are also presented.

Spotted Knapweed

Dense stands of knapweed often have little surrounding vegetation, possibly because they release chemicals that inhibit the growth of competing plants. Litter from the previous year's stems often decays or scatters during the current season, but it may accumulate in very dense stands and create more favorable burning conditions. Spotted knapweed probably resists low-severity fire because of its stout taproot. It also most likely colonizes after fire from seeds buried in soil or from off-site sources. Within the project area, knapweed often grows in highly disturbed areas of bare soil and low fuel loading, most often on roadsides. As a result, many plants were not killed by the fire.

Canada Thistle

Response to fire varies from positive to negative, depending on season of burn, soil moisture, and location. Dormant season burning stimulates growth of native herbaceous species that compete with Canada thistle. Fire during the growing season damages native species as well as Canada thistle. After top-kill, plants resume growth from buds located on the roots. Canada thistle grows in moist areas. Those areas that did not burn intensely in the analysis area can expect vigorous resprouting of thistle in known infestations.

Orange and Yellow Hawkweed

Exotic hawkweeds (*Hieracium spp.*) are creeping perennial herbs with shallow fibrous roots. Exotic hawkweeds can rapidly colonize and dominate a site because they possess a wide range of highly successful reproductive strategies including seeds, rhizomes, stolons, and adventitious buds. Most new infestations are established from seed, while expansion of established populations is primarily through vegetative spread. Once established, hawkweeds quickly develop into a solid mat of rosettes that expand until they dominate the site.

Within the analysis area, hawkweeds had already set seed prior to the Brush Creek Fire. Seeds that were not burned or sterilized from the fire would establish in moist, well-drained, acidic, coarse-textured soils that are low in organic materials. They are usually found in small, isolated pockets with the highest densities found in disturbed areas. Hawkweeds can grow in open areas, but may also tolerate heavy shade. Hawkweed has been observed in the understory of dense shrubs, especially in moist swales. Rapid colonization after fire was observed in the Little Wolf Fire (1994) to the south of the Brush Creek Fire where orange hawkweed is currently one of the most dominant plants in this landscape.

St. John's Wort

This species can survive prolonged drought and fire. Plants reproduce from numerous seeds and are rhizomatous, often re-sprouting from root crowns. Population explosions are common after fires due to the release of dormant seeds in soil or reduced competition in the burned areas. St. John's wort would rapidly recover from root crown sprouting following a spring burn and are able to out-compete other natives that may not germinate until fall. In fall burns, natives are able to germinate quickly and with establishment can compete with St. John's wort. The majority of St. John's wort within the analysis area had most likely set seed before the burns occurred. In addition, root crowns are expected to survive the fires.

Tansy Ragwort

Tansy ragwort is a biennial or occasionally a short-lived perennial. Plants can produce up to 150,000 seeds per plant that are locally distributed by wind or over longer distances by animals. Seeds can remain viable in the soil from 4 to 16 years depending on what depth they are buried. This species can also establish by vegetative buds. Although it has been more troublesome in the Pacific Northwest, it is becoming an increasing problem in Montana. Disturbances to native plant communities such as logging, road construction, and overgrazing provide potential habitat for this species. Open areas created by the fire and south facing slopes are most vulnerable to invasion by tansy ragwort.

The majority of the tansy ragwort plants within the fire area had set seed prior to the Brush Creek Fire. However, many of the unburned areas of the fire were along the sides of roads where there are known occurrences of tansy. Unburned seeds and plants roots in existing populations of the fire are expected to germinate and persist. These populations would act as seeds sources and are expected to spread into burned areas and into other disturbance corridors such as dozer lines in 2008 (first year following the fire). Germination and rosette development into new areas is expected for 2009 with bolting for flower/seed heads occurring in 2010 (George Markin, Rocky Mountain Research Station, personal communication).

Rush Skeleton Weed

Although rush skeleton weed (*Chondrilla juncea)* is not known to occur within the proposed project area or on the Flathead National Forest; there is a high risk for this species to establish in the project area. This is a perennial herbaceous plant which spreads by creeping rootstock and seed. Plants can produce up to 15,000 seeds annually. The burned areas within the proposed project area are highly susceptible to rush skeleton weed establishment by seed from known infestations on the adjacent lands of the Kootenai National Forest.

Weed Management

A Forest-Wide Weed Management Plan is currently under development to outline methodology in prioritizing treatment and inventory and monitoring protocols. In addition, this plan would outline a methodology for minimizing the establishment and spread of invaders in all projects and Special Use Permits, such as grazing allotments and timber management areas. Currently, treatment and inventory is prioritized at quarterly meetings of the Flathead National Forest Weed Advisory Group. Factors for prioritization include:

- **Weed invasive category** as outlined in the Flathead National Forest Noxious and Invasive Weed Control Environmental Assessment and Decision Notice (2001) (Exhibit T-1) and shown in Table 3-27 below.
- **Level of invasive risk** to a potential vegetation group.
    - The Western Montana Planning Zone Weed Risk Assessment is used as a tool to ascertain the level of invasiveness for weed species within potential vegetation groups (Exhibit T-2).
- **Special areas** that are threatened by weed invasion.

  - Particular areas of greater conservation concern need additional protection from weed invasion. Examples would be designated wilderness, sensitive plant habitat, and pristine native plant communities.
- **Potential for increased off-site movement** of weeds that could increase the spread to new areas.
  - Weed infestations that are located along roads, at trailheads, in grazing allotments, or at high use recreation sites are higher priority for treatment because of the increased vectors of spread in these areas.

Table 3-27. Weed Treatment Prioritization on the Flathead National Forest.

Forest Priority	State Category	Objectives	Prioritization Factors
1	3 (Potential Invaders)	Currently absent on FNF; goal is prevention, then eradication, if possible	• detection • available funds
2	2 (New Invaders)	Localized containment and strong emphasis on overall population reduction	• available funds • relative invasive nature of the species and its potential to displace native vegetation • potential for off-site movement of seeds • relative ecological importance of rarity of the site that could be damaged by the presence of the invader species
3	1 (Widespread Invaders)	Containment and localized reduction of populations	• available funds • relative invasive nature of the species and its potential to displace native vegetation • potential for off-site movement of seeds • relative ecological importance of rarity of the site that could be damaged by the presence of the invader

Efforts to control the spread of noxious weeds include prevention, containment, and eradication methods. Eradication is generally limited to localized areas and Category 2 and 3 species. Methods used for eradication include hand pulling and herbicide applications.

Containment methods are used to prevent weeds from spreading into new areas and reducing the coverage, if possible, in existing infestations. Containment methods include closing infested areas to travel, washing vehicles and equipment upon entering or leaving an infested area, using weed-free seed and straw mulch for re-vegetation, hand pulling, and herbicide application around the perimeter of the infestation. Prevention uses similar techniques as containment, with the objective of preventing a new weed infestation rather than limiting spread of an existing one.

Since 1997, noxious weed treatments in the proposed Sheppard Creek Project area have concentrated on the control and containment of tansy ragwort. Aerial spraying for control of tansy in the Little Wolf Fire area occurred in 1997 and 1999. In addition, chemical and biological treatments have continued annually in this area. These controls have demonstrated a decline in total acres of tansy on this area, as indicated by reduced yearly acres treated (estimated 1093 acres treated in 1997 to 1.5 acres in 2005). A Forest closure order of the

Little Wolf Fire area also assisted in the containment of this species. This closure order was in effect for 11 years and was lifted in 2007.

During the Brush Creek Fire, control and containment strategies were also applied during suppression efforts to reduce the potential spread and introduction of tansy ragwort and other noxious species into the fire area. Weed washing equipment was staged at the Brush Creek Fire camp and also at a spike camp on the Kootenai National Forest. All vehicles and equipment were washed to remove mud and seeds before entering into the fire area and upon demobilization from the fire.

Environmental Consequences

Direct and Indirect Effects

Alternative A - (No Action)

Alternative A provides the least opportunity for creating weed habitat due primarily to no new areas of ground disturbance. However, invasive species currently in and near the project area would have potential for expansion into the burned areas. In addition, new invaders may also establish in the burned areas as a result of vehicle and human presence, potentially depositing new invasive species from other regions.

Effects Common to All Action Alternatives

Salvage harvest and temporary road construction are proposed for this project. General effects on the risk to weed establishment and spread are discussed below by activity. Areas with more acres of ground disturbance or open roads are expected to have greater vulnerability to weed colonization and spread.

Timber Harvest and Other Vegetation Treatments

The effects of logging are variable depending on the amount of ground disturbed during the activity; the more bare soil exposed, the more germination substrate is available for colonizing weed seeds. Ground-based systems (tractor and tractor/swing) with wheeled machinery usually disturb more ground than skyline and cable systems. Skyline usually has less ground disturbance than cable systems, which may use a combination of tractor and cable systems. Helicopter extraction of logs is even less disturbing to the ground within the actual units; however, areas used for landings can be impacted. Areas used for landings with any logging system can also be highly impacted.

Alternative D proposes the greatest number of harvest acres. The acres of the harvest systems with most ground disturbance are greatest for Alternative D, although acreage of tractor, tractor/swing, skyline, and cable is very similar to Alternative B. Alternative D would have more risk to native communities in the project area from weed establishment and spread than Alternatives B and C due to the greatest acreage of ground disturbance. Alternative C has the least number of harvest acres and the least acreage of the most impactive harvest systems.

Alternative C would pose the least risk of noxious weed spread. The differences in these logging systems and prescriptions by alternative are displayed in Table 2-10.

Vegetation habitat type can influence susceptibility to weed invasion. Riparian areas are often more susceptible to infestations from weeds adapted to mesic habitats than upland forest. In Alternative D, 510 acres of salvage harvest (portions in "B" units) are proposed in Riparian Habitat Conservation Areas (RHCA) where monitoring detects bark beetle activity. The RHCA includes riparian areas with buffers of wet soils and associated vegetation. Ground disturbance in the moist soils of the RHCA could increase the potential of noxious weed establishment in riparian corridors, especially for weeds such as Canada thistle and oxeye daisy that thrive in moist environments. Soil and banks in riparian areas often have frequent natural disturbance, which can exacerbate the spread of weeds once colonized. Alternative B and Alternative C do not propose ground disturbance in RHCA, and therefore have the least risk of weed spread in riparian corridors.

Another consideration is time of year timber salvage would occur. Winter logging may reduce the potential of weed spread. Although winter logging does not eliminate all soil impacts, this logging method would reduce the total equipment contact with soil substrates when compared to non-winter operations. Substrate that is protected by a layer of snow during harvest and skidding would have fewer disturbances to the native plant community and soil. Less disturbed native plant communities are more resistant to weed invasions than disturbed communities (Dukes 2002). Additionally, the potential of bringing in weed seeds to the units is reduced in the winter, as most weed seed would be under snow. Alternative B and Alternative D both propose similar amounts of winter logging, at 41 percent and 42 percent respectively. Alternative C proposes the greatest acres of required winter logging (53 percent). Units that have had past harvest and burned with low to moderate severity may have unburned weed infestations. Winter logging of these units would reduce soil disturbance and opportunity for weed establishment and dispersal (see Chapter 2 - Features Common to All Alternatives and Alternative Summary and Description).

The amount of ground disturbance from skidding may also affect the potential of noxious weed spread. Slash mats can provide protection of the soil substrate and minimize the spread of weeds. Alternative B, C, and D would require similar percentage of slash mat use for summer harvest, at 14 percent, 8 percent and 10 percent respectively.

Machinery can also spread weed seeds if not washed prior to use; therefore, design criteria include cleaning all off-road equipment prior to entering the area. Use of dedicated skid trails would also minimize spread across units. Other criteria designed to minimize soil impacts would also aid in reducing noxious weed spread.

Tree planting occurring throughout the salvage area may also contribute to weed expansion. Vehicles and personnel may act as vectors for weed spread. However, planting activities would be of short duration with minimal impact to the soil. In addition, planting conifers would assist in regeneration of natural vegetation and reduce the potential for exotic weed establishment into the burned areas when conifers establish a canopy cover.

Temporary Road Construction and Haul Routes

Portions of the existing road network would be used to implement this project. Use of existing roads facilitates weed establishment because motorized vehicles, non-motorized vehicles, and horses are among the main vectors of weed spread.

All alternatives propose similar miles of roads for hauling, with Alternative C having the least amount of miles (Table 2-10). Road maintenance to implement best management practices (BMPs) on haul routes may occur for all action alternatives. This activity may create new ground disturbance for potential new weed establishment.

Temporary road construction to access some units is also proposed for all action alternatives. Alternative B proposes 26.9 miles of temporary roads and would pose the highest risk of altering native plant communities with the greatest potential for weed expansion and dispersal. Alternatives D and C propose less than half of the temporary roads proposed in Alternative B. Alternative D proposes construction of 11.7 miles of temporary road, and Alternative C proposes 9.5 miles of temporary road. Alternative C would provide fewer miles of exposed bare soil and reduce the risk of invasive weed establishment. Temporary road construction activities would expose bare soil and parent material, creating suitable substrates for weed germination. In addition, use of these temporary roads may also contribute to the dispersal and spread of weed seeds. Historic template roads may have current weed infestations, whereas new roads would be constructed in areas with more native vegetation. Weed seeds on historic road templates may be carried into harvest units for units proposed for non-winter logging operations. Proposed weed control actions, revegetation, and closing these roads to vehicular use would lessen the establishment and spread of weeds.

Seeding and planting of forbs and shrubs would create competition with non-native invaders on the newly disturbed soils of the temporary roads. This may be effective short-term mitigation for weeds. However, over the long-term, temporary roads would remain on the landscape as these roads are not completely obliterated. Over the long-term, the temporary roads would most likely have a mix of the planted revegetation species, new colonizers from the surrounding vegetation, and potentially some weed species.

It is unknown how long the effects of the temporary road construction would persist on the landscape to act as corridors for weed establishment and invasion. Observations of old forest roads on the Flathead National Forest from over 50 years ago indicate that some roads may recover, with the surrounding forest vegetation inhabiting the old road template. Weed prevention measures were most likely not implemented during these older harvest operations. However, conditions during those times are unlike current existing conditions which now have adjacent weed populations near proposed units.

The seeding of temporary roads as a conservation measure to reduce future weed invasion has been occurring on the Flathead National Forest for the past 30 to 40 years, using primarily non-native mixes of grasses and forbs. Native grasses and forbs have only been applied on this forest for the last couple of years. Observations of some of the temporary roads constructed in the past indicate some success with prevention of weed invasion on these roads. Shade intolerant weed species, such as knapweed, are not as abundant as the native and non-native grass and forb seed mixes. However, shade tolerant species such as hawkweed (and sometimes Canada thistle and oxeye daisy) are often abundant. There is no information on the circumstances of how these roads were built or rehabilitated to make inferences on how or why the weeds established in these old road beds. Therefore, there is potential over the long-term for temporary road templates that are reclaimed after use to increase the susceptibility of weed invasion into areas accessed by these temporary roads.

In presently unroaded areas where weed infestations are currently absent, more aggressive planting of native shrubs and forbs would encourage and accelerate the return of the native plant community to decrease the potential for new weed infestations into these weed free areas. Proposed temporary road construction in currently weed free areas (large areas previously unroaded) includes roads GS, YY, XX, and Z. When these roads are proposed for use in Alternative B, C, and D, shrub and forb plantings would reduce the risk of weed spread into these weed free areas.

Cumulative Effects

<u>Alternative A - (No Action) Cumulative Effects</u>

Past ground disturbing activities such as timber harvest, road construction, trail construction, road maintenance, and fire suppression activities (e.g., fireline, dozer line, safety zone construction) have contributed to the establishment and spread of noxious and invasive plants in the area. Recreational and economic land uses (hunting, hiking, fishing, logging, mushroom harvesting, firewood gathering, etc.) have also promoted the spread of weed seeds because users and their vehicles become vectors for weed seed spread. Wildlife have likely contributed to weed spread in the past by transporting weed seeds across the landscape. All these activities are likely to continue into the future to some degree.

The Brush Creek Fire itself has had a great impact on the susceptibility of the area to weed invasion for a few select species (i.e., orange hawkweed, meadow hawkweed, and tansy ragwort). There is increased susceptibility in the burned areas for new invader colonization for many species with aerially dispersed seeds found in the area. Ongoing activities that may contribute to weed spread for the Brush Creek Fire area are road maintenance work as part of the post-fire restoration work (BAER) and personal and commercial mushroom harvesting in the burned area.

Noxious weed treatments have occurred on the Tally Lake Ranger District. If surveys detect new and growing infestations as a result of the fire, appropriate weeds treatments will likely be prioritized for this area. Planned revegetation efforts in areas affected by fire suppression activities and a few other areas seriously affected by the fire would help to reduce opportunities for weed spread, as planted and seeded native and non-invasive exotic species are established and compete with weeds. Both survey and treatment would occur during the 2008 season as part of post-fire restoration work.

The No Action Alternative would create the least amount of new ground disturbed areas for potential new weed establishment and spread. The total existing condition of infested weed acres is expected to continue to increase with existing uses and conditions in the No Action Alternative.

Effects Common to all Action Alternatives

In addition to the cumulative effects described for Alternative A, the action alternatives would also contribute to cumulative effects to the degree described above for each proposed activity. Past, present, and reasonably foreseeable actions within the Sheppard Creek Post-Fire Project area (federal, state, and private) that may have affected or may affect noxious weeds include timber harvesting, road construction, maintenance, and reclamation, recreation and forest product gathering, noxious weed control, mushroom harvesting, wildland fire and fire suppression, cattle grazing, and Burned Area Emergency Response. These actions may have historically affected noxious weed populations and may continue to have effects.

People, vehicles, domestic animals, wildlife, and wind are all vectors contributing to the transport of weeds within the project area. Once seeds are dispersed to a new site, habitat type and disturbance patterns influence the establishment potential of invasive plant species. Past, present, and future activities with the greatest amount of ground disturbance accompanied by a vector source of noxious weed seeds have the greatest potential for noxious weed establishment and spread.

Timber Harvesting and Prescribed Fire

Timber harvesting opens up the canopy and creates new substrate from ground disturbance for noxious weed colonization where propagules are present. Logging equipment may carry noxious weed seeds into the harvest area. Currently there are no data on the quantitative increase in weed infestations from past timber harvests in the Sheppard Creek Project area, although weed invasion and expansion has been observed in other areas of past timber management projects. Past, present and future timber harvests cumulatively contribute to increases in noxious weed distribution and populations.

Prescribed burning activities within the analysis area cumulatively contribute to increases to noxious weed distribution and populations. However, prescribed fire is generally of low to moderate intensity. Although there is potential for weed establishment, the potential for establishment and spread into the burned areas is low due to the low intensity burns. Low intensity burning, mimicking the natural fire, may invigorate native species germination as native plants are adapted to natural disturbance such as fire. Should weeds become established, potential for spread of weeds would be lower than that of the ground disturbance of timber harvest. The prescribed burns would have short-term low intensity disturbance that would promote understory native vegetation to compete with potentially establishing weeds.

Wildland Fire and Fire Suppression

Suppression activities associated with the Brush Creek fire have disturbed soils and created favorable areas for weed establishment, thus contributing to increasing weed distribution and populations. A small portion of the project area includes the 1994 Little Wolf Fire, which experienced a substantial increase in weed populations and consequently contributed to increased weed distribution and populations in the Brush Creek fire.

Burned Area Emergency Restoration

Burned Area Emergency Restoration (BAER) work has occurred and would continue to occur in 2008. Noxious weeds would be treated on 147 acres under this authority, mostly along the highest priority roads. These roads already have weeds present that may rapidly spread into adjacent burned or disturbed areas. Treatment would help limit the amount of weed spread into recently burned areas while natural recovery occurs and areas where proposed salvage harvest creates ground disturbance. Where the targeted BAER treatments overlap with Sheppard haul routes, the BAER weed treatment may serve as an additional decrease in the potential spread of noxious weeds associated with the Sheppard project. Monitoring 260 acres for weed establishment (includes roads, dozer lines, and safety zones) would also occur as part of the BAER efforts. This monitoring may help identify priority areas and areas of new infestations for treatment. BAER activities for noxious weed control may reduce the potential spread of noxious weeds.

Road Construction, Maintenance, Closure, and Reclamation

Road construction and maintenance creates ground disturbance which contributes to the potential spread of noxious weeds. Road closures limit use of road and amount of new weed propagules spread into the area. However, road closures may have also created conditions that prevented established weed populations from being treated by spraying weeds from a vehicle.

Reclamation of unneeded roads has both positive and negative effects on the propagation of noxious weeds. Reclaiming roads reduces human travel in a given area thus reducing the spread of new weed seed. Weed treatments just prior to reclamation activities can reduce the amount of weeds along road and adjacent areas. However, reclamation activities such as water bar construction and culvert removals create ground disturbance and favorable substrates for weed establishment. Overall, road reclamation may decrease amounts of weeds in the area accessed by the reclaimed road for shade intolerant species, but may increase weeds that are shade tolerant as they may persist and spread untreated into adjacent areas.

Stream Habitat Restoration

Culvert installation and replacement, placement of log structures, and equipment associated with stream habitat restoration activities may cause ground disturbance and increase the potential spread of weeds. However, the scope of these activities is small and would have minimal additional contributions to overall weed infestations.

Cattle Grazing

Cattle serve as vectors and may cause ground disturbance, thereby increasing the potential spread of noxious weeds. Grazing on the Swaney and Island Meadows/Lemonade Springs allotments contribute to the cumulative effects of noxious weed spread. Temporary suspension of grazing on the unburned portions of the Swaney allotment in the Sheppard Creek project area would prevent potential spread of noxious weeds due to cattle during the early post-fire conditions when new substrate is available for weed colonization.

Recreation and Forest Product Gathering

Hiking, horseback riding, camping, motorcycle and ATV riding, snowmobiling, boating, fishing, guiding/outfitting, driving, sightseeing, and forest product gathering are past, present, and foreseeable activities. People and associated activities can be vectors contributing to the transport of weeds within the project area. Trail and campground building and maintenance can create ground disturbance and increase the potential spread of weeds. Recreation has likely increased and would continue to increase noxious weeds in the project area, although the scope compared to large-scale disturbance is minimal and likely limited to established roads, trails, campgrounds, and a few dispersed locations.

Mushroom Harvesting

Commercial and personal use morel mushroom harvesting would occur during the 2008 spring/summer/fall seasons and beyond. Mushroom picking itself does have the potential to spread weeds, through extra vehicle and foot traffic serving as vectors. However, the scope of increased noxious weeds due to mushroom harvesting is small.

Mineral Extraction

Ground disturbance and vehicle traffic from quarrying for minerals may increase the potential spread of noxious weeds. Gravel and rock pits are disturbed areas which usually have high weed infestations. Treatments with chemical or biological agents may not always eradicate populations and therefore there is a risk of spread to new locations. However, the extent of mineral extraction that is occurring or projected to occur is small and the associated increase in noxious weeds is minimal compared to other large scale disturbances.

Noxious Weed Control

Since 1997, noxious weed treatments in the proposed Sheppard Creek Project area have emphasized the control and containment of tansy ragwort. Treatment of other noxious weed species in this area has not been a priority and has only been incidental during tansy ragwort target treatments. This treatment strategy has reduced the size of existing populations and the establishment of new populations of tansy ragwort, but other noxious weed populations have remained or increased in this area (e.g. hawkweed). In the near future, it is expected an overall increase in noxious weed acres in this area would result from the current treatment strategy due to: 1) the large current area of weed infestations in the project area, 2) the need for prioritizing treatments for this area with other sites across the forest, and 3) the limited funds for effectively treating all desired acres.

Future spraying of haul routes and other roads associated with the Brush Creek Fire may temporarily decrease noxious weed establishment and spread on a short-term basis. However, to maintain the gains accomplished by these treatments, more intensive long-term integrated management is needed. Ongoing and reasonably foreseeable noxious weed control within the project area would cumulatively contribute to maintaining or increasing total noxious weed distribution and populations due to the high levels of infestations and current priorities for treatments.

Summary of Direct, Indirect, and Cumulative Effects

Many past, present, and foreseeable actions have and would contribute to weed risk and spread in the project area. The Brush Creek Fire has created conditions ideal for weed spread, and the Sheppard Creek Post-Fire project may contribute to the potential spread of weeds by: 1) delaying the recovery of natural vegetation that could compete with weeds, 2) serving as a vector for new populations, and 3) by creating additional ground disturbance. This contribution to cumulative effects would be reduced, however, by design criteria (Chapter 2, Features Common to All Action Alternatives) that would lessen the impact of weed spread; specifically, aggressive weed treatments, winter logging, soil stabilization measures, revegetation of disturbed sites, and restoration of constructed temporary roads. The objectives of the weed treatments associated with Action Alternatives are to reduce the short-term potential for new establishment into the new disturbed areas created by this project, not to reduce the total infested acres of the project area.

Action Alternatives would increase the infested noxious weed acres from existing conditions, more so than the No Action Alternative, even with the lack of haul route weed treatments for No Action Alternative. With the No Action Alternative, most of the proposed haul routes would be treated for weeds through the post-fire restoration work (BAER). The ground disturbance proposed for all Action Alternatives would create new areas for potential new establishment of weeds with the increased presence of equipment and personnel acting as vectors for weed spread into new areas. Furthermore, Alternative D would have the greatest potential for weed establishment over Alternative B and C due to the greatest amount of potential ground disturbance. Alternative C has the least potential for weed establishment, due to least miles of temporary roads, least amount of disturbance acreage due to harvest, most acreage of required winter logging, and no management in RHCA.

REGULATORY FRAMEWORK AND CONSISTANCY

Management direction for noxious and invasive weed control on the Flathead National Forest is set at the national and forest levels. Forest Service policies were developed in response to Federal laws guiding implementation of noxious weed control actions. These policies are set forth in Amendment 2000-95-5 of the FSM, Chapter 2080, Noxious Weed Management, and have been incorporated into the Forest Plan. Treatment and monitoring of known weed populations in the project area would be implemented under the authority and guidance of the Flathead National Forest Noxious and Invasive Weed Control Decision Notice (May 2001) and Environmental Assessment (March 2001) (Exhibit T-1). These were designed to meet legal requirements and Forest Service policies for noxious weed control. The proposed project incorporates and is consistent with this Decision Notice and Environmental Assessment. Design criteria and management requirements for actions proposed under this project follow requirements documented in the FSM Amendment for Noxious Weed Management, Road, and Timber Management Projects.

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THREATENED, SENSITIVE, and RARE PLANTS

Introduction

The Endangered Species Act (ESA), as amended (16 U.S.C. 1536(c), 50 CFR 402), requires that the Forest Service conserve endangered and threatened species of plants as well as animals. In accordance with Section 7(c) of the Act, the USFWS has determined that the following threatened or endangered listed species may be present on the Flathead National Forest:

- Water howellia (*Howellia aquatilis*) and
- Spalding's catchfly (*Silene spaldingii*) (USDI Fish and Wildlife Service 2008).

A letter was received on December 4, 2001, from R. Mark Wilson, Field Supervisor, USFWS, identifying these threatened, endangered, and proposed species that may occur on the Flathead National Forest. The letter states that the range of Spalding's catchfly includes the upper Flathead River System and that areas below 5000 feet are considered within the range of water howellia.

In addition to plants protected under the ESA, the Forest Service identifies species for which population viability is a concern as "sensitive species" designated by the Regional Forester (FSM 2670.44). Currently, 52 plant species are designated as sensitive on the Flathead National Forest (Exhibit S-1). Forest Service policy requires that activities conducted on NFS lands be reviewed for possible impacts to threatened, endangered, or sensitive (TES) species (FSM 2670.32). The Forest Service has no jurisdiction to protect habitat of sensitive plant species on private lands.

Information Sources

Data sources used for this analysis include the Montana Natural Heritage Program's (MNHP) Element Occurrence Database; the Flathead National Forest's Threatened, Endangered, and Sensitive Species (TES) Survey Atlas; and the Flathead National Forest's TES Plant Location Database. These databases include data collected from field surveys conducted by the Forest Botanist, trained technicians, and other botanists contributing surveys and element occurrences to the MNHP. All other sources of information are cited in the text.

Analysis Area

The analysis area for the Sheppard Creek Project is based on the area of the project's influence/impacts on known occurrences or potential habitat for Federally threatened/endangered and Regional Forester's sensitive plants within the project area. The project area includes all treatment units and road systems with activities related to this proposed project.

The spatial bounds of the threatened and sensitive species analysis area are the extent of the Brush Creek fire where proposed salvage harvest would take place (see Figure 2-1).

The temporal bounds are up to 50 years after the 2007 Brush Creek Fire. Following the fire, vegetation conditions would take approximately 10 to 50 years to return to a closed overstory and understory tree and shrub canopy cover. These conditions would shade out and compete with shade-intolerant noxious weeds established after the fire and activities proposed in this document. During this recovery time, opening of the canopy from the existing conditions resulting from the Brush Creek Fire and increased soil disturbance from salvage activities would increase the potential for weed establishment. Regenerated stands consisting of primarily lodgepole pine would create a closed tree canopy approximately ten years following the fire to cover shade-intolerant weeds and allow for native plants to more successfully compete. All other conifer stands may take up to 50 years for understory tree and shrub cover to establish conditions unfavorable for shade-intolerant weed persistence within the stands. Shade-tolerant weeds, such as hawkweed, may persist indefinitely even after the canopy closes. It is expected that after a 50-year period the rate of new infestations due to the disturbance would be at a minimum.

Affected Environment

Occurrences of Threatened and Sensitive Plants

Water howellia

In Montana, water howellia is only known to occur in the Swan Valley, approximately 65 miles directly to the southeast of the project area. There are no known occurrences or potential habitat within the proposed treatment units of the Sheppard Creek Project area. Aerial photo interpretation did not locate ponds, old oxbows, and other wet areas of potential habitat. No occurrences are known to the project area. Water howellia is excluded from further discussion in this document due to the lack of occurrences and potential habitat within or near the project area.

Spalding’s catchfly

In 2000, aerial photos of the entire Flathead National Forest were reviewed by Maria Mantas (former Forest Botanist) to locate large expanses of grassland with potential habitat for Spalding’s catchfly. Grassland openings were delineated from aerial photos in areas along the North Fork of the Flathead River floodplain from the Canadian border to Polebridge and at Danaher, Horse Hill, and Bar Creek Meadows within the Bob Marshall Wilderness. Spalding’s catchfly was not located during focused surveys for this species in the above areas. These grassland habitats were determined to be unsuitable (too high in elevation) for Spalding’s catchfly.

Additional potential grassland areas were located on aerial photos within the Hog Heaven Range Allotment (Swan Island Unit of the Swan Lake Ranger District) and the south slopes near Ashley Lake (Tally Lake Ranger District). Surveys specifically targeting Spalding’s catchfly were conducted in 2006 within potential grassland areas in the Tally Lake Ranger District; no new occurrences or suitable habitats were located during these surveys.

There are no known occurrences of Spalding's catchfly within the proposed Sheppard Creek Project area boundaries or within the Flathead National Forest, based on MNHP database and Flathead National Forest sensitive plants database. Spalding's catchfly is excluded from further discussion in this document due to the lack of occurrences and potential habitat within or near the project area.

Regional Forester's Sensitive Plants

The entire project area will be evaluated for potential habitat for sensitive plants using aerial photos, knowledge of previous surveys conducted in the project vicinity, and project-specific surveys conducted in 2008. Portions of proposed salvage units, haul routes, landings, and other staging areas will be evaluated for potential habitat. Only areas with the highest potential for sensitive plants and areas with highest likelihood for invasive weed occurrences (i.e. roadsides) will be surveyed. A complete species list of plants encountered would be assembled for each area surveyed. All surveyors will be trained and tested in the identification and habitat associations of the Flathead National Forest sensitive plants.

Historical & Existing Condition

Vegetation and Landform

The Sheppard Creek Post-Fire Project is located east of Star Meadow in the Sheppard, Griffin, and upper Good Creek drainages of the Stillwater River. Topography consists of low, rolling hills varying from 4000 to 6000 feet in elevation. Glacier till and glacially scoured landtypes are common. Lacustrine soils in the basins are prone to erosion.

Subalpine fir/menziesii, beargrass, and twinflower habitat types, with some subalpine fir/queencup beadlily, represent the cool and cold moist conditions over most of the area. Minor amounts of warm/dry Douglas-fir habitat types occur on south-facing slopes and cold/dry subalpine fir/alder and grouse whortleberry types are at high elevations. More than 65 percent of the fire area had high vegetation burn severity resulting in over 85 percent tree and other vegetation mortality.

Sylvia Lake is in the southwest corner of the analysis area. Numerous small wetlands are scattered, mostly along the streams.

Regional Forester's Sensitive Plants

Little is known about the historical condition for threatened and sensitive plants on the Tally Lake Ranger District. Botanical surveys that may have detected sensitive plants were not initiated in the area until the onset of the Forest's Botany Program in 1991.

Based on the information sources and surveys listed above, there are no known sensitive plant species located within or near the project area. Several sensitive plants occur within a five-mile radius of the project boundary (Table 3-28).

Rare Plants

Rare plants are species currently being monitored due to potential interest or concern for historical or conservation reasons. Their status and occurrences are being monitored to assure viability is maintained so they do not become listed on the Regional Forester's sensitive plant list or the threatened and endangered list. Little is known about the historical condition for rare plants on the Tally Lake Ranger District. Botanical surveys that may have detected rare plants were not initiated in the area until the onset of the Forest's Botany Program in 1991. One rare plant, *Angelica dawsonii,* occurs within a five-mile radius of the project boundary (Table 3-28).

Table 3-28. Regional Forester's Sensitive Plants and Other Rare Plants within Five Miles of Project Boundaries.

		Habitat Guilds												
Species	**EO#**	**AV**	**F**	**W**	**R**	**MCT**	**MC**	**MMC**	**GO**	**MS**	**CRS**	**S**	**A**	**D**
Botrychium crenulatum	08, 09			X	X		X	X		X		X		
Angelica dawsonii	01				X			X						
Bidens beckii	01	X												
Carex chordorrhiza	02		X	X										
Cypripedium parviflorum	12		X	X	X			X						
Cypripedium passerinum	09		X	X	X			X						
Idahoa scapigera	01					X								
Lewisia pygmaea	01								X		X			
Meesia triquetra	03		X											
Petasites frigidus var. nivalis	01		X	X	X			X						
Scirpus cespitosus	07		X											
Scheuchzeria palustris	06		X	X										

EO# = Element Occurrence number in the Montana Natural Heritage Program database
AV=Aquatic and vernal pools; F=Fens and fen margins; W=Marshes, seeps, springs, and wet meadows; R=Riparian; MCT= Vernally moist cliffs or mossy talus; MC= Mid-elevation moist coniferous forests; MMC=Margins of moist coniferous forests; GO=Dry grasslands & openings in ponderosa pine and dry Douglas-fir forests; MS=Mid-montane/Subalpine grass/forb; CRS=Canyon walls, crevices, rock outcrops and slides S=Subalpine forests; A=Alpine; D= Disturbed areas

Potential Occurrences

Based on the information sources listed above, the project area potentially contains habitat types for sensitive plants associated with the entire 13 habitat guilds listed in Exhibit S-2. Habitat guilds are used to group sensitive plants into habitat areas where the species would likely be found. The majority of the project area is upland coniferous forest with small inclusions of these other habitat guilds.

Environmental Consequences

Direct and Indirect Effects

Alternative A – (No Action) for Sensitive Plant Species

There would be no ground disturbance associated with this activity, as no action is proposed for this alternative, therefore no direct effects to sensitive plants would result. The response of each of the sensitive plant species to management activity varies by species, and in some cases, is not fully known. Local native vegetation has evolved with and is adapted to the climate, soils, and natural processes such as forest succession, fire, insect and disease infestations, and windthrow. Any management or lack of management that causes these natural processes to be altered may have impacts on native vegetation, including sensitive plants. Indirect long-term effects would depend on natural disturbances.

Disturbance-associated sensitive plants such as Howell's gumweed (*Grindelia howellii*) and some moonworts (*Botrychium* spp.) occasionally establish along roadsides. These species can be opportunistic along artificially created roadside habitats. Alternative A would not create additional roadside habitat for this opportunistic establishment. Roadside occurrences are not considered representative of the natural disturbance habitats such as grasslands or rocky outcrops that these sensitive plants more commonly occupy. Preservation of these roadside sensitive plant occurrences are secondary to those occurring in natural habitats.

Effects Common to All Action Alternatives for Sensitive Plant Species

Potential Occurrences

Due to the late summer timing of the Brush Creek Fire, surveys for sensitive plants within the Sheppard Creek Project area have not been conducted and are planned for the summer of 2008. If sensitive plants are found during these surveys, they would be evaluated and protected as necessary. A contract clause would incorporate this into any timber sale contract specifying that the contract would be modified to protect these plants if located (see Chapter 2, Features Common to All Action Alternatives).

The Sheppard Creek Project area contains habitat types for sensitive plants associated with the following habitat groups (Exhibit S-2): aquatic and vernal pools; vernally moist cliffs or vernally moist talus slopes; alpine; margins of moist coniferous forest; marshes, seeps, springs and wet meadows; mid-montane/subalpine grass/forb; riparian associates; fens and fen margins; subalpine forests; canyon walls, crevices, rock outcrops and slides; disturbed areas; mid-elevation moist coniferous forests; dry grasslands and openings in ponderosa pine; and dry Douglas-fir forests.

For those potentially occurring sensitive plants listed in Exhibit S-2, the direct and indirect effects for undetected occurrences are unknown and can only be speculative due to lack of known locations. Undetected occurrences may experience mechanical compaction, noxious weed competition/displacement, roadside dusting, and hydrologic alteration.

Spread of noxious weeds has the greatest potential for indirect effects on potentially occurring sensitive plant populations within the project boundary. Equipment associated with this project would be washed prior to entry on the national forest to reduce the introduction of weeds into the disturbed area. In addition, other project design criteria to minimize spread of noxious weeds would mitigate this potential impact (see Chapter 2, Features Common to All Action Alternatives).

Undetected occurrences in units treated during periods without snow compaction may experience mechanical compaction, noxious weed competition/displacement, roadside dusting, and hydrologic alteration due to salvage activities. Undetected annual plants disturbed before seed set may experience decreased viability in subsequent years, due to a reduction of the seed bank. Perennial plants may experience ground disturbance to rootstocks (rhizomes, taproots, and bulbs), potentially inhibiting the plants ability to resprout from rootstock.

For each action alternative, varying acreage of proposed ground disturbing activities would be required to occur during winter months. Minimal direct effects are expected for those plants located in units proposed for winter treatments, as plants would be protected under compacted snow. Although winter logging does not eliminate all soil impacts, this logging method would reduce the total equipment contact with soil substrates and reduce soil and vegetation disturbance when compared to non-winter operations (Klock 1975).

Planting of trees, shrubs, and forbs, which would occur for noxious weed control, reforestation, and wildlife habitat improvement, is proposed for all action alternatives. There may be short term impacts from trampling and minimal compaction from foot traffic to potential occurrences. Over the long-term, planting would speed up the increase of canopy cover which will shade out the shade-intolerant weed species. The potential reduction in noxious weeds would benefit sensitive plants and their habitat.

For Alternatives B and C, potential occurrences of plants associated with aquatic and vernal pools; marshes, seeps, springs and wet meadows; riparian; and fens and fen margins habitats would be avoided with the use of Riparian Habitat Conservation Areas (RHCA) delineation buffers (see Hydrology and Fisheries sections). Alternative D proposes 510 acres of salvage harvest (portions in “B” units) in RHCAs.

Occurrences located during project implementation would be reported to the Forest Botanist and Project Operations Leader and appropriate mitigation measures would be applied to the location (see Chapter 2 Features Common to All Action Alternatives).

Cumulative Effects

Effects of the No Action Alternative

Alternative A would not increase the potential for establishment and spread of new noxious weed occurrences. Weed establishment and spread, facilitated by ground disturbance and vehicle traffic in and out of the project area, would not occur with Alternative A. In addition, the potential for weed invasion and competition for nutrients and light with sensitive plant populations and native vegetation would not occur.

Effects Common to all Action Alternatives

Because little is known about the condition of sensitive plants in the Tally Lake Ranger District before the initiation of the FNF Botany Program in 1991, cumulative effects from past activities are described in general and are speculative for potentially occurring plants within the project area. Therefore, the cumulative effects analysis below describes the potential impacts of past, present, and future activities for all potentially occurring sensitive plants, undetected in the past, present, and future.

Past activities such as road construction, timber extraction, dispersed recreation, and other development have occurred within the Sheppard Creek Project area boundary**.** Past, present, and foreseeable actions within the analysis area (federal and nonfederal) include timber harvesting, road construction and maintenance, recreation, noxious weed control, mushroom harvesting, and fire suppression. These actions may have historically affected sensitive plants and may continue to have effects. Please refer to Exhibit S-3 for the cumulative effects worksheet describing the relationship of sensitive plants to all past, present, and reasonably foreseeable activities in the project area.

Timber Harvesting, Fire Suppression, and Prescribed Fire

Timber harvesting and road construction may alter the hydrologic processes for sensitive plants of wetland-associated habitat groups (Exhibit S-2) including mid-elevation moist coniferous forests. Changes to the hydrologic processes at wetlands may result in both a decrease and increase of wetland water levels. Timber harvesting and road construction often decreases canopy cover and in consequence may decrease evapotranspiration rates. This may result in increased inundation of wetlands from runoff. In addition, increased canopy openings near wetlands may increase evaporation of the wetlands, effectively reducing water levels earlier in the growing season.

For non-wetland associated sensitive plants, timber harvesting often increases light level to the understory. This may be a beneficial effect for some rare or sensitive plants, but may have adverse effects for other rare plants requiring greater canopy cover (e.g. clustered lady's-slipper). In many cases, timber harvest creates stand changes not unlike that of naturally occurring fires; however, the pattern and distribution of forest size classes has drastically shifted from patterns that were created under natural disturbance regimes. Today, forest stands are far more fragmented in the landscape in reference to forest structure and size class. Fragmentation may limit recruitment of new populations into disturbed areas, and may alter patterns of seed dispersal, seed predation, germination rates, and survivorship of young plants (Jules 1998).

Timber harvest (excluding winter harvest) may affect non-wetland sensitive plants and habitat by creating unfavorable conditions for establishment and persistence, at least in the short term. Soil compaction may occur, which can alter current and future success of understory plants due to mortality, reduction in future recruitment, changes in soil moisture, and changes in mycorrhizal associations. Physical disturbance of the understory community may eliminate species from the stand that are disturbance intolerant, particularly plants which have shown little tolerance for logging disturbance. The temporal recovery of individual plants after disturbance is species-specific and may depend on factors of the disturbance and effects to the microsite, tolerance of the species to disturbance, and presence of regenerative methods of survival (i.e. rhizomes, taproots, bulbs, corymbs). Frequent and intense disturbance may favor ruderal species, and cause a decline of forest understory species that have low dispersal rates (Halpern and Spies 1995). Conversely, stands allowed to mature with no additional disturbance may favor recovery of all but the most disturbance intolerant species.

Timber harvesting opens up the canopy and creates new substrate for noxious weed colonization where propagules are present. Noxious weeds can have detrimental effects to the plant community altering its composition and function (Thorpe, et al. 2006; Yurkonis, et al. 2005). Weed invasion and expansion has been observed in areas of past timber management projects. These projects may have had effects on sensitive plant populations due to introduction of noxious weeds.

In addition, fire suppression has created a denser understory condition in many un-harvested stands where historically, low intensity understory fires occurred regularly. The fires that have been eliminated from the understory played a role in reducing fuels and encroaching vegetation (USDA Forest Service 1998). Fire suppression resulting in closed-canopy may have effects of reduced light levels to sensitive plants in the understory.

Prescribed fire and underburning may typically have short-term direct effects to potentially occurring sensitive plants from direct burn over. Undetected annual plants disturbed prior to seed set may experience decrease population viability in subsequent years, due to a reduction of the seed bank. Perennial plants may experience ground disturbance to rootstocks (rhizomes, taproots, and bulbs), potentially inhibiting the plants ability to re-sprout from rootstock.

Wildland fire, Fire Suppression, and Post-Fire Restoration

No known effects to sensitive plants resulted from suppression activities and post-fire restoration efforts due to the lack of known occurrences within the fire area. The fire created conditions favorable for noxious weed establishment (see Noxious Weed section in this chapter). In addition, suppression activities disturbed soils (dozer lines and other staging areas) and created additional areas for weed establishment. Areas within the fire perimeter would be actively monitored for invasive weeds and active management of weeds would occur in compliance with the Flathead National Forest Noxious Weed and Invasive Weed Control Decision Notice and Finding of No Significant Impact (USDA Forest Service 2001b). Aerially dropped fire retardant was also used in suppression efforts. Plants may experience short term effects of reduced vigor from direct contact to aerial applications. Whole plants and root death may also result. Retardant may increase weed invasion in the long-term due to phosphates released in the soil from retardants (Larsen, et al. 1999; Bell. et al. 2005).

Roads

Past, present, and future maintenance of the roads have both adverse and positive cumulative effects on documented and potentially occurring roadside sensitive plant populations. Disturbance of roadsides may benefit those sensitive species that have a competitive edge in disturbed environments and temporarily adversely affect these populations until new seedlings establish in the openings. Maintenance of roads may increase traffic along these roads and thus increase potential for disturbance of plant populations adjacent to roads. Road construction and maintenance may also affect wetland habitats. It is possible that past (and future) road construction may have affected ground water and sediment flow in some wetlands. Increased siltation may result in shifts in the wetland vegetation composition, supporting emergent vegetation in place of submergent vegetation types (USDI 1996). Timber harvesting and development may also contribute to these same effects to wetland plants.

Past and future closures and reclamations of roads would potentially have short term effects to known and potentially occurring sensitive plants growing near and on these roads. However, closure and reclamation of roads would reduce impacts overall.

Recreation

Trails and other areas frequented by recreationists may contribute to the cumulative effects to sensitive plants. Trail construction/maintenance near wetlands may affect sensitive wetland plants by increased siltation into wetlands or the dispersal of noxious weed seeds from human vectors. However, most recreationists are reluctant to tread in the mucky waters of wetlands. Non-wetland plants may experience cumulative effects of trampling, weed introduction, and collecting from dispersed recreation.

Mushroom Harvesting

Commercial and personal use morel mushroom harvesting has and would occur during the 2008 spring/summer/fall seasons and beyond. Post-fire mushroom harvesting is usually dispersed so that no substantial trampling occurs at one site. Minor amounts of trampling may occur at potential sensitive plant locations. These effects are expected to be localized, and of low to moderate intensity and, depending on the intensity, of short to moderate duration.

Chemical Control

Sensitive plants adjacent to areas of chemical weed control may be at risk of exposure to chemicals used in weed control. However, on the Flathead National Forest, sensitive plant surveys are conducted for each site (not previously treated) before any chemical control treatments, as required by the Flathead National Forest Noxious Weed and Invasive Weed Control Decision Notice and Finding of No Significant Impact (USDA Forest Service 2001b). With the exception of some sensitive plants that occur in “disturbed” environments rare plants do not persist with noxious weeds due to differing habitat requirements. Weed control on State and private lands may have adverse effects to plant viability for these plants that occupy disturbed habitats that may favor weed establishment.

Summary of Effects

None of the action alternatives is expected to have direct, indirect, or cumulative effects on any known occurrences of sensitive plants due to the lack of known occurrences. However, habitat for sensitive plants does occur within the project area. All ground-disturbing activities from the on-set of the Forest's Botany Program since 1990 have been analyzed for effects to threatened, endangered, and sensitive plants prior to project implementation. Surveys for potentially occurring plants in this project area would be conducted in 2008. Foreseeable actions would be modified to mitigate anticipated impacts resulting from foreseeable action as required by Forest Service policy.

The potential spread of noxious weeds resulting from this proposed salvage project and past, present, and future projects described above has the greatest potential for cumulative effects on potentially occurring sensitive plant populations. The potential for weed spread would be reduced by project design criteria.

Due to the small scope of direct and indirect effects and the measures proposed to control noxious weeds, cumulative effects of the project on potential occurrences are expected to contribute minimally to the total effects from past, present, and foreseeable actions. However, cumulative effects on unknown occurrences can only be speculative due to lack of known locations.

REGULATORY FRAMEWORK AND CONSISTENCY

Threatened or endangered status affords a species and its habitat special protection from adverse effects resulting from federally authorized or funded projects. It is the responsibility of the Forest Service to design activities that contribute to the recovery of listed species in accordance with recovery plans developed as directed by the Endangered Species Act (ESA) (50 CFR part 402). The Flathead National Forest's Amendment 20 to the Land Resource Management Plan (LRMP) provides for conservation measures to ensure the protection of water howellia. Amendment 21 to the LRMP has a goal to "provide sufficient habitat to promote the recovery of threatened and endangered species and conserve the ecosystems upon which they depend."

Federal laws and direction applicable to sensitive species include the National Forest Management Act of 1976 and Forest Service Manual 2670. Amendment 21 to the Forest Plan has standards to conduct analyses to review programs and activities, to determine their potential effect on sensitive species, and to prepare a Biological Evaluation. It also states "*adverse impacts to sensitive species or their habitats should be avoided. If impacts cannot be avoided, the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole will be analyzed. Project decisions will not result in loss of species viability or create significant trends towards federal listing."* Future conservation strategies for each species would present direction on maintaining habitat diversity and managing for population viability, as required by the NFMA and Forest Plan Amendment 21. The Forest Service is bound by Federal statutes (ESA, NFMA Act), regulations (USDA 9500-4) and agency policy (FSM 2670) to conserve biological diversity on NFS lands. A goal in Forest Plan Amendment 21 is to "*ensure that Forest Service actions do not contribute to the loss of viability of native species*."

All action alternatives described in the Sheppard Creek Post-Fire Project DEIS would meet the direction of Forest Service Manual 2670.3 (sensitive plant species) and is consistent with the Forest Plan direction for sensitive plants. In addition, all activities are also in compliance with ESA and Flathead National Forest LRMP Amendments 20 and 21, with respect to federally listed plants.

The activities associated with the action alternatives *may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability* for potentially occurring sensitive plant species and proposed plant species listed in Exhibit S-2. This is based on the, 1) presence of suitable habitat for potentially occurring sensitive plants within the project area; 2) the potential for indirect effects of noxious weed competition; and 3) the delination of new occurrences located prior to project implementation.

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FIRE AND FUELS

Introduction

Wildland fire has historically been the dominant disturbance factor in forests across the Northern Rocky Mountains. Along with timber management, fire has created the current mosaic patterns of forest species composition and structure observed across the landscape. Most forests have evolved with the continual influence of wildland fire. Forested communities and ecosystems depend on this type of disturbance regime for their continued perpetuation on the landscape (Habeck and Mutch 1973).

Natural Historic Fire Regimes best illustrate wildland fire disturbance patterns. A fire regime describes the frequency, predictability, and severity of wildland fire in an ecosystem. Wildland fire regimes can range from non-lethal to stand-replacing levels, typically becoming less frequent as severity increases.

Drought cycles and fuel availability have a considerable influence on fire regimes. Wildland fires often occur during the driest months of the year, typically July, August, and early September, and can have considerable effects to an area during drought periods. The quantity and type of fuels also affect fire behavior. Wildland fuels are made up of dead woody debris and living vegetation. Fuel quantities can vary considerably, depending on the vegetation composition and recent fire history.

Pre-settlement wildland fires burned through the summer season until they were extinguished by fall precipitation. In the settlement period before 1941, wildland fire suppression efforts were often not successful and resulted in fires burning thousands to tens of thousands of acres. Suppression efforts since then have altered pre-settlement fire regimes and reduced the number of forested acres burned each year. The combination of wildland fire suppression, fire exclusion, and natural disturbance processes has allowed fuels to accumulate in unmanaged timber stands. This situation existed prior to the Brush Creek Fire in the Sheppard Creek Project area.

Information Sources

Fire history information was obtained from the Flathead National Forest GIS fire history coverage, Timber Stand Management Record System (TSMRS), and aerial photos. The fire history coverage was created for and has been used to look at past fire history patterns and pre-settlement fire frequency. Past harvest information was taken from Forest Service Activity Tracking System (FACTS).

Analysis Area

The spatial bounds of the *Fire and Fuels* analysis to disclose the effects of the proposed project are the Flathead National Forest lands affected by the Brush Creek Fire. These lands are located within a much larger ecosystem, which expands across the Northern Rocky Mountains. The fire history polygons extend beyond the analysis area boundary and are used to describe historic fire disturbances typical of the Northern Rocky Mountain ecosystem.

The temporal bounds of the analysis are the present time to approximately 60 years into the future. This time span allows for the current fuels mosaic created by the fire to decompose and be dominated by new vegetation.

Affected Environment

Fire Ecology

As stated in the introduction, wildland fire has helped shape today's forested landscapes in the Northern Rockies. The frequent occurrence of fire can cause high mortality to most life forms found in these communities. However, due in part to frequent fire activity many of the vegetation species are well adapted to this fire-dependent environment and display unique survival characteristics.

Fire often occurs in this area during dry periods of July and August, and can become a major disturbance event. During severe drought periods, fire activity often lasts well into September when reduced daylight hours typically allow for increased diurnal humidity recovery and reduced fire activity.

Where fire has occurred in the most recent past, fuel loadings after the fire can be quite variable depending on the forest structure found pre-fire. Prior to the Brush Creek Fire, most of the Sheppard Creek drainage had not experienced a large fire for at least 120 years. Fire history records show a large fire occurred here during 1889, burning the head end of Sheppard Creek around Tepee and Sheppard Mountains. It burned approximately 15,000 acres and left unburned patches scattered across the landscape. Although fire starts occur frequently from summer lightning storms, fires greater than one acre have been rare in the Sheppard drainage since 1889, with the exception of the Sheppard Mountain Wildland Fire, which burned 456 acres in 1991. Most, if not all, of the forested communities on the Flathead National Forest have been disturbed by fire in the last two to three centuries.

Wildland Fire History and Suppression

For the purpose of understanding fire history it is useful to classify or subdivide a landscape into discrete categories that have different environmental characteristics. The Sheppard Creek drainage can be categorized or characterized by the moist lower subalpine; cool lodgepole pine; and moist Douglas-fir fire groups described by Fisher and Bradley in 1987. Each of these fire groups has varying fire return intervals. Sneck (1977) studied the fire history within the moist, lower subalpine fire group and found that fire-free intervals varied with topography, but the average interval was 128 years. According to Hendrickson (1970), severe fires in seral lodgepole pine probably ranges from less than 100 years to about 500 years. A tentative mean fire-free interval of 15.8 years was reported by Habeck (Crane, et al. 1983) for the moist Douglas-fir habitat.

Fire history data informally collected by ranger district crews and from historic aerial photography within the immediate project area boundary and surrounding area indicates that large fires occurred in 1889, 1910, 1926, 1940, and 1994. These data have been organized and presented in a forest-wide historic fire GIS layer (refer to Figure 3-5 and Table 3-29 for fire history in the vicinity of the Brush Creek Fire. This map shows a large portion of the project area has not been affected by historic fire since 1889. Recent smaller fires adjacent to and within the project boundary burned in 1991 in 2000.

Summer lightning storms occur frequently over the drainage. Lightning strikes are numerous, occurring more frequently on ridges and mid-slopes, and less frequently at lower elevations. Most storms are accompanied by precipitation. Fire ignitions occurred regularly in the project area prior to 2007 but had not resulted in many large fires. Most fires occurring in and near the analysis area between 1940 and 2006 were suppressed at one acre or less. During this time period, 19 human-caused fires and 39 lightning-caused fires were recorded within the analysis area (Exhibit O-4).

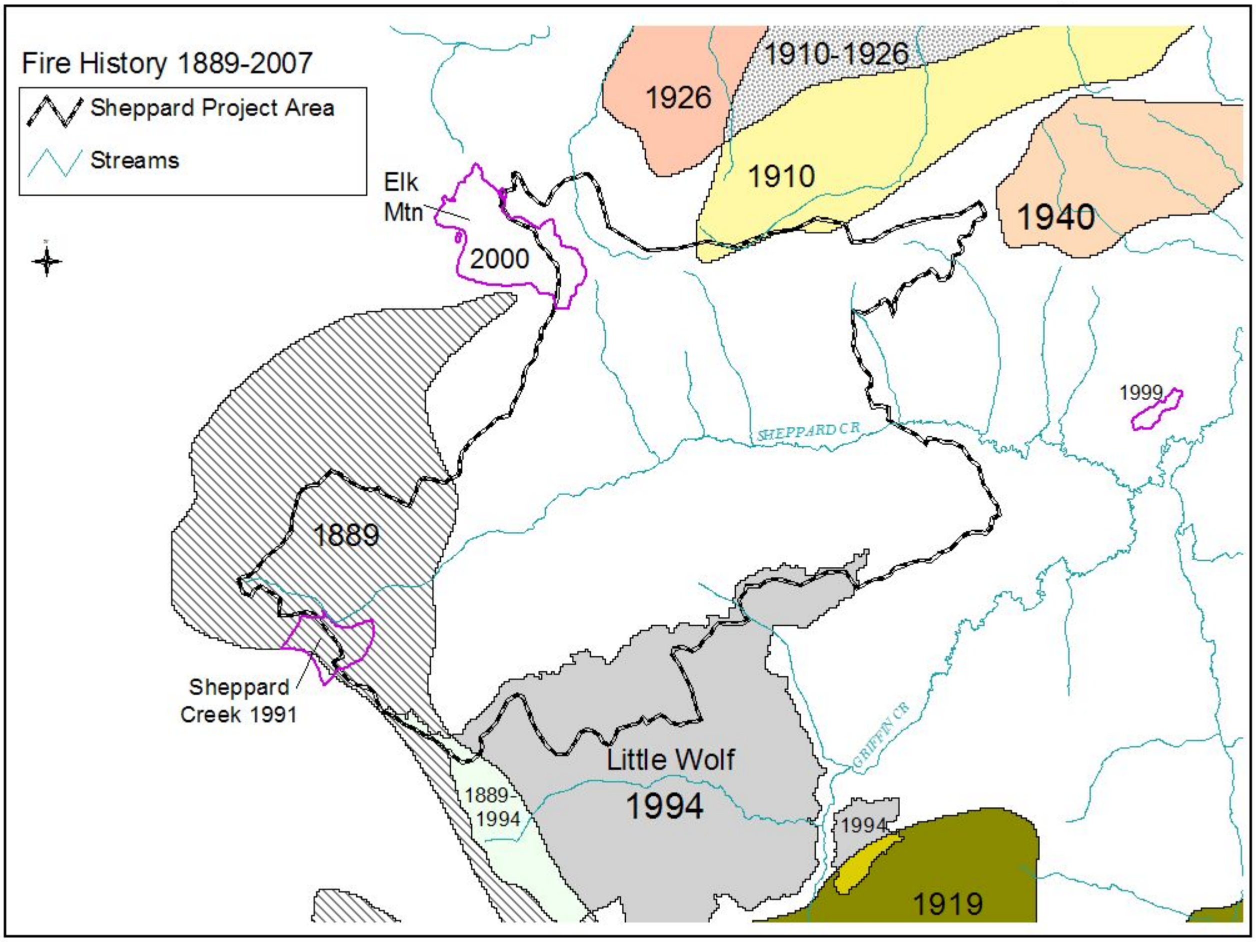
The fires of 1889, 1910, 1926, 1940, 1994, and 2000 correspond with large fire episodic years in the Northern Rockies. These years coincide with local and regional drought periods in which mass ignitions from large, dry lightning storms and occurrence of strong winds accounted for hundreds of thousands of acres burned in the Northern Rockies. The fire season of 2007 was similar to these fire episodes on the Flathead National Forest, which resulted in nearly 70,000 acres burnt by wildland fire forest-wide this past year.

Table 3-29. Summary of Historic Fire Disturbance Affected Acres.

Year of Fire Disturbance	Acres Burned in Project Area	Total Acres Burned in Fire Disturbance	Year of Reburn	Acres of Reburn within Project Area
1889	3191	17,371	1991, 1994, 2007	151, 102, & 3191
1910	127	21,759	1926, 2007	6 and 127
1991	150	465	2007	150
1994	1994	10,068	2007	1994
2000	214	1,025	2007	214

Fire history maps for the past large fires show typical patterns of fire spread. Generally, fires would tend to spread from west or southwest to the east or northeast. These fires were both a mixed severity and lethal fire type. In some areas, nearly all existing trees were killed; in other areas more of an under burn occurred, leaving varying amounts of the larger over story trees or patches of unburned areas. This pattern and frequency of fire, with some variation depending upon climatic cycles and change in vegetative conditions through time, probably reflects what has occurred within the project area for many centuries.

Figure 3-5. Fire History Map



Within 12 to 15 years after the occurrence of a large or unusually severe fire, it is expected that fallen, dead timber would create a correspondingly large mass of heavy fuel (Arno, et al. 1999; Lyon 1984). This becomes incorporated into a new dense fuel bed with small conifers and large shrubs, which can readily support another severe wildfire, often called a reburn or “double burn” (Arno, et al. 1999). In the initial years after the Sleeping Child Fire of 1961, tree seedling densities averaged 34,000 per acre (Lyon 1984). Similar tree densities were noted post-fire in the Red Bench Fire of 1988. Sometimes the influx of post fire down woody debris combined with grass, forbs, shrub and sapling regeneration capable of supporting a reburn occurs sooner. The Moose Fire (2001) reburned portions of the Adair (1994) and Anaconda (1999) fires in Glacier National Park. About 17,800 acres, which burned in the 1903 South Fork Fire, reburned in 1910.

Historically, reburns have occurred with some regularity in the Northern Rockies. In Table 3-29 and the Fire History Map of the Sheppard Creek Project boundary and surrounding areas we see portions of four wildland fires within the drainage that have experienced reburns. Much of the Sheppard Creek drainage was not affected by reburns, however, portions of the 1994 Little Wolf, Elk Mountain, and Sheppard Creek Fires did reburn in the 2007 Brush Creek Fire event. Some conditions that appear to make an area more prone to reburns are:

- ample fuels for large fires,
- large tracts of relatively contiguous downed fuels,
- west or southwest orientation of major drainages that parallel the prevailing summer winds,
- mid to upper elevation ridges paralleling these same summer winds,
- high lightning frequency,
- and prolonged drought (Barrett 1982).

Some of these conditions existed in the project area and contributed to the growth of the Brush Creek Fire of 2007.

The change in policy and effectiveness of wildland fire suppression in about 1940 has contributed to the changing landscape and the influence of future fires on vegetative condition (structure, composition, and fuel loading) within the analysis area. Over time, the changes and consequences inherent in continued active fire suppression include:

- Vegetation conditions would continue to progress towards older, more dense stands dominated by shade-tolerant trees, with extensive "ladder fuels" to carry a fire to the treetops;
- Fuel loadings would increase;
- Suppression of wildland fires would increase in risk, complexity, cost, and the probability of large lethal fires would increase; and
- Increased intensity and severity exposes firefighters to greater risk and hazard during initial attack and extended attack.

The effects of suppression vary depending on site conditions. In general the changes in vegetative condition resulting from fire suppression may increase fuel loading and the likelihood of large lethal fires over what might have occurred historically. In the case of the Brush Creek Fire, approximately 56 percent of the analysis area had been previously harvested. Even-aged regeneration treatments occurred on 90 percent of the previously harvested area. Areas that experienced regeneration treatments reset the fire disturbance clock, acting similar to a fire disturbance event. Portions of the Brush Creek Fire environment not treated with regeneration harvest were nearing the end of the natural fire cycle. The mixed severity fire which burned within the Brush Creek Fire perimeter was likely consistent with historical fire occurrence.

The appropriate management response for all wildland fires under the Forest Plan requires all fires be suppressed (excluding areas covered under an approved Fire Management Guide or Plan). The National Forest portion of the Sheppard Creek Project area has two different Fire Management Units (FMU). The FMU C (Developed Area Concerns) includes the Star Meadows guard station and cabin rental site. The remainder of the analysis area is in FMU B (Mixed Values). In both FMU B and C, the appropriate management response is suppression with safety of fire management personnel being the first priority. FMU C values to be protected would be a higher priority during multiple fire situations than FMU B. Initial attack in both FMUs would be the appropriate initial attack actions to control a wildland fire.

The risk of a wildland fire affecting private property continues to increase as settlement patterns increase along the private-public interface. The 2007 fire season highlighted the increased risk of major economic and resource losses due to large wildland fire. Although the Brush Creek Fire did not affect the Flathead Valley's wildland urban interface, the potential for loss of life and property were real with regard to the property owners in the Star Meadows and Good Creek communities. These areas include many residences that are in heavily wooded areas with limited fire suppression access. No zoning or building restrictions currently exist in Flathead County that would limit fire hazard around these homes.

<u>Fire Effects</u>

Fire commonly results in high mortality to the above ground portion of plants. However, it is well known that a high percentage of the plants in the Northern Rocky Mountains can also survive fire and grow from underground stems or root crowns that are not killed in the fire (Stickney 1990). This unique adaptation to a fire-frequented environment provides a readily available, on-site colonization event, soon after the fire is out. This is particularly true in areas where low to moderate intensity fires are common. However, in large fires, areas with heavy fuel loadings would burn at intensity and severity levels that would result in greater mortality to the understory plant community. Therefore, the potential is much greater for more severe and long-term effects to the pre-burn community. This type of fire activity has been termed stand replacement, lethal fire and is becoming more common throughout the Northern Rocky Mountain landscapes.

The influence of fire on the Sheppard Creek Project area can be described in a number of ways:

- Effects of the recent Brush Creek Fire – burn pattern and severity
- Historical Fire Regime – how fire has historically shaped the landscape
- Condition Class – how current conditions may depart from the historical fire regime

Effects of the Brush Creek Fire

Fire behavior, and the resulting effects, is the manner in which a fire reacts to the influences of fuel, weather, and topography (Glossary of Wildland Fire Terminology 1996). Forest fuel is combustible material or organic matter that could burn if ignited (Brown 1975). Removal of fuels helps to reduce or retard wildfire spread and severity (Pollet and Omi 1999) and is the only element affecting fire behavior that can be controlled.

Fuels are broken into three categories: fine fuels (such as grass or forbs), small woody fuels less than three inches in diameter, and large woody fuels greater than three inches in diameter. Fine fuels carry the ignition. Small woody fuels can lose their moisture faster, start easier, and burn more readily (Agee 1993) influencing a fire's rate of spread and intensity. Large woody fuels contribute to development of large fires and high fire intensity (Brown, et al. 2001). Fire hazard and resistance to control are highest when large woody fuels exceed 25 to 30 tons per acre with small woody fuels of five tons per acre or more (Ibid).

There is abundant scientific evidence that increased fuel loads could result in increased fire intensity and severity (DeBano, et al. 1998; Omi and Martinson 2002; Rothermel 1983; Arno and Brown 1991). In other words, given the same weather and topographic conditions, areas with higher fuel loads would release more energy (burn hotter), exhibit longer flame lengths, have greater potential to convert to crown fires, be more difficult to contain, pose greater risks to firefighters, kill more vegetation, and damage soils more severely than areas with lower fuel loads. In addition, there is clear scientific evidence and abundant experience demonstrating large continuous areas of relatively high fuel loads are more likely to result in larger fires than areas where the spatial arrangement of high fuel loads is discontinuous.

The Brush Creek Fire burned with a range of severities resulting in a mosaic of effects on the vegetation and soil. Muraro (1971) discusses a typical diurnal wildfire burning cycle in lodgepole pine that highlights the interaction of fuels, humidity, and temperature and the resulting mosaic burn. Severity is a function of the total fuel consumed by fire, a reflection of both total heat produced (intensity) and duration of heating of the soil surface or vegetation. A discussion of fire severity is included in the vegetation section of this chapter and includes definitions of the four vegetation severity levels. Severity effects to soils are approached differently and are discussed in the soils section of this chapter. Table 3-30 displays the approximate acres burned by vegetation burn severity level on National Forest System Lands in the Brush Creek Fire perimeter. Figures 3-1 through 3-4 display the vegetation severity levels.

Table 3-30. Acres Burned on National Forest System Lands and Percent of Total Fire Acres by Vegetation Burn Severity Level within the Project Area.

Severity	High (Crown Fire)		High (Underburn)		Moderate		Low		No Fire		Total Acres
Totals	10,850	48%	3,721	16%	4,895	22%	3,048	13%	137	<1%	22,651

* See vegetation project file for rule set used to calculate severity.

Although fire suppression for almost 70 years on these sites has resulted in changes to forest communities, the Brush Creek fire behavior and resulting fire severities were not outside the range of what has historically occurred on the Flathead National Forest. The coarse scale mosaic of lethal and mixed severity burn patterns is typical of what occurs in this area's fire regimes. Suppression has been and would continue to be the appropriate management response for these forested systems given the high resource values, proximity to town sites, and outlying interface communities.

Historical Fire Regimes

Historical Fire regimes are a classification system used to describe areas of similar fire behavior (frequency, severity, extent, and pattern) across an ecosystem. Prior to the Brush Creek Fire, the Sheppard Creek drainage had not changed substantially from its historic fire regimes. Specific information regarding fire regime in the project area was taken from the National Fire Plan Cohesive Strategy (USDA Forest Service 2000a) fire regime GIS layer (Exhibit O-8 and O-10).

A majority of the Sheppard Creek drainage is in a stand replacement (lethal) fire regime with a 95 to 180 year fire return interval based on the previous vegetation and cover types. Under a lethal fire regime, fires burn into tree canopies and can kill most of the overstory trees. Mortality can vary depending on time of day when the fire burned through an area, fuel conditions, fire intensities (how hot the fire is burning), terrain, and weather. This lethal fire regime was found throughout the drainage.

A small portion of the watershed is classified in a mixed severity fire regime with a mean fire return interval of 40 to 120 years. This regime is confined to the drier south and west aspects in areas typically dominated by Douglas-fir cover types, and low to moderately steep slopes (generally less than 35 percent slope) at lower elevations. For a spatial representation of both fire regimes represented within the project area, see Exhibit O-6 in the project file.

Condition Class

Condition classes are used to describe the degree of departure from historical fire regimes, and thus potential fire effects in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure (Schmidt et al. USDA) (refer to Table 3-31). Defining current fuel condition class is based on the departure of vegetation, fire severity, and is then used as a proxy to the risk of losing key ecosystem components (such as hydrologic function and vegetative attributes).

Table 3-31. Condition Classes (from Laverty and Williams 2000)

Condition Class	Attributes	Example management options
Condition Class 1	– Fire regimes are within or near a historical range. – The risk of losing key ecosystem components is low. – Fire frequencies have departed from historical frequencies by no more than one return interval. – Vegetation attributes (species composition and structure) are intact and functioning within a historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	– Fire regimes have been moderately altered from their historical range. – The risk of losing key ecosystem components has increased to moderate. – Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. – Vegetation attributes have been moderately altered from their historical range.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3	– Fire regimes have been substantially altered from their historical range. – The risk of losing key ecosystem components is high. – Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape pat-terns. – Vegetation attributes have been substantially altered from their historical range.	Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments. These treatments may be necessary before fire is used to restore the historical fire regime.

* See project file Exhibit O-7 for a spatial representation of Fire Regime Condition Class. Current Condition class for most of the project area is Condition Class 1.

Prior to the Brush Creek Fire, the burned area was predominately Condition Class 1. After the Brush Creek Fire moved through the drainage, it is safe to assume that a majority of the drainage remained in Condition Class 1. This includes areas affected by regeneration harvest. There may be small unburned areas of Condition Class 2 within the Sheppard Creek drainage. A spatial representation of Condition Class within the Sheppard Creek drainage prior to the Brush Creek Fire is available in the project file (Exhibit O-7).

Environmental Consequences

No significant issues related to fire influences were identified (please refer to the Issues section of Chapter 2).

The following Effects Indicators were used to focus the fire influences analysis and disclose relevant environmental effects:

- Effects on fuel conditions, fire behavior and fire regimes within the project area (risk, hazard, severity, frequency, size).
- Effects on wildland fire starts and suppression (effectiveness, cost, safety).
- Effects on prescribed fire escape risk (pile burning).

Direct and Indirect Effects

<u>Alternative A - No Action</u>

No acres are treated under this alternative, and thus there are no direct or indirect effects to the vegetation. Existing conditions as described above under "Affected Environment" would be maintained.

Fuel Condition, Fire Behavior, Wildland Fire Starts, and Suppression

In Alternative A, there would be no fuels reduction and the probability of more severe fire behavior would increase as snags fall (Arno & Brown 1991). Historically, fires of this nature are not without precedent on the Tally Lake Ranger District, with the initial wildland fire disturbance followed by a reburn, as described in the Affected Environment section. This was evident on 1994 acres of the Brush Creek Fire that had previously burned in 1994 during the Little Wolf Fire. Currently in areas within the Brush Creek Fire that burned at high severity, most of the potential fuel has been burned and is charred. As snags fall and fine fuels from grasses, shrubs, and conifers develop, a fuel complex capable of carrying a reburn wildland fire event would exist. Fuel loads may exceed 70 tons per acre, and in many cases may surpass 100 tons per acre (Fischer 1981). As indicated by Brown and others (2003) high to extreme fire hazard potential exists when downed CWD (course woody debris) exceeds 30 to 40 tons per acre.

In areas of light to moderate severity fire, the potential for difficulty in extinguishing future fires also exists; however, the fuel complex would be somewhat different. Although these areas did not experience a crown fire that charred most vegetation, high levels of subsequent mortality are expected. Ground fire effectively killed trees without consuming foliage. The result would be a greater accumulation of fine fuels than in areas that burned more intensely. This fuel complex includes dead needles, branches and stems, and large woody material. In the event of a future fire, the fuels may burn hot enough to consume organic matter in the soil. When dead and live tree biomass increase, so does flame length and fire intensity (Rothermel 1983).

The Federal Wildland and Prescribed Fire Management Policy direction is that the appropriate management response to a wildland fire would be used. The Forest Plan and the Fire Management Plan indicate suppression as the appropriate management response in the Sheppard Post Creek Project area. Appropriate initial attack actions were used to control the Brush Creek Fire. This would continue to be the case where human life, property, and certain resource values are highest priority.

The large fuels remaining in the burned area would decay slowly, and likely remain on the landscape for decades. A reburn results when fall-down of the old burned forest contributes substantially to the fire behavior and fire effects of the next fire. The possibility of a reburn is small on any site, but it is high over the landscape. Potential for spotting and crown fires is greater where large woody fuels have accumulated (Brown, et al. 2001, unpublished). A severe fire occurrence in the next several decades would depend on the amount of fuels present, vegetation development, point of ignition, and weather. Based on Brown's paper, potential spread of a future fire in the areas that burned in 2007 at a moderate to high severity are described as follows:

0 to 10 years after 2007 fire – Severe fire is unlikely because large woody fuels would still be accumulating and there would not be enough decay to support prolonged smoldering combustion.

10 to 30 years after 2007 fire – Most of the large woody fuels would have fallen down, with some decay to support prolonged burning. A duff layer would not be well established. High severity burns would primarily occur where large woody material was lying on or close to the ground. High severity burns could be substantial where a large portion of the soil surface was directly overlain by large woody pieces.

30 to 60 years after 2007 fire – Large woody fuels would have considerable rot and a duff layer may be well established depending on the amount of overstory conifer. More severe burning is possible, depending on extent of soil coverage by large woody pieces. If a conifer overstory is present, crowning and burnout of the duff could amplify the burn severity.

The Brush Creek Fire area would be resistant to fire growth and spread in the short-term until there is enough vegetation to carry and sustain fire into the larger dead downed fuels that have and would continue to accumulate on the ground. It would take over 30 years for a duff layer to become established in areas that burned with moderate to high severity (Brown, et al. 2001, unpublished). Fine fuels would increase as shrubs and grasses resprout and new seedlings become established. Non-salvaged areas that burned under moderate to high severity conditions would reach and likely exceed the desired levels of CWD over the next 10 to 30 years as most snags fall to the ground. Given the fuel loading during the 10 to 30 year period following a wildland fire disturbance high severity burns could be substantial in Northwest Montana (Brown, et al. 2001, unpublished).

Escaped Prescribed Fire

No prescribed fire would occur under the No Action Alternative; therefore, there would be no risk of escape.

Effects Common to All Action Alternatives

The direct effects of the alternatives differ primarily in the acreage treated where fuel loadings would be reduced, as described in Table 2-10. All acres proposed for harvest would have some level of fuel reduction. Specific differences in alternatives are addressed below.

Fuel loadings in the salvage units may vary widely depending on trees removed, standing trees remaining, and amount of debris removed based on logging method. Ocular surveys of the 2001 Moose Fire post salvage treatment areas using the USDA Forest Service, National Fuel Classification and Inventory System, Post Treatment Photo Series for Region 1 indicate a fuel bed mosaic varying from approximately 15 to 60 tons per acre. The salvage treatment areas proposed in the Sheppard Creek Project area are expected to result in similar fuel bed characteristics as the Moose Fire post treatment areas. The objective during harvest would be to reduce the amount of slash on the ground from logging operations by whole tree yarding and disposing of slash at the landing, while maintaining adequate levels of dead wood for soil, wildlife, and other resource needs.

The landscape level risk of large wildland fire within the Sheppard Creek Project area would increase over time as vegetation continues to fill in the burned area, and residual trees fall and accumulate on the forest floor.

All of the action alternatives would have an effect on fuel conditions and fire behavior within the Sheppard Creek Project area. Salvage logging under Alternatives B, C, and D would reduce the standing dead and eventual downed slash within the treated areas. This would change the potential fire behavior in the short term, reducing the fire intensity and severity within the salvage harvest units relative to similar untreated stands.

The harvesting of the dead standing trees and piling of attached tops and branches would dramatically reduce the current and future downed fuels. The fuel reduction treatments would modify the fuels so the primary fire carrier is the light grass, brush, and shrub fuels, not the whole profile including dead down fuels. This change in fuel conditions reduces the fire intensity and severity, but lighter fuels can increase the rate of spread. This is because opening up the canopy allows more sun and wind into the lower layers of the forest, increasing fuel temperatures and decreasing humidity, drying out the lighter fuels. However, it would improve the probability of suppressing a fire, as suppression resources can be very effective on rapidly moving, lower intensity fires. Fuel management modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano 1998). Fuel management includes reducing the loading of available fuels, converting fuels to those with a lower flammability, or isolating or breaking up large continuous bodies of fuel (Ibid).

While fire behavior would be modified in salvage units, none of the action alternatives would substantially modify landscape level fire behavior. Treated areas may provide safe locations to anchor future fire suppression efforts and reduce the potential spread.

A precise evaluation of the effects of salvage logging and tree retention on reburn fire intensity has not been accomplished by the scientific community. What is in the literature is that when dead and live tree biomass increase so does flame length, and fire line intensity (Rothermel 1983). The majority of the proposed salvage harvest units in the action alternatives would experience standing tree biomass retention levels between 50 to 70 percent (Exhibit O-11). Fire intensity and flame lengths would be greater in untreated areas due to higher amounts of dead biomass.

The effects of salvage logging would be different by alternative, due to the difference in treatment prescription and/or acres treated. Alternative D would be the most effective fuel reduction based on total biomass removed and acres treated and Alternative C would be the least.

Wildland Fire Starts and Suppression

No alternative has an influence on the time and place a natural fire may start. Wildland fire is a natural, ongoing process whose time and location can never be precisely predicted by fire behavior science. Life, property, and resources are always at risk during wildland fire events. Human-caused fire is also unpredictable, but can be greatly diminished with ongoing educational fire prevention programs.

The risk of a large wildland fire threatening the Sheppard Creek Project area would not be mitigated by the proposed action or its alternatives. The action alternatives would reduce the fuel loadings, fuel continuity, and the availability of ladder fuels in the treated areas and may keep fire confined to the ground, reduce fire intensity, reduce firebrands, and afford a high probability of control through the use of engines, hand crews, and air tactical resources. Agee, et al. (2000) states "Surface fuel management can limit fireline intensity and lower potential fire severity."

As compared to the existing condition, Alternatives B, C, and D would initially increase road access available for initial attack of fires (refer to the following table). However, these roads would only be open and available for use by suppression resources while they are being used for salvage operations. Once the roads are no longer needed for salvage logging activities, the roads would be obliterated or reclaimed and access for suppression activities would be returned to the pre-fire situation.

Table 3-32. Roads Available for Travel by Fire Management Resources during Salvage.

Feature	Alt. A No Action	Alt. B Proposed Action	Alt. C	Alt. D
Temporary Road Construction	0	26.9 miles	9.5 miles	11.7 miles
-Use of Historic Templates	0	17.3 miles	6.6 miles	8.5 miles
-New Temporary Roads	0	9.6 miles	2.9 miles	3.2 miles
System Road Construction	0	0 miles	0 miles	0 miles

Early detection would continue to play a key role in preventing small fires from growing into large fires. Access may be limited and may prevent rapid response time from ground personnel. Where this becomes an issue, delivery of firefighting personnel would then be accomplished aerially with smokejumpers or helitack crews. Suppression costs during initial attack associated with aerial delivered personnel might be somewhat higher but may be more efficient and effective in limited access areas. In most instances response time to a fire is critical, although rapid response may be secondary to environmental elements associated with fuel loadings, topographical features, and fire weather. These components play a very important role in fire behavior and fire growth and would determine what resources would be needed and how many.

Bermed roads are not available during initial attack response; however they may be used for access to extended attack fires that require personnel for several days. Equipment may be used to open bermed roads if management determines that is the safest and most effective way for fire personnel to access an extended attack fire.

None of the alternatives would affect firefighter safety during initial or extended attack. Firefighters are taught that escape routes and safety zones are dynamic based on their (the firefighters) location on the fire line. An escape route is a short path through vegetation where access can be gained to a safety zone in a matter of minutes. Safety zones are either natural (clean burn areas, rock areas or water) or human-made (constructed areas, clearcuts or roads) adjacent to the fire line. Safety zones must also be survivable without a fire shelter and be readily accessible.

Escaped Prescribed Fire

There is a very low risk of escaped prescribed fire for all the action alternatives because the only burning prescriptions involve landing piles. These are burned in late fall when soil and fuel moistures would greatly reduce the potential for spread beyond the piles.

Cumulative Effects

Alternative A- No Action

Cumulative effects under no action would occur as an inevitable and natural consequence of the working of ecosystem processes. The Sheppard Creek Project area would immediately begin to re-vegetate beginning a natural succession eventually creating a forest much like the one that burned in 2007. The naturally occurring longer fire intervals and fire exclusion in combination with natural processes such as insect, disease, and fire mortality allow forests to grow and change through any existing stand structure diversity, typically leading to more uniform and more flammable conditions.

Over time, these natural increases in vegetation and downed woody debris increase the probability that any future fire would be a high intensity, lethal severity fire, and involve large areas. The risk of this kind of wildland fire event, in the Sheppard Creek Project area, increases substantially over time.

Effects Common to all Action Alternatives

As with the No Action alternative, cumulative effects would occur as an inevitable and natural consequence of ecosystem processes. Proposed treatments could substantially alter landscape level vegetation development over time through removal of competing dead biomass, reduced probability of reburn, and reforestation activities that influence tree species composition. Please the Vegetation section of this chapter for more information.

The most influential cumulative effect relating to fire and fuels across the Sheppard Creek Project area results from past timber harvest. The project area has been treated with various levels of timber harvest activities on 56 percent of the area. The majority of the harvest activities took place during the 1970s, 1980s, and 1990s. These areas where past harvest occurred disrupted the fuel continuity which affected the intensity of the Brush Creek fire. It was noted in ocular surveys that more than half of the stands treated with regeneration harvest methods in the past experienced high mortality with either a severe crown fire or a low intensity surface fire with occasional single or group tree torching. Mortality was moderate to high even with low intensity surface fire due to the thin bark and low branches of the sapling- and pole-sized stands. The remaining area that had received past harvest did not burn or burned with less severity due to a less dense overstory and lower surface fuel loads from past fuel treatments.

There are two present or reasonably foreseeable timber sales adjacent to the project area boundary; one is the Kootenai National Forest salvage project in response to the Brush Creek Fire and the other is the Gregg-Plume timber sale that was authorized under the Good Creek Resource Management Project Final EIS and Record of Decision in 2000. These sales would remove timber from approximately 600 and 1500 acres respectively. These sales contribute to the disruption of fuel continuity across the affected landscape immediately adjacent to the Sheppard Creek Project area.

Pre-commercial thinning has occurred on 620 acres of the project area. The long term benefits of commercial thinning include reduced stand density and crown spacing as well as increased stand vigor. Pre-commercial thinning slash would temporarily increase the fuel loading on the ground. This concern lessens as snow load compacts slash and red needles fall to the forest floor.

Initial attack suppression efforts were effective in keeping fire starts small within the project area; exceptions include the previously mentioned Elk Mountain, Sheppard Creek, and Little Wolf Fires. Given the recent fire activity that occurred and historic suppression efforts, the project area is within its historical fire regime and condition class. The cumulative effects of all action alternatives, assuming continued success with fire suppression for the next 60 to 100 years, would likely result in the Sheppard Creek project area landscape remaining in a fire regime that includes mixed and high severity fire regimes, regardless of the amount of biomass removed.

A negligible amount of firewood cutting has occurred within the project area and is expected to continue. The prospect of firewood cutting affecting the overall fuel loading in comparison to the recent fire, and any of the action alternatives, is minor. However, it does contribute nominally to the total fuel reduction cumulative effect.

REGULATORY FRAMEWORK AND CONSISTENCY

All fuels and fire management activities considered in the action alternatives are consistent with direction in the Flathead Forest Plan Appendix G, Fire Management Direction, and the Federal Wildland and Prescribed Fire Management Policy.

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AIR QUALITY and SMOKE MANAGEMENT

Introduction

The primary air quality concerns associated with forest management activities is dust from unpaved roads and smoke from both wildland and prescribed fire. The main air quality concern associated with this project is particulate matter (PM) produced by the prescribed burning of residual fuels from harvest activities. Wood smoke produces particles too small to be seen by the human eye, measuring 10 microns (one micron equals one millionth of a meter) and smaller. Larger particles tend to settle out of the air quickly, and are less likely to affect public health. Particles 10 microns and smaller (PM_{10}) may be inhaled deep in the lungs, posing a threat to public health. Particles 2.5 microns and smaller ($PM_{2.5}$) are considered the highest concern for potential health effects.

The basic framework for controlling air pollutants in the United States is the 1970 Clean Air Act (CAA), as amended in 1990 and 1999 (42 U.S.C. 7401 et seq.). The CAA was designed to protect and enhance the quality of the nation's air resources. The CAA encourages reasonable federal, state, and local government actions for pollution prevention. State Implementation Plans (SIPs) are developed to implement the provisions of the Clean Air Act. The SIPs describe the actions a state takes to achieve and maintain the "national ambient air quality standards" (NAAQS). Under the CAA, the Environmental Protection Agency (EPA) sets standards for air quality to provide both health and visibility protection. Montana has also set standards to help protect air quality.

Smoke from prescribed fire must meet the ambient air quality standards for PM_{10} and $PM_{2.5}$. In Montana, the state standard is the same as the federal NAAQS for PM_{10}, which is 50 micrograms per cubic meter for the annual arithmetic mean, and 150 micrograms for the 24-hour average. Montana does not have a standard for $PM_{2.5,}$ although the federal NAAQS is 15 micrograms for the annual arithmetic mean and 35 micrograms for the 24-hour average.

Information Sources

The Smoke Impacts Spreadsheet (SIS) was used to estimate $PM_{2.5}$ emissions and airborne concentrations downwind of prescribed burning. SIS consists of existing accepted models in a spreadsheet format. SIS utilizes Consume 2.1 for pile burning emissions and CALPUFF 5.5 to model smoke dispersion, as well as FOFEM 5 to estimate material available for burning.

Analysis Area

The Montana Air Quality Bureau divides the State of Montana into ten airsheds. Airshed 2 is the primary analysis area for assessing the influence of the Sheppard Creek Project activities on air quality because it encompasses the effects of activities undertaken in the project area (as defined by the Montana/Idaho Airshed Group). Approximately 1300 acres of the project area lies within Airshed 1. Due to prevailing winds that come from the west and southwest, Airshed 2 is likely to receive the most impact of any action. Airshed 1 is included in the analysis area.

Airshed 2 is comprised of Flathead, Lake, Sanders, and the northern portions of Missoula and Powell counties. The Kootenai National Forest, which is entirely in Airshed #1, lies immediately to the west and north of the project area. Airshed 1 is comprised of all Lincoln County and the northwest tip of Sanders County (Figure 3-6). Airsheds are managed by Airshed Groups composed of the government agencies and timber companies that routinely perform prescribed burns, and with the assistance of National Weather Service meteorologists specifically assigned to the Airshed Group. Please see Figure 3-6 for a map of airshed locations.

Affected Environment

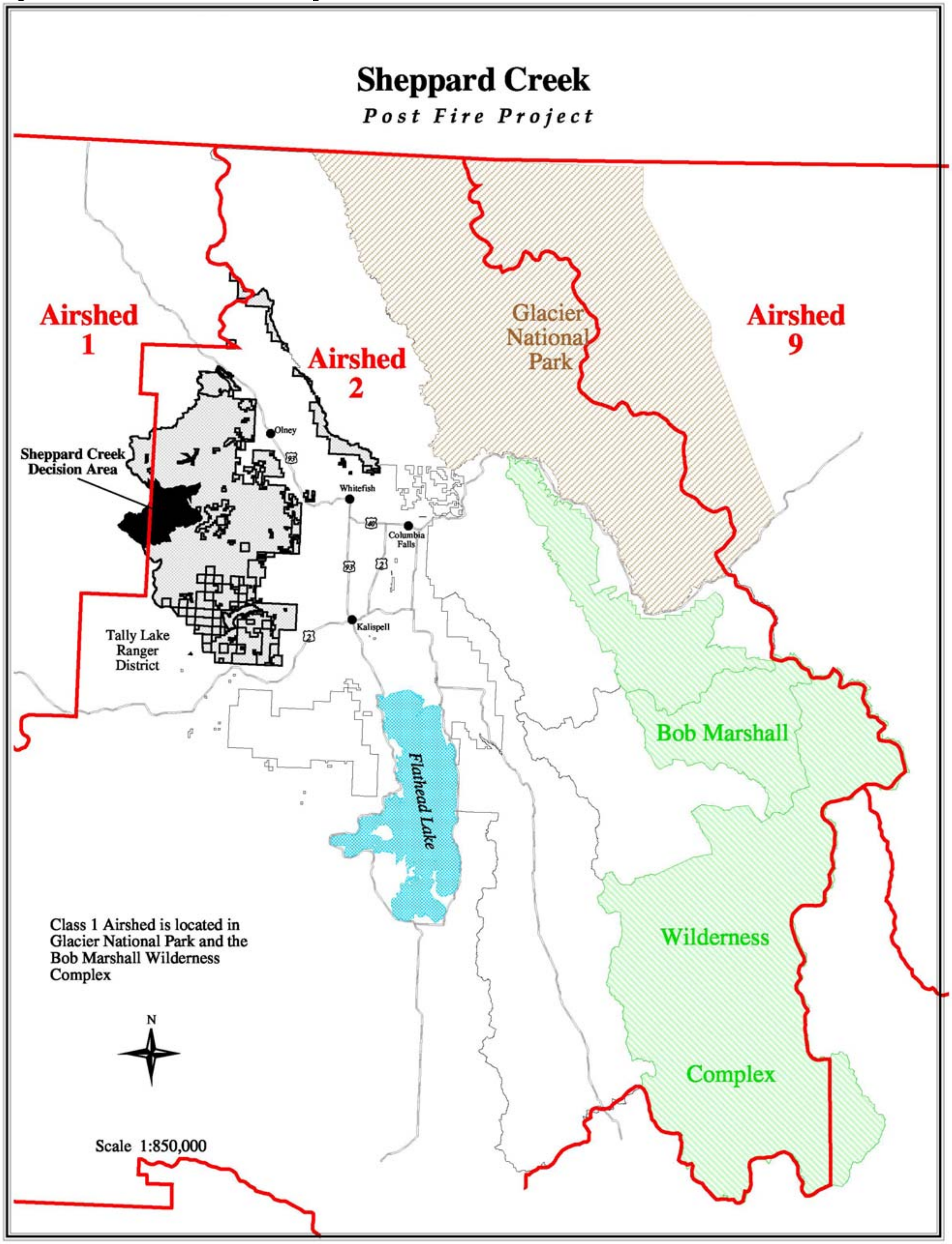
Airshed Characteristics

According to Air Quality reports from the EPA, the air quality of the Flathead River Valleys is considered to be good to excellent throughout the year and meets Montana air quality laws and the Clean Air Act.

Fire has historically been a part of the vegetative dynamics in the Northern Rockies as evidenced by the burn mosaics of the surrounding forested lands. Fires continue to be a part of the natural forest ecosystem and produce local short-term impairment of air quality.
Air quality may be affected and various amounts of pollutants may occur from the following:

- Prescribed burning in the spring and fall by the Flathead NF, Glacier National Park, Montana Department of Natural Resources, and timber and land development companies.
- Prescribed burning to the west and south by other National Forests, other agencies, and private companies or citizens.
- Wildland fire use for resource benefit occurring in the summer months in the Flathead National Forest, Bob Marshall Wilderness, Great Bear Wilderness, and Glacier National Park.
- Wildland fires burning upwind as far away as California and Alaska, depending on the size of the fire.
- Agricultural field burning in the Flathead Valley and Idaho.
- Weather patterns, which help cause degradation when low pressure systems over Idaho pull suspended pollutants (dust and smoke) from large metropolitan airsheds and farms in Oregon, Washington, and Idaho.
- Dust storms in China.

Figure 3-6. Airshed Location Map.



Meteorology

Smoke dispersion is primarily determined by transport winds and mixing height. Transport winds determine the direction of a smoke plume and the speed at which it travels, while mixing height controls the ability of smoke to mix into an air mass. In the spring and summer, solar heating of the earth's surface is much more intense, increasing the amount of warm air contributing to an unstable atmospheric condition. The more unstable the atmosphere the higher the likely mixing height would be, and the greater the dispersion. During the fall and winter, stable atmospheric conditions prevail as cooler air pools in the valley bottoms. Solar heating is not enough to heat this pooled air, so the stable conditions remain, reducing dispersion until a frontal passage scours out the valley air.

Forest Service management of prescribed fire and wildland fire use contributes smoke that may cause short-term deterioration of air quality in the area. Managed prescribed fires contribute smoke to the airshed, though prescribed fires tend to produce less smoke than wildfires of equal size since fuel consumption is typically lower in prescribed burns. On the Flathead National Forest, prescribed burning is generally accomplished when dilution, dispersal, and mixing conditions are considered fair to excellent.

Sensitive Areas

The EPA designates communities that do not meet air quality standards (NAAQs) over a period of time as "non-attainment areas." States are then required to develop a plan to control source emissions and ensure future attainment of the standards. The emissions from prescribed fire may be considered as contributing emissions. Three cities in the Flathead Valley are considered sensitive areas because they are non-attainment areas for PM_{10}: Kalispell, Columbia Falls, and Whitefish. Within Airshed 1 Libby is considered a sensitive area because it is non-attainment areas for PM_{10} and $PM_{2.5}$.

The CAA require measures "to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreation, scenic, or historic value." These areas are designated Class I airsheds. Of particular concern under this requirement is visibility or haze. Stringent requirements are therefore established for areas designated as Class I areas (42 U.S.C. 7475 (d)(2)(B)). Designation as a Class I area permits only very small increments of new pollution above existing air pollution levels. There are several Class I airsheds in the vicinity. Glacier National Park and the Bob Marshall Wilderness Complex are both Class I airsheds most vulnerable to project activities affecting air quality as these lie downwind of the project area. The Cabinet Mountain Wilderness is also a Class I Airshed that may be impacted by any actions, but considered unlikely due to the distance and location relative to the project area.

Environmental Consequences

There were no significant issues raised regarding air quality for this project (see chapter 1). Particulate matter less than 2.5 microns in diameter were used as the effects indicator for air quality and to disclose relevant environmental effects. $PM_{2.5}$ was chosen because while more than 90 percent of all particulate matter produced by wildland fires is less than 10 microns in diameter, 80-90 percent of that is less than 2.5 microns in diameter. For this reason, some models only predict $PM_{2.5}$ emissions. These small particles are inhalable and respirable. Respirable suspended particulate matter is that proportion of the total particulate matter that, because of its small size, has an especially long residence time in the atmosphere and penetrates deeply into the lungs. Small smoke particles also scatter visible light and thus reduce visibility (NWCG 2001). Maximum predicted 24 hour $PM_{2.5}$ emissions along with total $PM_{2.5}$ is shown for each alternative.

Direct and Indirect Effects

<u>Alternative A – No Action</u>

No prescribed burning would occur in this alternative, therefore no prescribed burning smoke emissions would be produced by this alternative.

<u>Effects Common to all Action Alternatives</u>

Pile burning would occur under each action alternative to treat residual fuels from salvage logging, producing direct smoke emissions. The pile burning would consist primarily of landing piles. Salvage landing piles would be primarily made up of larger diameter material generally greater than eight inches in diameter with little fine material. Smoke emissions from piled forest residue vary with combustion efficiency and quantity of fuel burned. Post-fire landing piles are more compact, easily piled, and have very little dirt lending to a relatively low emission rate in relation to the total acres treated.

The Smoke Impact Spreadsheet Model (SIS) (USDA Forest Service 2005) was used to model emissions produced from each of the action alternatives. Estimates for total number of piles, and tonnage of each landing pile, for each alternative were based on best professional judgment and experience. For the SIS Model, it was assumed that poor atmospheric conditions would be experienced. SIS- CALPUFF was used to model smoke dispersion and concentrations for each alternative. Each of the action alternatives would produce particulate matter at various levels. Table 3-33 contains the acres of treatment by alternative, an estimate of the total $PM_{2.5}$ and the maximum predicted 24 hour $PM_{2.5}$ measured in microns per meter cubed ($\mu g/m^3$). The NAAQS $PM_{2.5}$ is 35 $\mu g/m^3$ for the 24-hour average. Predicted ground level concentrations for a 24-hour average were less than 35 $\mu g/m^3$, and ground level $PM_{2.5}$ almost completely dispersed by midnight the day of ignition for all action alternatives (Exhibit J-1). It is unlikely that managers would ignite as many piles modeled in one day, although managers shall insure all burning would occur under conditions designed to ensure adequate smoke dispersal. Potentially, pile burning would be conducted over the course of one to two years after fuel treatment activities, further lowering the concentrated impacts of pile burning.

Table 3-33. Predicted 24 Hour and Total $PM_{2.5}$ Emissions.

Alternatives	Acres	Number of Piles	Maximum Predicted 24 Hour $PM_{2.5}$ ($\mu g/m^3$)	Total $PM_{2.5}$ (Tons)
A	0	0	0	0
B	6,346	317	16.705	20.94
C	3,902	195	16.705	12.88
D	7,465	373	16.705	24.64

Particulate matter associated with road dust from increased traffic of logging trucks and road equipment working within the project area would contribute to a decrease in air quality. Generally, fugitive road dust does not travel far from its source due to a high content of large particles that have a high gravitational settling velocity. Transport of fugitive road dust in the PM_{10} category and less should be further limited by high vegetation heights, and limited number of vehicles traveling within the project area. Surface treatment, such as watering or treatment with chemical dust suppressants can be effective in reducing particulate emissions. Mitigation to reduce fugitive road dust emissions from logging equipment and road maintenance may not be needed depending on moisture content of the road surface or operational time of year (e.g. late fall, winter, early spring).

Distance to Class I Airsheds and non-attainment areas makes it likely that there would be no detrimental effects to air quality and areas of concern. Dispersion modeling estimates smoke concentrations in $\mu g/m^3$ for the 24-hour average for Whitefish, the nearest non-attainment area, to be 0.29 (Exhibit J-2). According to the Air Quality Index, between 0 to 15.4 is considered "Good."

Cumulative Effects

This section discloses past, present, and reasonably foreseeable effects from federal, state, tribal, and private land fire use activities. The cumulative air resource analysis is unique in that past impacts to air quality are not usually evident. However, present and foreseeable effects could include impacts from other prescribed forestry burning, agricultural burning, and dust from agricultural lands, residential wood combustion, traffic exhaust, fugitive road dust, or point sources of pollution. Individual sources of smoke from other agencies are too numerous and variable to list. Because of the complexity and uncertainty of timing associated with other agencies burning, coordination with the Montana/Idaho State Airshed Group is critical to minimize cumulative air quality impacts within Idaho and Montana.

Any cumulative effects from this project could impact areas within Airshed 1 and 2. Particulate matter associated with this project could combine with air pollutants from other projects in the area. Prescribed burning, road dust, vehicle emissions, and wildfire could adversely affect the air quality in the analysis area and surrounding area temporarily. The Flathead Valley and areas around Libby could be affected by smoky conditions for short periods during prescribed burning operations or during the summer wildland fire season. Road dust due to log hauling and normal public traffic would be common in the project area. Dust abatement may be used if needed on haul roads to minimize the effects of road dust.

Wildland fires locally, or anywhere in the northwest and Canada, can affect regional haze in the Flathead Valley and Libby area. Wildland fires would continue to produce smoke, primarily during the summer months.

The 1990 air quality rules relate to fine particulates ($PM_{2.5}$), and visibility (regional haze). Additionally, EPA has issued the Interim Air Quality Policy on Wildland Fire and Prescribed Fire. The Interim Policy encourages states to develop and certify EPA smoke management programs to address emissions from prescribed fire and wildland fire use for resource benefits. The operations of the Montana/Idaho State Airshed Group are critical to minimizing cumulative air quality impacts within Idaho and Montana. The purpose of the coordinated operations of the Airshed Group is to minimize the cumulative impacts of smoke from all prescribed fire conducted by its members. This requires considering other sources of smoke including wildland fire use, wildland fire, private citizen burning, and other air pollution sources.

REGULATORY FRAMEWORK AND CONSISTANCY

Forest wide standards for maintaining air quality are: "Coordinate all Forest Service management activities to meet the requirements of the State Implementation Plan, State Smoke Management Plan, and Federal air quality standards" (FNF, LRMP, II-64, Forest Plan). There are no specific Forest Plan directions by Management Area for air quality. Whenever prescribed fire is used, Forest Plan Appendix G states, "Esthetic, visual, soil, air, and water quality concerns will dictate fire management direction in some areas."

The Clean Air Act of 1970 and amendments to the act (1972, 1977, 1990), (42 U.S.C. 7401 et seq) provide direction to protect and enhance the quality of the nation's air resources and to protect public health and welfare. Section 109 of the Clean Air Act requires the EPA to develop primary air pollution standards to protect human health and secondary standards to protect public welfare. Section 110 requires states to develop State Implementation Plans that identify how the state will attain and maintain national ambient air quality standards and other federal air quality regulations. The State Implementation Plan is made known through the Montana Clean Air Act and implementing regulations. The regulations provide specific guidance on maintenance of air quality, including restrictions on open burning (ARM 16.8.1300). The act created the Montana Air Quality Bureau and provides its regulatory authority to implement and enforce the codified regulations.

To maintain compliance with the various regulations concerning maintenance of air quality, Region One of the Forest Service participates in the Montana/Idaho Airshed Group. The

Group is comprised of timber companies and government agencies that commonly conduct prescribed burning, and federal, state, and local air regulators.

The Group has developed a set of smoke management practices intended to maintain compliance with the State air quality standards through a Memorandum of Agreement (MOA) with the Montana Air Quality Bureau. Beginning March 1, 2000, this includes a monitoring system for the months of the open burning season that extends from March 1 through November 30. The Montana Air Quality Bureau recognizes the current smoke management practices and the Montana airshed coordinating process as Best Available Control Technology for prescribed burning. Through this MOA, the Montana/Idaho Airshed Group shares information and coordinates activities to assure cumulative actions do not result in unacceptable effects on air quality in Montana. By participating in the Montana/Idaho Airshed Group, complying with the MOA with the Montana Air Quality Bureau, and meeting the requirements of the State Implementation Plan and the Smoke Management Plan, the proposed activities would comply with the Forest Plan and the Clean Air Act.

By treating both natural and activity generated fuels, the proposed activities would meet the objectives of the Forest Plan in which the fuels management program intends to treat fuels to the degree needed to facilitate implementation of the fire protection program and other dependant activities of the Forest Plan. The proposed activities are also consistent with State laws requiring the treatment of slash to reduce the effects of high intensity fires.