FIRE AND FUELS

Introduction

Fire has historically been the dominant disturbance factor in forests across the northern Rocky Mountains creating the current mosaic patterns observed across the landscape. Most forests have evolved with the continual influence of 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 fire disturbance patterns. A fire regime describes the frequency, predictability, and severity of fire in an ecosystem. Fires 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. Fire 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.

Presettlement wildland fires burned through the summer season until they were extinguish by fall precipitation. In the settlement period before 1941, wildland fire suppression efforts were often not successful and resulted in fires burning thousands to ten 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 fire suppression, fire exclusion, and natural disturbance processes has allowed fuels to accumulate in unmanaged timber stands. This situation currently exists in the West Side area.

Information Sources

Fire history information was obtained from the Flathead National Forest GIS fire history coverage. This coverage was created for and has been used to look at past fire history patterns and pre-settlement fire frequency.

Analysis Area

National Forest System Lands within the West Side Post-Fire Project boundary served as the analysis area to disclose the effects of the proposed project. These lands are located within a much larger ecosystem, which expands across the Northern Rocky Mountains. 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. In most years, fire commonly occurs throughout this area. Fires are occasionally large and have widespread influence on social and biological resources. The following discussion provides an overview of how fire has affected the landscape conditions.

Affected Environment

Fire Ecology

Historically, fire has been the dominant disturbance factor to the forest communities across the Northern Rocky Mountains. The mosaic patterns of the current forested communities are the result. The frequent occurrence of fire across the landscape can cause high mortality to all life forms found in these communities. However, due in part to frequent fire activity many of the vegetation species are well adapted to this fire-dependent environment and display unique survival characteristics. "Fire-dependent forest ecosystems require fire treatment for their continued perpetuation on the landscape" (Habeck and Mutch 1973).

Fire often occurs in this area during dry periods of July and August, and becomes a significant disturbance event. During severe drought periods fire activity would often last well into September.

Where fire has occurred in the most recent past, fuel loadings can be quite variable depending on the forest structure found pre-fire. Prior to the West Side Fires, much of the surrounding area had not experienced a significant fire event for the last 75-100 years, and perhaps as long as 250 years in some portions of the project area. Although fire starts occur frequently from summer lightning storms, fires greater than one acre have been rare since 1929. 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

Wildland fire was a dominant disturbance in the South Fork Flathead watersheds prior to the 1930s. Field surveys by H. B. Ayres for the U.S. Geological Survey in 1898 provide the earliest glimpse of the role fire has played in the watershed. Maps and narrative of the Lewis and Clarke Forest Reserve [including the area in which the West Side Reservoir Fires occurred] describe large areas of "recently burned". His notes state "approximately 310 square miles of the approximate 1860 square miles in the South Fork of the Flathead River have recently burned… most of this burned in 1889, some of it for a second time" also " about forty years ago many fires occurred. Most of the burns of that time have reburned since." These burned and reburn areas are a result of the large fire episode of 1889. His mapping of recently burned areas (circa 1889) are north to northeast of Emery Creek, on Columbia Mountain and east of Graves Creek on the eastside of the South Fork of the Flathead River to the Spotted Bear River. Ayers eludes to fires burning at all levels of intensity (fire severity on vegetation) but the extreme fire episode of 1889 was generally a stand replacement event which burned approximately 26 percent of the total reserve area (approximately 1200 square miles).

Ayres does make a brief reference to the fire severity in the immediate vicinity of the West Side Project Area. He states that,

"The areas having old mixed forests with a fair stock of young growth… such areas occur on the lower half of the South Fork of the Flathead River. The upper portions of this valley has been overrun by moderate fires that have thinned the forest, and while most of the land is restocked, the seedlings are seldom over ten feet high." Also, his vegetative mapping indicates mixed severity natural historic fire regimes occurring at lower to mid elevations transitioning to a natural historic fire regime of stand replacement at mid to upper elevations.

Prior to the West Side Reservoir Fire's in 2003, approximately 76.5 percent of the West Side Reservoir's watersheds had not been disturbed by large wildland fire since 1885, much of it undisturbed for over 200 years.

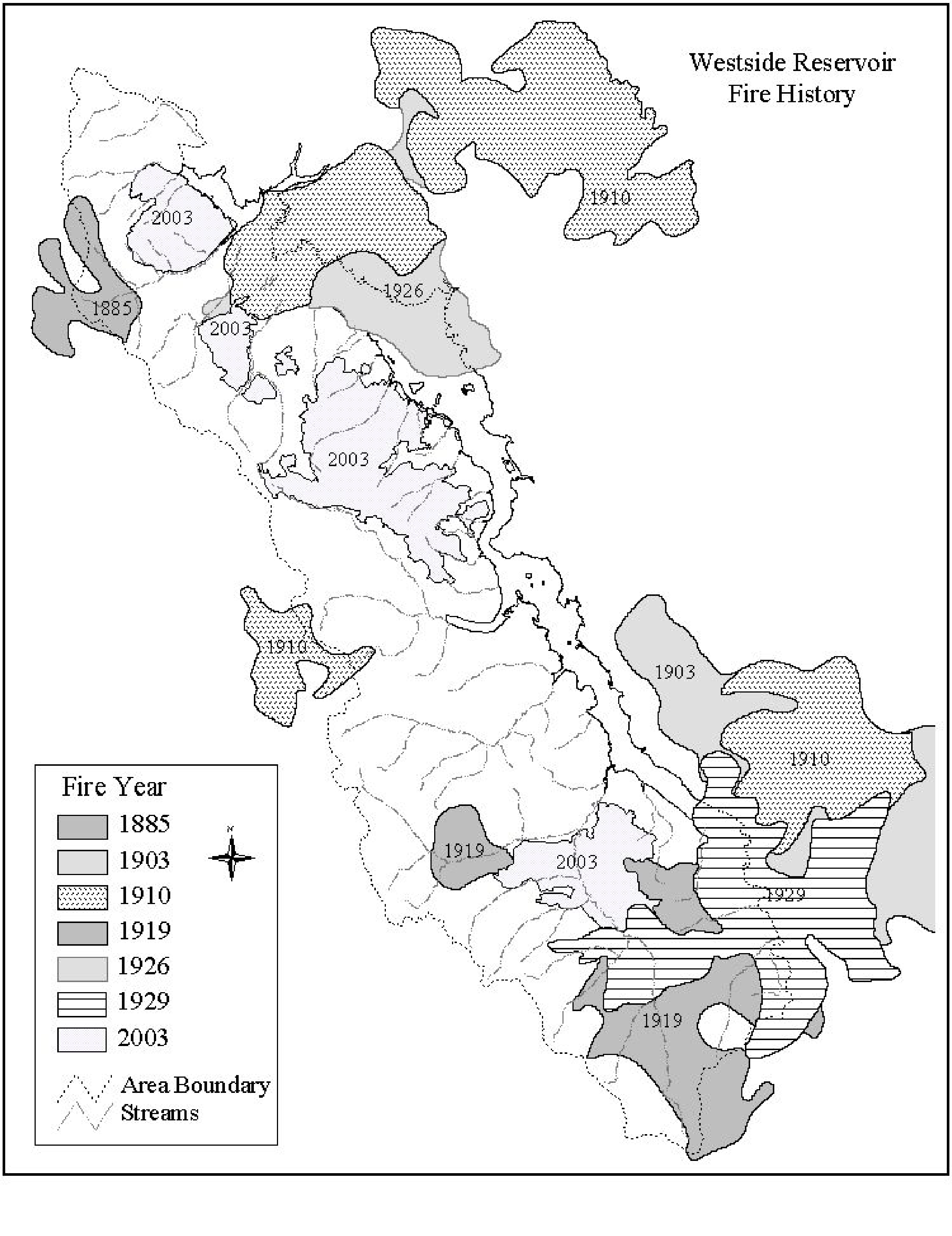
Fire history for the immediate South Fork area indicates that large fires occurred in 1885, 1903, 1910, 1919, 1926 and 1929 (refer to Figure 3-13 and Table 3-31). Summer lightning storms occur frequently over the drainage. Lightning strikes are numerous, occurring more frequently on ridges and mid-slopes, and less frequently at lower elevations. Most storms are accompanied by precipitation. Fire ignitions occurred regularly in the project area prior to 2003 but had not resulted in large fires since 1929. Historically, from 1885 thru 1929 the West Side analysis area averages one large wildland fire affecting acres in and immediately adjacent to the area every 7.5 years. These historic large fires often burn in numerous fires from numerous dry lightning ignitions and average approximately 38,623 acres burned, in the immediate vicinity of the West Side analysis area. The fires of 1910, 1919, 1926 and 1929 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 during episodic fire events accounted for hundreds of thousands of acres burned in the Northern Rockies. The fire season of 2003 was similar to these fire episodes on the Flathead National Forest, which resulted in more than 300,000 acres burnt by wildland fire.

Table 3-31. Summary of Historic Fire Disturbance Effected Acres.

Year of Fire Disturbance	Acres Burned in Project Area	Total Acres Burned	Year of Reburn	Acres of Reburn within Project Area	Total Acres Reburn
1885	2832	5957	none	none	none
1903	30	65,212	1910, 1929	0, 30	17,580, 8567
1910	5717	65,530	1926	3386	21,529
1919	27,461	33,239	1929	9178	11,447
1926	9533	32,918	2003	*	none
1929	13,229	28,880	2003	*	none
2003	31,545	31,545	none	none	none

* Acres not significant due to down wood decomposition period long enough to reduce fuel hazard created by the prior wildfire.

Figure 3-13: Fire History Map



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 northeaster. 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.

Within 12 to 15 years after the occurrence of a large or unusually severe fire, it is expected that fallen, dead timber will create a correspondingly large mass of heavy fuel (Arno, Parsons and Keane 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, Parsons and Keane 1999). In the initial years after the Sleeping Child Fire (1961) tree seedling densities averaged 34,000 per acre (Lyon 1984). Similar tree densities were noted post-fire in the Red Bench Fire (1988) area. 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 3-31 and the Fire History Map of the West Side area we see three of the six wildland fires in the West Side area have experience reburns. The fire of 1903 had reburns occur in 1910 and 1929, reburning approximately 17,850 and 8567 acres respectively. The 1910 fire episode had a reburn of approximately 21,529 acres in 1926. The 1919 fire episode had a reburn of 11,447 acres in 1929. The wildland fires of 1926 and 1929 were not reburned but fell within the effective wildland fire suppression period from 1929 to 2003.

The size, spread, intensity and severity of a reburn fire are affected by many factors. These factors include seasonal timing of the start, drought effects, weather, wind, appropriate management response, terrain and fuels. The McDonald II Fire only burned a few hundred acres of the Gates Park Fire, because it occurred in late July, when the available live surface fuels were still green. Yet when a similar start occurred in late August of 2001, the live surface fuels sustained fire because they were cured and affected by long-term drought (McBratney, personal communication). A similar scenario would occur over time within the West Side Fires. Reburns are not undesirable in and of themselves, but only where the effects of such fires are inconsistent with land management goals and objectives (i.e. desired watershed, soil, fisheries, wildlife, vegetation, or social conditions).

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

- Vegetation conditions would continue to progress towards older, more dense stands dominated by shade-tolerant trees, with extensive "ladder fuels" to carry a fire to the treetops

- Fuels loadings would increase
- Suppression of wildland fires would increase in risk, complexity and cost and the probability of large lethal fires would increase
- Increased intensity and severity exposes firefighters to greater risk and hazard during initial attack and extended attack.

The effects of suppression vary depending on site conditions. 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 West Side Fires the environment was near the end of the natural fire cycle. Overall fire in the project area was still functioning naturally. The mixed to lethal severity fires which burned large areas in 2003 with uniform lethal severity were likely analogous with historical fire occurrence.

The appropriate management response for all wildland fires under the existing Flathead Forest Plan requires that all fires be suppressed (excluding wilderness areas covered under an approved Fire Management Guide or Plan) using the appropriate management response. The National Forest portion of the West Side Post Fire Project area has two different Fire Management Units (FMU)1. The FMU C (Developed Area Concerns) is a one half mile wide corridor adjacent to Hungry Horse Dam facilities including the power lines. 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 appropriate initial attack actions to control a wildland fire.

There are two administrative sites located within the West Side Project area. The first is the Anna Creek Work Station located on Forest Road 895 adjacent to Anna Creek. The immediate area surrounding the work station received fuel reduction treatments during the fire suppression activities of 2003 and is considered adequate in defensible space/FIREWISE for structure protection at the present time. The second area is the Heinrude Lease Site located between Forest Road. 895 and Hungry Horse Reservoir south of Heinrude Creek. This area contains numerous privately owned dwellings and structures on leased public land. The area is a hazardous fuel reduction project in progress with defensible space being improved on yearly.

The risk of a wildland fire affecting private property continues to increase as settlement patterns increase along the private-public interface. The 2003 fire season highlighted the increased risk of major economic and resource losses due to large wildland fire. Although, the West Side Fires did not affect any of the Flathead Valley's wildland, urban interface, the potential for loss of life and property were real with regard to the town of Hungry Horse and the outlying intermix community types along the South Fork of the Flathead River and Hungry Horse Reservoir. The town of Hungry Horse is approximately 2.4 miles north of the West Side wildland fire's perimeter and the closest South Fork Flathead River intermix community is approximately 2 miles north of the West Side wildland fire's perimeter. These areas include many residences that are in heavily wooded areas with limited fire suppression

[1] Flathead National Forest Fire Management Plan- 2002, Appendix C.

access. No zoning or building restrictions currently exist in Flathead County that would limit fire hazard around these homes.

Flammable building materials such as wood shake roofs are popular, but can reduce the likelihood that homes would survive a wildland fire. Bridges with low weight capacities and narrow roads that lack turnarounds can limit emergency vehicle access to homes and limit escape routes. Firefighters have trouble in reaching and successfully protecting homes that have poor access, no defensible space or are not built or maintained to resist catching on fire. Even if firefighters can access property, they often cannot remain on site due to the extreme fire behavior and intense heat caused by heavy fuel loadings adjacent to the buildings. In addition, greater human use of the interface area leads to a higher potential for human-caused fire starts, and a greater risk that fires originating on private land could spread to National Forest System Lands.

Fire Effects

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 particular true in areas where low to moderate intensity fires are common. However, in large fires, areas with heavy fuel loadings fire would burn at intensity and severity levels that would result in greater mortality to more of 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 West Side Reservoir analysis area can be described in a number of ways:

- Effects of the recent West Side Fires – 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

<u>Effects of the West Side Reservoir Fires</u>

The West Side Reservoir Fires burned with a range of intensities, severities and durations, resulting in a mosaic of effects on the vegetation and soil. These effects are referred to as the ecological effects of fires, usually on the dominant organisms of the ecosystem, i.e. a stand dominated by lodgepole pine (Agee 1997). 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 and duration of heating of the soil surface. A discussion of fire severity is included in the vegetation and soils sections of this chapter.

Table 3-32 displays the approximate acres burned by vegetation burn severity level on National Forest System Lands in the West Side Reservoir Fire's perimeters. Figures 3-1 through 3-4 display the fire perimeters and the severity levels.

Table 3-32: Acres burned on National Forest System Lands/% of Total Fire Acres by Vegetation Burn Severity Level

Severity	High*		Moderate		Low		Unburned**		Total Acres***
Totals	13,070	41%	9354	30%	7900	25%	1221	4%	31,545

* Includes "Burned: seedling/sapling severity class.
** Unburned areas within the fire perimeter.
*** Does not include non-forest acres (primarily river, water, wetlands).

Although fire suppression for over 70 years on these sites have resulted in changes to forest communities, fire behavior and resulting fire severities were not outside the range of what has historically occurred in Flathead River drainages. 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 will continue to be the appropriate management response for these forested systems given the: high resource values, the proximity to town sites, the outlying intermix communities and the associated facilities of the hydroelectric installations associated with Hungry Horse Dam (operational in 1952).

Although fire starts have occurred at regular intervals as a result of frequent lightning storms in the area, all of these starts were rapidly extinguished through suppression or natural process. During the fire seasons of 1988, 2001 and 2003 there have been five extreme exceptions to fires being rapidly extinguished. These are: Red Bench, Moose, Robert, West Side Reservoir Complex and Wedge fires respectively. Historic fires that have commonly occurred in this area have created forest communities dominated by western larch and lodgepole pine, spruce and to a lesser extent, Douglas-fir.

Historical Fire Regimes

Historical Fire regimes are a classification system used to describe areas of similar fire behavior (frequency, severity, extent, pattern) across an ecosystem. The watershed has not changed significantly from its historic fire regimes.

A majority of the watershed is in a stand replacement (lethal) fire regime with a 200+ 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 200 year lethal fire regime was found throughout the drainage primarily in the cool, moist habitat types.

A small portion of the watershed is classified in a mixed severity fire regime with a fire return interval of 35-100 years. This regime is confined to the drier south and west aspects in the Douglas-fir cover types, and low to moderately steep slopes (generally less than 35 percent slope) at lower elevations adjacent to Hungry Horse Reservoir in which the overstory is dominated by western larch remnant cohorts.

Currently, fire regimes within the West Side analysis area perimeter remain in predominately a stand replacement (lethal) fire regime with a 200+ year fire return interval based on the fuels and cover type typical for the area. Outside the fire perimeter, the dominant fire regime also remains lethal with a 200+ year fire return interval.

Condition Class

Condition classes (refer to Table 3-33) 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). The relative risk of losing one or more key components that define an ecological system (such as hydrologic function and vegetative attributes) is the basis for defining current fuel condition class within a project area.

Subsequent to the West Side Fires, the burned area is Condition Class 1. The areas unburned and that are in the stand replacement fire regime are also in Condition Class 1. Although the areas unburned by the West Side Fires and the historic fires of the later 1800's through the 1929 fires in the stand replacement fire regime are nearing the end of their natural fire cycle. The mixed severity fire regime's areas left unburned by the West Side Fires may be Condition Class 2.

Environmental Consequences

No significant issues related to fire influences were identified (refer to Chapter 2).

The following Effects Indicator was 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, reburn potential)
- Effects on wildland fire starts and suppression (effectiveness, cost, safety)
- Effects on prescribed fire escape risk (pile burning and/or jackpot burning)

Table 3-33: 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 significantly 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 patterns. Vegetation attributes have been significantly 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.

Direct and Indirect Effects

Alternative 1- No Action

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 1, there would be no fuels reduction and the probability of more severe fire behavior will increase as snags fall (Arno & Brown 1991). Historically, fires of this nature are not without precedent on the Hungry Horse and Spotted Bear Ranger District, as described in the Affected Environment section, with the initial wildland fire disturbance followed by a reburn occurring frequently. Currently in areas within the West Side Fire Project that burned at high severity, most of the potential fuel has burned and is charred. As snags fall and fine fuels from grasses, shrubs and conifers develop, a fuel complex capable of carrying a reburn wildland fire event will exist. Fuel loads may exceed 70 tons per acre, and in many cases may surpass 100 tons per acre (Fischer 1981).

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

Fire intensity is driven by the amount of fine fuel in the fuel complex and fuel moisture, both dead fuel and live fuel where it is a significant component of the fuels complex (Rothermel 1983, Agee 1993). The risk for future high intensity fire in the post-fire plant community is driven, in part, by the amount of fine fuels in the fuel bed and the extent and type of live fuels present that are also available for burning (live fuel moisture drops below a critical level).

Fire severity as it relates to soil damage is a function of fire duration. Fire duration, in turn, is a function of fuel loading, fuel moisture, particle size, and packing ratio. As well documented in smoke management literature (see for example NWCG 2001) the more fuel available to burn (loading and moisture), the greater the consumption. The smaller the particle size, the quicker it would burn, hence the importance of fine fuels to fire intensity (Rothermel 1983, Agee 1993). The higher the packing ratio of the fuels, the longer such fuels can burn. Thus downed logs and duff are the main contributors to fire severity as defined above (Agee 1993). Burnout time for duff and downed logs can be days, as opposed to hours for finer fuels. When large concentrations of downed logs exist, the potential for fire severity increases due to fire residence time associated with these logs burning. Burning of the concentrated fuels results in soil temperatures remaining high for several hours and significant changes in soil properties; whereas the soil temperatures produced in low severity fires may not result in any appreciable changes in soil properties (DeBano 1991).

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

The large fuels remaining in the burned area will decay slowly, and likely remain on the landscape until it burns again. A reburn results when fall-down of the old burned forest contributes significantly to the fire behavior and fire effects of the next fire. The possibility of a reburn is small on any site, but it is high over the landscape. Accumulations of large woody fuels can hold a smoldering fire on a site for extended periods. Heat from the large fuels in direct contact with the ground could have severe effects on soils. Potential for spotting and crown fires is greater where large woody fuels have accumulated (Brown et al. 2001, unpublished). A severe fire occurrence in the next several decades would depend on amount of fuels present, vegetation development, point of ignition, and weather. Based on Brown's paper, potential spread of a future fire in the areas that burned in 2003 at a moderate to high severity are described as follows.

0 to 10 years after 2003 fires – Severe fire is unlikely because large woody fuels would still be accumulating and there would not be enough decay to support prolonged smoldering combustion.

10 to 30 years after 2003 fires – Most of the large woody fuels would have fallen down, with some decay to support prolonged burning. A duff layer would not be well established. High severity burns would primarily occur where large woody material was lying on or close to the ground. High severity burns could be substantial where a large portion of the soil surface was directly overlain by large woody pieces.

30 to 60 years after 2003 fires – Large woody fuels would have considerable rot; a duff layer may be well established depending on the amount of overstory conifer. More severe burning is possible, depending on extent of soil coverage by large woody pieces. If a conifer overstory is present, crowning and burnout of the duff could amplify the burn severity.

The West Side Fire area would resist fire growth and spread in the short-term until there is enough vegetation to carry and sustain fire into the larger dead downed fuels that have and would continue to accumulate on the ground (refer to Direct and Indirect Effects Alternative 1- No Action above for additional discussion). 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. Snags would begin to fall, with the majority being on the ground in the next 10 to 30 years. Historically, the 10 to 30 year period following a wildland fire disturbance is the most prone for the large size reburn scenario to occur in Northwest Montana.

Fire behavior 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). Fuels contribute to the rate of spread of a fire, the intensity of the fire, how long a fire is held over in an area, flame length, and the size of the burned area (Rothermel 1983). Removal of fuels helps to reduce or retard wildfire spread and severity (Pollet and Omi 1999). Fuels are broken into 3 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).

Fire behavior is affected by fuel characteristics such as forest density, species composition, amount of surface fuel, arrangement of fuels, and fuel moisture content (Rothermel 1983). Fuels are the only element affecting fire behavior that can be controlled. Fuel management can include reducing the loading of available fuel, converting fuels to those with lower flammability, or isolating or breaking up large continuous bodies of fuels (Debano 1998). Fuel management includes: reducing the loading of available fuels, converting fuels to those with a lower flammability, or isolating or breaking up large continuous bodies of fuels (Ibid).

Beschta et al. (1995) states that "We are aware of no evidence supporting the contention that leaving large dead woody material significantly increases the probability of a reburn." We agree with the authors of the Beschta Report that the amount of fuel does not affect the probability of reburn or wildland fire ignitions in general. The meteorological and physical processes that generate lightning, and the human behavior that leads to human-caused fires, with existing fuel moistures determine the probability of reburn. The purpose and need of the fuel reduction portions of the West Side Post Fire project proposal is not to reduce the probability of reburn or the occurrence of future fires. Rather, it is to reduce the intensity and severity of future fires, when they inevitably occur, by reducing the amount of dead vegetation that would fall to the ground and accumulate over time. There is abundant scientific evidence that increased fuel loads can result in increased fire intensity and severity (DeBano et al.1998, Omi & Martinson 2002, Rothermel 1983, Arno & Brown 1991, etc.). 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.

As stated in the Beschta document, the degree of alteration of fire regimes varies across the landscape. Moist forest types (low frequency-high intensity fire regime), such those found throughout the project area, have been less altered through fire suppression activities than dry pine forests (high frequency-low severity fire regime) (Agee 1994).

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 will be reduced, as described in Table 3-34. Specific differences in Alternative C are addressed below.

Table 3-34: Fuel Reductions by Alternative

	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Total Salvage Treatment Areas	0 acres	4921 acres	3949 acres	5300 acres	5338 acres

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 using The USDA, Forest Service, National Fuel Classification and Inventory System, Post

Treatment Photo Series for Region 1, of the Moose Fire post salvage treatment areas indicate a fuel bed mosaic varying from approximately 15 to 60 tons per acre. The salvage treatment areas proposed in the West Side project area are expected to result in similar fuel bed characteristics as the Moose Fire post treatment areas. The objective during harvest will be to minimize the amount of slash on the ground from logging operations. If soil conditions and access allow, excessive slash may be treated by slash piling and prescribed pile burning.

The landscape level risk of large wildfire within the West Side Fire project area would increase over time as vegetation continues to fill in the burned area, 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 West Side Fire area. Salvage logging under Alternatives B, C, D, and E 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, piling, of the dead standing trees and subsequent prescribed fire use 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 fuels (Ibid).

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

There is no support in the scientific literature that the probability for reburn is greater in post-fire tree retention areas than in salvage logged sites. The real question is not whether there is a greater probability for reburn, but if reburns occur would they be of greater intensity and more destructive to resources. The Beschta authors are correct that the intense reburn concept is not reported in the literature. It took time since fire suppression started (early 1900's) for forest tree density and cover to increase, and it took time for random ignitions to burn these altered sites (Entity Fire 1970, 107,000 acres; Dink Leman Fire 1989, 52,000 acres; Tee Fire 1994, 140,000 acres). Because of the timetables involved, the field-testing of the intense reburn concept started in the recent past and would continue into the future.

A precise evaluation of the effects of salvage logging and total tree retention on reburn fire intensity has not been accomplished. 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 action alternatives would reduce dead tree biomass by approximately 40% to 80% from the no action alternative, which would subsequently reduce fire intensity and flame length in those areas treated. Fire intensity would be greater in untreated areas due to high amounts of dead biomass.

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 in the West Side Fire 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 would 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) state “Surface fuel management can limit fireline intensity and lower potential fire severity”.

As compared to the existing condition, alternatives B, C, D, and E all reduce roads available for initial attack of fires. This reduction in available road mileage could increase the response time of firefighters in the event that a fire would have been previously accessible by road. The reduction will also reduce the potential for human caused fires that may occur because of reduced road access.

Table 3-35. Available roads for travel by fire management resources [2](miles)

EXISTING		Alt. B	Alt. C	Alt. D	Alt. E
With decisions	Without decisions				
245	263	168	155	149	167

All mileages for alternatives include existing decisions

Table 3-36. Available roads for travel by fire management resources behind berms [3](miles)

EXISTING		Alt. B	Alt. C	Alt. D	Alt. E
With decisions	Without decisions				
49	72	85	78	82	85

All mileages for alternatives include existing decisions

Remote, limited access fires are common on the Flathead National Forest. The fire management response to a new fire varies depending on fuel conditions, topography, current and

[2] Roads that are considered available for travel are all roads open yearlong, open seasonally, and closed yearlong with a gate.
[3] Roads that are closed yearlong behind berms may be available for travel, but only after equipment arrives to open the road. They are not considered available for initial attack.

expected weather, and values at risk. If it is determined that a new fire has low potential for growth and response time is not critical, then firefighters may walk to the fire. If response time is critical, aerial delivery of firefighters may be necessary. Options for aerial delivery include smokejumpers, helitack crews, or heli-rappel crews. Aerial delivery may increase the initial cost of managing the fire, however it can be a more effective and efficient method in limited access areas.

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.

All of the action alternatives would limit fire suppression vehicle access to portions of the West Side Fire area and surrounding National Forest System Lands. Closing roads also minimizes the potential for person caused fires that may occur by reducing travel along roadways. Early detection would continue to play a key role in preventing small fires from growing into large fires. The exception to this would be where fuel loadings are high due to fire exclusion or the fire regime. Access may be limited and may prevent rapid response time from ground personnel due to road closures. 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.

Closing roads generally would not affect public safety. The precise location of a fire start cannot be predicted. Fire behavior of a start also cannot be predicted, because weather and fuels vary over time. If extreme fire conditions are predicted or exist, restrictions and/or closures would be put into effect to limit public access to the forest. Generally, fire spread and intensity (based on typical fuels and weather within the West Side Fire area) would not impede exit access from a general fire area.

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 prescribed involves machine piles. These are burned in late fall when soil and fuel moistures would prevent spread beyond the piles.

Direct and Indirect Effects Specific to Alternative C

The effects of salvage logging would be slightly different in this alternative, due to the difference in treatment prescription and/or acres treated. Additional snags and woody debris recruitment material would be retained in treated areas, thus retaining a greater dead fuel loading, and the potential for a greater downed dead fuel loading in comparison to the salvage prescription and/or acres treated in other alternatives. Over time this would create potential for a slightly higher intensity fire, relative to other alternatives. This alternative treats 3949 acres with salvage logging.

Cumulative Effects

Cumulative Effects of Alternative A

Change would occur as an inevitable and natural consequence of the working of ecosystem processes. The West Side Fire area will begin immediately to re-vegetate beginning a natural succession eventually creating a forest much like the one that burned in 2003. The naturally occurring longer fire intervals and fire exclusion in combination with natural processes such as insect, disease and fire mortality, allow forests to grow and change through any existing stand structure diversity, typically leading to more uniform and more flammable conditions.

Over time, these natural increases in vegetation and downed woody debris increase the probability that any future fire would be a high intensity, lethal severity fire and involve large areas. The risk of this kind of wildland fire in the West Side Fire project area increases substantially over time under all Alternatives.

Cumulative Effects of Alternatives B, C, D and E

As with the no action alternative, change would occur as an inevitable and natural consequence of the working of ecosystem processes. Proposed treatments are of a scale that they would not substantially alter landscape level vegetation development over time, or the potential fire behavior when/if another fire occurs.

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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