Forest Vegetation

Introduction

This report documents the analysis and silvicultural review of forest vegetation associated with the Mid Swan Blowdown Salvage Project. The report describes the analysis area(s), the methodologies used, the affected environment, and the environmental consequences of implementing the alternatives to forest vegetation. Detailed information relative to forest vegetation which is not included in this report is located in the project record and/or individual stand files located at the Swan Lake Ranger District.

During project development, internal and external discussions revealed several issues and concerns relating to forest vegetation. These issues help frame this forest vegetation analysis and include:

- Effects of the alternatives on forest insect and disease conditions, primarily related to bark beetles.
- Effects of the alternatives on old growth characteristics.
- Effects of the alternatives on snags and down woody material.
- Effects of the alternatives on the recovery of salvable timber volume.

The effects of the alternatives on other vegetation components such as invasive species, threatened, endangered, or sensitive plants and animal habitats, and fire and fuels are analyzed in respective sections of the Mid-Swan Blowdown Environmental Assessment.

Analysis Area

The scale of the analysis area was chosen to allow sufficient size and time to illustrate the potential effects of the alternatives without those effects diminishing to unnoticeable levels. The following descriptions identify the analysis area for this project.

Spatial Bounds

The spatial boundary for this analysis is the Mid Swan Blowdown Project Area, also referred to as the analysis area. This 4,480-acre area is large enough to capture trends and patterns of forest vegetation, but not too large to have the potential effects of the 690 acres of proposed actions associated with this project so small as to be negligible. This boundary was also chosen because it includes the areas most significantly affected by the wind events.

Temporal Bounds

The temporal bounds of this analysis are designed to capture the direct, indirect, and cumulative effects of the alternatives to forest vegetation within the analysis area. Activities are planned to begin in 2009 and would likely take one or possibly two seasons to accomplish. It is difficult to estimate when a random event, such as these wind storms, may occur again and establish similar pre-treatment conditions. Given this, the effects of the proposed activities (essentially removing down and damaged trees) would likely last between 15 and 100+ years. Where salvage treatments are proposed, an effects time frame of 15 to 20 years is estimated. This length of time was chosen by reviewing forest succession data for western Montana, which describes stand development over time

(Arno et al. 1985). After this length of time it is believed that, in the absence of stand replacing disturbance or additional treatments, natural forest succession processes would alter residual stand conditions. This is due to accumulation of surface fuels, height growth of advanced regeneration, ingrowth of shade tolerant species, expansion of residual tree crowns, and individual tree mortality. Some effects, such as changes in species composition and large down woody material, could last even longer (i.e., 100+ years). The temporal bounds of past activities for the cumulative effects analysis is limited to the 1950's by the availability of accurate data relating to forest vegetation conditions. Due to planning time frames, the temporal extent of future actions relating to forest vegetation is defined as 5 years.

Data Sources, Methods, & Assumptions Used

Methodologies

Silvicultural Prescription and Diagnosis Process

The silvicultural prescription and diagnosis process provides information with which to move the forest vegetation toward a desired condition and meet management objectives. It is a systematic process that integrates interdisciplinary resource goals and objectives and identifies silviculturally sound treatments to achieve those objectives. The process can be done at both the landscape and stand level. The Forest Service Handbook (FSH 2409.17) provides national and regional direction for the prescription and diagnosis process.

Landscape Level Process: The landscape level diagnosis process normally precedes the stand level process. This helps to place stand-level analysis into context with the surrounding ecological conditions. The Flathead National Forest Guide for Watershed Analysis provides direction related to this process. The following steps are typically included in the landscape level diagnosis process:

- **Step 1**: Characterize the current existing condition of the landscape.
- **Step 2:** Develop desired landscape conditions based on overall landscape characteristics, capabilities, resource objectives, and land management direction.
- **Step 3:** Identify treatment options and alternatives that could move the landscape towards the desired condition. This is accomplished by comparing the existing condition to the desired condition.
- **Step 4:** Develop a silvicultural prescription for the landscape which includes the generalized activities that could achieve the desired condition.

Stand Level Process: As mentioned above, this process commonly follows and closely parallels the landscape level analysis but at a more site-specific scale. The following steps are used in the stand level process to systematically achieve desired stand and ultimately desired landscape conditions.

- **Step 1:** Examine and identify existing stand conditions.
- **Step 2:** Develop desired stand conditions based on site capabilities, site characteristics, resource objectives, and land management direction.
- **Step 3:** Compare the existing stand conditions to the desired stand conditions and consider options that will achieve the desired conditions.

The following options should be considered:

- No action if the current stand conditions acceptably meet the desired condition.

- Modify the existing stand through intermediate treatments (thinning, prescribed fire, or other activities, which do not replace the current stand) to meet or move closer to the desired stand condition.
- Replace the current stand if it cannot be reasonably modified to meet the desired stand conditions. All regeneration options should be considered including uneven-aged, two-aged, and even-aged methods.
- Stabilize or improve the existing stand if it cannot be modified or replaced (due to external conditions) to meet the desired conditions at this time. This will essentially hold the stand until replacement can be considered. Treatment options may include sanitation, salvage, or other actions.
- Defer treatment because conditions external to the stand do not permit any treatment at this time, even though the stand does not currently meet the desired condition.
- **Step 4:** Develop a detailed silvicultural prescription for each treatment area that identifies the area to be treated and the specific activities to be implemented. This step is done following the issuance of a decision by the Deciding Official.

Both a landscape and stand level diagnosis were used for this project. However, the process differed given that this project responds to a natural disturbance. The wind storms determined which stands, and/or portions of stands, were affected and to what degree. Therefore the diagnosis process dealt primarily with examining the post wind condition of only those affected areas. Additionally, the options to move the existing condition toward the desired conditions were limited. Appendix A of the Silviculturist's Report, Project File Exhibit G-1, contains detailed information relative to the diagnosis for each area analyzed using this process for this project.

Spatial Analysis

Spatial analysis of the forest vegetation resource for this project was done using the ArcMap 9.2 software. Data from the Flathead National Forest Geographical Information System (GIS) Library was used as the basis for the analysis. A number of project specific GIS layers were created by Ranger District Resource Specialists. Note that slight variations in area calculations may result from spatial analysis.

Remote Sensing

The LANDFIRE (Landscape Fire and Resource Management Planning Tools Project) biophysical setting and fire regime layers were used to help characterize historical/potential vegetation types and disturbance regimes within the analysis area. LANDFIRE is an interagency vegetation, fire, and fuel characteristics mapping project. Detailed descriptions of the biophysical settings and fire regime groups used in this analysis can be obtained at the LANDFIRE website at http://www.landfire.gov/NationalProductDescriptions24.

The 2006 R1 VMAP product, developed by the Forest Service Region One Geospatial Services Group, was used to estimate stand conditions where existing inventory data was lacking or determined to no longer reflect current stand conditions. R1 VMAP classifies vegetation into spatially distinct polygons with attributes related to life form, dominance type, size class, and canopy cover. VMAP data was incorporated into a GIS layer that identified forest vegetation attributes within the project area.

Forest Growth and Yield Modeling

The Forest Vegetation Simulator (FVS) was used to model stand hazard and risk of additional losses in wind damaged and adjacent stands from various bark beetles. Specifically, Version 2.02 of the Suppose Interface and the Inland Empire Variant were used. Due to limitations in data, only a sample of the stands within the analysis area were modeled and results were extrapolated to stands with similar conditions.

Data Sources

Landscape Level Analysis

A landscape analysis was completed in February, 2004 for the Upper Swan Valley. The Upper Swan Valley Landscape Assessment (Project File Exhibit R-2) was completed by the Swan Ecosystem Center in cooperation with the Forest Service and provides a broad view of existing and historic vegetation conditions. The Mid Swan Blowdown Project falls within the area this assessment analyzed.

Additional data was used at a finer scale to characterize the landscape associated with this project. Forest Inventory and Analysis (FIA) plot data was summarized and used to describe existing forest vegetation conditions. Forest Inventory and Analysis plots are installed at random locations on all land ownerships across the country. These plots are monumented and re-measured over time. This provides the ability to make estimates of forest conditions over broad areas and at variable times.

Data related to historical forest vegetation conditions was derived from a variety of publications and will be referenced later in this report.

Insect and Disease Aerial Detection Surveys are conducted annually using fixed-wing aircraft and sketch mapping technology. Data associated with these surveys was incorporated.

In June 2003, the Swan Lake Ranger District completed the Meadow Smith Record of Decision. This document and the associated Environmental Impact Statement (EIS) provide data relating to forest vegetation in the vicinity of the analysis area and were also referenced. A copy is on file at the Swan Lake Ranger District Office.

Stand Level Analysis

Individual stand inventory data was used in the stand level silvicultural diagnosis process and in the analysis of the affected environment. Stand level data has been collected over time using Forest Service stand exam protocols. Stand exam data used in this project was collected between the years 1981 and 2008. This stand data is stored in the Timber Stand Management Records System (TSMRS) and the Field Sampled Vegetation (FSVeg) databases.

In addition to the stand exam data previously mentioned, each stand within the analysis area that was affected by wind damage and provided an opportunity for management actions to meet the project objectives as described by the Forest Plan had a silvicultural walkthrough conducted in 2008 by the District Silvicultural Staff. During these walkthroughs, observations of forest vegetation conditions and the stand level diagnosis process were documented. This information is summarized in Appendix A of the Silviculturist's Report (Project File Exhibit G-1) and hard copies of this information are on file at the Swan Lake Ranger District Office.

Stand level data from these sources was complied into GIS layers and analyzed spatially using the methods described above.

Assumptions

When completing an analysis of a dynamic resource such as forest vegetation at this scale some assumptions are necessary. Assumptions were also made due to variation and interpretation of terminology and standards associated with silviculture and forest vegetation conditions. The following are some assumptions used in this analysis:

Vegetation data used in this analysis is assumed to represent current on-the-ground conditions. Efforts were made to ensure that this assumption is true including:

- Field verification,
- New stand exam data collection, and
- Aerial photo interpretation.

At the time this report was written, no large-scale or catastrophic events were known to have occurred since the data for this analysis was compiled.

GIS data used in this analysis is assumed to be accurate to within acceptable standards. This includes ownership boundaries, stand delineations, project and analysis area boundaries, etc.

Modeling of forest stand dynamics using the methods described above gives a reasonable estimate of stand hazard and risk using established methods. The outputs from this modeling can be applied to “un-modeled” stands with similar conditions, existing on similar sites, and within close proximity to the modeled stands.

Definitions of terminology related to silviculture and forest vegetation for this analysis come from The Dictionary of Forestry (Helms, 1998) and/or the Forest Plan and associated amendments.

Areas identified as “Old Growth” in this report are those areas that meet the specifications and descriptions in Old-Growth Forest Types of the Northern Region (Green et al. [as amended]) for the Western Montana Zone.

Best Available Science

An internal review of literature was conducted prior to this analysis in order to compile relevant information. Sources included recent and historic peer reviewed publications, past Forest Service environmental analyses, relevant MS and PhD thesis works, and contractor and Forest Service Specialist Reports. If contradictory information is presented through the public involvement process for this project, it will be addressed in the responses to comments section included in the Decision Notice.

Inconsistency between Resource Effects Analyzes

The effects of the alternatives may vary (either positively or negatively) depending on the resource area being analyzed. It is possible that this could occur even for a particular measurement indicator. It is also possible that inconsistency could arise between resource areas based on inconsistent use of terminology.

Measurement Indicators

Four measurement indicators were identified to evaluate the effects to forest vegetation. These were chosen because they are measurable (both qualitatively and/or quantitatively), are affected by

silvicultural activities, and are related to the project's Purpose and Need. See the Fire and Fuels Section of this EA for more detailed discussions related to reduction in fuel loadings and shifting fire behavior.

1. **Bark Beetle Conditions:** This indicator will measure the extent of known bark beetles in the analysis area and discuss the effects of proposed actions to these beetles. It will also report the risk of bark beetle damage to stands within the analysis area.

2. **Old Growth Characteristics:** This indicator will discuss the effects of proposed actions on management toward late seral/old growth conditions, vegetative fuel continuity, and landscape health/pattern/function.

3. **Snags and Coarse Down Woody Material (CDW):** This indicator will discuss the effects of the proposed actions to these forest vegetative attributes.

4. **Salvage Volume:** This indicator will highlight the variation in salvage volume between alternatives.

Affected Environment

This section will explore and discuss the historic, existing, and desired conditions of general forest vegetation within the analysis area. This information is useful in placing the proposed actions into context.

Historic Conditions

Much work has been done related to the historic forest vegetation conditions of the Swan Valley and western Montana. While this work covered broad areas, they often included portions of, and can be applied to, the analysis area. The Upper Swan Valley Landscape Assessment (Project File exhibit R-2) includes a detailed historical analysis that is also applicable to the analysis area. Historical forest vegetation conditions provide us with an idea of what the area looked like at various points in time. However, it is important to remember they are limited by the availability and accuracy of historical information and do not necessarily identify ideal conditions given today's ecological and social environment.

Historic Disturbances

Disturbance relative to forest vegetation can be defined as a relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resource availability or the physical environment (Helms 1998). Observations and recent studies (Barrett 1998 and 2002; Ayers 1898; Arno et al. 1995; Freedman and Habeck 1985) indicate that fire has been the most influential natural disturbance factor following the retreat of the most recent glacial events in the Upper Swan Valley. Fire also provides us a record of its effects to forest vegetation, through fire scars and forest conditions, making it one of the most easily analyzed historic disturbances. Many other natural and human-induced disturbance factors have influenced the forest vegetation in and around the analysis area including:

- Insects
- Disease
- Floods
- Residential and commercial development
- Wind
- Invasive species
- Transportation systems and
- Timber harvest

Data were available from recent studies and historical accounts to determine some of the historic disturbances related to fire and insects and diseases. Most of the anthropogenic disturbances will be discussed later in the Ownership and Management section.

Fire: Research studies have looked closely at the fire history and fire regimes within the Swan Valley. At least one of the associated research plots is within the analysis area and others are within 1 mile of the analysis area. These studies, combined with fire history data from historical accounts, provide a picture of how fire has been a dynamic agent of change in the area's forest vegetation.

Fires were frequent in the Swan Valley until the early 1900's, with the earliest fire evidence dating from about 1241 A.D. On average, a fire occurred about every 8 years (range of 3 to 23 years) between 1586 and 1929 in the Upper Swan Valley, with the last major fire occurring in 1929 (Barrett 2002). Barrett (1998) reported that 1768, 1814, 1850, 1889, 1910, 1919, 1929 were important fire years in the Swan Valley. A GIS Dataset from the Flathead National Forest's GIS Library spatially displays the locations of some of the major fires in those years within the analysis area (Project File Exhibit G-1, Figure 1).

Arno and others explored the fire history of late seral ponderosa pine, Douglas fir, and western larch stands in the vicinity of the Mid Swan Project Area. They found that frequent low intensity surface fires maintained these stands with an open understory structure. Fire scars revealed evidence of fire between 1601 and 1899 with a mean fire interval of around 20 -30 years (Arno et al, 1995).

Fires were the result of natural causes, such as lightning and traditional burning by Indians (Barrett and Arno 1982; Ayers 1898; Arno, et al. 1997; Barrett 2002 and 1998). Most Indian fires occurred in the valley grasslands and lower-elevation forests dominated by ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and western larch (*Larix occidentalis*). These fires were likely ignited to improve big game browse, berry production, food gathering and hunting, improved travel, communication and horse grazing (Barrett 1981).

Areas of similar fire severity, frequency, size, and pattern have a similar fire regime (Brown 2000; Long 1998). The Upper Swan Landscape Assessment (Project File Exhibit R-2) defines three identified regimes in the area:

1. Frequent, low intensity non-lethal severity fire regime with 1 to 25 year intervals.
2. Less frequent and more severe mixed severity fire regime with 25 to 75 year intervals resulting in scattered mortality.
3. Infrequent stand replacing lethal severity fire regime with intervals greater than 75 years (SEC, 2004).

Most fires burned with low to moderate severity, with the occasional severe fire creating a diverse mosaic across the landscape of mature stands that burned repeatedly interspersed with younger fire regenerated age classes. During the pre-settlement era, valley bottom forests were dominated by mixed-severity fire regimes; low-severity fires were restricted to the driest terrain, and high severity fires were largely found on steep slopes at higher elevations and moist canyon bottoms (Barrett 2002). Barrett (1998) looked closely at the areas unique riparian "pothole" stands from a fire history stand point. He found that even in these areas, frequent non-lethal and mixed severity fires burned within a few feet of the shoreline at intervals similar to adjacent drier sites.

One of the LANDFIRE project products includes a GIS layer identifying fire regime groups. While LANDFIRE is a national project developed at a relatively coarse scale, local fire history researchers and fuels managers feel that data in this fire regime group GIS layer is a reasonable representation of the fire regimes in the Swan Valley landscape. Within the analysis area, LANDFIRE reports two major fire regime groups (IV at 13 percent and III at 87 percent). Table 3-9 summarizes these fire regime groups. See the Fire and Fuels Section of this document for more site-specific discussion of fire regimes within the project area.

TABLE 3-9.
LANDFIRE FIRE REGIME GROUPS

Group	Frequency	Severity	Severity Description
I	0 – 35 years	Low / mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory
II	0 – 35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory
III	35 – 200 years	Mixed / low	Generally mixed-severity; can also include low severity fires
IV	35 – 200 years	Replacement	High-severity fires
V	200+ years	Replacement / any severity	Generally replacement severity; can include any severity type in this frequency range

In the summer of 2003, the Crazy Horse Fire burned approximately 11,000 acres total occurring within 15 miles of the analysis area. The Holland Peak Fire burned roughly 1,600 acres on the east side of the Swan Valley, 14 miles from the Mid-Swan Blowdown Project Area in the summer of 2005. These fires are the largest and most recent fires in the Upper Swan Valley. Both fires burned in a mosaic pattern with variable intensities. Both fires do contain considerable contiguous acreage where stand replacement burning occurred.

Insects and Diseases: Numerous forest insects and diseases exist within the analysis area and larger Swan Valley at endemic levels. They have been interacting with and shaping the forest vegetation in the analysis area for some time. Those currently present and affecting forest vegetation are discussed in the Existing Conditions Section of this report.

Historical accounts indicate that epidemic insect outbreaks have occurred in the area in the past. The most well documented epidemic was an outbreak of spruce bark beetles in the Swan Valley following a large scale wind event in 1949 (Project File Exhibit R-2).

It should be noted that two major diseases currently affecting forest trees are non-native and were not historically present within the analysis area. Larch casebearer was introduced from Europe and arrived in the Swan Valley in 1968. This defoliator's population peaked in the 1970's and is now declining. White pine blister rust was introduced in 1910 and has since had a dramatic effect on the forest composition within the Swan Valley. Western white pine in the

mid-lower elevations and whitebark pine in the upper elevations have been significantly affected by this disease.

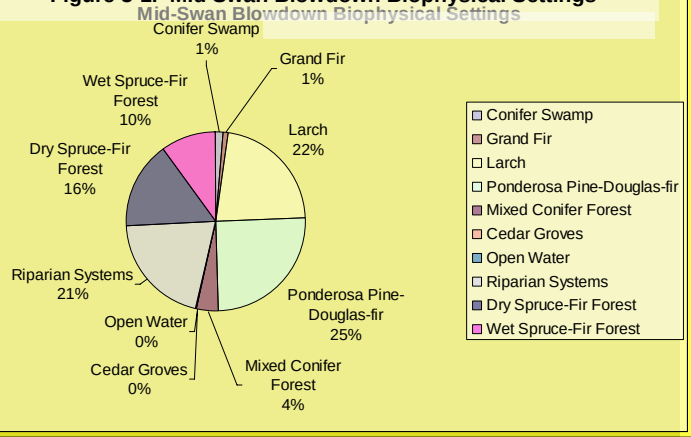
Other Disturbances: Undoubtedly, as this project supports, other natural disturbances have occurred throughout history in the area. Most are not well documented, except for the major wind event in 1949 mentioned above.

Historic Forest Vegetation Conditions

The forest vegetation conditions within the Swan Valley have been documented at various times throughout history starting at about the turn of the 20th century. These accounts have been at varying intensities and for diverse purposes. Most accounts were to inventory the areas timber resources. More recent efforts were conducted to explore the ecology and reconstruct the historical conditions associated with the areas forests. Additionally, the LANDFIRE Project has developed biophysical setting data, which estimates potential historic forest vegetation.

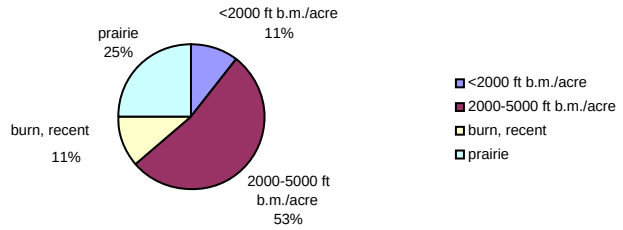
Biophysical Settings: LANDFIRE defines a biophysical setting as the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime (www.landfire.gov). Here again, local fire history experts have reviewed the biophysical setting data for the Swan Valley and find it to be expectable based on their knowledge (Barrett personal communication 2008). Ten biophysical settings are represented in the analysis area. Figure 3-1 summarizes the distribution of the biophysical settings within the analysis area.

Figure 3-1. Mid Swan Blowdown Biophysical Settings



Historic Composition and Structure: H.B. Ayers recorded observations of the Swan Valley in 1899 during his mission to survey the timber of the then Lewis and Clark Forest Reserve. His journals describe large expanses of the Swan Valley dominated by large trees of ponderosa pine, Douglas-fir, and western larch grown in an open canopy on the valley, benches and foothills and denser stands of shade tolerant species on the stream bottoms and high elevations.

Figure 3-2. Ayres (1989) Forest Conditions Reported within the Analysis Area



"The lands of the upper valley, where the rather scant covering of larch and lodgepole pine at first gives the impression of very poor soil, but upon close examination it is found that the sparseness of tree growth is largely do to frequently occurring fires which have thinned the forest." (Ayers 1898)

Figure 3-2 illustrates the forest conditions Ayers reported within the analysis area in 1898.

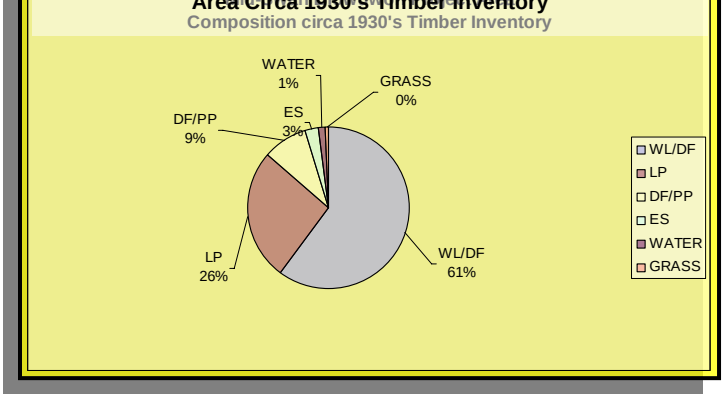
The Project Silvicuturist for the Meadow Smith Project on the Swan Lake Ranger District developed Table 3-10 (Vigil 2002) to equate some of Ayer's descriptions into approximate tree densities by tree size. This helps to illustrate that density varied by tree size where larger diameter stands would have fewer trees per acre.

TABLE 3-10.
PONDEROSA PINE DIAMETER, VOLUME, AND DENSITY COMPARISON OF 2,000 AND 5,000 BOARD FEET PER ACRE (SCRIBNER BOARD FOOT VOLUME)

Diameter and Height of a Tree	Volume per tree (board feet)	Volume per Acre (board feet)	Tree per Acre	Basal Area per Acre (square feet)
10" diameter and 50 ft tall	10	2,000	200	109
		5,000	500	273
16 " diameter and 90 ft tall	226	2,000	9	13
		5,000	22	31
20" diameter and 110 ft tall	478	2,000	4	9
		5,000	10	22
30" diameter and 130 ft tall	1,567	2,000	1	5
		5,000	3	15

1930's Timber Inventory: During the 1930's a broad scale timber inventory was conducted, which identified cover, stocking, and estimated age. These data were collected over a large area and the resolution is not as fine as today's inventories. However, these data were confirmed to be reasonable and valuable by Hart in 1989 and 1994. This inventory was digitized into a GIS shapefile which is available in the Flathead National Forest GIS Library. Figure 3-3 displays a summarization of what the composition of the analysis area was as a result of the 1930's Timber Inventory.

Figure 3-3. Composition of the Mid Swan Blowdown Project Area Circa 1930's Timber Inventory



Amendment 21: In 1998, the EIS for Forest Plan Amendment 21 analyzed the historical distribution of seral stages by forested terrestrial community for the Swan Subbasin (USDA 1998). In addition to the timber inventories mentioned above, this analysis used data from aerial photo interpretations, computer modeling, fire history studies, and pollen and charcoal records. Again, this analysis was broad and looked at the entire Swan River Watershed. However, it can provide some

insight into the historic distribution of terrestrial communities and the distribution of seral stages within the Mid Swan Blowdown Analysis Area. The Amendment 21 Analysis reported a historic range and 75 percent median of that range for each of three (early, mid, and late) seral stages in each of three terrestrial community groups (subalpine, montane, and lower montane) within the Swan Subbasin. Table 3-11 displays the results of that analysis and is presented to provide a possible range of historic conditions (Project File Exhibit R-4).

TABLE 3-11.

HISTORIC SERAL STAGES WITHIN THE SWAN SUBBASIN

Seral Stage	Terrestrial Community Groups		
	Subalpine	Montane	Lower Montane
	Approx. Historic Range	Approx. Historic Range	Approx. Historic Range
Late Seral	8 to 10%	20 to 22%	2 to 6%
Mid Seral	7 to 10%	31 to 37%	2 to 5%
Early Seral	2 to 3%	7 to 18%	0 to 1%

In addition to the results in Table 3-11, the Final Forest Plan EIS (FEIS) reported that the area historically had a relatively large representation of the lower montane group and a small representation of non-forest area. At the time of the analysis, the lower montane group had been substantially decreased. This is likely due to timber harvest (targeting of fire resistant species) and fire suppression allowing fire-intolerant species typical of the montane group to invade. One possible explanation for the increase in non-forested area is agricultural and residential development.

Again, it is important to note that the Amendment 21 Analysis of a historical range of seral stages was done for the entire Swan Subbasin. Given that the Mid Swan Blowdown Analysis Area is a subset of that Subbasin and given the disturbance regimes within the Mid Swan Blowdown Analysis Area, the actual distribution of seral stages could be drastically different from the Amendment 21 Analysis results at any given point in time.

Ownership and Management: The Swan Valley has diverse and interesting land ownership patterns. Though some similarities exist, most of the various owners have managed their lands with different objectives.

Most of the private lands were derived from the 1862 Homestead Act. Settlement of the area was relatively slow due to primitive and difficult access. Filing of homestead claims was most active between 1916 and 1920; and by 1919, 70 homesteads had been established in the Swan valley (Project File Exhibit R-2). Private non-industrial lands are residences, pastures, or small wood lots that are primarily located in close proximity to the Swan River and Montana State Highway 83.

In 1864, Congress granted lands to the Northern Pacific Railway Company as an incentive for building a transcontinental railroad. Sections of land in the Swan Valley were granted in lieu of sections already withdrawn along the planned railroad route. This action and later land exchanges have resulted in the checkerboard ownership pattern that characterizes the Swan Valley (Project File Exhibit R-2). These granted lands are now managed by the Plum Creek Timber Company (PCTC), which owns approximately 64 percent of the private land in the Swan Valley (Savage 2008). Forest management on PCTC lands has focused on utilization

of wood products, and has evolved with the science of forestry over time. Harvest levels on PCTC lands have fluctuated over the years.

Federal land in the Swan Valley was originally part of the Lewis and Clark Forest Reserve. In 1907, the name was changed and the forest was divided into the Flathead National Forest and the Blackfeet National Forest. Surveys of the area were completed in the early 1900's. Early forest management consisted of small timber sales, which were purchased primarily for fuel wood, house logs, and other homestead improvements.

Fire suppression started in the early 1930's and was effective. Current increased tree densities, changed forest composition, and longer fire intervals are evidence of the effectiveness of fire suppression (Barrett 1998).

Timber harvest on NFS lands in the Swan Valley has changed throughout time based on policy, objectives and social values. In general, harvest activity peaked between the 1960's and 1980's (See Past Harvest Activity below). Following World War II, there was improved access and increased demand for timber to fuel an expanding nation. Regeneration cutting was the era's preferred silvicultural system.

The NFMA looked closely at forest management practices across the country and set new policy direction. This direction led to smaller areas of regeneration harvest, increased artificial planting, and increased intermediate harvest treatments. By the 1990's salvage logging of wind-damaged and insect or disease-related mortality was the dominant or only harvest activity on NFS lands.

A summarization of past harvest activities across all ownerships within the analysis area will be discussed in the Existing Conditions Section of this report. This is because existing forest conditions are influenced by past activities.

Existing Conditions

Using the methods described earlier, the existing condition of the forest vegetation within the analysis area was investigated at all scales from the landscape to individual trees. This section discusses the existing site conditions, disturbance agents, and various attributes of the forest vegetation.

Site Conditions

A site can be defined as the environment where a tree or forest stand grows (Helms 1998). As far as tree growth is concerned, the site is controlled by the total physiologically available supply of solar energy, water, carbon dioxide, and various chemical nutrients (Smith et al. 1997). Individual sites are comprised of unique combinations of the physical environment including:

- Landform (elevation, aspect, topography),
- Climate, and
- Geology.

Generalizations of sites can be made to characterize the landscape. The following discussion describes some of the general site conditions found in the analysis area.

Landform: The elevation, topography, and aspects within the analysis area are variable, but generally confined to the valley bottom. Elevation ranges from approximately 3,300 feet up to about 4,140 feet at the base of the Swan Range. These lower elevations are typified by undulating topography with small east-west ridges with slopes generally less than 25 percent. Higher on the slopes of the Swan Range, slopes generally range from 25 percent to sheer cliffs. All directional aspects and slope shapes (concave and convex) are present (Project File Exhibit R-2).

Climate: The analysis area is at the eastern extent of the Pacific maritime climatic influence. Mean winter temperatures range from 15 to 250°F and summer temperatures average in the 80's with extreme temperatures reaching 100°+. Higher elevations average 10 to 20 degrees cooler. Precipitation in the form of rain averages 30 inches on the valley floor to over 100 inches at the highest elevations. The bulk of the precipitation usually comes from October to mid-February and again from mid-May to early-July (Project File Exhibit R-4).

Geology: Overtime the geology of the analysis area has been shaped by faulting and uplift followed by numerous glacial events. Geological processes have resulted in depositional, erosional, and breakland landforms. Soils are generally acidic and include fine silts, organic soils, lakebed deposits, and glacial tills derived from mostly shale and quartzite. Valley bottom soils are most productive, partially due to a 6 to 12 inch layer of ash deposited from the eruption of Mount Mazama (Project File Exhibit R-2). The Soils Report for the Mid Swan Blowdown Project EA contains detailed information related to the Soils Resource (Project File Exhibit J-1).

Site Classifications: From a silvicultural perspective, it is useful to classify sites. Classification can provide information about a particular site related to susceptibility and vulnerability of trees to damaging agents, problems with competing vegetation, and responses to various silvicultural treatments (Smith et al. 1997). In forestry, sites are typically classified qualitatively by environment or vegetation or qualitatively by their potential for tree growth.

On the Flathead National Forest, the most common way of classifying sites is by habitat type. All land areas potentially capable of producing similar plant communities at climax may be described as the same habitat type. By focusing on climax plant communities, habitat types account for successional change overtime and thus provide a permanent and ecologically-based system of land stratification (Pfister et al. 1977). Pfister's Forest Habitat Types of Montana is the document used to systematically classify sites into habitat types, which are named for the climax vegetation community (dominant tree species followed by dominant undergrowth species, e.g., *Abies lasiocarpa/Clintonia uniflora*).

Appendix I of Forest Plan Amendment 21 has grouped similar habitat types into coarser potential vegetation groups. Table 3-12 provides a generalized description of the habitat types used to define the potential vegetation groups. Appendix I of Amendment 21 (Project File Exhibit R-3) includes the detailed list of habitat types by potential vegetation group. Figure 3-4 displays the distribution of potential vegetation groups within the project area. Appendix A of the Silviculturist's Report (Project File Exhibit G-1) also contains detailed information related to individual stands associated with this project, including habitat type information.

TABLE 3-12.
HABITAT TYPES USED TO DEFINE POTENTIAL VEGETATION GROUPS

Amendment 21 Potential Vegetation Groups	General Description of Habitat Types
Warm Dry	Ponderosa Pine and Douglas-fir/grass types
	Most Douglas-fir types and dry grand fir types
	Douglas-fir/twinflower and most grand fir types
Warm Moist	Grand fir/queencup beadlily types
	Western redcedar and western hemlock/queencup beadlily types
Cool Moist	Subalpine fir/queencup beadlily and Menziesia types
Cold Moist	Subalpine fir/beargrass and dwarf huckleberry types
Riparian	Western redcedar/devil's club types
	Subalpine fir/bluejoint types
Cold	Subalpine fir/ grouse whortleberry and woodrush types
	Whitebark pine and alpine larch types

Existing Forest Vegetation Conditions

As previously mentioned analysis of forest vegetation can be done at the landscape and stand level. Here we will discuss various aspects of the existing condition of forest vegetation within the analysis area at multiple scales.

Landscape: The Upper Swan Valley Landscape Assessment (Project File Exhibit R-3) described the general forest conditions at a landscape scale by grouping the analysis area into what was termed "Ecosystems." The assessment identified five "Ecosystems" in the Upper Swan Valley. Three of those forested "Ecosystems" are represented in the Mid Swan Blowdown Project Area. The following summary descriptions of those "Ecosystems" was incorporated from the Cooney McKay Project Silvicultural Report (Higgins 2007) and are described as they would be encountered traveling from west to east, or upslope.

The warm-moist valley bottoms include the undulating flat lands of the valley floor with its many wetlands. This is a warm moist habitat that is mostly forested with a large diversity of conifer and deciduous tree species. Openings in the forest are numerous, largely due to human settlement. These areas contain a mix of western larch, western white pine, lodgepole pine, Douglas-fir, ponderosa pine, Engelmann spruce, grand fir and subalpine fir on the more well drained sites. The neighboring riparian zones are bordered with cottonwood, birch and aspen. Disturbances in this area included primarily low and mixed severity fire, and occasionally high severity fire. High-intensity winds have also occurred at intervals and caused extensive blowdown.

The moderately warm benches to the east include a pattern of riparian and potholes along its entire length, with ponderosa pine and western larch growing mostly on the drier areas. It is a mixture of forest types with deciduous species and Engelmann spruce around the wetlands and along riparian areas, and mixed stands of lodgepole pine, grand fir, subalpine fir, Douglas-fir and western red cedar. Historically, these were likely to be open grown stands, where fire disturbances tended to be of low severity to mixed severity. A number of these historically open stands are now crowded with younger trees, mostly Douglas-fir and lodgepole pine, increasing the risk for intense fires that might kill the large, older ponderosa pine, western larch, and Douglas-fir.

The cool-moist midslopes include a transition between the warm-moist valley bottoms to the east and the cold-steep forested uplands to the west. Tree species in this area include Douglas-fir, lodgepole pine, western larch, western white pine, Engelmann spruce, grand fir,

western red cedar and subalpine fir. Disturbances in this area included a combination of low, mixed, and high-severity fires. High-severity winds causing blowdown have also occurred in the area causing increased insect problems.

As referenced earlier, the 1998 EIS for Forest Plan Amendment 21 analyzed historical and current distribution of seral stages by forested terrestrial community for the Swan Subbasin. Again, this analysis was done at a broad scale, but can provide us with some idea of the forested conditions in 1998. This also allows us to compare historical and 1998 conditions for the Swan Subbasin. Table 3-13 displays the approximate 1998 distribution of seral stages by forested terrestrial community group. These percentages do not include nonforested areas.

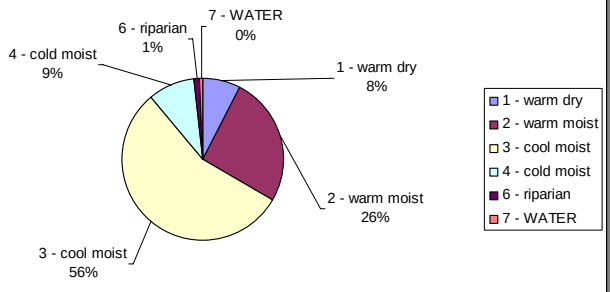
TABLE 3-13.
1998 DISTRIBUTION OF SERAL STAGES WITHIN THE SWAN SUBBASIN

Seral Stage	Terrestrial Community Groups within Swan Subbasin		
	Subalpine	Montane	Lower Montane
	Approx. 1998 Percent	Approx. 1998	Approx. 1998 Percent
Late Seral	2	10	1
Mid Seral	11	52	1
Early Seral	2	11	1

Stand: Analysis of stand level existing forest vegetation conditions was accomplished by assessing individual stand conditions using the methods described earlier and then compiling these data and summarizing them for the analysis area. Appendix A of the Silviculturist's Report (Project File Exhibit G-1) has detailed information for individual stands used in this analysis. The stand level analysis and diagnosis process that was discussed in the Methodology Section primarily occurred on lands identified in the Forest Plan as suitable for timber harvest and that were significantly affected by recent wind events. Areas outside this land base (such as private lands and unsuitable lands) have limited stand level information. Information related to these areas was obtained using a combination of existing inventories, aerial photo interpretation, and incorporation of the R1 VMAP product. It should be noted that most data used in this analysis to characterize the existing forest vegetation condition was collected pre-wind event. The changes in composition, seral stage distribution, old growth, and forest structure resulting from the blowdown will be discussed below.

Composition: Composition refers to the proportion of various species with a stand or area. A variety of species exist within the Mid Swan Blowdown Analysis Area. The spatial distribution and proportions of each species is directly related to site condition and inter-species competition. As previously mentioned habitat types are commonly used to classify sites and also provide an indication of the potential and existing vegetation, both overstory and understory. Figure 3-4 displays the distribution of potential vegetation groups as a percent within the analysis area.

Figure 3-4. Distribution of Potential Vegetation Groups within the Mid Swan Blowdown Analysis Area



Cover types are used to express the dominant species within an area based on plurality (also commonly referred to as forest type or existing vegetation). That is, the specie or species most abundant

for a given area. Cover type information was summarized for the analysis area and illustrates species composition. Again the current composition of the analysis area is the result of past disturbances, site conditions, and the competitive advantages of individual species. Cover type information for NFS lands was taken from stand inventory data and, in most cases, reflects pre-wind conditions. However, site-specific field verification confirmed that the cover types remained the same for all areas post wind event. Proposed Units 6, 8, and 10 are the only areas where wind damage has resulted in a slight shift in species composition due to the severity of damage. Still, the residual trees and advanced regeneration are consistent with pre-wind species composition. Cover type data for non-NFS lands were derived from the 2006 R1 VMap product discussed in the Methodologies Section of this report. Appendix B of the Silviculturist's Report (Project File Exhibit G-1) contains rule sets that were developed for the nearby Hemlock Elk Environmental Assessment to consistently apply data to determine cover types. These rule sets were modified to include aspen cover types and applied to the Mid Swan Blowdown Project. As Appendix B of the Silviculturist's Report states, the Non-Forested classification include areas where the canopy cover of tree species is less than 10 percent. Table 3-14 summarizes this information.

TABLE 3-14.
COVER TYPE SUMMARY (ALL OWNERSHIPS)

Cover type	Acres	Percent Analysis Area
Non Forested	152	3
Hardwood	13	0
Lodgepole	1026	23
Douglas-fir	1903	43
Western larch	633	14
Ponderosa Pine	200	4
Spruce/subalpine fir/mountain hemlock	399	9
Grand fir/western hemlock/western redcedar	139	3
Total	**4465**	**100**

Seral Stage Distribution: Often forests are seen through our eyes as static entities. For example, stand of trees we have visited many times continues to appear unaltered. This concept could be no farther from the truth. Change is constant in forest communities. Change occurs at all scales from a seedling sprouting to a wildfire consuming tens of thousands of acres of trees. This change is multi-dimensional and also occurs at various time scales. Often the timescale of change within a forest is comparatively long, as some trees within the analysis area have existed at the same location and similar form for hundreds of years. At a stand and landscape level, this change is often associated with many of the disturbance factors previously discussed. These disturbances often result in the establishment of a new age class or cohort.

A successive change in species dominance following disturbances is referred to as succession. Ecologists have recognized a number of successional patterns within forest communities based on site characteristics and the competitiveness of species (Oliver and Larson 1996). A seral stage is a temporal and intermediate stage in the process of succession (Helms 1998). Forest Plan Amendment 21 identified three seral stages. These three seral stages were primarily defined by tree size. Tree size is a more commonly and easily measured attribute than tree age. It is believed, as in Amendment 21, that there is a correlation between tree size, successional development, and tree ages. Although this correlation does not fit well under certain circumstances, it is generally accepted given the disturbance regimes and patterns of forest communities in the Northern Rockies.

Three seral stages were identified in this analysis to illustrate distribution of successional development and hence tree size and age. These seral stages are not associated with species composition. Appendix B of the Silviculturist's Report contains a rule set that was developed to consistently classify data into seral stages. The three seral stages used here are similar to Amendment 21 in name and how they relate to tree sizes, but differ in there classification. Of note is the fact that Amendment 21 uses the term Late Seral to describe old growth. However, here old growth is defined by meeting the criteria of Green et al. as previously mentioned. Therefore late seral in this analysis would likely contain old growth areas, but it also contains those areas meeting the size descriptions given in the Silviculturist's Report, Appendix B (Project File Exhibit G-1) but do not meet Green et al. old growth definitions. A more detailed discussion of old growth will follow.

Tables 3-15 and 3-16 display the seral stage distribution by forested cover type within the analysis area. Post-wind seral stage was adjusted in Units 6, 8, and 10 to reflect severe stand-replacing wind damage. These areas were classified as early seral for this analysis. Wind damage created additional small pockets of early seral conditions. However, these pockets were scattered and generally less than 1 acre in size. Therefore, the associated parent stands were not considered to be early seral.

TABLE 3-15.
CURRENT COVER TYPE OF THE MID SWAN PROJECT AREA

Seral Stage	Description	Acres	Percent of Forest Area
Early Seral	Seedling/Sapling Trees	1,276	30
Mid Seral	Poletimber and Immature Sawtimber and/or Dominant Trees 5 to 15" DBH	752	17
Late Seral	Mature Sawtimber and/or Dominant Trees > 15" DBH	2,286	53

TABLE 3-16.
COVER TYPE SUMMARY (ALL OWNERSHIPS)

Cover type	Early Seral Acres	Mid Seral Acres	Late Seral Acres	Total Acres	% Forested Area
Hardwood	13	0	0	13	<1
Lodgepole	323	377	297	997	23
Douglas-fir	658	233	1,041	1,932	45
Western larch	108	67	458	633	15
Ponderosa Pine	102	0	98	200	5
Spruce/subalpine fir/mountain hemlock	72	42	285	399	9
Grand fir/western hemlock/western redcedar	0	33	107	140	3
Total	**1,276**	**752**	**2,286**	**4,314**	**100**

As Table 3-16 illustrates, the majority of early-seral areas are dominated by the Douglas-fir cover type, the majority of mid-seral areas are dominated by the lodgepole cover type, and the majority of the late-seral areas are dominated again by the Douglas-fir cover type.

Old Growth: As mentioned earlier old growth in this report is defined by Green et al. (as amended) for the Western Montana Zone. Appendix C of the Silviculturist's Report includes the minimum criteria and associate characteristics used to make old growth determinations. Stand inventories and subsequent review by the District Silviculturist and Wildlife Biologist were conducted to identify portions of the proposed units which met the Green et al. definition

of old growth. The Wildlife Section of this EA also discusses the amount, location, and spatial distribution of areas identified as old growth.

The Northern Region of the Forest Service (Region One) has developed a report that assesses stand inventory data and compares it to the Green et al. old growth criteria. Assuming that stand inventory data represents current conditions, this report allows for a stand old growth determination. Given that this project is in response to stand altering disturbance, in some cases post wind event data was needed to make old growth determinations. All stands associated with proposed salvage units had old growth field verification completed by the District Silviculturist and Wildlife Biologist in 2008.

The District Silviculturist and Wildlife Biologist also identified areas within proposed salvage units where new inventory data was needed to make an old growth determination. These areas included some late-seral stands where pre-wind event data suggested a positive old growth determination and/or a near positive old growth determination. In four stands (Units 2, 3, 5, and 18) post-wind stand exams were conducted. In three other stands (Units 1, 10, and 19) only large tree ages were sampled as pre-wind inventory data suggested that stand ages did not meet minimum old growth criteria.

Four proposed salvage units fall into stands meeting old growth criteria. They are Units 2, 5, 13, and 18. Table 3-22 displayed later in this document lists the minimum criteria and associated characteristics from Green et al. (as amended) used to make this determination.

Figure 9 in the Silviculturist's Report displays the seral stage of stands on NFS lands within this analysis area including those that were determined to meet Green et al. minimum old growth criteria after running the Region One Old Growth Report. Two stands were also identified here as old growth that were not reported as old growth in the Region One Old Growth Report results. They were identified as old growth here because they were close to the minimum criteria and field verification suggests that they were consistent with the old growth descriptions in Green et al. These areas equate to 8.9 percent of the forested NFS stands in the Mid Swan Blowdown Vegetation Analysis Area (see Spatial Bounds description). As mentioned, this determination was made using stand inventory data that was collected at various points between 1981 and 2008 and at varying intensities. Confidence in this old growth determination, outside of proposed salvage units, varies depending on the presence of stand inventory data and on how well existing stand inventory data reflects current conditions. It should also be noted that this old growth determination may differ from the areas displayed as old growth in the Wildlife Section of this EA due to differences in analysis areas.

Statistical estimates of the amount of old growth can be more confidently made at large scales. Forest Inventory and Analysis data have been used to produce statistical estimates of old growth for the entire Flathead National Forest and each 5th code watershed unit. The estimate of old growth for the forest is 11.0 percent with a 90 percent confidence interval of 9.0 to 13.1 percent (Bush et al. 2007). The majority of the analysis area falls into the 5th code watershed labeled 1701021102 (including Lion Creek), the estimate of old growth for this watershed unit is 12.99 percent with a 90 percent confidence interval of 3.57 to 24.18 percent (Bush and Leach 2004). These results, the process, and its appropriate application documented by Czaplewski (2004) are available on the USDA Forest Service Inventory and Analysis website at http://fsweb.r1.fs.fed.us/forest/inv/index.htm.

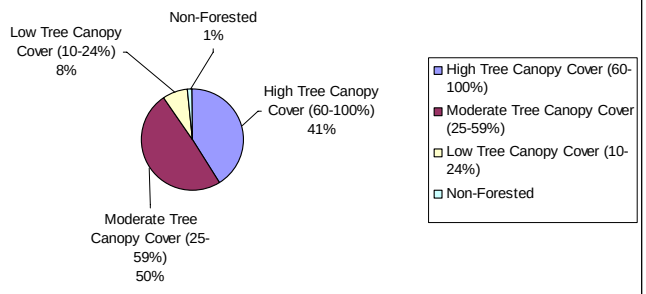
Forest Structure: Forest structure describes the vertical and horizontal distribution of components of a forest. Vertical structure describes the arrangement of trees and their crowns from the forest floor to the top of the forest canopy. This attribute can be classified as either single storied (tree crowns consisting of one main canopy layer), two storied (tree crowns forming two distinct canopy layers), or multi-storied or continuous (where tree canopies occupy three or more distinct canopy layers). Horizontal structure is often referred

to in terms of density. In forestry, density can be measured in many ways, but is most commonly expressed in terms of basal area, trees per acre, or canopy cover. The amount of down woody material and the number of standing dead snags are significant elements of forest structure and are discussed in this analysis. Wind damage has altered forest structure and, in particular, the amount and distribution of both down woody material and standing dead snags throughout the analysis area. A discussion of these pre and post-wind down woody and snag conditions will follow. A detailed description of wind damage type, severity, distribution, and extent will be covered in the existing disturbances section of this report.

Numerous combinations of forest structure exist within the analysis area and vary based on species composition, seral stage, and past disturbance. In terms of vertical structure, the following conditions exist. Most of the areas dominated by the lodgepole cover type and the early-seral stages for all cover types are single storied. This is primarily due to stand dynamics in the early seral stages, and the result of stand-replacing disturbances in the lodgepole cover type. Some of the more xeric (dry) areas dominated by the ponderosa pine, western larch and/or Douglas-fir cover types also exhibit single-storied canopies. Two-storied vertical structure exists in areas where remnant overstory trees exist above a smaller cohort (group). These cases are most commonly the result of mixed-severity fire regimes or past seed tree and/or shelterwood harvests. Some areas exhibit this structure due to historic non-lethal fire regimes, which favored single storied stands creating a single dominant overstory, but where recent fire suppression has allowed a second canopy layer to develop in the absence of fire. Multi-storied stand structures exist in many of the mesic areas and areas dominated by shade-tolerant species. This structure appears to be increasing across the Swan Valley landscape due to the absence of fire and proliferation of shade tolerant understories (Barrett 2002 and 1998; Freedman and Habeck 1985; Arno et al. 1997).

Horizontal structure is also variable across the analysis area. Many of the early-seral areas have extremely high tree densities (over 1,000 trees per acre). Density is also high in many of mid and late seral areas, also as result of the absence of fire and subsequent shade tolerant ingrowth. One measure of density is canopy cover, which is the proportion of the forest floor covered by the vertical projection of tree crowns (Berglund et al. 2008). This attribute of forest vegetation is readily measured using remote sensing technology. A summary of canopy cover for tree dominated areas (areas where tree canopies are greater than 10 percent of the area) within the analysis area using 2006 R1 VMAP data is displayed in Figure 3-5.

Figure 3-5. Canopy Cover within the Mid Swan Blowdown Analysis Area Tree Dominated Areas



In areas affected by wind damage, the following forest structural conditions exist. Vertical structure has been variably altered by wind damage. In severely affected areas, post wind vertical structure is primarily single or two storied where few to no residual trees remain standing. These conditions are the exception over the analysis area. More commonly, post wind vertical structure includes small dispersed canopy gaps created by scattered dominant and codominant wind thrown trees. In these gaps, the smaller advanced regeneration and lower crown classes typically remain as they were less affected by the wind. Stand density was also variably affected by wind damage. Again, in severely affected areas, overstory tree density was significantly reduced since most of the trees were wind thrown. In

the majority of the wind affected areas, density was reduced at a lesser scale. Individuals and pockets of overstory trees were blown down.

Quantitative data relating to pre-wind down woody material and standing dead snag numbers specific to the analysis area is relatively lacking. Some stand inventory data contains standing dead snag information, and few to none of these exams sampled down woody material data. In terms of standing dead snag numbers, inventory data collected between 1981 and 2008 for stands within the analysis area reported a range of approximately 0 to 22 snags per acre greater than 9 inches DBH. Quantitative information relating to down woody material within the analysis area is included in the Fire and Fuels Section of this EA.

Similar to the broad estimates of old growth mentioned earlier, statistical estimates of the number of snags per acre and the amount of coarse down woody material per acre can be made analyzing FIA Data at varying spatial extents. The confidence of estimates made using FIA Data is higher as more data is incorporated. In this case, the Swan River Watershed was used to characterize these attributes across the landscape within which this project falls. Although this area is broader than the analysis area boundary, it allowed for the incorporation of more data and thus better estimates of the existing condition for snags and coarse woody material. It should be noted that these FIA Data incorporate a wide range of forest conditions and sites. Table 3-16 summarize the estimates of standing dead snags per acre (greater than 9-inch DBH) and coarse woody material (tons/acre greater than 3-inch diameter) for the Swan River Watershed.

TABLE 3-17.
FOREST INVENTORY ANALYSIS SUMMARY ESTIMATES FOR THE SWAN RIVER WATERSHED (39 FIA PLOTS)

Attribute	Estimate	Lower 90 Percent Confidence internal	Upper 90 Percent Confidence Internal
Sanding Dead Snags (trees per acre 9“DBH)	14.2	9.1	20
Coarse Down Woody (tons per acre > 3” diameter)	22.5	15.2	30.7

Qualitative descriptions regarding down woody material and snags both pre-and post wind can be made from silvicultural diagnoses. Although highly variable, down woody material and standing dead snags exist at some level throughout most stands. Down woody material is often discussed as either fine woody material or coarse woody material. Graham and others (1994) define coarse woody material as any wood residue larger than 3 inches in diameter. Both down woody material and snags are the result of tree mortality. Tree mortality factors such as insects, pathogens, fire, wind, and other disturbances all contribute to the pool of dead trees available as snags and eventually down woody material. The recent wind damage has significantly altered the amount and distribution of down woody material and snags in the analysis area. Wind-severed needles and branches have added to fine down woody loadings. Entire tree boles, pieces of tree boles, and large branches increased coarse woody debris as trees were shattered, snapped off, and/or uprooted. These post-wind fine and coarse woody debris loadings are highly variable throughout the analysis area and even within proposed salvage units due to pre-wind down woody material amounts, damage severity, and tree size.

In most cases, snag numbers increased post wind. As will be discussed in the Disturbances Section of this report, one commonly observed type of wind damage was broken or snapped tree boles. Tree boles were severed leaving freshly created snags in a range of heights. Most of these new snags have little to no crown remaining. It appears that most snags that were present pre-wind remain due to the lack of a large heavy live crown to catch wind and act as a sail. Observations indicate that many pre-existing snags remained standing as adjacent live

trees were damaged. Some pre-existing snags were inevitably affected by the wind, either through the wind itself or by being struck by other trees.

Existing Disturbance

Most, if not all, of the historical disturbance agents that affected the forest vegetation within the analysis area are still present today. The extent and effects of each of these agents varies through time. The following provides a snap shot in time of the existing disturbance agents observed within the analysis area. As can be expected, wind has been the most significant recent disturbance agent within the analysis area. Again, Appendix A of the Silviculturist's Report (Project File Exhibit G-1) contains information related to disturbance agents observed within individual stands.

Wind: Although the effects of wind to forest vegetation are constant, only large scale wind events are typically recognized. This salvage effort responds to two recent stand-altering, large-scale wind events. Early roadside and aerial assessments were made of both events, and they are included in Appendix D of the Silviculturist's Report (Project File Exhibit G-1). Based on observations of older blowdown, it is obvious that wind has been a continual disturbance factor within the analysis area.

The earlier wind event affecting the analysis area occurred during the month of June 2008 near Goat Creek when high winds moved from west to east. Most of the tree damage associated with this storm affected stands in the Swan River State Forest. However, some damage to NFS lands occurred. Proposed salvage Unit 1 (15 acres) represents the largest concentration of wind damage on NFS land associated with this storm. This is a conservative estimate of the damaged area as unit boundaries represent concentrations considered to be economically viable for salvage efforts. Scattered damage exists outside of these boundaries.

The later and larger wind event occurred on the evening of July 4th. The storm moved from west to east across the Swan Valley and appeared to be straight-line wind. On the west side of the valley, the storm was centered around the Piper Creek Drainage; and on the east side of the valley, it was focused along the Lion Creek Drainage. Forested stands on all ownerships were affected by this wind event. Estimates of areas containing concentrations of wind damaged trees on NFS lands considered to be economically viable for salvage totaled approximately 690 acres. Again, this is a conservative estimate of overall affected area, as it does not include scattered wind damage or non-NFS lands.

The roadside assessment, aerial assessment, and silvicultural diagnoses revealed variability in damage severity, type, and distribution. Damage severity is generally typified by scattered damaged trees. Small groups of trees were commonly affected. A limited number of areas greater than a few acres in size were severely affected, that is, the majority of the overstory trees were damaged. They include Units 6, 8, 10, and portions of 11. Damage to individual trees includes uprooting, stem breakage, and severe bending, with uprooting being most common followed by stem breakage and then bending. Stem breakage includes single to multiple breakpoints in tree boles. Some areas have abundant trees with intact roots and no stem breakage; however, they are severely bent. It appears that dominant and codominant trees with large crowns were damaged more frequently than smaller crowned trees. The species affected also varied and includes ponderosa pine, western larch, Douglas-fir, lodgepole pine, Engelmann spruce and scattered other species. As mentioned earlier in this report, the distribution of damage is scattered and variable. No clear pattern can be established. It appears that the wind damage occurred in areas of natural openings, adjacent to previous harvests, concentrations of large trees, varying soil conditions and varying topographic positions.

I**nsects and Diseases:** Forest insects and diseases are major disturbance processes in forests of the Northern Rocky Mountains. Their effects can range from small-scale

disturbances, killing individual trees, to wide-spread outbreaks causing extensive tree mortality. Native forest pests have been part of our forests for millennia and function as nutrient recyclers, agents of disturbance, members of food chains, and regulators of productivity, diversity, and density (Black 2005). Aerial detection surveys, stand inventories, silvicultural walkthroughs, and Regional Entomologist field visits have identified species that are currently present and affecting the forest vegetation within the analysis area. The following section identifies the species present and discusses some of the characteristics associated with them.

The most recent aerial detection survey conducted by USDA Forest Health and Protection (FHP) Staff and was completed in 2007. Figure 11 in the Sivilcuturist's Report (Project File Exhibit G-1) shows the digitized results of the 2007, 2006, and 2005 annual surveys within the analysis area. Aerial detection surveys are most useful in detecting insect and disease damage that can be easily identified from the air, such as mortality and defoliation. It is important to note that not all insect and disease agents have mortality signals that can be detected (FHMP 2005). Bark beetles have the ability to migrate into the analysis area from adjacent areas. The following summary does not account for populations outside of the analysis area. Table 3-17 displays the major insect agents observed during these surveys within the analysis area.

TABLE 3-18.
2005, 2006, 2007 AERIAL DETECTION SURVEY RESULTS

Species	Acres Mapped	Number of Trees Affected	Occurrences
Mountain pine beetle	275	604	18
Douglas-fir beetle	15	37	7
Spruce Beetle	4	7	
Fir Engraver	34	86	2

Review of the stand inventories, silvicultural diagnoses, and Regional Entomologist Field Visits have revealed a number of insect and disease agents present within the analysis area. Regional Entomologists were contacted to provide assistance with this project. Two field visits were made within the analysis area and a report describing one of those visits is included in the Project File (Exhibit G-3). Blowdown events can create ideal conditions for rapid bark beetle population growth and the potential for subsequent outbreaks of certain bark beetle species (Berryman 1986). The following paragraphs identify the major bark beetles observed and provide a short discussion of their natural history. Miscellaneous insects and diseases are also mentioned. Here again, Appendix A of the Silviculturist's Report (Project File Exhibit G-1) contains site specific information related to these pests.

As mentioned, bark beetle populations following these wind events were a concern. Both field visits by Regional Entomologists found little current evidence of bark beetle activity, although some bark beetles were observed. Only two areas were surveyed during their visits. One area was dominated by primarily ponderosa pine wind damage, and the other area dominated by Douglas-fir and Engelmann spruce. Pine engraver beetles (*Ips. spp*.) were observed in some of the wind damaged ponderosa pine. In the other surveyed area, low numbers of Douglas-fir beetle, spruce beetle, western balsam bark beetle, and Douglas-fir pole beetle were observed in wind damaged trees. The results of these field visits suggested that it is possible most bark beetle flights had ended before these wind events and/or only small beetle populations were present in the surveyed areas.

It was suggested that District Silvicultural Staff note evidence of bark beetle activity in wind damaged areas as they proceed with diagnoses of each proposed salvage unit. Similar to

earlier findings, low levels of bark beetle activity was observed. However, bark beetle activity seemed to be widespread and relatively frequent. In 16 of 25 units (65 percent), bark beetle evidence was observed in wind damaged trees. Almost all observations were Douglas-fir beetle in wind thrown Douglas-fir trees, with some mountain pine beetle seen in wind damaged ponderosa pine

Mountain Pine Beetle: Mountain pine beetle *(Dendroctonus ponderosae)* is an aggressive bark beetle that feeds in the inner bark of host trees, often girdling and killing the tree. Hosts include most pine species with lodgepole pine, western white pine, and ponderosa pine being of concern within the analysis area. Infested trees fade within 1 year from yellow-green to red-brown. Large scale outbreaks are common, especially in lodgepole pine, when conditions are optimal and the beetles' food supply is abundant.

Amman and others (1977) developed a hazard rating system for lodgepole pine stands that focuses on three stand characteristics. Stands with an average age greater than 80 years, which have an average DBH greater than 8 inches, and exist within suitable climate for beetle brood development (<6,000 feet based on latitude) can be considered highly susceptible. Currently, Forest Service Entomologists use a more detailed hazard rating system developed by Shore and Safranyik (1992) that incorporates nearby beetle population data (Gibson 2004).

Mountain pine beetle was observed in numerous stands within the analysis area. Affects were primarily individual or small patches of lodgepole pine mortality. Most attacks appeared to be a few years old, but active populations were also noted.

Douglas-fir Beetle: Douglas-fir beetle *(Dendroctonus pseudotsugae)* is a bark beetle that attacks primarily Douglas-fir. Western larch may be attacked, but successful brood has only been recorded in down western larch trees. Douglas-fir beetle has one generation per year, with a spring emergence typically between mid April and early June. Douglas-fir beetles are not particularly aggressive and are attracted to wind throw and trees weakened by fire, drought, defoliation, or root disease. Outbreaks typically last 2 to 4 years (Kegley 2004).

Stand susceptibility is related to the proportion, density, age, and size of Douglas-fir. High hazard stands are considered to have stocking greater than 250 square feet basal area, greater than 50 percent Douglas-fir, average stand age greater than 120 years, and average diameter of Douglas-fir greater than 14 inches.

As mentioned, Douglas-fir beetle was observed in the analysis area during recent aerial detection surveys and in wind damaged trees in many of the proposed salvage units.

Spruce Beetle: Spruce beetle (*Dendroctinus rufipennis*) hosts include all native spruce trees and, occasionally, lodgepole pine. The beetles have a 1 or 2 year life cycle followed by a spring emergence. Spruce beetles have the potential for widespread epidemics. Periodic epidemics have occurred throughout the west over the last 100 years. Population increases are often associated with blowdown, landslides, fires, or logging slash (Munson 2005).

Schmid and Frye (1976) developed a stand hazard rating system that includes stand attributes such as site conditions, average diameter of live spruce, and the percent of spruce in the canopy.

Here again spruce beetle was observed in the analysis area during aerial detection surveys and Entomologist field visits. However, the occurrence of spruce beetle was low.

Pine Engraver: Pine engraver beetles *(Ips spp.*) attack all species of pine. Most frequently damage is in second growth ponderosa pine stands where trees 2 to 10 inches are killed. Normally, there are two generations per year and a complex life cycle. Adults become active in spring and infest fresh slash or damaged trees created between December and June. A second generation emerges from this material around August and seeks out new slash or standing trees if no slash is available. Most pine engraver problems are associated with disturbances such as wind throw, ice damage, logging, fire, etc. (Livingston 2004). Timely creation and management of slash and damaged trees is the most effect means of preventing population build ups.

Surveys conducted within salvage units identified pine engraver infesting wind damaged ponderosa pine. These observations were limited to areas dominated by ponderosa pine (Unit 11).

Miscellaneous Insects and Diseases: A number of additional forest insects and diseases were identified in the analysis area. They are listed here as miscellaneous because they were either observed infrequently or wind damage has had little effect on their dynamics. Undoubtedly, additional forest insects and disease occur in the project area.

- Indian paint fungus *(Echinodontium tinctorium).*
- Lodgepole pine dwarf mistletoe *(Arceuthobium americanum)*.
- Larch Dwarf Mistletoe *(Arceuthobium laricis)*.
- Pini *(Phellinus pini)*.
- Root Disease (Various).

Fire: The occurrence of fires within the analysis area is well documented. District Fire Management Staff log all confirmed fire starts on the Swan Lake Ranger District. They also keep records related to prescribed fire operations. No recent significant fires have occurred within the analysis area. See the Fire Section of this EA for detailed information related to fires in the project area.

Forest Management: National Forest System and private lands total 4,480 acres within the analysis area. The Forest Service keep records of past timber harvest activity, going back to around the 1950's. Private land past harvests were determined by analyzing recent satellite imagery and past harvest GIS layers, on file at the Flathead National Forest. Table 3-18 displays the timber harvest activity by decade for these land owners. In addition to the past timber harvest activities, a variety of forest management practices have affected the existing vegetation within the analysis area. These activities include, artificial regeneration (planting), timber stand improvement (pre-commercial thinning, etc), site preparation, and fuels treatments (prescribed burning, slashing, piling, etc). Records of these activities are only available for NFS lands and are reported in Table 3-19.

TABLE 3-19.
ANALYSIS AREA PAST HARVEST

	1950s	1960s	1970s	1980s	1990s	2000s	Grand Total
Regeneration Harvest							
Forest Service Acres	11	314	357	109	0	0	791
Private Land Acres	0	22	76	228	39	0	365
Total Acres Treated	11	336	433	337	39	0	1156
Intermediate Harvest							
Forest Service Acres	0	51	128	182	0	0	361
Private Land Acres	0	0	0	0	0	150	150
Total Acres Treated	0	51	128	182	0	150	511
Uneven-Aged Harvest							
Forest Service Acres	0	0	0	50	0	0	50
Private Land Acres	0	0	0	0	42	0	42
Total Acres Treated	0	0	0	50	42	0	92
TSI Treatments							
Forest Service Acres	0	0	143	132	51	82	408
Reforestation							
Forest Service Acres	11	130	201	117	17	0	476
Site Preparation							
Forest Service Acres	11	312	300	218	0	0	841
Fuels Treatments							
Forest Service Acres	11	312	498	209	21	0	1051
Grand Total (All Activities and Ownership)	**44**	**1141**	**1703**	**1245**	**170**	**192**	**4495**

Areas that were regenerated in the 1950s through the 1970s are typically fully-stocked poletimber stands ranging from approximately 300 to 2,000 trees per acre and averaging between 20 and 70 feet tall. Regeneration harvest that took place in the 1980s has resulted in areas of primarily sapling-sized trees with average heights of 10 to 20 feet and again range in density from approximately 300 to 2,000 trees per acre. Intermediate harvest treatments retain the existing stand in a modified condition. These harvested areas typically have lower densities, with more growing space available for residual trees.

Ownership and Development: Development of forested land has been on going in the Swan Valley since roughly the turn of the century. Although still a rural area, an increasing amount of land is being developed primarily for residential purposes. Often this development results in areas converted into a non-forested condition. This is typically done for house lots, transportation systems, out buildings, and pastures. In 2002, it was estimated that 900 people lived in the Upper Swan Valley (Project File Exhibit R-2). The Lands Section of this EA discusses the ownership and development within the analysis area in detail.

Comparison to Historical Conditions

Comparisons of existing conditions to historical conditions can help put management objectives and options into perspective. The previous discussion related to historical and existing forest vegetation conditions within the Mid-Swan Blowdown Analysis Area and the surrounding landscape allows us to

gain that perspective. The following key points summarize the comparisons between historical and existing conditions.

Disturbance: The scale, intensity, and frequency of the forest fires, the major disturbance factor within the analysis area, have been altered from historical conditions. Fire frequency has decreased due to elimination of traditional native burning coupled with effective modern fire suppression. Many of the non-lethal and mixed-severity fire regimes are now three to six fire intervals out of balance (Project File Exhibit R-2). Potential increased fire intensity and shifted fire regimes have occurred within the analysis area, as well. Long-term fire exclusion and selective logging has promoted a shift toward the stand-replacement fire regime across a broad area in the Upper Swan Valley (Barrett 1998, Hart 1994, Arno et al. 1995).

Insect and disease conditions have not changed extensively overtime within the analysis area. Many of the agents that are currently present (mountain pine beetle, larch dwarf mistletoe, root diseases, etc) were also likely historically present.

Forest Vegetation Condition: The amount of forested area within the analysis area is similar to historical conditions, with some potential decrease due to development.

The approximate distribution of seral stages is similar to historic conditions when comparing data from Amendment 21 to existing conditions data, recognizing that Amendment 21 defined late seral as old growth and this analysis did not. As stated in Amendment 21 and the Upper Swan Valley Landscape Assessment, the amount of old growth within the entire Swan Subbasin in 1998 was below the historic range. It also appears that there is currently less mid seral and more early seral conditions than historic data suggests.

The distribution of cover types appears to be similar to historic conditions. With possible increases in Douglas- fir dominated areas.

The amount of single-storied fire resistant shade-intolerant tree species dominated areas appears to be less than historical information indicates. This is largely due to shifts in fire regimes, the absence of fire, past timber harvest, and shade tolerant in growth.

Although natural events, such as recent wind storms, have increased coarse woody material and fuel loadings, historical accounts and descriptions, as well as existing conditions across the landscape, suggest that coarse woody material levels in wind affected areas is higher than would be expected and may affect fire behavior.

Ownership and Management: Ownership patterns and management are currently similar to historic conditions.

Desired Conditions

Desired forest vegetation conditions on NFS lands are directed by the Forest Plan. Project-level objectives consider Forest Plan direction in combination with current conditions. Stand-level desired conditions are developed by considering management direction and project Purpose and Need relative to site capabilities and current vegetative conditions. Regional strategies also help identify trends and desired conditions across the larger landscape.

Forest Plan Direction

Management Area Direction: The Forest Plan sets management direction for the Project Area. Activities proposed with this project are located within the following management areas (MAs):

- MA 5 – Roaded timberlands in areas with high scenic value. Maintain a pleasing natural appearing landscape in which management activities are not evident.

- MA 9 – Timberlands capable of providing white-tailed deer winter habitat. Provide cover for white-tailed deer winter habitat.

Amendment Direction: Amendment 21 of the Forest Plan and the associated appendices (USDA, 1998) provide management objectives and guidelines relative to forest vegetation and include following:

- Manage landscapes to attain the 75 percent range around the median amount of old growth that occurred historically, including recruitment of additional old growth where needed from appropriate mid-seral stands and prescribed treatments within existing old growth where current conditions pose a major or immediate threat.

- Maintain or actively restore landscape composition, structure, and patterns to a condition similar to that expected under natural disturbance and succession regimes.

- Manage landscape composition and patterns to reduce the risk of undesirable fire, insect, and pathogen disturbances.

- Where fuel conditions or fire regimes have been significantly altered, manage to restore the historical fire regime and reduce risk of undesirable fire events.

- Stand level objectives for all seral stages include maintaining dominance of shade-intolerant species such as western larch, ponderosa pine, and western white pine.

Purpose and Need and Project Level Objectives

- **Recover merchantable timber from areas affected by wind damage**

- **Provide wood products for local economies.**

The following secondary objectives would be accomplished through proposed activities.

Recover Merchantable Timber:

- While meeting this project objective, meet Forest Plan guidance for the management areas where the blow down has occurred;

- Reduce forest fuels buildup adjacent to public and private lands;

- Improve the general health, resiliency, and sustainability of forested communities;

- Reduce the risk of insect epidemics and severe disease infestations within the project area.

Provide wood products for the local economies:

- Contribute to short-term forest products for the local timber industry and provide for long-term sustainability of timber on NFS lands.

Environmental Consequences

This section describes the direct, indirect, and cumulative effects of the No Action (Alternative A) and the Proposed Actions to forest vegetation. The potential effects described are based on research, experience, and professional judgment.

Table 3-20 displays the treatment summary by alternative.

TABLE 3-20
TREATMENT SUMMARY BY ALTERNATIVE

	Alternative B		Alternative C		Alternative D	
	Acres	MMBF	Acres	MMBF	Acres	MMBF
Commercial Harvest Treatment Acres and Estimated Volume*						
Salvage	690	5.2	622	4.9	636	4.8
	Acres		Acres		Acres	
Reforestation Treatment Acres						
Hand Planting (Occurring in Units 6, 8, 10, 11)	90		83		59	
Logging System Acres						
Tractor	544		544		532	
Tractor/Skyline	82		75		45	
Forwarder	61		0		59	
Skyline	3		3		0	
Total Logging System Acres	**690**		**622**		**636**	
Slash Reduction Treatment Acres						
Lop and Scatter	157		96		152	
Lop and Scatter/Jackpot Burn	6		6		5	
Whole Tree Yard (WTY)	32		32		10	
WTY/Excavator Pile/Burn Piles	209		209		205	
WTY/Excavator Pile/Burn Piles/Jackpot Burn	286		279		264	
Wildland Urban Interface Acres						
Fuels Treatment within Wildland Urban Interface	332		298		321	
Fuels Treatment outside Wildland Urban Interface	358		324		315	

*Salvage volume estimates were based on preliminary cruise data collected for this project and represent the best available information. These are rough estimates due to the scattered nature of wind damaged volume and the low number of plots installed. Twelve plots were installed across proposed units and not all units had plots in them. The sample error for these estimates is approximately 50%. Although a defect factor was applied, these estimates are gross in terms of area and salvable volume. That is, they do not account for resource screens such as retention of coarse down woody material or reduction in unit acres (e.g. wetland buffers). It is likely that these estimates are higher than the volume which would be offered in any timber sale contract associated with this project. A more detailed volume determination and cruise will be conducted prior to implementation which will meet all Forest Service standards. Differences between alternatives are rough as well. It is likely that volume reductions in Alternatives C and D are greater than estimated here, primarily due to the large trees affected in old growth stands and the high proportions of blowdown in RHCA areas. In other words, some areas dropped in Alternatives C and D likely have above average volumes per acre.

Alternative A – No Action
Direct and Indirect Effects

The direct and indirect effects discussed in this section pertain primarily to effects that occur as direct or indirect (in time and space) results of the alternative. These may include immediate or longer-term effects.

No actions would occur under this alternative, allowing the processes of vegetation succession to continue in a similar fashion as they currently are. Firewood gathering, Christmas tree cutting, and

continued wildfire suppression consistent with Forest Plan direction is expected. The direct and indirect effects of Alternative A to bark beetle conditions, old growth characteristics, snags and coarse down woody debris (CDW), and salvage volume is discussed below.

Bark Beetle Conditions

Bark beetle conditions are likely to reflect the existing conditions under this alternative with the potential for change due to beetle migration into the analysis area and potential population growth within blowdown affected areas. As previously discussed, mountain pine beetle, Douglas-fir beetle, spruce beetle, pine engraver, and fir engraver have been observed in the analysis area, with Douglas-fir beetle, spruce beetle, pine engraver and mountain pine beetle observed within wind damaged trees in 16 of 25 of the proposed salvage units.

Bark beetle mortality would likely continue in a variety of tree species due to the presence of these beetles. Currently, these beetles exist at endemic levels. However, there is the possibility for population growth within the analysis area. Bark beetles have the ability to fly and, thus, the potential for migration into the analysis area exists for all alternatives.

It is widely accepted that wind damage can create ideal conditions for rapid population growth of certain bark beetles. This situation is most often associated with Douglas-fir beetle, spruce beetle, western balsam bark beetle and pine engraver (Kegley 2004; Munson 2005; Livingston 2004). As mentioned, low levels of Douglas-fir beetle, spruce beetle, and pine engraver were observed in wind damaged trees. Douglas-fir beetles currently within wind thrown trees would over winter and emerge in the spring if 2009 between April and June, depending weather patterns. These beetles would be attracted to suitable wind damaged trees or susceptible live Douglas-fir trees.

For the most part, spruce beetle has a 2 year life cycle. The majority of any spruce beetles in wind thrown trees are likely to emerge in the spring of 2010. These emerging adults would be attracted to susceptible spruce trees generally 4-inch diameter and larger.

Pine engraver beetles have a complex life cycle, most commonly with two generations per year. Pine engraver was observed in branches and boles of wind damaged ponderosa pine in August 2009. It is believed that these beetles emerged shortly after that observation and re-infested wind damaged trees, as they usually prefer standing live trees. The brood of these beetles would emerge in the spring of 2009 and look for freshly created slash or damaged trees. If none is available, population growth and subsequent damage is of little concern. If green slash is available, the cycle would continue and the generation emerging in summer 2009 would attack live standing ponderosa pine if no slash is available. Pole-sized ponderosa pine is at the greatest risk. There is a chance of freshly created slash or damaged trees existing in the spring of 2009 associated with this alternative. In some proposed salvage areas, severely bent ponderosa pine exist. These trees were structurally damaged by wind, but remained standing. In most cases, these trees are bent in the lower portions of the main stem at angles greater than 45 degrees. It is likely that these trees would fall down over the winter as snow loads build in the crowns and stress the already damaged boles. If these trees do come down during the 2008/2009 winter, they would provide an attractive environment in close proximity to known pine engraver populations putting adjacent pole sized stands of ponderosa pine at risk (Sturdivant 2008).

If wind damaged trees are left on site and conditions are suitable, it is possible that additional bark beetles could infest them in spring of 2009. Suitable conditions include phloem moist enough to create an ideal breeding environment. This situation is most likely to occur on the underside of large trees in locations sheltered from sun and direct heating.

The FVS was used to model and assess the hazard rating and potential for damage from forest insects including Douglas-fir beetle, spruce beetle, and mountain pine beetle and western pine beetle in ponderosa pine. Four representative stands were modeled and chosen because they are included

in proposed salvage areas and had inventory data collected in 2008, which reflects post-wind conditions. These areas were modeled for a 50-year time period starting in 2009 and had no treatments simulated. This essentially created a condition similar to the No Action Alternative. Stand hazard ratings are based only on stand conditions and do not factor in the proximity of known beetle populations or known beetles infestations of wind damaged trees. The results of this hazard rating simulation contained a mix of (no host), low, and moderate hazard, based on the area assessed. Table 3-21 displays the 2009 hazard rating results. As time progressed though, the simulation hazard ratings remained the same with the exception of one spruce beetle rating changing from low to moderate overtime. The detailed results of this simulation are included in the project file (Exhibit G-4).

TABLE 3-21.
2009 BARK BEETLE HAZARD RATINGS

Unit(s) in which Modeled Stands Fall	Old Growth	Spruce Beetle Hazard Rating	Douglas-fir Beetle Hazard Rating	MPB/WSB in Ponderosa Pine Hazard Rating
2 and 5	Yes	Low	Moderate	Moderate
3	No	No Host	Low	Low
11	No	No Host	Low	Moderate
18	Yes	Moderate	Moderate	Moderate

Given these hazard ratings, observed bark beetles, and suggested population dynamics associated with blowdown events, it appears that there is a moderate potential for increased future bark beetle mortality within the analysis area associated with this alternative.

Old Growth Characteristics

Old growth characteristics associated with this alternative are likely to reflect the existing conditions within the analysis area. Barring any additional disturbance, stands currently meeting old growth criteria would remain as old growth, and other stands would continue to have the potential to meet old growth criteria.

A discussion of old growth criteria according to Green et al. is warranted. Table 3-22 includes the characteristics used to make old growth determinations in addition to descriptions per Green et al. This table contains both minimum criteria and associated characteristics. Assuming a stand is consistent with old growth descriptions, minimum criteria must be met for a stand to be considered old growth, while associated characteristics are not required attributes of an old growth stand.

TABLE 3-22.
GREEN ET AL. (AS AMENDED) WESTERN MONTANA ZONE OLD GROWTH CRITERIA

		MINIMUM CRITERIA			ASSOCIATED CHARACTERISTICS					
Old Growth Type	Habitat Type Group	Minimum. Age of Large Trees	Minimum. Number TPA/DBH	Minimum. BA (ft²/ac)	DBH Varia-Tion[2]	Percent Dead/ Broken Top[1]	Probability of Down Wood [2]	Percent Decay[1]	No. Canopy Layer[3]	Snags ≥9" DBH[1]
1 PP, DF, L, GF, LP	A,B	170	8 > 21"	60	M	12/3-23	L-M	5 0-11	SNGL	6 0-22
2 DF, L, PP, SAF, GF	C	170	8 > 21"	80	H	11/0-21	M	5 2-12	SNGL/MULT	7 2-37
3 Lodgepole pine	C,D,E,F,G,H	140	10 >13"	60/ 70/ 80	L	11/5-22	H	6 2-15	SNGL	19 0-92
4 SAF,DF,GF,C,L,MAF,PP,WP,WH,WSL	D,E,F	180	10 > 21"	80	H	9 / 0-19	H	9 1-31	SNGL/MULT	15 2-43
5 SAF,DF,GF,L,MAF,PP,WP,WSL	G,H	180	10 > 17"	70/ 80	M	9 / 1-18	H	6 0-12	MULT	12 3-36
6 SAF,WSL,DF,L	I	180	10 > 13"	60	M	11 / 2-31	M	10 2-17	MULT	25 5-38
7 Lodgepole pine	I	140	30 > 9"	70	L	8 / 3-14	H	5 0-11 9-22	SNGL	17 9-22
8 SAF,WSL	J	180	20 > 13"	80	M	12 / 10-14	M	5 0-8	SNGL/MULT	37 33 -40

1/ These values are not minimum criteria. They are the range of means for trees >9" DBH across plots within forests, forest types, or habitat type groups.
2/ These are not minimum criteria. They are Low, Moderate, and High probabilities of abundant large down woody material or variation in diameters based on stand condition expected to occur most frequently.
3/ Not a minimum criteria. Number of canopy layers can vary within an old growth type with age, relative abundance of different species and successional stage.
4/ In Old Growth Type 3, 60 ft2 applies to habitat type Group E for LP, 70 ft2 of basal area applies to habitat type Group C for LP and habitat type Group H for ES,AF,WBP, 80 ft2 of basal area applies to all other habitat type and cover type combinations in Old Growth Type 3.
5/ In Old Growth Type 5, 70 ft2 applies to habitat type Group H for SAF, 80 ft2 of basal area applies to all other habitat type and cover type combinations in Old Growth Type 5.

Alternative A would have an effect on some of the associated characteristics in Table 3-21 including percent dead or broken topped trees, the probability of down wood, and the number of snags greater than 9 inches per acre. By not salvaging wind damaged trees, these attributes would not be altered and would continue to reflect the current post-wind conditions. All trees that have been uprooted, portions of shattered trees, and newly created snags with broken tops would remain in proposed salvage areas as ecological legacies.

It is possible that this alternative would have an effect on the risk of additional disturbances within proposed salvage areas; this has the potential to affect the minimum criteria listed above. As already discussed, Alternative A is likely to pose some risk of increased bark beetle mortality in some areas. Additionally, both fine and coarse fuel loadings in wind damaged areas have increased. Increases in fuel loadings are consistent with variability of wind damage. Small and large down woody fuels contribute to fire hazard and resistance to control. Large fuels can contribute to the development of large fires and high severity fires. Torching, crowning, and spotting are also greater where large woody fuels have accumulated under a forest canopy (Brown et al. 2003). As time goes on and large woody material begins to decay and brake up, its contribution to fire hazard is greater due to production of firebrands and receptivity to ignition (ERI 2008). Independent of this wind event, Barrett (2002) noted that fuel build ups in the Swan Valley may be promoting a shift toward future stand replacing fires. This increase in fuel loading and potential fire severity place old growth and potential old growth stands at some degree of increased risk.

Snags and Coarse Down Woody Material

Alternative A would have little effect on the existing condition of snags and coarse down wood (CDW). Snags and CDW are essential ecological elements of forest ecosystems which provide many physical and biological functions including wildlife habitat, nutrient cycling, soil protection, microsites for vegetative growth, etc. (Graham et al. 1994).

All pre-wind and post wind snags would remain standing until natural processes or firewood cutters fall them throughout the analysis area. In some areas, snag densities would be high due to newly created snags. Similarly, CDW would remain on site. Natural decay processes would break down wood, cycle nutrients, and incorporate organic material into the soil. Numbers of snags and/or CDW could potentially increase overtime due to tree mortality and existing snags falling to the ground.

The demand for firewood has risen in recent times. The Flathead National Forest provides personal use firewood gathering off of open roads. The Forest is one of the main suppliers of firewood for people in the surrounding communities. The Swan Lake District Office has received numerous requests to allow firewood gathering within wind damaged areas. Under this alternative, salvage activities would not occur and be offered to the public through a timber sale contract. As a result, a significant portion of wind damaged trees within 200 feet of open roads would be gathered for firewood. This area accounts for approximately 40 acres or 6 percent of the 690 acres of proposed salvage units.

Salvage Volume

Alternative A would have a profound effect on this measurement indicator. Under this alternative, no commercial volume would be removed from blowdown areas within the analysis area. As mentioned above, volume estimates associated with proposed salvage units includes approximately 5.2 MMF of saw log-sized material. Similar to the action alternatives, all commercial material outside of proposed salvage units would remain on site.

Alternative A – No Action
Cumulative Effects

The Mid Swan Project consists of three action alternatives and a No Action Alternative. The alternatives are described in detail in Chapter 2 of this EA. Past, current, and reasonably foreseeable actions on all lands within the analysis area (Tables 3-1 and 3-2 of this Chapter) were evaluated when considering the cumulative effects to forest vegetation associated with Alternative A. Past actions, which have affected the vegetation resource, include forest management and other activities within the analysis area. These activities are discussed in the Existing Conditions Section of this EA and provide the baseline vegetation conditions. Given that, the following discussion focuses on the current and reasonably foreseeable activities on all lands in combination with the effects of Alternative A on NFS lands. See the Cumulative Effects Worksheet (Project File Exhibit G-2) for additional cumulative effects information.

Bark Beetle Conditions

Current and reasonably foreseeable activities within the analysis area are limited and, therefore, the cumulative effects of Alternative A to bark beetles are also limited. The current salvage logging of wind damaged trees on private lands could have some effects relative to this indicator. Removal of attractive breeding environments could reduce the possibility of bark beetle population growth on private lands. Approximately 150 acres of blowdown salvage is currently ongoing within the analysis area on private land. It is impossible to predict natural disturbances that may affect bark beetle conditions.

Old Growth Characteristics

Again, current and reasonably foreseeable activities that could affect old growth characteristics within the analysis area are limited. The cumulative effects to old growth characteristics are expected to be similar to the effects described above under the direct and indirect effects section. As time goes on, stand conditions would naturally change and alter the distribution and abundance of old growth characteristics. Depending on the variables of natural mortality due to age, future wind events, fires, disease and insect activity, some stand may stay old growth, some stands may become old growth, and other stands may no longer be old growth.

Snags and Coarse Down Woody

Cumulatively, the effects to snags and CDW would continue to reflect existing conditions on NFS lands under this alternative. The 150 acres of salvage logging on private lands would have an effect on this indicator. Salvage of blowdown would reduce the amount of CDW depending on the specifics of the harvest. It is likely that most commercial-sized material would be removed. Fuel treatments would determine how much and what kind of non-commercial material would remain after operations. If snags are included in the salvage operation, then they too would be removed. It is difficult to do more than estimate the actual specifics of this salvage.

Salvage Volume and Other Private Harvest

Again, the salvage logging on private lands is the only current or foreseeable activity that would have an effect on salvage volume under this alternative. It is hard to estimate the salvage volume to be removed from these private lands, as volume would depend on wind damage type, severity and pre-wind stand conditions. If we assume a volume per acre similar to areas included in this project, it is reasonable to estimate approximately 1 MMBF of timber being removed.

It is likely that the Montana Legacy Project may affect land ownership of nearby Plum Creek Timber lands within the next few years. Under the Legacy land project, it is likely that there will be a period of interim ownership of current Plum Creek lands by private conservation groups with subsequent transfer of ownership of many sections of Plum Creek land to the Forest Service. Lands under this Legacy Project, as a condition of purchase by the conservation groups, will continue to provide some degree of timber to Plum Creek. However, at this time, the extent and specific location of any such harvest are not known.

Alternatives B, C, and D
Direct and Indirect Effects

This section discusses the effects to forest vegetation from implementation of the three action alternatives. Since the proposed actions are similar between alternatives, varying primarily by the number of acres treated, the effects discussion is combined. It should be noted that one variation between alternatives will also be discussed. That is, Alternative C does not include any salvage harvest in old growth stands. For this reason, old growth characteristics will be discussed for each alternative. Where possible, the effects will be quantified for each alternative to allow for comparison. Table 20 summarizes the proposed treatments by alternative.

The direct and indirect effects to forest vegetation will be discussed relative to the measurement indicators.

Bark Beetle Conditions

The effects to bark beetle conditions associated with the action alternatives will primarily relate to acres treated and removal of infested logs and potential breeding locations. No proposed actions involve modification of stand density or composition, which could affect stand hazard and resiliency to bark beetles.

Previous effects discussions of bark beetle conditions for Alternative A are relevant to the effects for the action alternatives. As postulated earlier, observations of bark beetle infested wind damaged tree and the presence of suitable breeding environments (wind thrown and bent trees and logs), place affected stands at risk to bark beetle mortality. Although observations of beetle numbers are relatively low, they have been observed in approximately 65 percent of proposed salvage areas, with attractive breeding conditions existing in all wind damaged areas which could remain viable for at least another season. Additionally, wind damaged areas outside of proposed salvage units and areas on private lands were not extensively surveyed for bark beetle increases following blowdown. This knowledge combined with results from stand hazard modeling (showing at least some hazard in most cases) suggests that removal of wind damaged trees would reduce the risk of bark beetle mortality in residual and adjacent stands.

Salvage operations are expected to begin in late spring or early summer of 2009. It is hoped that this timely removal of downed material would be accomplished before beetle emergence. In a report documenting a field visit by a Regional Entomologist (Project File Exhibit G-3), it was suggested that if salvage occurred in this time frame, threats from bark beetles would be reduced and even undetected beetle populations should be of little concern. Proposed fuel reduction treatments are designed in part through timing and method to mitigate any potential increased risk of bark beetle population growth associated with logging slash. Lopping, scattering, chipping, burning, and/or removal of activity generated slash would create conditions unfavorable to bark beetle breeding. Additionally, piles in units or at landings would not be created during favorable winter/early spring timeframes and would be treated prior to spring of the following year. See Appendix C of this document for more detailed descriptions of fuel reduction treatments.

One simplified way to quantify the effects to this indicator between alternatives is acres treated. This assumes that the potential for infestation of wind damaged trees exists on all acres. Table 3-19 above

identifies acres treated by alternative with Alternative B treating **690** acres, followed by Alternative D treating **636** acres, and finally Alternative C treating **622** acres.

Design Criteria (Chapter 2, Table 2-14) describing retention of snags and CDW material includes language to reduce the possibility of retaining infested material including no retention of logs with visual signs such as pitch tubes and boring dust and the preference for retention of less susceptible species such as western larch and grand fir.

Old Growth Characteristics

The effects of the action items to old growth characteristics involve entry into old growth stands and the effects of proposed activities on old growth criteria. Table 3-21 is displayed in the No Action Alternative effects discussion and lists the criteria used in Green et al. (as amended) to make old growth determinations.

The number of acres of old growth entered with salvage operations is one way to quantify the effects to old growth characteristics associated with the action alternatives. Each of the action alternatives proposes a unique number of acres of old growth entered by variations in the size of the four units falling in old growth stands. Table 3-23 summarizes these acres.

TABLE 3-23.
ACRES OF OLD GROWTH SALVAGED BY ALTERNATIVE

Salvage Unit	Alternative B Acres	Alternative C Acres	Alternative D Acres
2	9	0	9
5	8	0	8
13	11	0	11
18	28	0	26
Total Acres	**59**	**0**	**54**

As described in Table 3-22, both minimum criteria and associated characteristics are considered in Green et al. Proposed activities are not designed to affect any of the minimum criteria within old growth or potential old growth stands. That is, aside from possible incidental removal, the number of large live trees per acre, the minimum live basal area, or the minimum age of large trees would not be altered through salvage of wind damaged trees. Associated characteristics are expected to be affected by the action alternatives; specifically, the percent of trees with dead or broken tops, the probability of down woody material, and the number of snags per acre larger than 9 inches DBH. Effects to these characteristics would vary between alternatives by the number of acres treated (see Table 3-23) and by Design Criteria specific to old growth stands (Table 2-14). Design Criteria specific to old growth stands would not apply to Alternative C, since no salvage is proposed in old growth under this alternative.

The percent of trees with dead or broken tops would potentially be affected in non-old growth stands by removal of some wind damaged trees that have been broken/snapped off. The effects to this characteristic would vary by the proportion of wind damage of this type and the number of pre-wind dead/broken topped trees. In old growth stands, all snags would be retained including new wind sheared trees.

The action alternatives would affect the amount of down woody material within the treatment units as compared to the current conditions. This is because a purpose of this project is to salvage some of the merchantable down wood. Although the amount of down woody material would be reduced, Design Criteria are included in this project calling for retention of down woody material (See Table 2-14. This would ensure that the treated stands, after harvest, would retain down woody debris at levels

exceeding that present prior to the wind event, and at levels which meet or exceed forest plan standards. No salvage of down wood is proposed in old growth stands under Alternative C.

The number of snags per acre is also likely to be affected in non-old growth stands. In old growth stands, Design Criteria states that all snags are to be retained. In non-old growth stands, some snags may be salvaged. Design Criteria in non-old growth stands includes a minimum retention of eight snags per acre. The actual number of snags salvaged would depend on post-wind snag densities. The number of snags per acre is a dynamic attribute as the potential for new snags being created continually exists. Given that no non-wind damaged trees are proposed for harvest, live tree snag replacements would exist in all areas.

To summarize, in the 4 old growth units in which harvest is proposed, old growth minimum criteria (Table 3-23) would be met or exceeded post harvest and would be little changed from the existing condition. Relative to the associated characteristics described in Table 3-23, Design Criteria (Table 2-14) for the project are established to insure retention of down woody material, snags, and broken top trees, to meet or exceed the ranges described for these characteristics as described in Green et. al.

In the non-old growth stands, the project Design Criteria would result in stands that would not be precluded from the development of old growth characteristics as a result of this project.

Snags and Coarse Down Woody

Previous effects sections of this report have discussed the effects to snags and CDW material for the no action and action alternatives (see Old Growth Characteristics). Wind damage has resulted in wind thrown and broken trees, which now exist as portions of the snag and CDW pool. Proposed salvage activities would then, by default, have an effect on these attributes and their contributions to the forested ecosystem.

Specifics of the alternatives, coupled with project-wide Design Criteria, would influence the effects to snags and CDW in terms of where snags and CDW are retained or removed, and in terms of the amount of snags and CDW retained and removed. One important element of these variations is in relation to old growth versus non-old growth areas.

The specifics of alternatives which affect where snags and down woody material are retained or removed are tied to old growth and RHCA areas. In Alternative C all existing snags and CDW would be retained in old growth areas as they are deferred from this alternative. In Alternative D all existing snags and CDW would be retained in RHCA areas as they are deferred from that alternative. Outside of these areas and in Alternative B project wide Design Criteria specify the amount of snags and CDW retained/removed.

Chapter 2 contains project Design Criteria relating to snags and CDW. Design Criteria are specified for old growth and non-old growth areas. Numbers of snags per acre and amounts and kind of CDW material specified in these Design Criteria were developed by the Project Silviculturist and Wildlife Biologist to balance habitat needs, ecological contributions, and fire hazard. It is recognized that these wind events are natural disturbance processes, which are responsible for contributing a pulse of snags and CDW into the system. Design Criteria specified in this blowdown situation would ensure that portions of this stochastic event are retained as ecological legacies.

Regardless of Design Criteria, given minimum Forest Service merchantability specifications and the estimated amount of cull and defective material, it is expected that significant amounts of CDW material would be available for retention following the proposed actions. Experience and research show that, even in salvage treatments, CDW loadings tend to increase after harvest operations. Bull and others (1995) found an increase in tonnage of logs in treated old growth stands and Rumbaitis del Rio (2006) reported an increase in coarse wood area cover in salvaged areas compared to non-salvaged blowdown areas. Post harvest fuel treatments would address any situations where woody material loadings are unacceptable.

Similar to discussions in the Alternative A Effects Section, it should be noted that retention and/or removal of CDW is likely to affect fire hazard in wind damage areas. Tree boles, limbs, and foliage were deposited on the forest floor adding to both fine down woody (FDW) and CDW material loadings. In some areas this woody material is scattered and in other areas it is concentrated in large amounts. This down woody material is often referred to as fuels. Numbers of snags and logs and the thickness of the forest floor generally increase as fire frequency decreases (Fiedler 2007). Historical accounts and research mentioned earlier indicate primarily a mix of frequent low intensity and less frequent mixed-severity fires in and around the analysis area suggesting that fuel loadings were likely not extremely high. As suggested by Brown and others (2003), FDW and CDW contribute to fire hazard and fire severity. For optimal CDW loadings to provide for acceptable risk of fire hazard and fire severity, they suggest a maximum of 25 tons per acre in warm dry forest types and a maximum of 30 tons per acre in cool subalpine forest types. It can be reasoned that proposed salvage and activity fuel treatments, which reduce FDW and CDW loadings, would in turn reduce fire hazard and fire severity risk.

Salvage Volume

Each action alternative would affect this measurement indicator. The primary Purpose and Need of this project is salvage of merchantable timber from suitable lands. Salvage volume is, therefore, an important indicator with which to contrast the action alternatives. Given that wind damaged trees are primarily large diameter dominant and codominant trees, saw log material would be the primary product removed.

Design Criteria relative to retention of snags and CDW would also affect this indicator and would affect all action alternatives. New snags created through wind damage represent a portion of salvable volume. At times, these snags can account for significant volumes as they often include the base of the tree, which typically contains the largest and most valuable logs. All or some of these snags could be retained on site depending on old growth determinations and pre-wind snag densities. Aside from newly created snags, all wind damaged trees and associated volume is currently on the ground and, therefore, considered CDW material. Design Criteria relative to the retention of CDW material is also likely to effect salvage volume. Again, the actual effect and reduction of salvage volume would be based on existing CDW loadings and old growth determinations. In areas with scattered wind damage and minimal pre-existing CDW loadings, it is possible that all salvable volume would need to be retained to meet CDW Design Criteria. The opposite can be said for areas with high levels of pre-wind CDW. A factor of 6 tons per 1 thousand board feet of sawlog-sized timber will help frame the possible effects of retention of CDW on salvage volume.

The action alternatives vary, in regard to this indicator, by the number of acres treated and the damage severity on those acres. In theory each acre treated represents an amount of salvage volume. Based on the variability of wind damage discussed earlier, it is clear that each acre offers a unique quantity of salvable volume. It is possible to generalize volume extraction between alternatives by using rough unit and per acre volume estimates and extrapolating to remaining areas. See previous discussion on volume estimates used in this analysis. Table 3-24 displays a comparison between alternatives, based on the generalized data as described above.

TABLE 3-24.
VOLUME ESTIMATES AND ACRES TREATED BY ALTERNATIVE ON NFS LANDS

	Alternative B	Alternative C	Alternative D
Estimated Salvage Volume	5.2 MMBF	4.9 MMBF	4.8 MMBF
Acres Treated	690	622	636

Alternative B, the Proposed Action, includes all proposed salvage units and, hence, all acres to be treated. Alternative C drops Units 2, 5, 13, and 18, which fall into three old growth stands. Alternative D removes portions of eight units, which fall into RHCAs.

As previously mentioned, many of the wind-damaged trees are large dominant and codominant trees with large diameters. As can be expected, the proportion of large trees is high in old growth stands. Given this, wind damage and associated salvage volume per acre is high in some of the proposed units falling into old growth stands to be deferred from Alternative C. Observations indicate Units 2 and 5 have average (compared to other proposed units) estimated volumes of material to be removed per acre. Similarly, Unit 18 has slightly above average and Unit 13 has above average volumes per acre.

When considering the effects to salvage volume associated with Alternative D, similar generalizations can be made. Wind damage in riparian areas was considerable in most situations. Of most significant note are RHCA areas dropped within Units 6 and 8. These areas have above average volumes of material to be removed per acre. Other RHCAs to be deferred under Alternative D are estimated to have average to slightly above average volumes per acre.

Alternatives B, C, and D Cumulative Effects

Past, current, and reasonably foreseeable actions on all lands within the analysis area were evaluated when considering the cumulative effects to forest vegetation associated with the action alternatives. Past actions that have affected the vegetation resource include forest management and other activities within the analysis area. These activities are discussed in the Existing Conditions Section of this report and provide the baseline vegetation conditions.

As with the cumulative effects discussion for Alternative A, when considering the cumulative effects of the action alternatives, the direct and indirect effects previously discussed apply, in combination with current and reasonably foreseeable activities. The activities discernibly affecting forest vegetation are discussed in more detail in the Cumulative Effects Worksheet (Project File Exhibit G-2).

Bark Beetle Conditions

Current and reasonably foreseeable actions, in addition to the proposed actions which have the potential to cumulatively affect bark beetle conditions, include the 150 acres of salvage logging on private lands within the analysis area. Similar to all other effects discussions of this indicator, removal of infested trees and potential breeding locations would reduce the risk of bark beetle population growth and potential mortality. Table 3-24 displays cumulative acres treated and will be useful for all measurement indicators.

Old Growth Characteristics

No current or reasonably foreseeable activities are known to occur in old growth stands within the analysis area. It is believed that the 150 acres of salvage logging on private lands are not within old growth stands. This salvage logging does have the potential to affect old growth characteristics by altering the percent of dead or broken tops, the probability of down woody material, and the number of snags per acre. As mentioned in the Cumulative Effects Section for Alternative A, the actual cumulative effects would depend on the specifics of these salvage operations and pre-salvage stand conditions.

Snags and Coarse Down Woody

Cumulatively, salvage on private lands would affect snags and CDW within the analysis area. The Design Criteria mentioned earlier would not apply to these private operations. Coarse down woody material would be reduced, and it is possible that snag numbers could also be reduced if they are included in the salvage.

Salvage Volume

Again, the150 acres of salvage on private lands would cumulatively affect salvage volume in the analysis area. Additional commercial wood products would be brought to market through this private salvage. As mentioned in Cumulative Effects Section for Alternative A, 1 million board feet is be used as a rough estimate of the salvage volume from these 150 acres (See Table 3-25 below).

TABLE 3-25.
VOLUME ESTIMATES AND ACRES TREATED BY ALTERNATIVE ON ALL LANDS.

	Alternative B	Alternative C	Alternative D
Estimated Forest Service Salvage Volume	5.2 MMBF	4.9 MMBF	4.8 MMBF
Estimated Private Salvage Volume	1.0 MMBF	1.0 MMBF	1.0 MMBF
Forest Service Acres Treated	690	622	636
Estimate Private Acres Treated	150	150	150

As discussed in the No Action Alternative it is likely that the Montana Legacy Project may affect land ownership of nearby Plum Creek Timber lands within the next few years. Under the Legacy Land Project, it is likely that there would be a period of interim ownership of current Plum Creek lands by private conservation groups with subsequent transfer of ownership of many sections of Plum Creek land to the Forest Service. Lands under the Legacy Project, as a condition of purchase by the conservation groups, would continue to provide some degree of timber to Plum Creek. However, at this time, the extent and specific location of any such harvest are not known.

Regulatory Framework and Consistency

National Forest Management Act (NFMA)

NFMA and accompanying regulations require that several specific findings be documented at the project level and include the following:

Suitability for Timber Production: NFMA requires no timber harvesting shall occur on areas classified as not suited for timber production, except salvage sales, sales necessary to protect other multiple-use values, or activities that meet other objectives on such lands if the forest plan established that such actions are appropriate.

The silvicultural diagnosis process and the Forest Plan were used to determine that all areas associated with this project are suitable for timber harvest using the following criteria:

- Meet the definition of forestland
- Technological feasibility exists to protect soil productivity and watershed protection. Forest Plan standards, project Design Criteria, and applicable BMPs would be used to protect these resource values.
- There is reasonable assurance that lands can be restocked within 5 years of final harvest.

- None of the areas considered for harvest have been withdrawn from timber production

As stated earlier, all areas proposed for treatment are with in MAs where timber harvest is allowed per Forest Plan direction.

Maintenance of the Diversity of Plant and Animal Communities: Forest Plan (including Amendment 21) goals, objectives, standards, and guidelines address maintaining a diversity of vegetation and habitats across the forest to meet a variety of wildlife species and to provide for sustained yield of timber products. In addition to applying this Forest Plan direction, project Design Criteria prescribed by the Project Wildlife Biologist and Botanist also address plant and animal community needs.

Appropriateness of Even-Aged Management and Optimality of Clearcutting: NFMA directs that clearcutting be used only where "it is determined to be the optimum method." Other even-aged methods can be used where "determined to be appropriate." As stated in the treatment description section of this report, no clearcutting is proposed with this project.

NFMA Findings for Vegetation Manipulation: All proposals that involve vegetation manipulation of tree cover for any purpose must comply with the following requirements.

- Best suited to the multiple-use goals stated in the Forest Plan for the area with impact. All proposed treatments are consistent with multiple use Forest Plan direction and address the project purpose and need.
- Assure that the lands can be adequately restocked within 5 years. Previous regeneration harvests in the analysis area have been successfully stocked within five years. Regional reforestation indices also support that reforestation techniques have been successful.
- Not chosen because they will give the greatest dollar return. Although timber salvage associated with this project will generate revenue, interdisciplinary resources were considered in the development of this project.
- Be chosen after considering the effects on residual trees and adjacent stands. The effects to residual trees and adjacent stands were considered in the interdisciplinary development of this project. Residual tree protection measures are included in the Design Criteria section of this report.
- Be selected to avoid permanent impairment of site productivity and to ensure conservation of soil and water resources. The Soils and Water Resources Section of the Mid-Swan Blowdown Environmental Assessment includes protection and enhancement designs sufficient to ensure conservation of the resources.
- Be selected to provide beneficial effects to water quality and quantity, wildlife and fish habitat, regeneration of desired tree species, forage production, recreation uses, aesthetic values, and other resource yields. Following Forest Plan and MA direction, an ID Team considered all of these resources in the context of the surrounding landscape and this project as documented in the EA.
- Be practical in terms of transportation and harvesting requirements and total costs of preparation, logging, and administration. Standard logging systems and log hauling is prescribed for this project and has been determined to be practical for this project.

Flathead National Forest Plan Direction: As discussed in the Desired Conditions Section of the Silviculturist's Report (Project File Exhibit G-1), all planned activities are consistent with Forestwide and MA direction.

Forest Service Manual and Handbook: The FSH 2409.17 Silvicultural Practices direction was referenced and applied to the development of this project.