Colville National Forest
Bark Beetle Assessment for the Restoration Approach

ABSTRACT

The 2014 bark beetle assessment describes the response of the Colville National Forest to the unprecedented pine bark beetle outbreak in eastern Washington State. Of first concern is providing for human safety in areas affected by standing dead trees and hazardous fuel conditions from dead and down trees. The second objective is to improve resiliency to forest health threats through thinning overly dense forested areas and by reducing heavy fuel loads. Lastly, severely impacted areas will be treated to foster recovery. At the landscape scale, the maintenance of a mosaic of different stand structures, densities, and compositions may reduce the frequency and extent of bark beetle outbreaks.

for the greatest good

Background

Forests in the western United States are being affected by the largest outbreaks of pine bark beetles in decades. Mountain pine beetle (*Dendroctonus ponderosae*), western pine beetle (*D. brevicomis*), and pine engravers (*Ips* spp.) are prevalent pine bark beetles in Washington State at this time. The mountain pine beetle primarily attacks lodgepole (*Pinus contorta*) and ponderosa pine (*P. ponderosa*) (Table 1) and has been active on the Forest since 2003 (Mehmel 2014b).

The mountain pine beetle has been described as the most important biotic agent of change in western pine forests (US Forest Service 2013). The damage caused by the western pine beetle is most common in Ponderosa pine (Table 1). The impact of pine engravers is to a lesser degree than the other two beetles (Table 1) but the pest can affect all pines.

Table 1. Estimated affected acres and numbers of trees killed from pine bark beetle damage in Washington State in 2013 (WDNR 2014).

Beetle Species	**Host(s)**	**Mortality (ac.)**	**Est. Trees Killed (no.)**
Mountain pine beetle	Lodgepole pine	95,000	1,317,000
Mountain pine beetle	Ponderosa pine	12,000	34,000
Mountain pine beetle	Whitebark pine	1,200	910
Mountain pine beetle	Western white pine	430	510
Western pine beetle	Ponderosa pine	3,100	3,500
Pine engravers	All pines	260	700

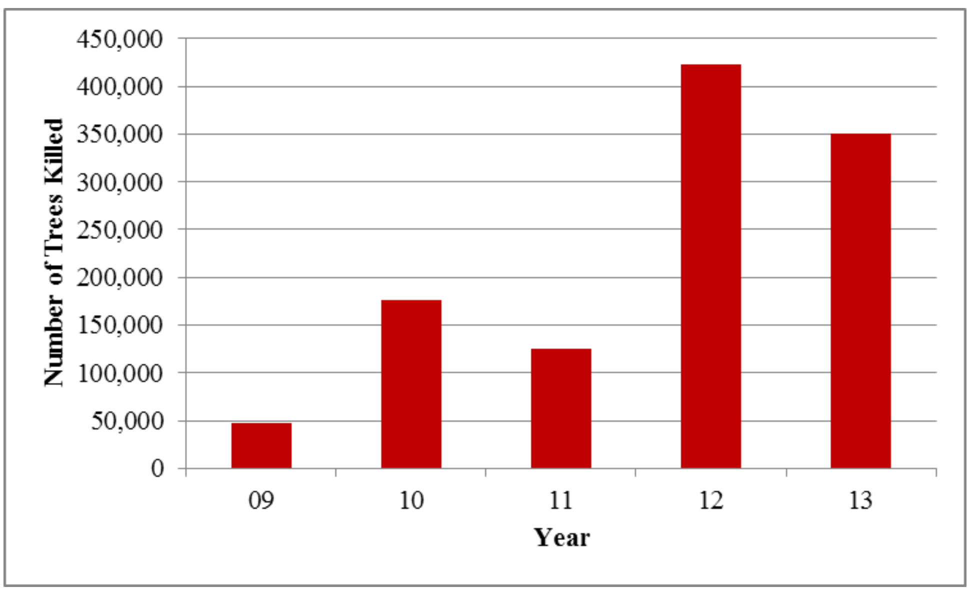

Figure 1. Number of trees killed by mountain pine beetle damage from 2009 to 2013 on the Three Rivers Ranger District, Colville National Forest (Mehmel 2014a).

Mortality of lodgepole and ponderosa pines from pine bark beetle damage increased from 2012 to 2013 in northern Ferry County in the Colville National Forest (WDNR 2014). Impacts from mountain pine beetle (Fig. 1) and the western spruce budworm (*Choristoneura occidentalis*

Freeman), a destructive defoliator, are the subjects of a 2012/2013 Forest Health Hazard Warning issued for Ferry County by the Washington State Department of Natural Resources (WDNR 2014). The mountain pine beetle has continued to be the primary cause of tree death with approximately 450,000 trees killed Forest-wide in 2013 (Mehmel 2014a).

In the absence of frequent understory fire, increased stand density and tree competition have made many forests more susceptible to bark beetle attack (Fettig 2012). Vigorous trees can produce pitch as a defense mechanism in response to beetle attack; whereas trees stressed due to competition for resources may not be able to do so. In addition, microclimatic influences associated with dense stand conditions may increase beetle success in finding host trees and beetle fecundity and fitness (Fettig 2012). Reducing stand density through thinning is the most effective treatment for reducing beetle-caused mortality. However, thinning prescriptions can vary widely. In order to be effective, pine forests must be thinned to less than 80 square feet of basal area (Mehmel 2014a).

Fire suppression over the years has also resulted in a predominance of older, even-aged, homogeneous forest stands. Heterogeneous forest stands of differing tree species, ages, and spatial patterns are more resistant to beetle attack because of the density-dependent mortality inflicted by the beetles (Fettig 2012, Smith et al. 2005). Heterogeneity may be accomplished by allowing gaps in the tree canopies that can lead to increased tree vigor and encourage reproduction and incursion of more diverse species.

Wildfire Risk and Hazard

Outbreaks of mountain pine beetle can alter stand structure and wildfire risk. However, active crown fires in lodgepole pine and spruce forests are primarily contingent on dry conditions rather than variations in stand structure (Black et al. 2013). Romme et al. (2006) determined that the risk of wildfire in Colorado forests may increase only during and immediately after outbreaks of bark beetles when the dry red needles are still on the trees (approximately one to two years post-outbreak, “red needle phase”). When the trees are in the in the red phase, probability of occurrence increases for crown fires because of the greater potential for torching and crowning, but does not change for surface fires because of the lack of modification of surface fuels (Hicke et al. 2012).

The primary driver of crowning is canopy bulk density (Van Wagner 1977). Once the needles fall off the dead trees (approximately three to five years post-outbreak, “gray needle phase”), the likelihood of both crown fire initiation and spread actually may be reduced in comparison to an unaffected stand, since the dead trees create gaps in the canopy and reduce canopy bulk density (Romme et al. 2006). Simard et al. (2011) determined that red and gray phase stands had on average 53% lower canopy bulk density, 42% lower canopy fuel load, and 29% lower canopy moisture content compared to undisturbed sites in the lodgepole pine forest of Greater Yellowstone Ecosystem.

Simard et al. (2011) found that predicted fire behavior in the decades that follow the outbreak (from 25 to 35 years) was qualitatively different than at the early stages in that crown fires in the old post-outbreak stands were predicted to be of the passive type. Passive crown fire is a type of crown fire in that the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods (Scott and Reinhardt 2001).

Surface fire probability can increase after the trees reach the gray and old phases because of the fine fuels from the canopy and the encroachment of woody and herbaceous vegetation in canopy openings (Hicke et al. 2012). However, the authors found that the effects of reduced canopy bulk density outweigh increased torching potential associated with higher surface fuel loads.

Over time, as the dead overstory decays and falls to the surface, both "fire risk" (fire start and spread) and "fire hazard" (increasing fire intensity and severity) are high and this stage could persist for several decades (Gray 2013). In addition, rates of spread and fireline intensities can be higher in epidemic stands due to decreased vegetative sheltering and its effect on mid-flame wind speed (Jenkins et al. 2008).

Kulakowski and Jarvis (2011) found that over the past century the occurrence of severe fires in lodgepole pine forests in western North America has been primarily influenced by climatic conditions rather than changes in fuels caused by bark beetle outbreaks. Based on projected changes in climate, Bentz et al. (2010) suggested that future thermal regimes may be particularly favorable for mountain pine beetle populations and could significantly affect the frequency and severity of disturbances that shape forest ecosystems. Beetle outbreaks and wildfire are both expected to increase as the climate warms, increasing the probability that they will overlap in time and space and heightening the need to understand how multiple disturbances interact to shape forest ecosystems (Harvey et al. 2013).

Goals and Objectives

The pine bark beetle epidemic presents risk of human injury from falling dead or dying trees and hazardous fuels conditions from downed and dead trees. The health and the vigor of the forest are also at risk for continued pest outbreaks and the potential risk from wildfires. In addition, bark beetle outbreaks result in cascading impacts to other resources such as altered water quality and quantity, soil surface temperatures, carbon storage, and nutrient cycling (Edburg et al. 2012).

The primary goals of treatments are to provide for human safety and protection of community values. Removal of hazardous trees that may fall in campgrounds and trailheads or across roads is essential. In addition, defensible space (e.g. buffer zones around homes and structures) has been shown to be critical to reducing ignitability in the vicinity or homes and settlements (Black et al. 2013). Modelling and empirical research on ignition potential indicates that ignitions from flame radiation are unlikely to occur from burning vegetation beyond 40 m (130 ft) of a structure and that thinning trees to produce gaps in the flame front has a significant ignition mitigation effect (Cohen and Butler 1996).

Secondary objectives of the treatments include thinning and fuels reduction to increase forest resiliency and recovery of severely impacted areas through reforestation. Risk factors that increase the likelihood for mountain pine beetle outbreaks in lodgepole pine stands are 1) stands older than

80 years, 2) average diameter at breast height of eight inches or greater, 3) basal area over 120 square feet per acre, and 4) low elevation (Mehmel 2014a).

Treatments

In light of the pine bark beetle outbreak within areas on the Forest (Fig. 2), vegetation management treatments can be focused on removal of susceptible species such as lodgepole pine within areas that have acceptable road access and relatively low resource concerns (e.g., sensitive wildlife species, riparian areas, designated Wilderness Areas). The objective of the treatments could be to capture the value of the wood prior to it degrading to the point that it's no longer useful as a forest product.

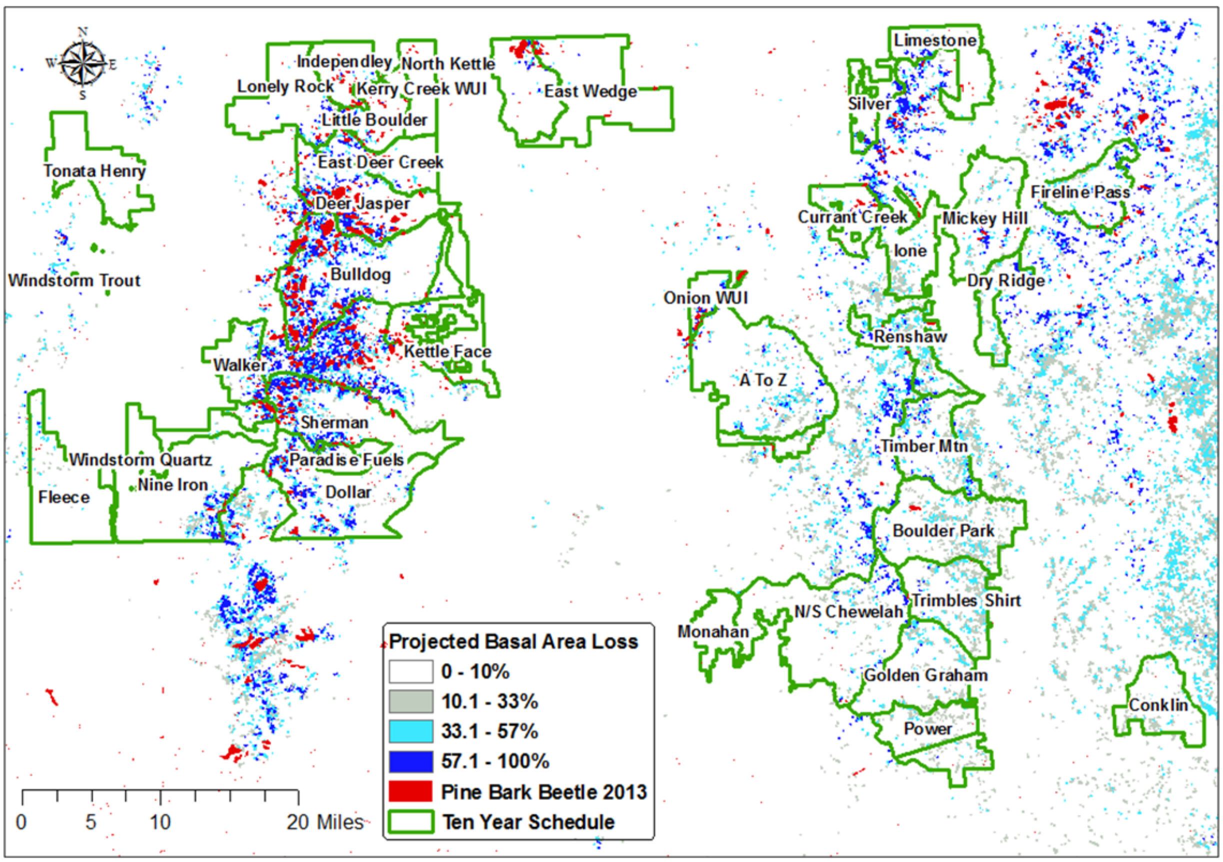

Figure 2. Ten-year vegetation management schedule, recent pine bark beetle damage (WDNR 2013), and projected future basal area lost from mountain pine beetle damage between 2013 and 2027 (Krist et al. 2014).

It is anticipated that much of the wood would be processed by local mills and that would help to retain the local infrastructure and sustain the local and regional economy. In addition, many areas along open roads could be designated as permitted firewood cutting for the public. The firewood access would also aid in reducing fuel loads and would accentuate local community values as alternate sources of heat are more costly.

The Forest maintains a ten year schedule of vegetation management projects (Fig. 2). All of the large vegetation management projects on the Forest include treatments for forest resiliency. Thinning of stands can provide the greatest benefit in terms of forest vigor and can create a more diverse stand structure. Prescribed burning for maintenance, mechanical thinning followed by prescribed burning, and timber stand improvement treatments also can provide tremendous value.

While the treatments are not expected to put an effective stop to the bark beetle outbreak, it is anticipated that they could break up the age- and species-class homogeneity of the pine stands at the landscape scale. The mitigation of potentially adverse bark beetle and fire effects is maximized when treatments occur at landscape scales and integrate the spatial arrangement of forest types and stand conditions (Jenkins et al. 2008). Increased heterogeneity in spatial stand structure; and tree age, size, and species can help future disturbances to operate closer to the natural range of variability

Fuels Reduction Treatments

In fire-adapted ecosystems, some measure of fire use at the appropriate intensity, frequency, and time of year should be an essential component of management strategies intended to protect and sustain watersheds, species, and other natural resources over the long term (Laverty and Williams, 2000). Fire suppression activities and some past management practices over the past 100 years have excluded fire from many of the fire-adapted ecosystems in the region. In the absence of fire, many of these lands have become subject to an over-accumulation of shrubs and small trees, diminishing ecosystem diversity, health, and resiliency and fueling conditions for unnaturally intense fires that threaten communities, air, soil, water quality, and plant and animal species (Laverty and Williams 2000).

The primary index used to prioritize treatments across the nation is the Fire Regime Condition Class (FRCC) and that is computed as departures of current conditions from the historical fire and landscape conditions (Keane et al. 2007). The primary use of FRCC is to identify and prioritize those landscape areas that are in need of treatment so land managers can distribute funding, resources, and personnel to implement restoration activities and fuels reduction treatments (Laverty and Williams 2000).

FRCC classes are generally equivalent to low, moderate, and high departure (Fig. 3) from the natural or historical range of variability (HRV), considered a baseline for coarse-filter assessment of risks to ecosystems, habitats, and social values (Hann 2004). HRV provides land use planning and ecosystem managers a critical spatial and temporal foundation to plan and implement possible treatments to improve ecosystem health and integrity (Landres et al. 1999). The authors maintain that understanding the past composition and structure, spatial and temporal variability, and the principal influential processes of ecological systems helps managers set goals that are more likely to maintain and protect ecological systems and meet the social values desired for an area. For example, HRV provides a representative time series of reference variables such as burned area, vegetation cover type area, and vegetation patch size distribution to guide land management (Aplet and Keeton 1999).

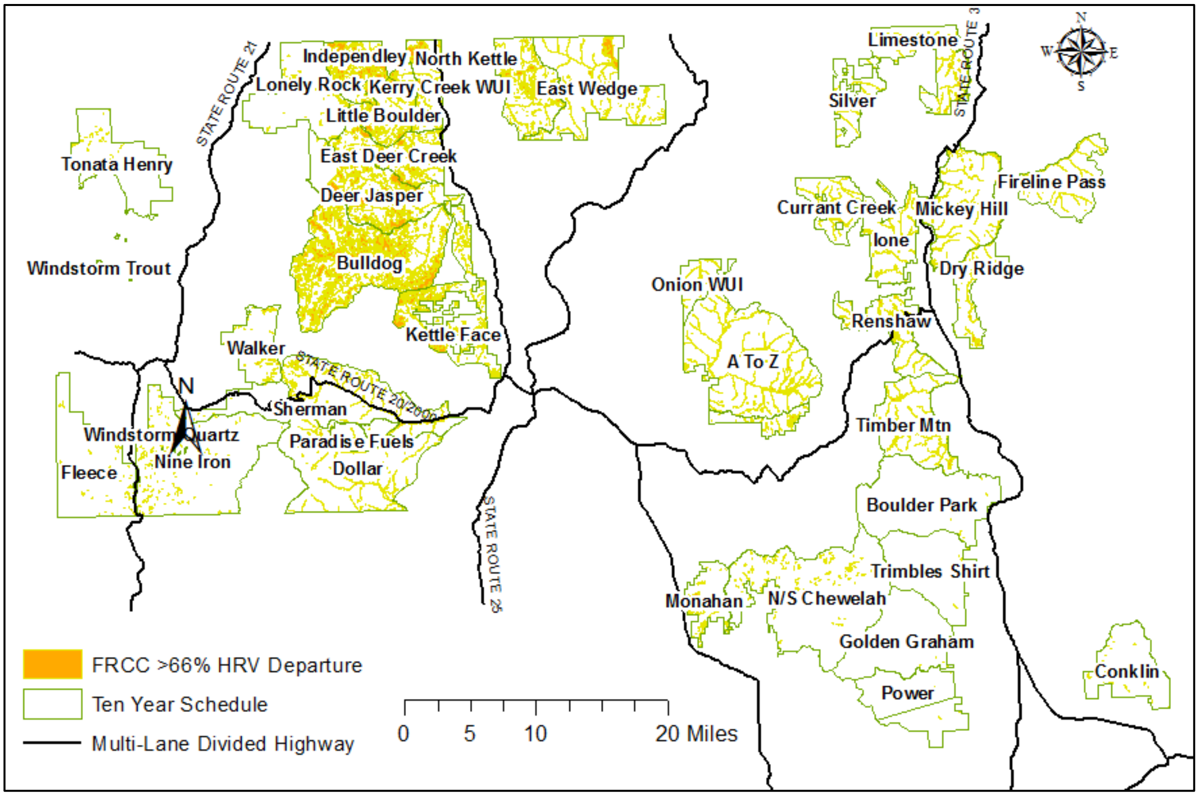

Figure 3. Ten-year vegetation management schedule and Fire Regime Condition Class with >66% departure from HRV and on the Colville National Forest, 2013.

Some FRCC values on the Forest are heavily departed from HRV, especially on the western side (Fig. 3.) A common strategy would be to focus treatments on areas with the greatest risks such as those with critical habitats, municipal watersheds, and community values at risk of uncharacteristic wildfire. Another essential logistical and economic consideration for treatments would be adequate road access. Key fuels reduction work using hazardous fuels funds will be focused on treatments in the Wildland Urban Interface and can be prioritized using local Community Wildfire Protection Plans.

Silvicultural Treatments

Tree density management is the primary silvicultural tool to reduce susceptibility to future pine bark beetle epidemics. A common index that represents relative tree density is the stand density index (SDI) (Reineke 1933). The index is a relative density measure used to characterize stocking levels (Fig. 4) and it is based on the relationship between tree size and the number of trees per acre.

Perhaps the greatest advantage of the stand density index and similar indices is their independence from site quality and stand age (Powell 1999). For example any pure, fully-stocked, even-aged stand of a given average stand diameter has approximately the same number of trees per acre as any other pure, fully-stocked, even-aged stand of the same species and average stand diameter (Reineke 1933, Powell 1999). Maximum SDI values have been developed for different forest species. For example, Long (1985) determined the maximum SDI for lodgepole pine to be 690. The

SDI values for each stand can be compared to the species maximum to determine the relative stocking of the stands.

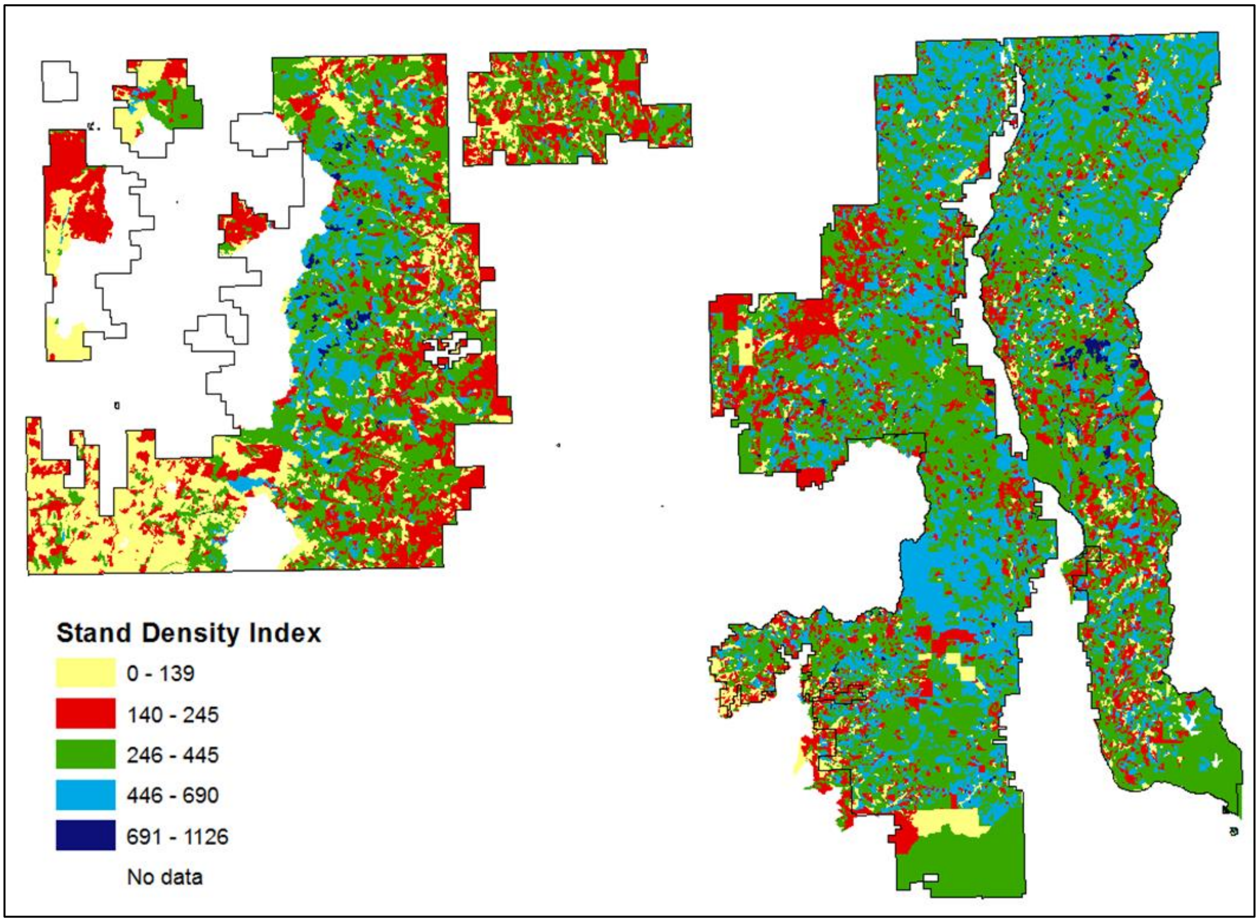

Figure 4. Stand density index values on the Colville National Forest, 2014.

In lodgepole pine stands, a maximum stand density index between 20% and 35% of maximum SDI (from 140 to 245) has been identified as a zone of high susceptibility to beetle attack (Anhold et al. 1996). The zone of high susceptibility is highlighted in red in Figure 4.

Below 20% of maximum SDI (less than 140), individual trees have high vigor in general and can defend themselves successfully against a pine beetle attack. Above 35% of maximum SDI (greater than 245), tree vigor and defenses are reduced by increased competition, however the phloem is so thin that trees are largely unsuitable for bark beetle development and spread (Cabrera 1978).

Stand-level forest measurements collected in 2014 across the Forest were analyzed for SDI values (Fig. 4) using FSVeg Spatial Data Analyzer, a U.S. Forest Service extension for use in the ArcMap application (ESRI Inc.). One strategy is to use SDI values to develop a restoration map that indicates where treatments are needed based on selected variables. Stand density index and stages of stand development (e.g. Stand Initiation, Stem Exclusion, Understory Reinitiation, Old Forest) are key variables. For example, stands with an SDI greater than 300 and in the Stem Exclusion or the Understory Reinitiation development stages could be selected for treatment.

National Insect and Disease Risk Map data (Krist et al. 2014) and recent insect and disease aerial survey data (http://www.fs.fed.us/foresthealth/technology/adsm.shtml) can be layered on the SDI and stand structure data to effectively determine the location and distribution of potential restoration opportunities. In addition, the insect and disease data can be used to inform other agency assessments such as the Integrated Resource Restoration, Watershed Condition Framework, Terrestrial Ecosystem Condition Assessment, Existing Vegetation Classification Mapping and Inventory, and Hazardous Fuels Prioritization Allocation System (Krist et al. 2014).

Reducing Susceptibility with Density Management

Density management regimes are silvicultural strategies that can help lower susceptibility to beetle damage before outbreaks occur or when the outbreak is in the early stages. Two density management regimes have been identified for young lodgepole pine stands (Anhold et al. 1996). One approach is the low density regime. A very open stand is maintained in the regime by conducting a heavy initial precommercial thinning that would reduce stand density to approximately 105 trees per acre.

The low density approach results in open lodgepole pine stands that will have typically a large shrub component and live crowns that could reach near the ground. The presence of an early successional shrub component and low crowns with potential cover could be beneficial to wildlife or other resource habitat objectives. Drawbacks to the low density approach are a reduced potential timber yield because the site will not be fully stocked. Other potential disadvantages include greater stem taper and larger knots than in regimes of higher density (Anhold et al. 1996).

The second approach to reduce future susceptibility in young lodgepole stands is the high density regime. The regime calls for a fully stocked stand and includes multiple precommercial thinnings to avoid density-related mortality. The first thinning would reduce tree density to approximately 500 trees per acre. A second precommercial thinning would be conducted to reduce the density to approximately 300 trees per acre when the stand reaches an average tree diameter of about eight inches.

The high density approach results in a fully stocked site and maximizes timber volume production while minimizing susceptibility to mountain pine beetle attack. The drawbacks of the higher density regime are increased costs due to repeated precommercial thinning entries and the lack of other habitat features that may be beneficial for other resources such as wildlife. However, the high density regime may meet habitat needs such as the required structure for goshawk nest stands (Lilieholm et al. 1994).

Management options in older lodgepole pine stands are more limited. In stands where the average tree diameter already exceeds eight inches and relative density is high, thinning should be limited and SDI should maintained at greater than 35% of maximum SDI (larger than 245). In stands with an SDI value in the high beetle susceptibility range (20 to 35% maximum SDI), thinnings should be done to no more than 20% maximum SDI (140 or less) (Anhold et al. 1996). Either density level that is selected would have to be maintained until final harvest.

Salvage Harvest Treatment

Much of the interest from the public is in the trees that are visibly dying from bark beetle damage in large patches across the landscape. The typical treatment for the degree of mortality experienced from the present bark beetle epidemic is to break up the stand, remove the older lodgepole, and ensure that a mix of tree species will be regenerating in the future. Further management actions could include measures to increase species and age heterogeneity and ensure that the stands have a component of early seral species such as western larch, ponderosa pine, or Douglas-fir.

A salvage harvest treatment would allow mountain pine beetle-damaged dead and dying trees to be cut and removed. The treatment could apply to units proposed for commercial harvest. Lodgepole pine could be the primary tree species harvested, though some other pine may be included, especially within plantations of ponderosa pine that include off-site stock. The objectives of the salvage treatment could include: reducing falling tree hazards near roads, trails and recreation sites; reducing fire hazard within strategic areas; and using dead and dying trees for products (such as saw timber, firewood, chip wood, etc.) to support local and regional manufacturing infrastructure.

Collaborative Process

Representatives from diverse interest groups have committed to seek common ground and work with the Forest collaboratively on forest management solutions. The goal of the collaborative process is to emphasize community participation while developing a project proposal that emphasizes ecological restoration. A successful integrative and collaborative decision-making process includes integrated and balanced goals, inclusive stakeholder involvement, monitoring and adaptive management, and multidisciplinary data (Keough and Blahna 2006). Landscape-scale assessments that are used on the Forest such as the Ecological Management Decision Support models and FSVeg Spatial Data Analyzer analyses are valuable tools for spatially depicting ecosystem condition in ways that are easily understood and communicated in the collaborative process.

Other Considerations

Sensitive species, such as whitebark pine (*P. albicaulis*), need to be protected from mountain pine beetle attack across the Forest. The species is an important ecosystem component that influences the success of other organisms and plays a vital role in first colonizing areas disturbed by fire or landslides, stabilizing the soil, moderating snow melt, and providing the cover that allows regeneration of other tree species (Aubry et al. 2008). Whitebark pine was designated by the U.S. Fish and Wildlife Service in 2011 as a candidate for protection under the Endangered Species Act because of the threats to the species from damaging pests and habitat loss.

Aubry et al. (2008) maintained that the future of whitebark pine in Oregon and Washington as well as throughout its range is of serious concern because of the species' high susceptibility to infestation by mountain pine beetle, its acute vulnerability to infection by the non-native fungus *Cronartium ribicola* (white pine blister rust agent), its risk of being destroyed in large and intense wildfires, and the likelihood of its being replaced in some subalpine mixed conifer forests by more shade-tolerant tree species, a trend that is exacerbated by fire exclusion.

Figure 5. White bark pine (Richard Sniezko, USFS).

Nearly all whitebark pine occurrences are in designated wilderness areas or special interest areas so any treatments need to be carefully coordinated. Current whitebark pine restoration strategies in use on the Forest include more accurate mapping of distribution, condition assessments and monitoring, beneficial silvicultural prescriptions, and cone crop surveys. In addition, silvicultural prescriptions in vegetation management projects may favor retention of larger trees of other highly valued species at risk to pine bark beetle damage such as ponderosa pine.

Conclusions

The 2014 Bark Beetle Strategy describes the response of the Colville National Forest to the unprecedented pine bark beetle outbreak in eastern Washington State. Providing for human safety and improving forest recovery and resiliency are primary objectives of the strategy. Actions include fuels reduction and silvicultural treatments. Stand density management will be used as a silvicultural tool to reduce susceptibility to future pine bark beetle epidemics. Additionally at the landscape scale, the frequency and extent of bark beetle outbreaks will be addressed through the maintenance of a mosaic of stand structures, densities, and compositions. Included in the strategy are considerations for sensitive species at risk such as whitebark pine.

The bark beetle epidemic is accelerating and will require prioritized placement of treatments and integration of multiple program funds regionally and nationally (US Forest Service 2011). Funding of management actions through use of the bark beetle strategy can affect accomplishments of goals in other resource areas and affect achievement of vegetation treatments outside of bark beetle impacted areas. However, the outcome of the strategy is expected to be less risk of human injury from falling trees, reduced fire risks to community values, and forests with more resilience to biotic and abiotic threats.

The optimum method to ensure success in restoring ecosystems is collaborating with the local public in planning efforts. Regional planning, including stakeholders in identifying and assessing values at risk, is an important component of the strategy (Laverty and Williams 2000). The authors identified the Sierra Nevada Ecosystem Management Project (http://pubs.usgs.gov/dds/dds-43/) and the Interior Columbia River Basin Management Project (http://www.icbemp.gov/) as examples of regional-scale planning that address resources at risk and establish priorities for broad geographic areas.

APPENDIX A: Vegetation Management Schedule and Beetle Damage and Risk

The Colville National Forest covers an area of about 1.1 million acres. Of those acres, approximately one third of the area is suitable for implementation of vegetation management projects. The Forest maintains a ten year schedule for the projects. Current projects are described in Appx. B. Vegetation management projects in the current fiscal year (FY) 2015 and those that are planned for FYs 2016 through 2019 are depicted in Fig. 6.

Mountain pine beetles are most closely associated with lodgepole pine. When an outbreak occurs in a lodgepole pine stand, the beetles preferentially attack the largest diameter trees (Mehmel 2014). Over the course of an outbreak, 85% or more of the large diameter trees can be killed along with progressively smaller proportions of the small diameter trees (Cole and Amman 1980). There are approximately 136,172 acres of forest stands with a lodgepole pine component outside of designated wilderness and roadless areas on the Forest. Of those, about 78,729 acres (58%) have a majority lodgepole component, while 57,443 acres (42%) have a minority lodgepole component. However, annual harvest treatments in the project areas average about 7,000 acres and fuel reduction treatments about 6,000 acres per year. Therefore, the annual projects cannot be expected to treat all beetle-affected trees, nor can they change the course of the epidemic. The epidemic must be addressed with a long term and large scale restoration strategy.

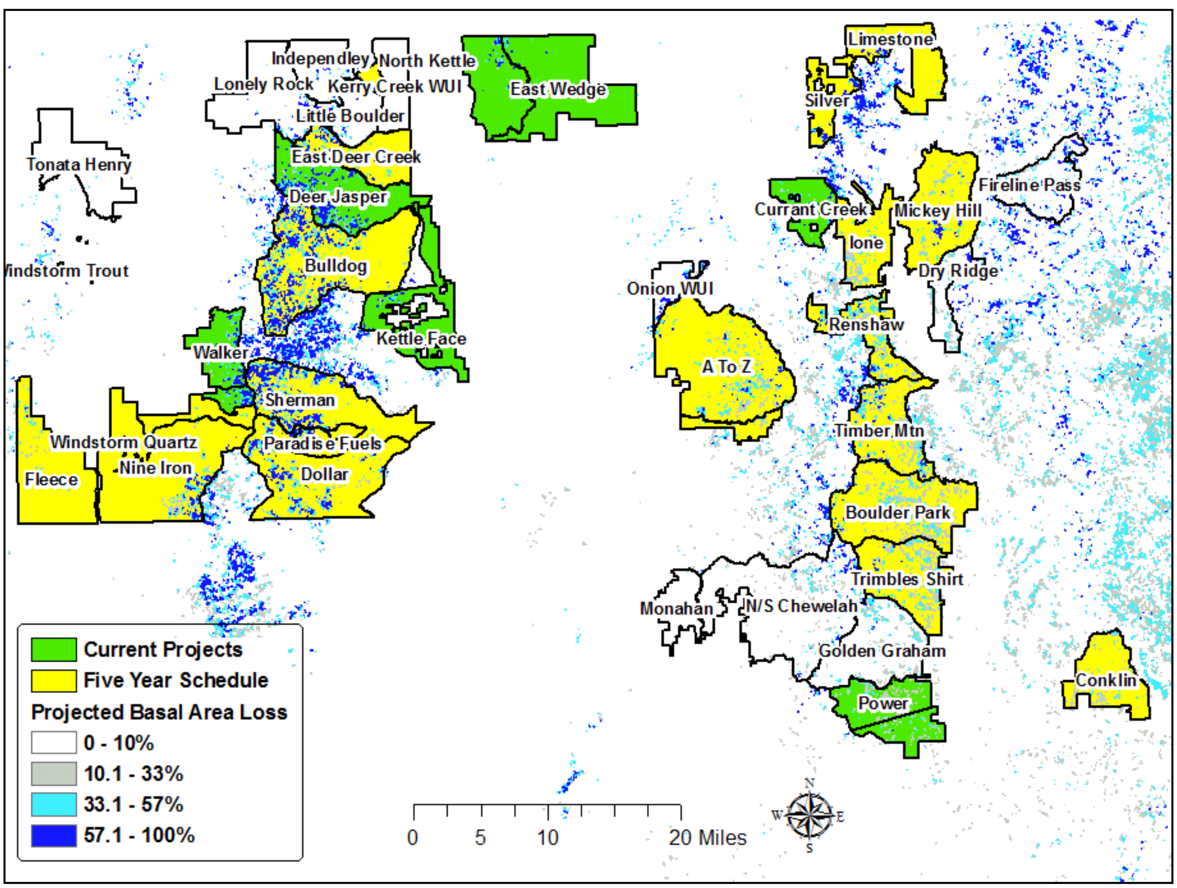

Figure 6. Current vegetation management projects, five year project schedule, and projected future basal area lost from mountain pine beetle damage between 2013 and 2027 (Krist et al. 2014).

Current and predicted insect and disease data are essential for planning for restoration projects. Analyses of data such as the annual aerial surveys (Mehmel C. 2014a) and the 2013-2027 National Insect and Disease Risk Maps (Fig 6.) (Krist et al. 2014) are used as tools for determining the risk of damage from insects and for prioritizing restoration opportunities on the Forest. "Risk" is defined as the expectation that without remediation at least 25% of standing live basal area greater than one inch in diameter will die over a 15-year timeframe from 2013 to 2027 (Krist et al. 2014).

The 25,130 acre Deer Jasper Restoration Project area (Appx. B) is predicted to have a large area of medium to high level risk of projected loss from pine bark beetle damage (Fig. 6). The project area is scheduled to be treated in FY 2015 with commercial and pre-commercial thinning and fuels reduction treatments. The treatments are expected to increase forest resilience to insect outbreaks, wildfire, and climate change. Likewise, the 14,178 acre Walker Fuels Reduction Project (Appx. B) contains areas with high risk of basal area loss (Fig. 6). The project will also be treated in FY 2015. Other project areas such as Sherman and Bulldog are predicted to have very high risks of loss (Fig. 6). Both projects are in the planning schedule (Fig. 6) and are expected to be treated within the next one and three fiscal years, respectively.

The Forest invests significantly large resources in project planning that involves National Environmental Policy Act (NEPA) analyses. The Forest has improved efficiency of the process by increasing the use of landscape scale analyses and a collaborative process. Tools that can use the most efficient existing authorities in current law and policy such as the Healthy Forest Restoration Act, the Healthy Forest Initiative, Environmental Impact Statements, and Categorical Exclusions (CEs) (US Forest Service 2012) can maximize restoration in the event of a major disturbance.

CEs are supplements to NEPA regulations and are tools that can be useful when managers are faced with damaging events such as the current widespread insect outbreak. A proposed action may be categorically excluded from further analysis under extraordinary circumstances. For example, a CE could be used to close an area during a period of extreme fire danger or to remove hazardous insect- or drought-killed trees along roadways.

The use of a CE allows more efficient management of natural resources by reducing the time and investments spent analyzing proposals that do not have significant environmental impacts. For example, a CE was used in the planning process for the Currant Creek project (Appx. B) to quickly manage the damaging effects from the mountain pine beetle outbreak in the area. In addition, a CE was used for restoration in the Windstorm Quartz and Trout projects (Appx. B). Trees in the Quartz and Trout projects were badly damaged by a windstorm in July, 2012.

The restoration strategy for the Forest facilitates strategic decisions on the tools and resources to use, and the timing and location of activities within the vegetation management schedule. The outcome of landscape scale restoration is threefold; 1) increased human safety, 2) increased resiliency of the ecosystem to disturbance, and 3) recovery of severely impacted areas.

APPENDIX B: Treatments within Current Vegetation Management Projects

I. FYs 2015/2016 Deer Jasper Restoration Project EA (Deer Jasper, Doghouse)

PROJECT LOCATION

The approximately 25,130 acre Deer Jasper Restoration Project area (Fig. 6) is located in Ferry County, Washington on the Three Rivers and Republic Ranger Districts on the Colville National Forest in Northeast Washington. The Deer Jasper sale is expected to be awarded in fiscal year (FY) 2015 and the Doghouse sale is planned for award in FY2016.

PURPOSE AND NEED

The purpose and need for this project is to reduce the adverse impacts caused by Forest Service system roads; reduce hazardous fuel conditions in strategic areas; allow for dry and mixed conifer forests to more closely reflect historical tree species putting these forests on a trajectory towards greater resilience to uncharacteristic wildfire, insect outbreaks, and climate change; enhance, or accelerate the development of high quality lynx foraging habitat; and provide forest products that are economically viable and sustainable.

TREATMENTS

Acres to be treated include about 5,878 acres of commercial thinning, 673 acres of pre-commercial thinning, and 12,019 acres of ladder fuel reduction treatments.

Treatment Type	Acres
Commercial thinning	5,878
Small pole thinning	370
Shelterwood removal with reserves	111
Pre-commercial thinning	673
Ladder fuels reduction	12,019
Prescribed fire	4,710
Prescribed fire-optional	4,512
Mechanical piling	5,824
Hand piling	618
Lop and scatter	1,541
Leave tops attached	9,659

In addition, the following treatments will be implemented in the project area:

- Salvage relating to mountain pine beetle: dead and dying trees resulting from mountain pine beetle impacts in units proposed for commercial harvest will be removed.
- Enhancement of aspen, large Ponderosa pine and western larch.
- Site preparation and reforestation: planting will reintroduce native species.
- Fireline construction: hand or machine fireline around prescribed fire and optional burn units including those next to private land.

PROJECT LOCATION

The East Wedge planning area (Fig. 6) is located in Stevens County Washington approximately 21 miles north of Kettle Falls, Washington in an area between the Kettle River and the Columbia River. The project area is approximately 43,692 acres and extends from the vicinity east of Pierre Lake north to the United States-Canada border.

PURPOSE AND NEED

Purpose: Improve overall forest health on National Forest System (NFS) lands within the planning area through active management.
Need: Stands are limited in their ability to function within their historic range of variability due to fire suppression and past management resulting in biomass accumulation. Stand treatments are needed to reduce susceptibility to continuing insect and disease-caused mortality, promote late-successional characteristics and landscape level diversity, develop or protect horizontal and vertical forest structure, and reduce susceptibility to cyclic repetitions of stand-replacing fires.

Purpose: Break up the existing fuel continuity on NFS lands to reduce the risks of wildfire damage to federal and non-federal lands and structures.
Need: Stand conditions are such that fuel reduction methods are needed to thin and/or remove the vegetation, reduce ladder fuels, and remove surface fuels.

TREATMENTS

Approximately 4,700 acres of overstocked and 1,900 acres of insect-impacted stands will be treated within the project area. Approximately 11,500 acres will be treated to reduce fuels and decrease horizontal and vertical fuel continuity.

Treatment Type	Acres
Commercial thinning	1,089
Shelterwood/seedcut	229
Variable density thinning	3,453
Group selection	190
Precommercial thinning	509
Salvage	15
Biomass thinning	186
Prescribed fire	4,564
Fuelbreak treatments	805

In addition, the following treatment will be completed:
An estimated 520 acres of regeneration need will be created in scattered shelterwood patches ranging from one to ten acres in size as part of the variable density thinning treatments.

III. FY 2014 Walker Fuels Reduction Project EA (Walker)

PROJECT LOCATION
The Walker Fuels Reduction planning area (Fig. 6) is comprised of 14,178 acres and is located about 10 miles east of the town of Republic, Washington. It is bounded on the south side by State Highway 20, by the Kettle Crest on the east, and on the west by the Forest Boundary. The northern boundary roughly coincides with the watershed divide between the North Fork Sanpoil and Herron Creek.

PURPOSE AND NEED
Purpose: Create a diverse landscape of stand conditions similar to those found historically which were more resilient to fire, insects and disease.
Need: Treatments are needed to reduce tree density, increase stand vigor and decrease the potential for insect and disease outbreaks thus creating forest conditions that produce less hazard fuels and are less prone to stand replacing wildfire.

Purpose: Break up the existing fuel continuity on National Forest System lands, and reduce the risks of wildfire damage to private lands and structures.
Need: Stand conditions are such that fuels reduction methods are needed to thin vegetation, reduce ladder fuels, and remove surface fuels.

TREATMENTS
Approximately 6,555 acres of vegetation on National Forest lands will be treated including about 2,025 acres commercial thinning, 518 acres pre-commercial treatment, and 2,975 acres other fuel treatments. In addition, 5,087 acres of underburning and 838 acres optional burning will be implemented to dispose of treatment created and existing surface fuel.

Treatment Type	Acres
Prescribed fire	5,087
Prescribed fire-optional	838
Other fuel treatments	2,975
Commercial thinning	2,025
Precommercial thinning	518

IV. FYs 2013/2014/2016 Power Lake EA (Flowery Trail, Delaney, Ninebark, Middle Fork)

PROJECT LOCATION

The Power Lake project area (Fig. 6) is comprised of 22,452 acres. The boundaries of the project area stretch from the Pend Oreille River valley to the peak of Chewelah Mountain northwest of the planning area. The Flowery Trail Stewardship was awarded in FY2013. The Delaney Stewardship and Ninebark Timber Sale were awarded in FY2014. The Middle Fork Timber Sale is expected to be awarded in FY2016.

PURPOSE AND NEED

Purpose: The purpose for this project is to promote tree growth, reduce insect and disease levels, and maintain or restore riparian vegetation and big game habitat. Treatments would improve forest conditions by focusing on establishing the composition, structure, pattern, hydrologic function, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable and resilient.
Need: Stands within the project area are overstocked, less vigorous, and less resilient to uncharacteristically high levels of loss due to insects, disease, and wildfire. Many stands have large amounts of ladder fuels and growth of tree species that are less tolerant of fire because of the suppression of wildfires over the past 100+ years. This has resulted in a higher probability of increased fire size, frequency, intensity, and severity across the landscape and increased risk of detrimental effects to key ecosystem components like watershed function and wildlife habitat.

TREATMENTS

Approximately 7,053 acres on NFS land will be treated. In commercially treated areas, prescribed fire or mechanical treatments will be done. Outside commercially treated areas, prescribed fire and mechanical treatments will be done. Precommercial thinning will occur on about 1,769 acres.

Treatment Type	Acres
Selection harvest	3,935
Thinning	2,710
Shelterwood	105
Overstory removal	2
Selection/shelterwood[1]	105
Shelterwood/selection	41
Thinning/shelterwood	142
Seed tree harvest	13
Prescribed fire	6,000
Fuel treatments-mechanical	1,053

[1] Where multiple treatments are proposed together, the treatment listed first will be the primary treatment for an area. The second treatment will be implemented within inclusions (e.g., proposing a shelterwood treatment for a small lodgepole pine pocket within an area that will have a thinning proposed for the remainder of the unit.)

V. FYs 2012/2013 Kettle Face Fuel Reduction EA (North/South Kettle Face)

PROJECT LOCATION
The Kettle Face Fuel Reduction project area (Fig. 6) is comprised of 23,058 acres on NFS lands and is located approximately 12 miles northwest of Kettle Falls, Washington. Kettle Face South was awarded in FY2013 and Kettle Face North was awarded in FY2012.

PURPOSE AND NEED
1. Create defensible space along access and escape routes to increase public and firefighter safety.
2. Improve fire suppression abilities.
3. Reduce wildland fire risk to homes, structures, infrastructure, and forest values (e.g. wildlife habitats, scenic views, campgrounds, streams, soils.
4. Improve the resiliency of the forest landscape to wildland fire.

TREATMENTS
Approximately 16,203 acres will be treated including about 6,952 acres of commercial thinning, 611 acres of precommercial treatment, and about 8,597 acres of other fuel treatments.

Treatment Type	Acres
Commercial thinning	6,174
Free selection harvest[1]	567
Irregular shelterwood	156
Group selection	55
Precommercial thinning	611
Ladder fuel reduction-primary	2,061
Mechanical fuel reduction	4,288
Ladder fuel reduction-secondary	2,664

[1]Combination of thinning, group selection, individual tree selection, and small irregular shelterwoods.

VI. FY 2013 Currant Creek Salvage Project CE (Currant Creek)

PROJECT LOCATION
The Currant Creek project area (Fig. 6) is located in the Smackout Valley area near Chandler Meadows and Smackout Creek on the Three Rivers Ranger District, Stevens County, Washington.

PURPOSE AND NEED
Purpose: to harvest dead, dying and at risk commercial lodgepole pine that are being affected by the mountain pine beetle outbreak.
Need: Realize the economic value from dying and dead beetle-killed trees. Retain forest health by removing beetle-affected and –killed trees. Provide saw logs to help sustain local industries and communities.

TREATMENTS
Treatments include commercial harvest of 235 acres of live, dead or dying lodgepole pine and fuel reduction treatments of full tree skidding, machine piling, and pile burning.

VII. FY 2013 Windstorm Salvage Project CE (Windstorm Quartz, Windstorm Trout)

PROJECT LOCATION
The project area is comprised of 458 acres in the Windstorm Quartz/Trout projects (Fig. 6) on the Republic Ranger District, Ferry County, Washington.

PURPOSE AND NEED
Purpose: to salvage dead and/or severely damaged down trees within windstorm affected areas. In addition, there may be opportunities to help meet the Forest Plan desired future conditions in these areas by implementing silvicultural practices and treating slash created from the wind thrown timber.
Need: to salvage down timber from the July 20, 2012 windstorm before it loses a substantial portion of its economic value. Economic damage from blue stain caused by beetles could be reduced by quick removal of logs in harvest units before colonization. The project could also provide saw logs to help sustain local industries and communities.

TREATMENTS

Treatments include commercial harvest of 234 acres of downed timber and snapped off merchantable trees within 200 feet of an open road; retention of sufficient numbers of down logs and snags for future wildlife habitat; and fuel reduction treatments of full tree skidding, machine piling, and pile burning. In addition, supplemental reforestation of western larch and ponderosa pine would occur where the windstorm has created openings.

APPENDIX C: LITERATURE CITED

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