3.3 Watershed Resources (Soil and Water)

The project area is located within the North Fork Shoshone River Drainage beginning 11 miles upstream of Buffalo Bill Reservoir. The proposed treatment areas are contained within 15 sixth-level hydrologic unit boundaries (HUBs) or watersheds.

Past Assessments

The Forest recently performed a watershed assessment and roads analysis (Shoshone NF, 2002a and 2002b respectively) for the majority of the analysis area; Big Creek (100800120302) and Whit Creek Composite (100800120303) were not included in that assessment. However, the watershed resources within the Big Creek and Whit Creek Composite HUBs are very similar to the rest of the analysis area. Existing condition descriptions in Shoshone NF 2002a and 2002b were used as part of the following existing condition descriptions.

Hydrology

Overall, the HUBs in the analysis area are in good hydrologic condition. The North Fork Shoshone River drainage is a snowmelt runoff dominated watershed. As such, the annual peak flow typically occurs in early to mid-June and is a function of the annual snow pack and snowmelt rate. Peak flows in the North Fork River itself have been recorded as high as 20,000 cubic feet per second (cfs), while base flows during winter can be as low as 100 cfs. Localized summer thunderstorm events are common and they regularly produce short duration increases in flow and sediment.

Natural sediment sources include upland and stream bank/channel erosion. Suspended sediment loads are very high during snowmelt runoff and thunderstorm flow events. Most bedload sediment is mobilized during the snowmelt season, however summer thunderstorm events can produce debris flows that deliver a substantial amount of material to main stem channels.

Stream Channels. Several of the Rosgen (1996) stream channel types occur within the analysis area and are described in the project file. The analysis area is located in the Absaroka Volcanic geologies. They are young in geologic time, have unconsolidated soils with poor infiltration rates, and are highly erodible. Tributary streams typically have high gradients and steep slopes, and large substrate with pocket pools providing the majority of the fish holding habitat. Much of the large wood that enters these streams is highly mobile (Young, 1994). Many streams in the area have naturally high bedload transport rates and are subject to debris flow activity. Reaches located on alluvial fans or near geologic control points such as dikes are often naturally unstable, evolving from one stream type to another following debris flows or other large sediment inputs.

Given the relatively limited human activity in the analysis area and physical characteristics of the hydro-physiograpic region, most the stream channels in the analysis area exhibit the stream types and conditions that would naturally be expected to occur. Thus, reference reach conditions exist throughout much of the project area. There are localized reaches that are functioning at-risk, particularly short lengths along the Buffalo Bill Cody Scenic Byway and within meadows that receive heavy recreation use. There are no known reaches that are non-functioning.

Water Quality. Surface water classes and use designations established by the Wyoming Department of Environmental Quality (WDEQ) for the major surface waters in the analysis area are listed in Figure 26.

Figure 26. Major surface water classifications within the analysis area (WDEQ 2001).

Surface Water	Water Class and Use Designation

All surface waters within the Washakie and North Absaroka Wilderness Areas	Class 1[15] - drinking water supplies, game and non-game fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic value
Non-Wilderness portions of the North Fork Shoshone River, Big Creek, Whit Creek, Elk Fork, Sweetwater Creek, Sheep Creek, Fishhawk Creek, Eagle Creek, Grinnell Creek, and Middle Creek.	2AB—drinking water, game fish, non-game fish, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry, and scenic value
All other non-wilderness waters	3B—other aquatic life, recreation, wildlife, agriculture, industry, and scenic value

A full range of water quality parameters apply to the use designations. The water quality criteria that have the potential to be affected by this project include: settleable solids, floating and suspended solids, protection of aquatic life, turbidity, dissolved oxygen, temperature, water purity, oil and grease, and biological.

Several water rights exist both on and off the national forest. The rights are directly tied to the use designations and include Forest rights and off-Forest rights. Water from the analysis area flows into Buffalo Bill Reservoir, which is used for municipal water supply by the City of Cody and the Northwest Rural Water District (Shoshone NF 2002b). There may also be domestic water supply uses directly from the North Fork Shoshone River between the national forest boundary and the reservoir; additionally, recreation users rely on water in the area for human consumption and stock watering (Shoshone NF 2002b).

Presently, no major concerns with providing for water quality sufficient to support the designated uses exists. None of the streams in the analysis area are water quality limited (i.e. identified by the State in their 305(b) report or 303(d) list). The Clover Mist Fire of 1988 caused additional sediment discharge that may be affecting beneficial uses. Because the fire was naturally ignited and the burn area is in wilderness, mitigation of effects was neither possible nor reasonable (Shoshone NF 2002a).

Effects. The effects of management activities on watershed resources are a function of the type, timing, methods, and amount of disturbances. Figure 27 lists the type and amount of treatments within each sixth-level HUB, as proposed by alternative two. Project specific BMPs have been selected and designed to reduce the effects of the action alternatives and to provide for watershed conservation.

The soil, water, and aquatic resources effects analysis will focus on aquatic ecosystems, soil productivity, geologic hazards, special areas, and cumulative effects.

[15] Class 1 designations are based on value determinations rather than use support and are thus protected for all uses in existence at the time of their designation. The designation date is November 28, 1975.

Figure 27. Type and amount of treatments within each sixth-level HUB proposed under Alternative 2.

Sixth Level HUB Name/Number	HUB Area (Acres)	Treatment Type and Areas by Watershed (acres)				Percent of HUB Treated
		Mechanical	Mechanical & Burn	Burn	Total Treatment	
Upper North Fork Shoshone River/100800120101	42,626	272		49	321	1%
Crow Creek/100800120103	12,346	16		Boundary	16	Less than 1%
Middle Creek/100800120104	23,197	85		212	297	1%
Grinnell Creek/100800120105	19,398	70		68	138	1%
Libby Creek Composite/100800120201	27,695	551	22	1,167	1,739	6%
Eagle Creek/100800120202	36,976	16		192	209	1%
Fishhawk Creek/100800120203	37,937	2		176	178	Less than 1%
Gunbarrel Creek/100800120204	10,490	39	Boundary	383	422	4%
Moss Creek Composite/100800120205	31,626	387	248	2,259	2,895	9%
Clearwater Creek/100800120206	12,639			288	288	2%
Sweetwater Creek/100800120207	29,531			Boundary	Boundary	Less than 1%
Lower Elk Fork/100800120209	34,676	1	39	3,360	3,400	10%
Grizzly Creek Composite/100800120301	37,832	21	4	2,633	2,658	7%
Big Creek/100800120302	16,575			779	779	5%
Whit Creek Composite/100800120303	44,298	189		1,891	2,080	5%
Totals	***483,663***	***1,649***	***313***	***13,470***	***15,432***	***3%***

Aquatic Ecosystems

Sediment: *Most sediment delivered to streams comes from a source zone along streams whose width depends on topography, soils, and ground cover. Connected disturbed areas like roads and other disturbed soils near streams can deliver sediment during runoff events. Sediment deposits in stream beds harm insect populations and fish reproduction.*

For the affected environment, sediment is entering streams at existing road and trail crossings and at areas where roads or trails run parallel to streams. Sediment may be entering streams at recreational use and special use facilities. Localized areas disturbed by grazing (wildlife and recreation horses) may also be contributing sediment to stream courses.

The demand for water quality is expected to remain high in order to provide for the designated uses. Those uses could be affected or put at risk if sediment delivery to streams is not adequately controlled. Proper implementation of the project BMPs is a proven method to minimize sediment delivery to streams.

Under Alternative 1, current conditions would continue; no salvage for fuels reduction, harvest or burning activities would occur.

The action alternatives were based on project design (BMPs). Design/mitigation is such that operations cannot proceed if unacceptable impacts would occur to soil and water resources (such as excessively wet conditions). Implementation and effectiveness monitoring conducted on-Forest

confirms that BMPs control non-point source pollution. Proper implementation of the BMPs would limit sediment delivery to streams during and after the actions.

The effects of harvesting to salvage timber, other mechanical treatments, and prescribed fire treatments on increased sediment delivery would be minor. Alternative 2 would disturb approximately 500 acres more than Alternative 3. The timber sale contract would require the purchaser to perform road maintenance, which would include armoring of stream crossings to reduce sediment delivery to streams. This effort would involve armoring the road approach, installing drainage structures near crossings, and other measures described in the BMPs. Road maintenance could correct existing drainage problems.

Figure 28 provides a comparison of sediment indicators by alternative. The potential for sediment delivery to streams is increased with greater disturbed area near streams (within the WIZ) and the greater number of stream crossings. Sediment delivery from the action activities would be limited by following BMPs. Operations in riparian areas, wetlands, and along stream banks would be strictly controlled to limit sedimentation.

Figure 28. Comparison of indicators related to sediment.

Alternative	Temporary Road Mileage*	Temporary Road Mileage in WIZ	Number of Temporary Road Stream Crossings*	Mechanical & Mechanical/RX Treated in the WIZ (acres)*	Prescribed Burn Area Treated within WIZ (acres)*
1	0	0	0	0	0
2	12.3	3.8	20	904	1,352
3	7.7	3.2	10	797	1,352

*These values are approximated and may vary somewhat with implementation of the action.

Bed/Bank Stability: *Bed and bank stability can be damaged from trampling by animals or humans, vehicle impact, degraded bank vegetation, or excessive flow augmentations. Streams can be made wider and shallower, pools and overhanging banks can be destroyed, and much sediment can be added to streams.*

Under Alternative 1, there would be no impact to stream banks from project activities. Existing roads would continue to cross or parallel stream courses. With continued fire suppression and no mechanical treatments the potential for intense wildfire is high. In addition to releases of excessive sediment there is the potential for substantial inputs of large wood into the stream systems after intense wild fires. This situation has the potential to create large debris jams and substantially modify the stream channel. This scenario was documented in Jones Creek after the 1988 fires (Young, 1996).

Both action alternatives would temporarily affect bed/bank stability through the construction of temporary roads and the associated stream channel crossings. However, after use and prior to the next spring runoff, temporary roads would be decommissioned and the natural drainage pattern and ground cover would be restored. Also, all skid trails and any designated stream channel crossings on skid trails, would be properly closed and rehabilitated after use.

The mechanical treatments and prescribed fire activity would not have substantial negative effects on bed/bank stability. Under the action alternatives, the BMPs provide specific direction for treatment within the WIZ to reduce the risk for bank degradation. Stream crossings on temporary roads and skid trails pose the greatest threats for destabilizing streambeds and banks, and adding fine sediment to the stream. The use of armored crossings on roads and road and skid trail designation prior to construction would mitigate concerns.

The number of stream channel crossings on temporary roads is shown in Figure 28**.**

Flow Regimes: *Flow regimes can be altered by major changes in cover type or ground cover, dense road networks, or water projects. Water temperature and chemistry, sediment transport, aquatic habitats, and aquatic life cycles can be degraded.*

Runoff is a function of precipitation, interception, evapo-transpiration, and the change in soil storage. Studies in areas similar to the analysis area have documented that streamflow can increase up to 30 to 40% when 30 to 40% of the vegetation is removed (Troendle and King 1985 and 1987, Troendle and Olsen 1994). The increase typically occurs early in runoff season before peak discharge is reached; late season runoff and summer storm flows are relatively unaffected (Troendle and Bevenger 1993). The greatest increases in seasonal water yield occur during wet years, however the greatest increases in peak annual discharge occurs during dry years (Troendle and King 1987, Troendle and Olsen 1994, Troendle and Bevenger 1993).

A sub-issue of the watershed assessment (Shoshone NF 2002a) was whether fire suppression over the past century has resulted in increased evapotransporation (ET) and thus affected the water balance of the North Fork drainage. Exhaustive analysis of available precipitation and streamflow data resulted in a conclusion that if there has been any change it is not detectable at the USGS gage directly downstream of the project area. This analysis however was conducted on data collected prior to the insect infestation. Since more of the watershed has now experienced a substantial change in evapo-transpiration, it is possible a change is now detectable. Unfortunately, streamflow data needed to do the analysis will not be available for a few more years.

Effects. Under Alternative 1, much of the analysis area would continue to experience the current insect epidemic. A decrease in ET from pre-insect epidemic is expected and may result in an increase of water yield at the watershed scale. Any increase would be expected to occur early in the runoff season. Based on data from Jones Creek and Crow Creek (Troendle and Bevenger 1993), peak flows are not expected to substantially increase.

Along with the decrease in ET expected in Alternative 1 due to insect caused mortality, Alternatives 2 and 3 would result in removing minor amounts of live trees (primarily thick understory trees) that may or may not experience insect mortality in the near future. Also, Alternatives 2 and 3 would decrease the interception of snowfall by tree stems. Due to the limited area within individual watersheds treated (see Figure 27), any changes in flow regime under Alternatives 2 and 3 are expected to be very similar, and at best only slightly greater, to those explained above under Alternative 1.

Temperature/Oxygen*: Summer water temperature is increased, and winter water temperature is decreased, by removing shade or damaging banks so streams are wider and shallower. Dissolved oxygen is usually reduced when summer water temperature is increased. Such impacts impair or destroy the suitability of water bodies for aquatic biota.*

Alternative 1, riparian and stream shading will continue to increase resulting in cooler summer temperatures and slower fish growth rates. Under the action alternatives removal of some over story conifer vegetation will increase summer stream temperatures and biological productivity slightly. Stream dissolved oxygen levels will not be affected since it is super saturated from entraining atmospheric oxygen as the water passes through riffles and over large rocks.

Under the action alternatives, a substantial change is not expected. Proper implementation of the BMPs during harvest and fuel treatments along streams would maintain a forested condition by retaining as much live vegetation as possible while still meeting project objectives. During prescribed burning operations, only light burning would be allowed within the WIZ. Operations would be conducted so that riparian area vegetative cover is retained within the WIZ.

Water Purity: *Water purity can be degraded by placing concentrated pollutant sources near water bodies, applying harmful chemicals in or near water bodies, or intercepting hazardous rock strata by roads. Degraded water purity can impair or destroy use of the water by aquatic biota and humans.*

There are no known water purity problems in the area. Alternative 1 would not affect water purity. The action alternatives would involve the use of hazardous chemicals such as diesel fuel. Some risk does exist that a water quality violation could occur due to accidental spillage. Contract

language and BMPs require proper storage and management of chemicals and petroleum products. A contingency plan is also required that details actions to be taken in the event that a spill occurs. With these safeguards, the action alternatives are not expected to affect chemical water quality.

Stream Habitat

Aquatic Life: *Aquatic life can be degraded by migration barriers, changed flow regimes, riparian damage, or big sediment or chemical loads.*

Current fish habitat conditions in most of the mid to upper reaches of tributary streams excluding the 1988 Clover Mist burned area are in or near reference conditions since there is minimal development, little to no roads, and no commercial livestock grazing.

In the main stem of the North Fork many reaches are naturally braided, unstable and often migrate laterally. This is primarily due to the heavy bed load delivered to the lower gradient valley system from the high gradient tributary streams. As a result, much of the main stem North Fork tends to be braided, shallow and wide with low riffle: pool ratios, instream cover and overhanging stream bank vegetation.

In these braided systems large wood primarily moves during high water and is deposited on bars in jams or individually. These jams provide fish habitat during high flows and spring spawning migrations. These natural stream habitat conditions result in less suitable fish habitat and lower fish production. In narrower, higher gradient, boulder strewn, canyon reaches the suspended bed load moves through the system and is deposited downstream. There are usually a high number of boulders in these reaches. As a result, there are higher number of pools, pocket pools and fish holding habitat. Single to multiple pieces of large wood can be found adjacent to the stream bank providing fish habitat during most flows. Where suitable fish habitat does exist in the main stem and tributaries fish densities are generally high.

The Clover Mist fire located in the upper North Fork drainage initially resulted in heavy stream sedimentation, channel modification and substantially reduced fish habitat and fish densities. Overtime, the fishery has recovered, primarily due to natural channel stabilization, establishment of stream side vegetation and increased nutrient loading that occurred after the fire.

Overall, fire suppression in the main corridor of the North Fork and its tributaries has resulted in riparian vegetation consisting of mostly older successional stages. This situation has resulted in increased shading, decreased stream side deciduous vegetation, increased conifers and decreased nutrient loading in the stream systems.

Effects. Under Alternative 1, no management actions to reduce fuels would be implemented; therefore, no human caused impacts to aquatic life associated with this project proposal would occur. A severe wildfire would increase stream sediment levels substantially and adversely affect aquatic biota in the short term similar to the Clover Mist fire. Nutrient availability, younger vegetative seral stages and biological productivity would increase after the fire in the long term. The indirect effect would be a reduction in aquatic fauna and flora over the short term and an increase over the long term. The potential for intense fire is higher for Alternative 1 compared to the action alternatives. Changes to stream habitat are not expected to be substantial under the action alternatives since a mosaic of fire and timber removal is planned in the riparian/stream zone. This type of treatment would help reduce the probability of a severe wildfire. This would indirectly benefit aquatic life by reducing potential large sediment inputs after a large fire.

3.3.1 Soils Resources

Soil Productivity

Per the National Ecological Hierarchy, the analysis area is in the Northern Absaroka Range subsection of the Yellowstone Highlands section (McNab, 1994). Six land type associations (LTAs) further describe landscape pattern within the assessment area (Houston, 1999). These land type associations were delineated considering geologic parent material, soil, vegetation, topography, and climate. The LTAs are described in the project file.

The analysis area is within the boundaries of the Soil Survey Area 656. This survey is in the process of being correlated by the Natural Resource Conservation Service. Map units and interpretations are located in the project file. Dominant soils within the analysis area are from the Mollisol, Entisol, Inceptisol, and Alfisol soil orders. Major management considerations for these soil types include steep slopes, surface compaction hazard, erodible surface, mass movement potential, soil rutting hazard and fire damage potential.

Soil Compaction: *Soil compaction* is *caused by excess weight of vehicles and animals. It impairs infiltration, root growth, and soil biota.*

Soil Compaction and Rutting Hazards. Regional guidelines for protecting the soil resource (FSH 2509.18-92-1) state that no more that 15% of an area will be left in a detrimentally compacted, displaced, puddled, severely burned, and/or eroded condition. This would be met through the project timing and the project design for project implementation in Section 2.2.4.

Effects. The No Action Alternative would not result in any impacts to soil health and productivity, soil compaction or rutting, soil fertility and nutrient removal, soil heating, soil erosion or regeneration hazard from management actions. Existing conditions for soil health and erosion resulting from roads, stream crossings, vehicles, etc. would continue at current levels.

However, in the event of a large, high-intensity wildfire occurring in the future, soils potentially would be affected by high temperatures, loss of vegetation, and fire suppression activities. High intensity fires and severe temperatures eliminates organic over, decreases soil nutrients, and increases pH. The formation of hydrophobic soils and increased erosion and sedimentation may persist for several years under this scenario. Firefighting activities could also adversely affect soils by causing compaction from heavy equipment and soils disturbance from constructing firelines. Low-intensity fires may have beneficial effects, including increased availability of nutrients, enhanced water infiltration capability, and reduced incidence of forest pathogens (Bauder 2000).

Soil compaction and rutting hazards can be avoided by restricting activities to periods of low soil moisture or when the ground is frozen (NRCS 1997, R2 Soils Group 1999). Under the action alternatives, timing and project design were considerations for the project to minimize soil impacts and limit compaction and rutting as described in Section 2.2.4. The effect to soils would be minimal since approved skid trails and temporary roads would be located to minimize short term detrimental conditions such as rutting, and long term detrimental conditions, such as compaction, at less than 15%. Also, soil effects would be minimal due to project design for timing that limits operations to low soil moisture or when the ground is frozen or snow covered.

Following mechanical and prescribed burning treatments to reduce fuels, project design BMPs includes the requirement that skid trails and landings would be reclaimed by removing berms, covering with slash, installing waterbars, and seeding if necessary. In steep areas, measures to minimize erosion, soil loss, and sedimentation were included in the project design.

In the action alternatives, coarse woody debris would be left at the rate of 12 to 15 tons/acre. This material would provide source material for decomposition. The loss of woody debris should not affect future grass and shrub land site productivity.

Beneficial effects to soils would occur in the treatment areas in the long term from the reduced potential of high severity wildfire.

In summary, no effects on soil resources would occur in the absence of a wildfire. If a wildfire occurred, the intensity of these effects would depend on the location and severity of the wildfire. Low-intensity wildfires would result in long term beneficial effects.

Soil Fertility and Nutrient Removal: *Soil fertility depends on organic matter and nutrients. Soil productivity can be degraded if humus and topsoil, or even excess leaves and limbs, are taken offsite.*

Effects. Low intensity fire will have a minimal effect (see above effects discussion). Fuel reduction units and tree removal will leave slash at the rate of 12-15 tons/acre for long term soil productivity.

Soil Heating: *Soil heating is caused by severe fires that occur when humus and large fuels are dry and large fuels are consumed near the ground. Soil heating alters soil physics, consumes organic matter, and removes much of the site's nutrients.*

Effects. The No Action Alternative would not result in any increased impacts from soil heating. Fuel reduction actions associated with the action alternatives would have beneficial effects due to the reduced risk of large-scale wildfire spread that would negatively affect watersheds and soils.

Under the action alternatives, slash-piles burning would produce localized effects. Vegetation immediately below the piles would be killed and the heat could damage the soil. Heat could also damage individual plants adjacent to the burn site. These effects would be negligible, localized and short term.

Under the harvest alternatives, low intensity jackpot burning would occur only in areas of high slash concentrations. This activity would lead to a flush release of nitrogen that would be rapidly used by new plant growth. However, some of this rapid release would be in a volatile state and lost in the atmosphere while the rest may become mobile in the soil, moving offsite. The movement offsite would be minimal given the low severity of the jackpot burning.

The ground cover left in the action alternatives is estimated at >50%. Slash piles would be located near landings and burned. Activity fuels within harvest units would be lopped and scattered to less than 24 inches in height; where concentrations exceed 15 tons/acre**,** jackpot burning would be utilized to reduce fuel loading.

Soil Erosion: *Severe erosion can impair long term soil productivity if soils are heavily disturbed on shallow or highly erodible soils.*

The dominant erosion process within the analysis area is Horton overland flow. This process occurs primarily during the summer thunderstorm period. Runoff becomes concentrated and develops into debris flows that can cause substantial alteration to 1st and 2nd order drainages. Subsequently, there is deposition of sediment into 3rd and 4th order mainstream channels. During this time, the typically shallow volcanic soils have entered a period where the site water balance is in deficit. Dry volcanic soils can exhibit natural hydrophobic tendencies.

A weathering process that creates small silt sized particles exasperates hydrophobic conditions. Water infiltration is reduced by these particles due to the clogging of surface layer pores during raindrop impact. Between these two mechanisms, runoff conditions increase, leading to debris flow conditions.

Erosion hazard potential within the watershed have been modeled using LTAs, documentation can be found in the North Fork Watershed Assessment Report. Overall the watershed (analysis area) exhibits greater than 90% moderate to high erosion hazard potential.

Natural sediment source areas include erosion from uplands and scour of stream banks. Both snow melt and rain storm stream flows carry very large amounts of suspended and wash load

sediment. Large volumes of bedload sediment are mobilized and moved during the snow melt season. During summer thunderstorm events considerable amounts of earthen material are eroded from uplands and ephemeral channels, and delivered to main stem channels through debris flows.

Erosion processes have not changed over time. Current erosion potential within the analysis area is influenced by three conditions that affect ground cover: periods of heavy grazing on winter ranges, wild and prescribed fire, and drought conditions that affect vegetation growth.

Erosion hazard is slight on 0 to 14% slopes, moderate on 15 to 35% slopes, severe and very severe on slopes greater than 35% (NRCS 1997). All soils are given a moderate to severe rating primarily where there are loamy surface textures on slopes are greater than 35%. Under mechanical treatments in the action alternatives, slopes greater than 40% are to be avoided per project design to minimize erosion hazard.

Erosion hazard ratings in the project area range from slight to very severe. The majority of mechanical treatment units in the project area are slight to moderate erosion hazard ratings. Of the mechanical units 34% are in the slight category, 53% are in the moderate, and 13% are in the severe to very severe category. For prescribed burning units, 8% are in the slight category, 45% in the moderate category, and 47% in the severe to very severe category.

Effects. Alternative 1 would not result in any increased soil erosion due to management actions. As no fuel reduction would take place, fuels would continue to build-up and this hazardous level of fuels increases the potential for a large-scale wildfire to occur in a large area.

For Alternatives 2 and 3, surface erosion amounts would be minimal until forest cover or grassland cover is reestablished. Using the Water Erosion Prediction Project (WEPP) model (Elliott 2000), the amount of on site erosion for prescribed fire and harvest alternatives has been calculated. The WEPP model is a complex computer program that describes the processes that lead to erosion. These processes include infiltration, runoff, soil detachment, transport, deposition, plant growth, and residue decomposition. However, it must be noted that WEPP is only a model and it is only a comparison tool. Proportions rather than exact amounts should be compared. The WEPP model does not account for erosion events/debris flows from high intensity summer storms, which is a major erosional process in the watershed.

WEPP estimated values were found to be less than two tons/acre. To put this data in perspective, 1/10 of an inch of soil lost over an acre is estimated at 16 tons/acre. It is estimated after five years with adequate tree regeneration the surface erosion rate would be negligible. For mechanical treatment units, implementation of project design criteria and contract clauses in Section 2.2.4 would minimize the potential erosion predicted above.

The majority of the soil loss will occur primarily due to normal debris flow activity during high intensity summer rain fall events.

Regeneration Hazard: *Forests must be restocked within five years after final harvest. Regeneration may be impeded on marginal sites due to seedling mortality, plant competition, and other factors.*

Effects. Seedling mortality refers to the probability of the death of naturally occurring or planted tree seedlings, as influenced by kinds of soil or topographic conditions. Seedling mortality is caused mainly by too much water (soil wetness) or too little water (soil droughtiness).

Alternative 1 would not affect regeneration.

Under the action alternatives, all mechanical treatment units should meet the five-year regeneration standards. Units with aspen treatment would successfully regenerate if browsing pressure is limited. Observations within past cuts on National Forest System lands in the analysis area show adequate natural regeneration.

3.3.2 Geologic Hazards

Soil creep, debris avalanches and flows, slumps, and earthflows can occur on unstable slopes if roads overload or undercut them, vegetation is removed from them, or runoff is emptied onto them. Hazard depends on type of disturbance, nature of earth material, and water content.

The Wyoming Geologic Survey has mapped the geologic hazards on the Forest (Case 1989). Approximately 9% of the project area is mapped as hazardous lands. The primary process is debris flow activity, which includes complexes and various combinations of slump, slide, and flow complexes. Maps can be found in the project file.

Effects. Under Alternative 1, existing geologic hazards and natural process would continue to alter the landscape. This is a major natural process within the project area.

Under the action alternatives, all units exhibit the potential for debris flow activity. This is due to the nature of the existing geology and topography. Project design features restrict timber harvest activities on slopes greater than 40% and temporary road design and skid trails location would avoid active flows and toe slopes of existing landslides. These measures reduce the risk and effects of potential slope failure or initiation of small slides.

Within the prescribed fire units the potential of debris flows would temporarily increase until vegetative cover is reestablished. However, the potential will be less with prescribed fire than from a high intensity wildfire. Under prescribed burn treatments it is estimated that 50% of the units will receive low intensity fire.

1.3.3 Special Areas

Riparian Ecosystems: *Riparian ecosystems provide shade, bank stability, fish cover, and woody debris to aquatic ecosystems. They also provided key wildlife habitat, migration corridors, sediment storage and release, and surface-ground water interactions. Composition and structure of riparian vegetation can be changed by actions that remove certain species and age classes.*

Historically, fire intervals were more frequent and burned more acres. As a result, meadows and parklands were more abundant. The majority of the riparian areas within the mixed severity fire regimes burned fairly frequently. Depending on conditions, riparian vegetation generally did not burn as frequently as the surrounding vegetation since it is within wet areas or at least where more moist conditions occur (Dwire, 2003). Even if the riparian area did not burn, the loss of tree cover adjacent to the riparian area usually would cause the water table to rise somewhat with the potential to increase the extent of wetlands.

The acres of riparian area, upland cottonwood, and aspen have and will continue to decline due to conifer encroachment and lack of disturbance such as wildfire. In the analysis area, the majority of the riparian habitat is located primarily along the many streams that dissect the landscape. Most of the riparian is a mature to old condition due to fire suppression.

The Forest has assessed the condition of the riparian areas that intersect perennial streams for properly functioning condition (PFC) within the project area. Overall, almost all riparian habitat within the project area is currently meeting proper functioning condition. The few riparian areas that are not meeting PFC are due to human related disturbances including some roads and development impacts associated with lodges, roads and concentrated livestock areas such as horse corrals/pastures in proximity to streams.

Effects. Natural successional processes would continue under Alternative 1 resulting in older age stands with progressively less deciduous riparian vegetation. Acres and condition of deciduous riparian vegetation, upland cottonwood, and aspen would continue to mature and decline.

The action alternatives would treat about 241 acres by removing some conifer and deciduous vegetation from the riparian area yet provides enough for large woody debris recruitment, cover

and a variety of habitats for terrestrial wildlife. Low intensity, mosaic burning patterns would be allowed within the riparian areas so that most of the organic cover is retained. Effects would be minimized because heavy equipment operation within riparian areas would be limited. Long term benefits include more diverse riparian habitat and a better mix of seral stages providing habitat for a variety of terrestrial and aquatic fauna and flora. Timber and fuel treatments in designated locations would help reduce the possibility of a large, intense wildfire that could adversely affect riparian habitat and the fauna and flora that use it.

For both action alternatives, short term adverse effects to riparian habitat are expected to be insignificant due to scattered riparian timber treatments mimicking natural fire regimes, creation of a mosaic pattern with diverse vegetative age classes, and project design features that would be implemented(see Section 2.2.4). The action alternatives would enhance riparian habitat over the long term and not adversely affect riparian habitat substantially in the short term.

Wetlands: *Wetlands control runoff and water quality, recharge ground water, and provide special habitats. Actions that may alter their ground cover, soil structure, water budgets, drainage patterns, and long term plant composition can impair these values.*

Alternative 1 would allow natural processes to continue; vegetation succession within wetlands would continue. Wetlands located within the treatment areas are typically moist areas in the valley bottom depressions, areas immediately adjacent to streams, or areas surrounding springs. Some existing wetlands have decreased in size and moisture content due to vegetation succession. Existing wetlands could increase somewhat in size and moisture content as insect caused tree mortality continues.

The action alternatives are not expected to substantially change the characteristics and hydrologic function of wetlands. The action alternatives would permit harvesting within wetlands only while the ground is frozen or protected with snow cover. BMPs will be implemented to maintain and enhance wetland conditions. Burning activities within wetlands would be conducted such that effective ground cover is maintained. Removal of timber would decrease future levels of downed woody debris within wetlands.

Floodplains: *Floodplains are natural escape areas for floods that temper flood stages and velocities.*

The majority of the floodplains in the analysis area are in good condition. There are a few minor and localized concerns where the transportation system encroaches into the flood prone area (Shoshone NF 2002a).

Alternative 1 would allow natural processes to continue.

The action alternatives would not substantially alter floodplain characteristics or values. The project BMPs provide for protection of floodplain functions during mechanical and prescribed fire treatments. The greatest potential to affect floodplains comes from the temporary road crossings. The BMPs however provide measures to properly install, use, and rehabilitate stream crossings so that no long term impacts occur. The project will not affect the ability of streams to access their floodplains. Stream crossing would be rehabilitated such that floodplains are returned to the original elevation and topography prior to the next expected spring runoff.

Activities within the WIZ would be conducted so that effective ground cover is maintained. Removal of timber would decrease future levels of downed woody debris, but are not expected to substantially change the characteristics and hydrologic function of floodplains.

Special Areas or Unique Characteristics. The project would not adversely affect any unique characteristics of the geographic area or these special areas: riparian ecosystems, wetlands, floodplains, and the municipal watershed.

Potential Research Natural Areas (RNAs). The project would involve treatment units in two potential research natural areas, the 15,675-acre Sheep Mesa Potential Research Natural Area and

the 11,634-acre Grizzly Creek Potential Research Natural Area. In the Sheep Mesa Potential RNA the action alternatives contain one mechanical treatment unit (M15) of 61 acres and approximately 0.75 miles of temporary road. The only other treatment is a prescribed burn unit (R21) of 121 acres. In the Grizzly Creek Potential RNA, two prescribed burn units are identified: R31 (271 acres) and R35 (241 acres) or 4.4% of the total area.

Alternative 1 would allow natural processes to continue and would not change naturalness or natural integrity.

Under the action alternatives, there would be short term changes to the natural integrity or natural appearance from mechanical treatments and temporary roads from treatments in M15. While there would be changes in the appearance of the landscape, this may be an efficient tradeoff to achieve the benefits of fuel treatment actions to reduce fire hazards to other resources. A temporary road would be needed for mechanical treatment, which would be closed and rehabilitated after mechanical treatment.

In the long term, (10 to 20 years or longer depending on soils, vegetation type, aspect, etc.), effects of the action alternatives would gradually return to a more natural appearing landscape. The project's mechanical treatments could influence the determination of any potential research natural area boundary; there would be an effect on the existing boundaries if the area treated was removed in future planning efforts. If boundaries are redrawn, such actions would affect only a small area of approximately 61 acres, which would be a small very small percentage of the overall area.

There would be little to no impact on the natural integrity or natural appearance from prescribed burning, as this activity is a controlled introduction of a natural landscape process (fire occurrence). While there would be changes in the appearance of small areas of the landscape, it would mimic the natural pattern of a low to moderate intensity fire with a mosaic pattern of burned and unburned areas that would emulate the natural fire processes. No temporary roads are needed for the prescribed burning actions. The percentage of acres burned in the RNAs are small compared to the overall area.

3.4 Fire and Fuels

This section presents the existing condition for fire management and fuels (fire history and fuels loading) within the analysis area, considering past and present activities that helped to shape the existing fire ecology based on the vegetation communities.

Wildfire, along with erosion processes has played a substantial role in shaping the character and development of the analysis area landscape. Fire evidence indicates that fires have been occurring over the landscape as seen by fire scars and large expanses of even aged forests. Most of the analysis area has not experienced fire for 150+ years and only recently (last 15 years) have wildfires grown to substantial acreages as what was experienced historically. The majority of the area vegetation is in a mature to overmature condition allowing more frequent natural disturbances such as wildfire and insect epidemics. Meadows and other openings are being encroached by conifers forming dense timbered stands with few breaks in continuity and increasing shade tolerant species that create ladder fuels conducive to crown fire initiation.

Land Type Associations wee used to estimate the extent of fire regimes in the watershed. The historical fire regimes[16] as developed by Hardy et al. (2001) and Schmidt et al. (2002) and

[16] Fire regime – a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention. The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with severity (amount of replacement) of the fire on the dominant overstory vegetation.

interpreted for fire and fuels by Hann and Bunnell (2001) were mapped from land type associations that examined broad vegetation type differences and then divided topographically to reflect changes in fire behavior. The analysis area contains 64% of the land area classified as high severity or stand replacement fire regimes. Figure 29 displays the acreages of the various fire regimes and Figure 30 displays the analysis area fire regimes.

Figure 29. Analysis area fire regimes.

Fire Regime	Description	Acres	%
I	0-35 yr frequency, low to mixed severity, <75% of dominant overstory replaced.	0	0
II	0-35 yr frequency, high severity, > 75% of dominant overstory replaced.	3,083	1
III	35-100+ yr frequency, mixed severity, < 75% of dominant overstory replaced.	144,840	35
IV	35-100+ yr frequency, high severity, > 75% of dominant overstory replaced.	164,866	39
V	200+ yr frequency high severity, stand replacement.	105,449	25
Total		418,237	100

The condition class indicates the change in fire regimes from historical to current conditions. The fire regime condition classes[17] were estimated. Figure 31 displays the estimated analysis area condition classes. The majority of the analysis area is in low departure (66%) from the natural regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern and other disturbances. The areas at moderate departure tend to be in the lower elevation regimes, in the drier Douglas-fir, grass and shrublands, where fire tended to burn more frequently, where moderate encroachment of shrubs and trees has occurred. In the mid elevation forested stands, moderate increases in tree density and encroachment of shade tolerant tree species have occurred. Areas considered at high departure from the natural regime include areas with a high percentage of encroachment and insect populations causing a high degree of mortality as currently experienced in the watershed. In most cases fire exclusion is responsible for the departure.

[17] Fire regime condition class – is a classification of the amount of departure from the natural fire regime, which include three condition classes per regime of low, moderate and high departure from historic conditions.

Figure 30. Map of analysis area fire regimes.

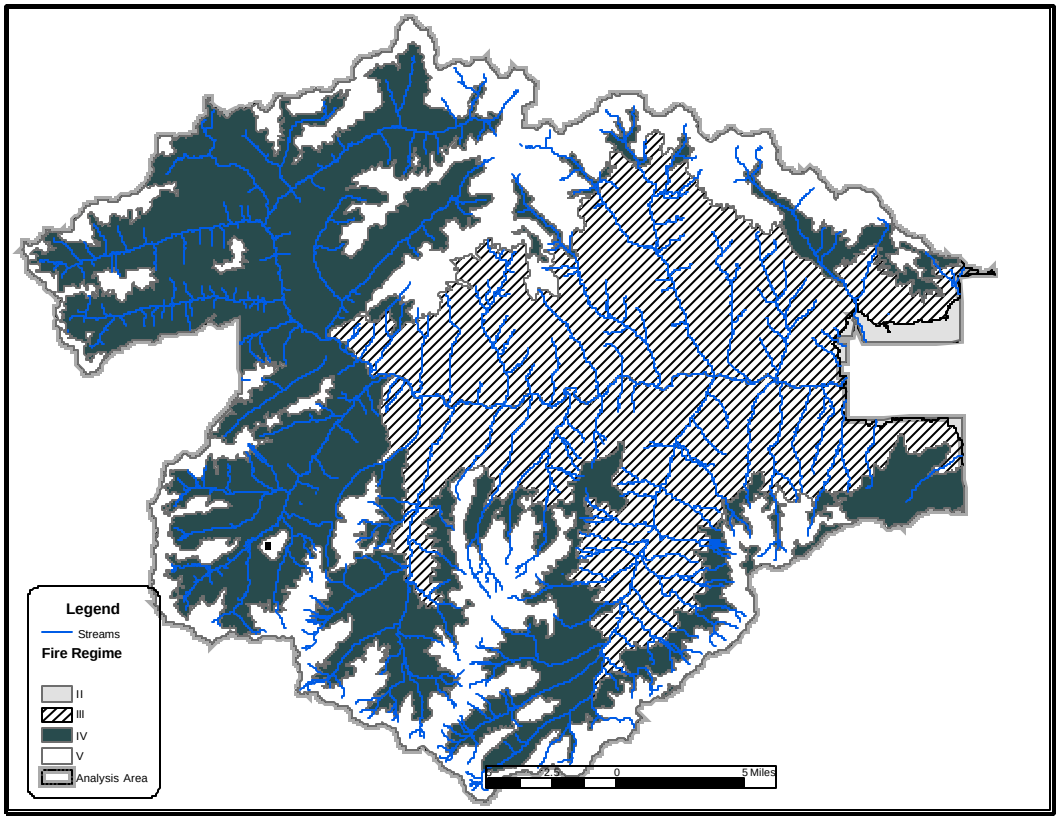


Figure 31. Analysis area condition class acres.

Fire Regime	Condition Class 1 Low	Condition Class 2 Moderate	Condition Class 3 High
I	0	0	0
II	1,850	1,233	0
III	47,797	88,353	8,690
IV	125,298	32,973	6,595
V	103,340	2,109	0
Total	278,285	124,668	15,285
Percentage	66%	30%	4%

Fire Risk

Since 1903, approximately 59,993 acres (14%) of the analysis area has burned, with the majority of the area burned in the last 15 years, the largest fire was the 1988 Clover Mist Fire.

Within the analysis area, there have been 264 documented wildfires on National Forest System lands in the last 64 years (1940-2003) (Cody Interagency Dispatch Center records, 2003). Human caused wildfires represent a higher percentage than natural wildfires but represent a much lower percentage of acres burned. The majority of the human wildfires has occurred along the highway corridor and is associated with recreational use.

The trend in the past 15 years suggests that the area is experiencing an increase in the number of wildland fires and acres burned. The trend seems to be in correlation with the increased insect mortality and associated hazardous fuels. Three fires within the analysis area in 2003 experienced

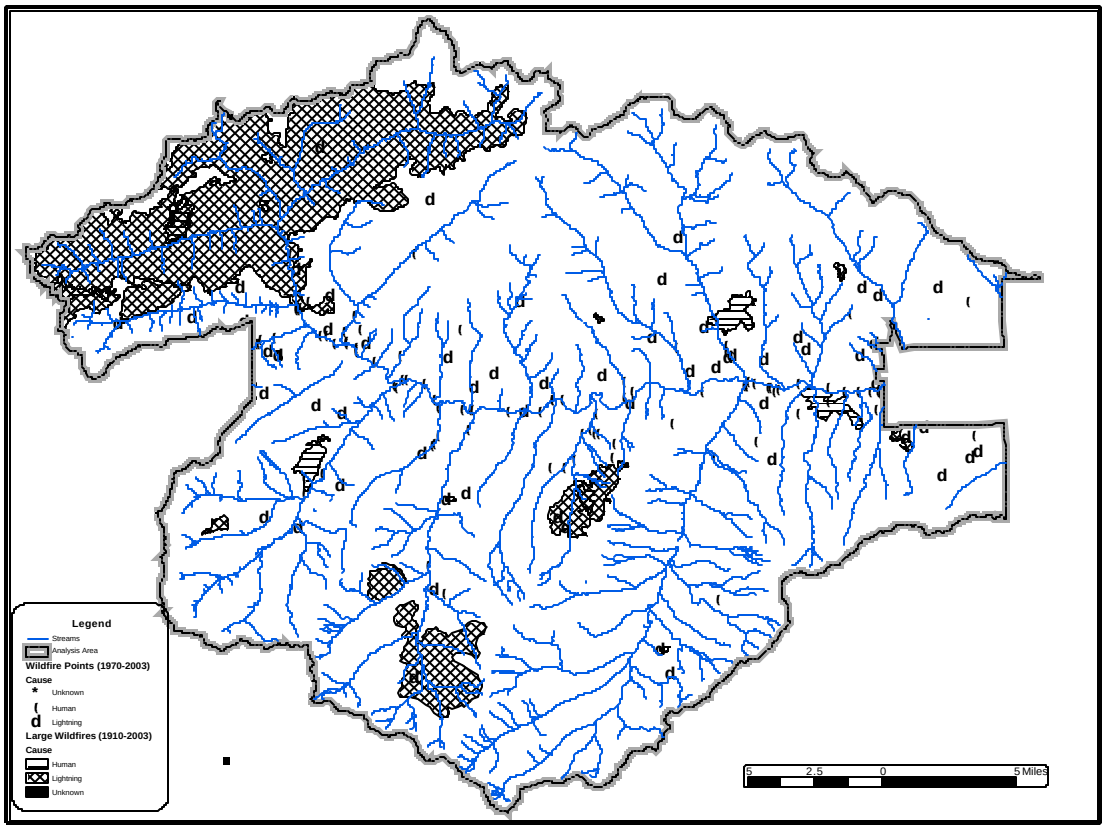
unusual fire intensity and fire growth due to tree mortality attributed to the insect epidemic. Figure 32 displays the number and acres of fires by cause. Figure 33 displays the location of all large wildfires since 1910 and small fires since 1970.

Figure 32. Fire cause and acres 1940-2003.

Fire Cause	# Fires	Percentage Fires	Average Fires/Year	Total Acres	Percentage Acres	Average Ac/Year
Human	157	59%	2.5	3,336.35	6%	52
Lightning	107	41%	1.7	54,241.25	94%	848

There have been two recent cases of wildfires burning into old wildfires. The 2003 East Fire burned out of Yellowstone Park and into the 1988 Clover Mist Fire and the 2001 Crow Fire in Jones and Crow Creek respectively, and the 2003 Blackwater Fire burned into the 1937 Blackwater Fire. In both fires, fire size was greatly decreased and the fire behavior, as a result of the older fire scars.

Figure 33. Wildfire locations 1910-2003.



Based on past fire history, the future probability of fire occurrence or fire risk was determined for the analysis area. Figures 34-35 display the current fire occurrence as well as the probability of future fire starts exceeding 1000-acres.

Figure 34. Analysis area fire occurrence (1940-2003).

Size Class	Acre Class	No. Fires	Total Acres	Proportion	Frequency	Probability/Yr
A	<0.25	184	19.1	0.70	2.88	4.5%
B	0.25-9.9	61	84.5	0.23	0.95	1.5%
C	10-99	9	232	0.03	0.14	0.22%
D	100-299	2	340	0.01	0.03	0.05%
E+	300+	8	56,902	0.03	0.13	0.20%
Total		264	57,577.6	100	4.13	6.47%

Figure 35. Probability of wildfire exceeding 100 acres within the analysis area.

Time Years	*Number of Fires*					
	0	**1**	**2**	**3**	**4**	**>4**
1	88%	11%	<1%	0	0	0
5	52%	34%	11%	2%	0	0
10	27%	35%	23%	10%	3%	1%
50	0	1%	3%	7%	11%	78%
100	0	0	0	0	0	100%

The analysis area contains two wilderness areas, the North Absaroka and Washakie. Each wilderness area has an appropriate fire plan that allows for natural fires to play their natural role as well as management-ignited fire to provide defensible fuel profiles along boundaries and structures. Fire use within the wilderness area has not been utilized in recent years because of the lack of defensible fuel profiles within the corridor near structures and developments.

Fire Hazard

Fire hazard refers to the availability of fuels (both live and dead) to sustain a fire and is best described by fire behavior fuel models as well as vegetation characteristics that lead to the initiation and sustained spread of crown fires that tend to threaten values at risk. The analysis area contains six of the 13 standard fuels models that range from alpine grass meadows to dense conifer timber stands to sage and grass. The fire behavior characteristics that are most important include flame length as it relates to fire intensity, rate of spread and crown fire potential. Fuel model 10 tends to be the most intense fuel model creating intense surface fires and a high probability of crown fires in the presence of ladder fuels.

Figure 36 displays a visual representation of the majority of the timber stands within the analysis area. Figure 37 displays the current stand characteristics as it relates to crown fires. The crown bulk density is a measure of crown density and compactness as it relates to horizontal movement of wildfire in the tree crowns, the higher the density the higher the probability of a crown fire.

The crown base height refers to the distance from the ground surface to the lowest tree branches. The lower the height, the easier a surface fire can burn up into the tree crowns and either torch the tree. sending embers ahead of the fire, or become a sustained crown fire if there is sufficient density to carry a crown fire.

The crowning index is the wind speed required to initiate and sustain an active crown fire, the torching index is the wind speed required to initiate torching and the fire hazard rating is a scale from 1-6 with 1 being low hazard and 6 being extreme hazard. These stand displays and data were obtained from stand exam data collected in 2002 and 2003 and processed with the Forest Vegetation Simulator (see project file).

Current stand characteristics show that no wind is required to initiate tree torching and a 23 mph wind will initiate crown fires with a very high fire hazard rating. These characteristics show that the current timbered stands are very susceptible to stand replacement crown fires that grow large quickly and are capable of burning large acreages.

Figure 36. Current stand profile of timber stands within the corridor.

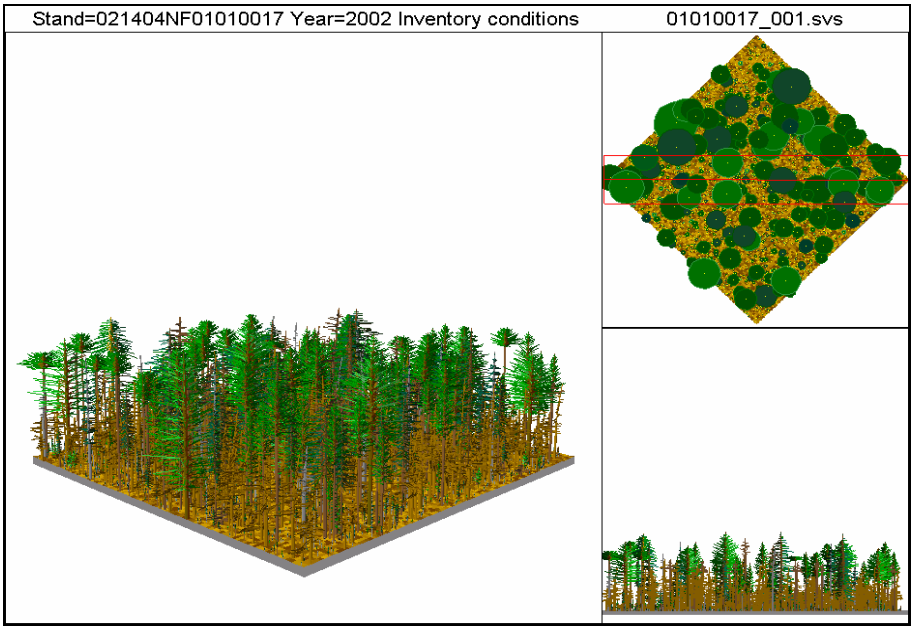


Figure 37. Current tree stand characteristics.

Year	Trees/Ac	Basal Area	Crown Bulk Density (kg/m^3)	Crown Base Height (ft)	Crowning Index (mph)	Torching Index (mph)	Fire Hazard Rating
2004	2928	116	0.09	2.00	23.06	0.00	5.00

Figure 38 displays the spatial location of the various fuel models and Figure 39 shows the acreage of each fuel model. The fire behavior models were developed from LandFire data that utilized LandSat imagery to assign fuel characteristics to the landscape including fuel models, canopy cover, stand height, crown base height and crown bulk density. While the data is still in development, it was used for this analysis realizing that it contained error but was adequate enough to provide a reasonable representation of the landscape fuel conditions.

Figure 38. Analysis area fire behavior fuel models.

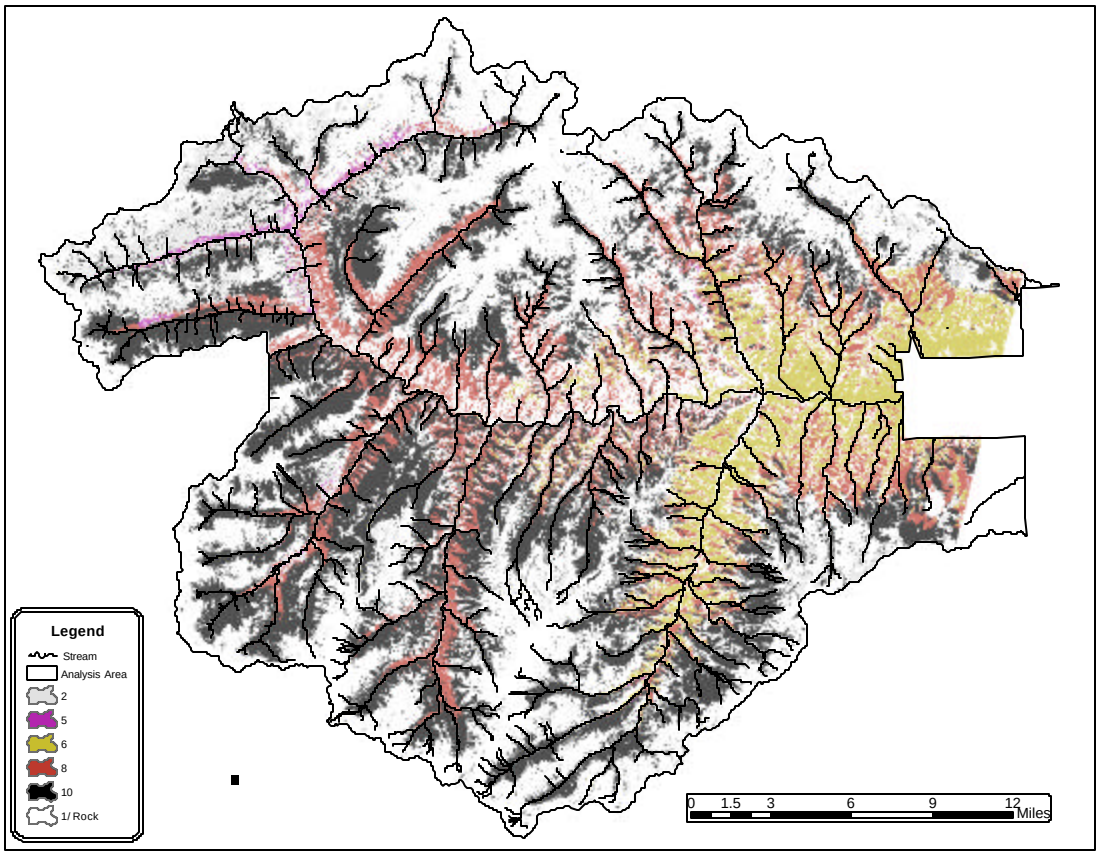


Figure 39. Analysis area fuel model acres.

Fuel Model	Description	Acres	Percentage	Fuel Loading t/a
1	Short Grass – Alpine/Rock	178,965	43%	.5-1
2	Timber (grass and understory)	38,650	9%	4-12
5	Brush (2 ft)	2,151	1%	3-9
6	Dormant Brush	30,045	7%	5-8
8	Closed Timber Litter	48,037	11%	5-18
10	Timber (litter and understory)	120,502	29%	15-100

Using fuel models, fire behavior characteristics of the analysis area can be shown that paint a picture of the character of wildfire that can be expected under various weather and fuel moisture conditions. For this analysis, the 50th and 90th percentile weather conditions were modeled to show fire behavior under moderate and high fire danger fuel and weather conditions. No attempt was made to model the extreme worst-case scenario, as only paving the entire corridor would provide 100% protection from these fires. It is felt that by providing treatments that enhance protection capability 90% of the time that the remaining 10% of the time we would have limited affect on fire behavior as was experienced during the 1988 fires when a large portion of the Greater Yellowstone area burned.

FlamMap was used to show the entire analysis area snapshot in time of various fire behavior characteristics. As would be expected, as fuel and weather conditions change for the worse, fire behavior characteristics also change. Current wildfire effects are generally stand replacement even with surface fires, due to heavy surface fuel loading (see project file).

Values at Risk

The values at risk include public and firefighter safety, commercial timberlands, and numerous lodges and cabins along the corridor. The analysis area is dissected east to west by the North Fork Shoshone River. Along this river is state highway 14-16-20 that runs from Cody, Wyoming, to the east entrance of Yellowstone National Park. Within ½ mile of the river and highway is the only developments within the analysis area other than remote backcountry outfitter camps that only contain facilities during the summer and fall. These facilities are mobile and able to be moved with adequate notification.

There are 162 buildings associated with 11 summer home groups, 11 lodge facilities with another 230 associated buildings, eight campgrounds, a Boy Scout Camp, four trailhead facilities, three picnic area facilities, radio repeater, ski area with lodge and lift facilities, and a historic ranger station and visitor center. In addition to buildings, there is 37.9 miles of powerlines and poles that supply electricity to the corridor as well as phone facilities scattered throughout the corridor.

Figure 40. Location of the analysis area Wildland-Urban Interface (WUI).

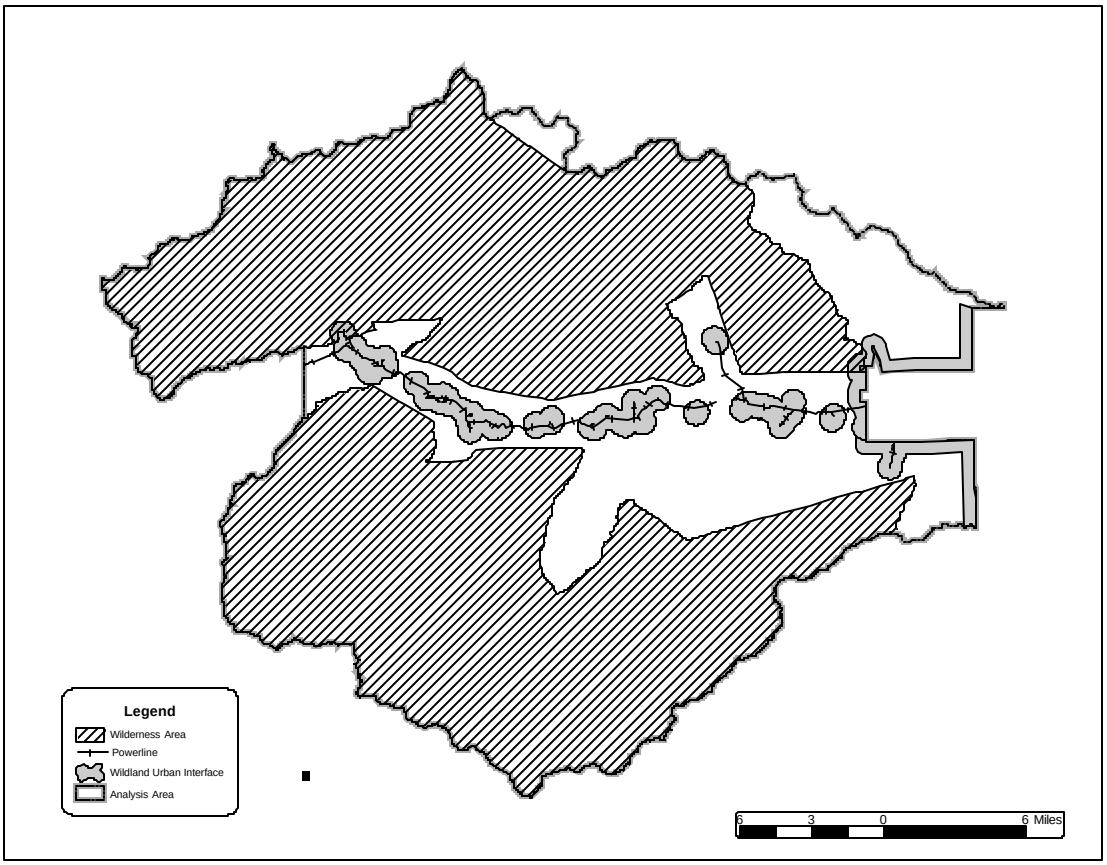


Figure 40 displays the location of the analysis area WUI. During the past four years there have been three wildfires that have threatened lodges and cabins on the western side of the analysis area, with approximately 15 million dollar suppressions costs primarily due to structure protection. In addition to the structure protection, the highway has been closed twice in the past four years creating economic hardship for corridor lodges. There are approximately 22,279 acres on the forest that is considered the wildland urban interface (WUI) or is within ½ mile structures.

Effects. The No Action Alternative would not implement any fuels treatments; areas of moderate to high departure fire regime condition classes would not be modified through any treatments except through natural fire use in wilderness areas. Fire use within wilderness areas would continue to be limited due to lack of defensible space along the corridor developments, allowing continued departure from the historic fire regime.

The probably of a wildfire ignition within the next five years that will grow to a fire greater than 1,000 acres is 48%. With the amount of dead and dying trees from the insect epidemic the probability will increase. The location of that wildfire is unknown although the occurrence of human starts is greater than natural starts along the corridor. With the increased amount of dead fuels throughout the analysis area due to the insects, there is a high probability of a large fire.

Existing fuel conditions would continue to into the future as the insect epidemic continues to cause high mortality. As the needles fall off the trees, crown fire potential will be reduced although it is expected that the dead trees would begin to fall in the next 5-20 years creating a jackstraw of down fuels that when ignited would burn intensely causing high mortality of the regeneration and co-dominate trees remaining after the insect epidemic.

Wildfires would continue to get large and threaten corridor buildings and developments, continuing to cost millions for suppression costs. Unpredictable crown fires and intense surface fires from the accumulation of down trees would continue to put public and firefighters at risk within the entire analysis area. Hazardous fuels mitigation would continue to occur within the special use lots around cabins and lodges as owners have the time and money to accomplish.

Figure 41 shows the change in stand characteristics over time assuming no treatment. Without treatment, timber stands will continue to become more dense with more surface fuel loading as shown in Figure 42, which displays Figure 36 as it would look like in 50-years. As the stand matures, canopy density (crown bulk density) increases which produces a crowing index of a five mph wind is all that is required to initiate a crown fire. Without treatment, the timbered stands become an extreme fire hazard that is highly susceptible to crown fires.

With no treatments the timber stands would become more vulnerable to wildfires and their potential detrimental affects to visuals and wildlife habitat. Figure 43 shows the effects of a wildfire that occurs in 2012. In the simulation, the entire understory is scorched and killed and the overstory appears to be scorched intensely as well. Figure 44 displays the effects of the wildfire five years later, where the overstory trees have all died with no living trees remaining, the result of a stand replacement fire. In very large wildfires such as the 1988 Clover Mist Fire, it can take many years before trees become established due to the lose of a conifer seed source. Figure 45, shows the effects of a very large wildfire and what the stand would look like in 50 years.

Figure 41. 50 year stand characteristics.

Year	Trees/Ac	Basal Area	Crown Bulk Density (kg/m^3)	Crown Base Height (feet)	Crowning Index (mph)	Torching Index (mph)	Fire Hazard Rating
2002	2928	116	0.09	2.00	23.06	0.00	5
2007	2877	124	0.09	2.00	23.06	0.00	5
2017	2730	138	0.10	2.00	21.43	0.00	5
2047	2229	214	0.33	3.00	5.30	0.00	6
2052	2153	230	0.34	3.00	4.83	0.00	6

Figure 42. 50 Year projected stand profile of timber stands within the corridor.

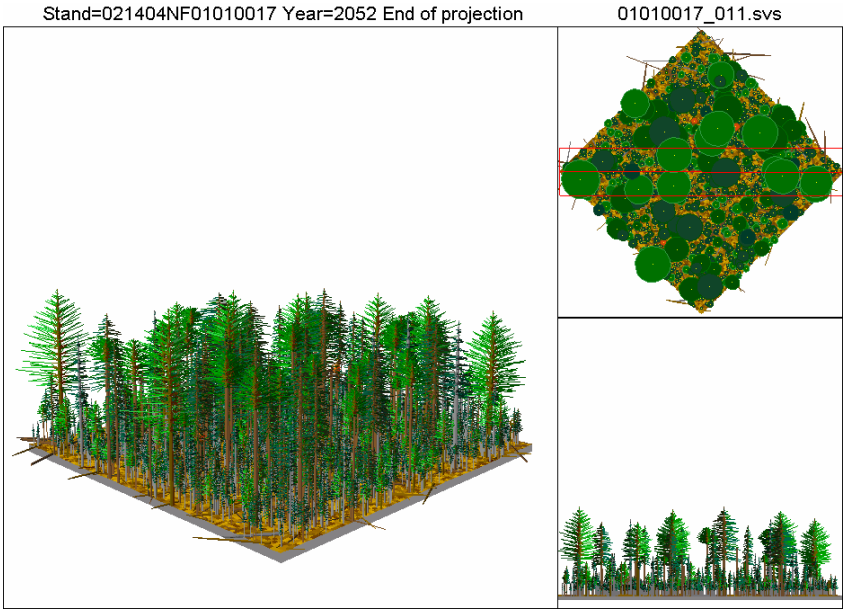


Figure 43. Wildfire effects (2012).

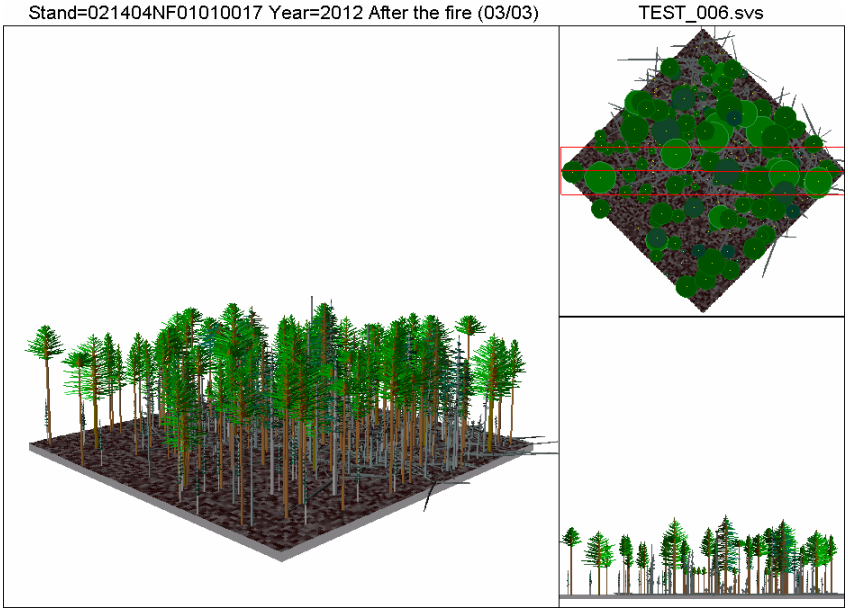


Figure 44. Five years after wildfire.

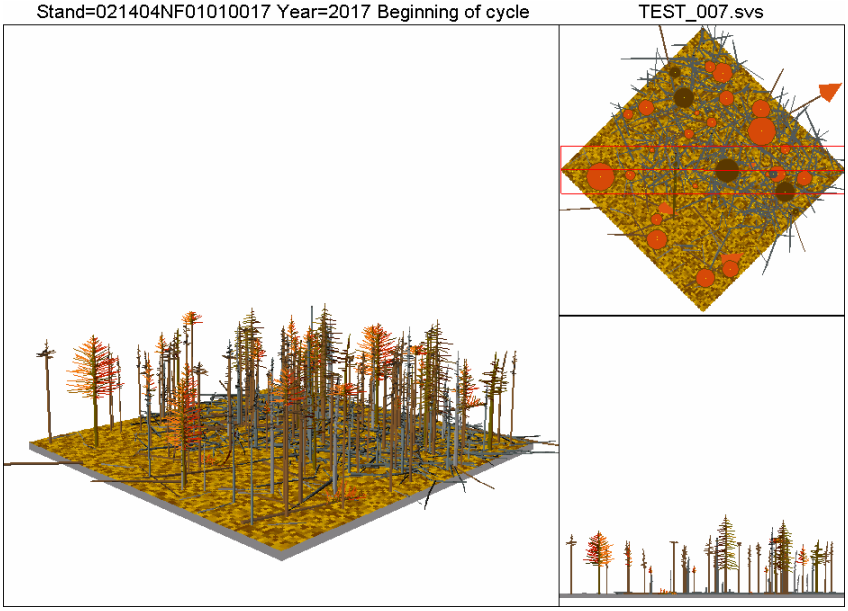
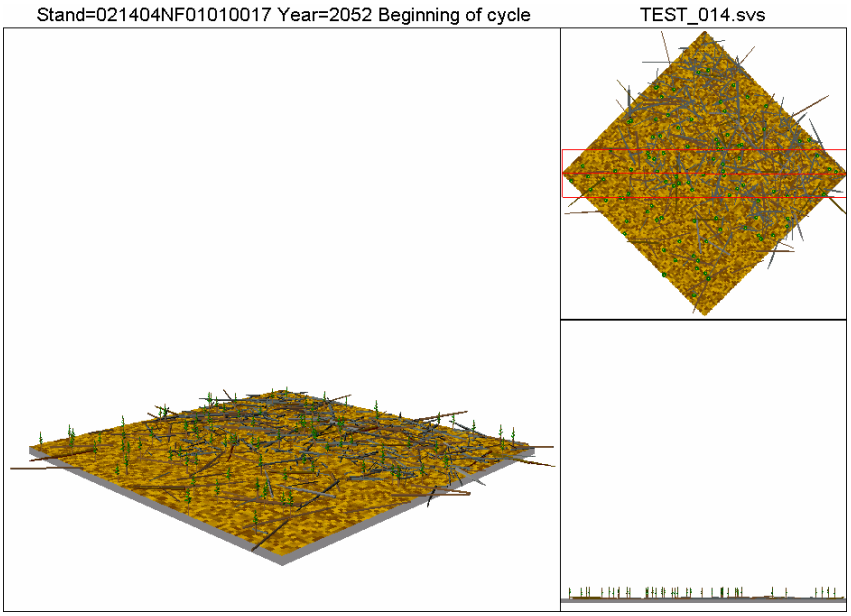


Figure 45. 50 years after wildfire.



Under Alternative 2, the probability of ignition would be similar to Alternative 1. The probability of a wildfire exceeding 1,000 acres within five years within the corridor would decrease due to the treatments. Outside the corridor, the probabilities would not change as a direct result of the treatments but would indirectly change, as fire use within the wilderness areas would be utilized more often. As natural fires are allowed to burn more frequently, over time, the mosaic of the burns will keep fire sizes smaller. This assumption is similar to what has occurred over the past couple of years where wildfires have burned into older wildfires, causing a change in fire behavior and smaller wildfires.

The treatments would directly move a portion of the moderate and extreme departure condition classes back to a low departure fire regime (4%). Indirectly, with natural fire use, it is expected that more of the moderate to extreme departure condition classes will burn and be set back to low departure condition class. Figure 46 shows the effects of the treatments on condition classes.

Figure 46. Alternative 2 condition class effects.

Fire Regime	Alternative 1 Condition Class			Alternative 2 Condition Class		
	1	2	3	1	2	3
II	1850	1,233	0	2058	1025	0
III	47,797	88,353	8,690	59,765	80,374	4,701
IV	125,298	32,973	6,595	128,217	31,027	5,622
V	103,340	2,109	0	103,612	1,837	0
Total	278,285	124,668	15,285	293,652	114,263	10,323
	66%	30%	4%	70%	27%	2%

Under Alternative 2, mechanically treating and prescribed burning in strategic locations throughout the corridor would result in a noticeable reduction in fire behavior within the corridor that decreases fire hazard and resistance to control. The primary concern is the buildings and developments within the corridor, which makes up approximately 5% (WUI) of the analysis area. Only 22% of the area considered WUI would be treated under this alternative with 4% of the

analysis area directly impacted by the treatments. Alternative 2 treatments would have indirect impacts of 15-18% to the analysis area and eventually to the entire area as natural fire use is implemented. Wildfires would continue to potentially grow large outside the corridor, primarily within the wilderness areas.

Utilizing FARSITE, three simulated wildfires were allowed to burn in three different locations for three days under similar weather conditions that occur at the 90th percentile as was experienced during the 2003 fire season locally. For the simulation no suppression activity was initiated so that fire growth could be determined by alternative. In reality suppression action would have been initiated, especially near values at risk and would have had a influence on fire growth. Figure 47 displays the change in fire size as a result of the treatments under all alternatives.

Under Alternative 2, an average acreage decrease of 55% was realized as wildfires that started outside treatment areas and burned toward developments into treated areas with decreased fire intensity that slowed fire growth dramatically. Figure 48 displays three measurable fire behavior characteristics of a simulated fire shown in Figure 49 and 50 by alternative. With Alternative 2 treatments, fire hazard were reduced which resulting in fewer acres burned. Figure 49 shows one of the simulations near Pahaska that started south of the resort and burned north and east under typical summer SW winds that burned through the Pahaska resort and the Sleeping Giant Ski Area, under the no action alternative. Figure 50 shows the same wildfire burning under the same conditions but after vegetation treatments have been completed under Alternative 2.

Figure 47. Simulation fire size by alternative.

	Fire 1 Acres	% Change	Fire 2 Acres	% Change	Fire 3 Acres	% Change
Alternative 1	4,370		5,041		2,768	
Alternative 2	2,138	-51%	1,492	-70%	1,530	-45%
Alternative 3	2,217	-49%	1,492	- 70%	1,530	-45%

Figure 48. Wildfire simulation - fire behavior characteristics.

Alt.	Flame Length (ft)		Rate of Spread (ch/hr)		Crown Fire		
	0-4	4+	0-20	20+	Passive	Active	Indep.
2	79%	21%	82%	18%	75%	24%	1%
3	99%	1%	92%	8%	77%	22%	1%

Flame length refers to the average flame length from the ground surface to the end of the flame and is an indicator of fire intensity, the longer the flame length the more intense the fire. Rate of spread refers to the speed of fire movement, a fire moving at 20 ch/hr is moving at ¼ mph or 22 feet/min. Passive Crown Fire refers to intermittent torching and crowning. Active Crown Fire refers to a crown fire that consumes surface and aerial fuels. Independent Crown Fire is rare but refers to crown fire independent of surface fire where only aerial fuels burn. Figure 51 and 52 also show crown fire locations.

Flame lengths on the simulated wildfires that exceeded four feet were reduced 20% as a result of the treatments. This reduction will allow more efficient and effective direct attack by hand crews, increasing suppression capability to decrease fire size and the amount of time firefighters are exposed to the hazards of wildfires. As fire sizes within the corridor are reduced, public safety will be enhanced.

Figure 49. Fire simulation with the No Action Alternative.

Figure 50. Fire simulation 2 under alternative 2.

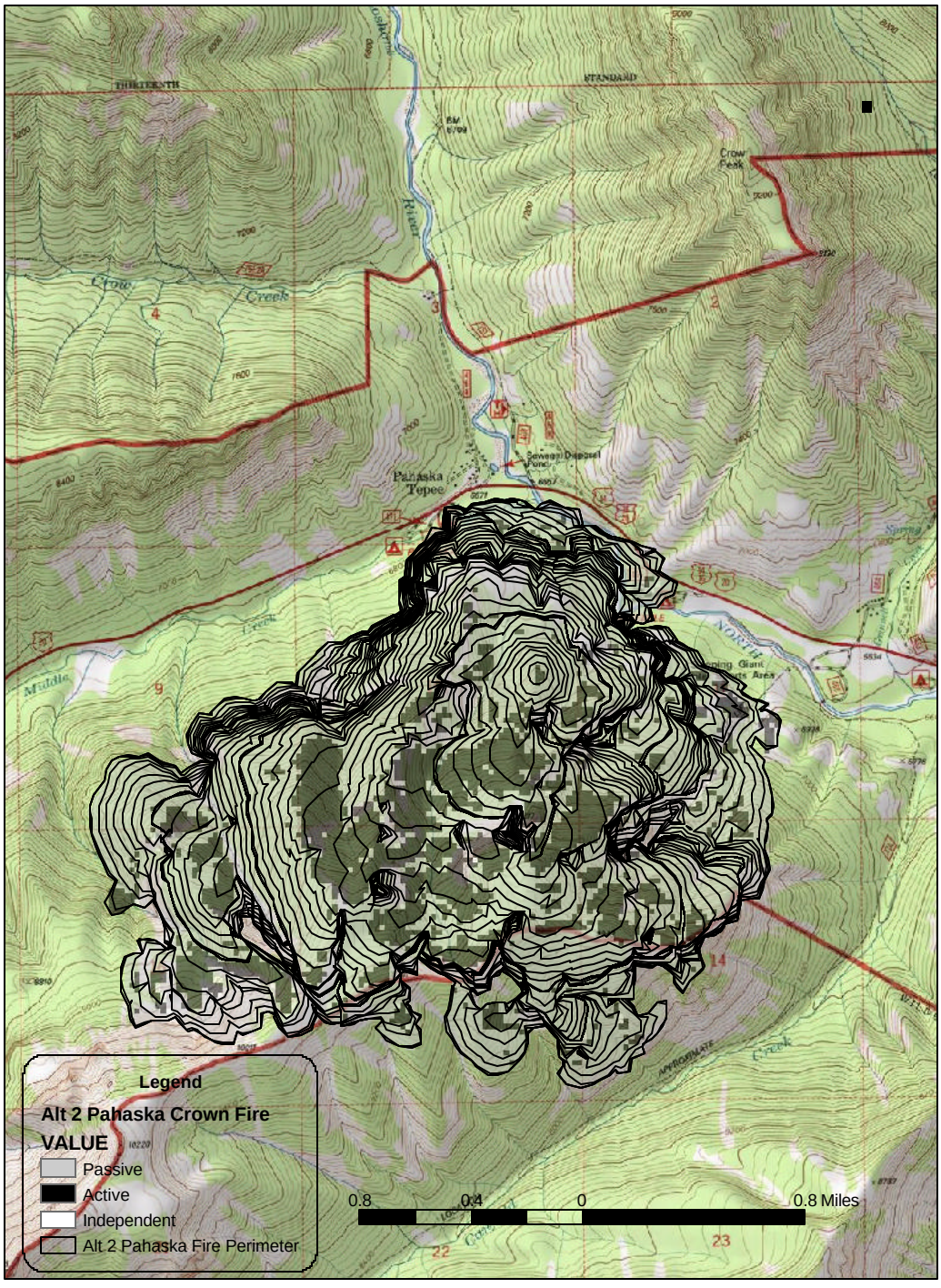


Figure 51 displays the same timber stand shown in Figure 36 after it was treated in 2007 under Alternative 2. Figure 52 shows the change in stand characteristics over time with treatments and a wildfire with natural regeneration. The stand fire hazard rating is reduced from very high down to low hazard as a result of the treatments. The torching index is greatly increased as a result of treatment with a 46 mph+ wind required to initiate torching.

2027 Fire

Figure 51. Treated stands under Alternative 2.

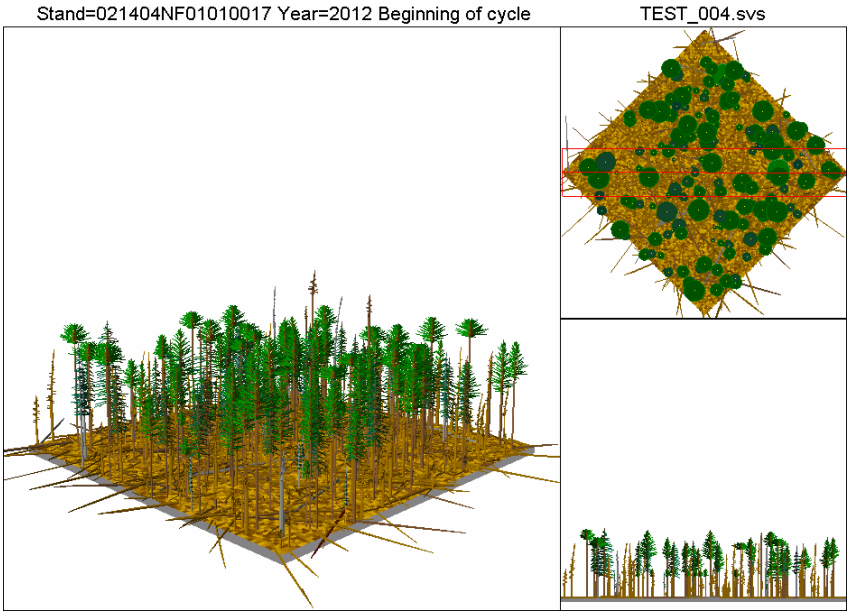


Figure 52. 50 year stand characteristics.

Year	Trees/Ac	Basal Area	Crown Bulk Density (kg/m^3)	Crown Base Height (feet)	Crowning Index (mph)	Torching Index (mph)	Fire Hazard Rating
2002	2928	116	0.09	2.00	23.06	0.00	5
2007	2877	124	0.09	2.00	23.06	0.00	5
2017	164	62	0.05	24.00	38.93	46.41	2
2047	572	32	0.03	47.00	55.15	51.98	1
2052	568	37	0.03	1.00	50.71	0.00	3

Figure 53 shows the same stand in Figure 36 after a wildfire. Figure 54 shows the same stand five years after the wildfire. Figure 55 shows the same stand 50 years later showing a healthy overstory with natural regeneration.

Figure 53. Treated stands burned by wildfire.

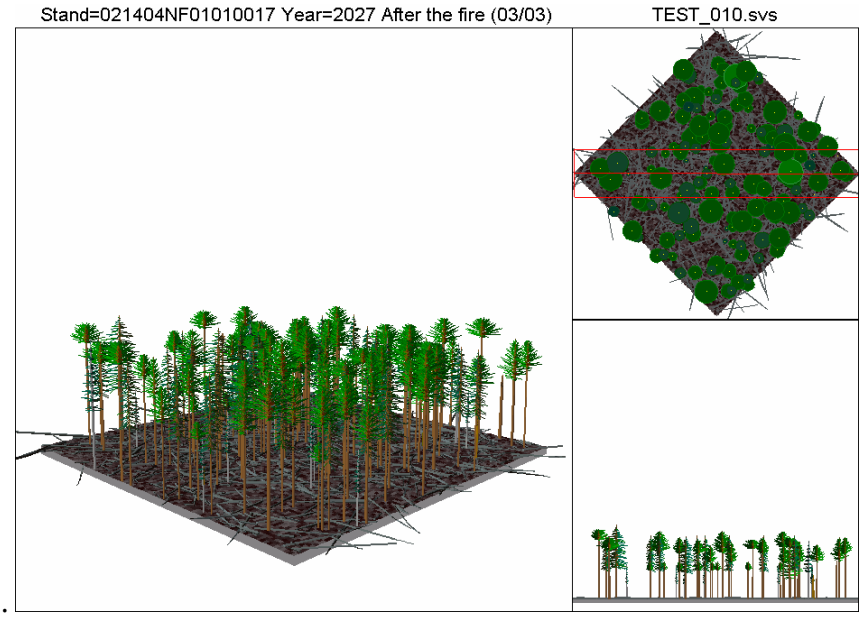


Figure 54. Treated stands five years after wildfire.

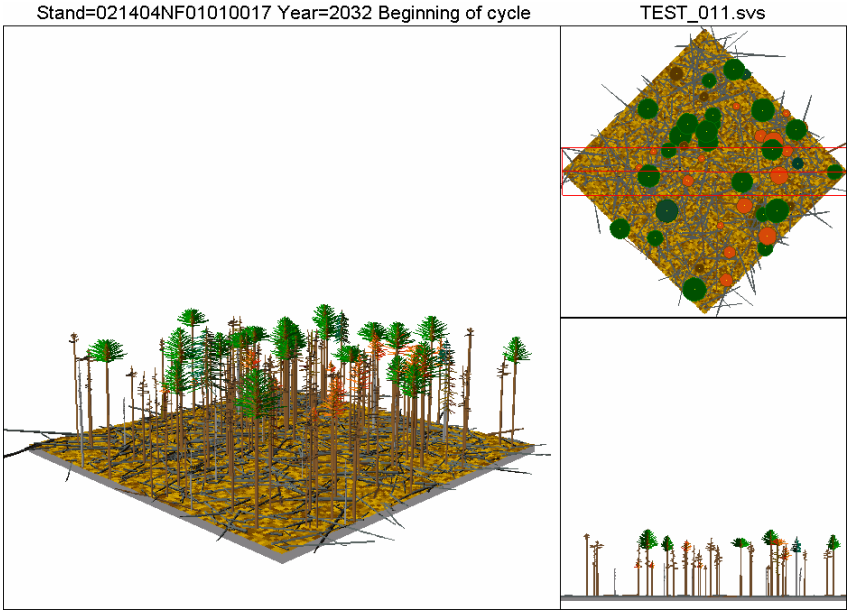
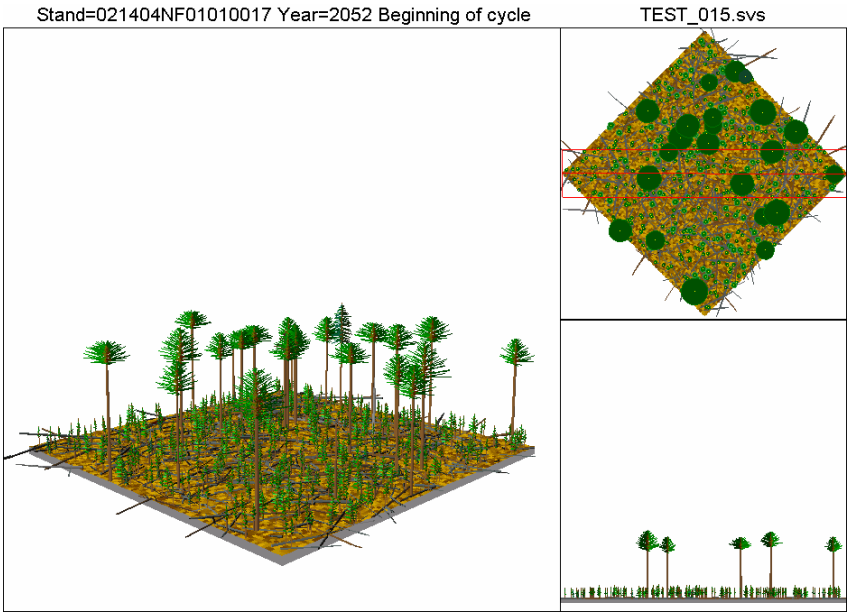


Figure 55. 50 year projection of treated stands burned by wildfire.



The effects of Alternative 3 would be similar to Alternative 2. Under Alternative 3 there would be a reduction in acres treated, primarily in the area around the Sleeping Giant Ski Area. In Figure 51, the effects of the reduction in treated acres are shown to have only increased fire size by 2% or 179 acres.

The areas impacted by having less suppression capability enhanced by creation of defensible space would include Pahaska Tepee, Sleeping Giant Ski Area, Shoshone Lodge and five summer home cabins. There would be 753 less acres demonstrating a change in fire behavior with a reduction in acres treated, which would increase resistance to control as well as decrease firefighter and public safety. Fire use would be limited in the area of Middle Fork, Canfield and Eagle Creeks as a result of this alternative as defensible space will be limited around high value development.

3.5 Transportation

Access and transportation planning was not raised as a key issue and the action alternative has little affect on access and system roads, the transportation system will not be discussed in depth.

The road system includes 27.26 miles of highway and approximately 38 miles of Forest system roads. Existing conditions are described in the more detail in the North Fork Watershed Assessment and the North Fork Road Analysis Report (SNF 2002), which describes the road system in relation to the aquatic, riparian zone, water quality, water production characteristics and other resource values of the area (project file). The affected environment in terms of the transportation system is limited, as the proposed action does not include any major changes to Forest system roads within the analysis area such as decommissioning because they are deemed unnecessary for resource management. Thirteen short user created, nonsystem routes totaling 2.8 miles and future user created routes would be obliterated as the opportunity arises.

Project design features in Section 2.2.4 of the EA and listed above would address most concerns related to transportation. Under both action alternatives, all temporary roads would be decommissioned immediately after use.

Effects. Under Alternative 1, the probability of large-scale wildfire within the analysis area has the greatest potential for adverse effects on resource values and/or the road system and infrastructure. Under this scenario, fire sizes, intensities and rates of spread, suppression costs, and hazards to the public and firefighters all increase substantially. Roads, power lines and infrastructure would be adversely affected and could affect access, such as the case of the highway being closed during wildfires and may require that portions of the area be closed to protect resource values or public safety both in the short- and long term. The likelihood of this occurring is greatest under Alternative 1, as no fuel treatments would be implemented to minimize the risk of wildfire by reducing the accumulation of hazardous fuels to enhance fire suppression capability.

If an action alternative were selected, present and future user created routes would be obliterated. The effect would be minor, as most are "spur routes" less than ¼ mile in length and do not provide access to any specific destination.

Road easements or agreements would be needed to implement treatments in the Green Creek and Whit Creek drainages.

In the Blackwater Creek drainage, Forest System Road #435 would require heavy maintenance for any logging truck traffic.

Under Alternative 2, fuel treatments would be implemented to minimize the risk of wildfire by reducing the accumulation of hazardous fuels to enhance fire suppression capability. About 12 to 12.5 miles of temporary roads would be needed to access units and implement the treatments and then would be decommissioned immediately after treatments.

Under Alternative 3, effects would be similar to Alternative 2, though reduced to the extent that fewer acres would be treated. About 8 to 8.5 miles of temporary roads would be needed to implement the treatment units and then would be decommissioned immediately after treatments.

3.6 Recreation

Since recreation was not raised as a key issue in the EA and the proposed action has minimal affect on recreation, the discussion related to recreation will not be discussed in depth.

Although there were many concerns relative to recreation concerning this proposal, it was felt and validated by the IDT that recreation concerns could be addressed through project design and timing and that recreation would not create a need for new or different alternatives. Conversely, RARE II areas and proposed activities within RARE II did drive new alternative formulation.

A summary of the affected environment from the North Fork Watershed Assessment is: most present human uses of the analysis area are associated with tourism and recreational activities. A variety of recreational pursuits can be directly tied to the attributes of the area: an intact ecosystem, a full complement of fish and wildlife species, developed recreation, backcountry and designated wilderness, and natural scenery. The trend is for increased recreation use and visitation and a growing local population and this trend is expected to continue.

The North Fork Corridor and the Buffalo Bill Cody Scenic Byway (US Highway 14-16-20), which provides access to the east gate of Yellowstone National Park, has been and continues to be the major travel route. Being in the Greater Yellowstone ecosystem, the area is recognized locally, nationally, and internationally for its recreation opportunities. Predominant front-country recreation pursuits include fishing, big game hunting, wildlife watching, rafting, photography, winter sports, scenery viewing and, in limited areas, ATV and mountain bike riding.

Principal backcountry activities include fishing, hiking, horseback day rides and multi-day pack trips, big game hunting, recreation and lands special-use permits are issued, specifically

recreation residences (summer homes), guest lodges and outfitter-guide operations are authorized in the analysis area. Twelve outfitter guide businesses provide professional services for these types of recreation activities. Big game and small game animals are hunted in the analysis area.

Effects. In describing Alternative 1, the current conditions and the expected future conditions in the absence of the project are presented.

In the short term, the existing access and recreation use would not change. The trend for increased visitation would continue. In the long term and in the event of a high intensity wildfire across the landscape, recreation use may change due to decreased aesthetics and changes in deer and elk use of the area associated with the loss of habitat.

Under Alternative 1, the probability of large-scale wildfire within the analysis area is greater than the action alternatives that implement fuel reduction. Under this scenario, fire sizes, intensities and rates of spread, suppression costs, and hazards to the public and firefighters all increase substantially with possible consequences to recreation, aesthetics, particularly outfitting, lodge business, developed recreation, hunting and dispersed recreation, tourism and the local economy. Such a fire could make the area undesirable for many recreation users, and may require that portions of the area be closed to protect resource values or public safety both in the short- and long term. The likelihood of this occurring is greatest under Alternative 1, as no fuel treatments would be implemented to minimize the risk of wildfire by reducing the accumulation of hazardous fuels to enhance fire suppression capability.

In absence of the project, all buildings, improvements, and infrastructure totaling 462 individual buildings/developments throughout the corridor would not receive the benefit of fuels reduction. This includes the key features shown below in Alternative 2, all of which are important recreation, historic and socio-economic values.

Under Alternative 2, fuel treatments would be implemented to minimize the risk of wildfire by reducing hazardous fuels to enhance fire suppression capability. All buildings, improvements, and infrastructure totaling 462 individual buildings/developments throughout the corridor would receive the benefit of fuels reduction. This includes these features on National Forest System lands, all of which are important recreation, historic and socio-economic values:

- The Buffalo Bill Cody Scenic Highway provides the only route through the east entrance to Yellowstone National Park via Cody, Wyoming.
- Approximately 68 recreation residences (summer homes) in 14 recreation residences groups totaling 162 buildings.
- Twelve special uses lodges/resorts complexes totaling 230 buildings with cabins, sheds, etc. Many of the lodges are eligible for the National Register of Historic Places.
- One organizational camp and lodges and one roadside chapel.
- Recreation facilities: ten trailheads, eight campgrounds, winter sports/ski area, three picnic areas, Wayside Visitor Center and a scenic byway.
- The historic Wapiti Ranger Station and other National Register sites.
- Twelve utility corridors, 37.9 miles of power poles and lines, and buried phone cables and boxes with above ground poles and lines that cross waterways.
- Miscellaneous: Two river rafting use sites, out buildings, storage sheds, garages, barns, corrals, out houses, radio repeater, fire memorial, etc.

With the implementation of Alternative 2, the effects to permit holders are minimized by addressing the concerns and comments around lodges and cabins and the need to restrict seasons and times to lessen impacts to businesses, lodges and high use seasons.

Recreation use patterns may change in the short term. Spring burning would have fewer impacts on tourist and recreational use of the area, which is generally light in spring. A fall burn would be

more likely to conflict with hunter activities. During ignition, recreation, recreation use of the project area would not be allowed for safety reasons. Smoke may drift into adjacent areas and decrease the quality of the recreational experience in the short term, possibly for several days.

Impacts to recreation use would be minimized by notifying the public of the intended burn time through news releases and/or posted notices. The burn prescription would minimize smoke impacts. In addition, the prescription would maintain a mosaic of burned and unburned sites to ensure that the area remained desirable for dispersed recreation in the long term.

With Alternative 2, recreation use would be affected in the short term. Mechanical treatments for fuel reduction involving salvage logging would have fewer impacts on cabin owners tourists and recreational use of the area if done in the winter, when use is generally light. Fall operations would be more likely to conflict with hunter activities. Spring salvage logging was eliminated through protect design for protection of soil and water resources and wildlife. Harvesting actions, equipment and logging truck traffic would be disruptive in close proximity to cabins and lodges and decrease the quality of the recreational experience in the short term. The mechanical removal of trees for fuel reduction and prescribed fire may remove vegetation that blocked overland-motorized travel. Following treatments, monitoring would be needed to determine if unauthorized motorized use is occurring and what compliance measures are needed.

Under Alternative 3**,** effects would be similar to Alternative 2, though reduced to the extent that fewer acres would be treated.

3.6.1 RARE II Areas and Wilderness

Regulatory Framework. On July 14, 2003, the United States District Court for the District of Wyoming permanently enjoined the Forest Service from implementing the Roadless Area Conservation Rule. This decision has been appealed to the United States Court of Appeals for the 10th Circuit by the defendant-intervenors. The court has not yet rendered a decision on this appeal. As a result, the Roadless Area Conservation Rule is not in effect and the Forest Plan (as amended) governs the management for inventoried roadless areas on the Forest.

RARE II Areas and Wilderness. RARE II areas occur in the analysis area, and would be affected by mechanical methods treatments that are planned within the RARE II areas in terms of intensity, magnitude, and duration. The mechanical treatments are for fuel reduction purposes around designated "Communities at Risk" (National Fire Plan), primarily in the wildland-urban interface (WUI). The mechanical treatments are focused on the WUI, which limits the size and extent to the minimum acreage needed to meet the project purpose and need.

There are two designated wilderness and six RARE II areas within the analysis area as shown in Figure 56. In RARE II areas in the project area, there are 2.1 miles of Forest Service road, .4 miles of decommissioned roads, and .2 miles of undetermined and other roads. This totals 2.7 miles of road present in RARE II areas.

Maps for existing roads, treatment units for the actions alternatives, and RARE II areas are included in the maps at the back of Chapter 2.

RARE II areas are areas that met minimum criteria for wilderness as defined by the Wilderness Act of 1964 and Forest Service Guidelines when they were first designated. Wilderness characteristics include natural integrity and appearance, opportunities for solitude and primitive recreation, special features, and manageability and boundaries.

Figure 56. Affected Environment for RARE II Areas and Wilderness

Area	Acres in Analysis Area	Percent (%) of Analysis Area	Rare II Areas with Mechanical Treatment Units	Units with Temp Roads and Lengths in RARE II (miles)
N. Absaroka Wilderness	155, 212	37.1	N/A	N/A
Washakie Wilderness	154,198	36.8	N/A	N/A
Total Wilderness	309,419	74		
Sunlight Headwaters RARE II	814	0.2	0	N/A
Trout Creek RARE II	9,456	2.2	0	N/A
Sleeping Giant RARE II	5,173	1.2	M10, M11, M17, M18, M23, M30	M10 (0), M11 (1.59 m), M17(.59 m), M18 (.22 m), M30 (.98 m)
Wapiti Valley East RARE II	449	0.1		N/A
Wapiti Valley North RARE II	18,335	4.4	M2, M12, M13, MR2	M2 (.13 m)
Wapiti Valley South RARE II	43,492	10.4	M4, M7, M26, M27, M28, M29, M31, MR9	M4 (.10m), M31 (.29m)
Total RARE II	77, 719	19	18 units	
Outside RARE II And Wilderness	31,111	7		

Many of the RARE II areas do not currently meet the minimum criteria due to manageabilty and boundary concerns and development that negate natural integrity and appearance and opportunities for solitude and primitive recreation (ski area, cabins, roads, past harvest activities, etc.). These concerns are such that the degree of development may mean that portions of the areas are not suitable for wilderness designation. These units are encumbered by development and/or the ski area boundary:

- The units having ski facilities in them are (M10 eastern corner), M17, M18 and M19 have either ski lifts, buildings or a lodge located within the unit.
- The units within the ski area permit boundary include M10, M17, M18, M19, M20, M11, and M50 (powerline unit)
- M4, M31 and MR9 all have had previously logging activity with old roads and skid trails.
- M7 in Pagoda Creek has both a system road and cabins inside RARE II

Other units with past activities are:

- M2, M10, M1, M29 – past logging, old roads/skid trails
- M17, M18 – roads to ski lifts and ski trails
- M12, M13 – past logging, trail
- M7 – roads and cabins

Units without past activity are M23, M30, MR2, M26, M27, and M28. Out of the 18 units in RARE II, 12 are substantially developed or altered from past or present activities. Figure 57 summarizes the degree of disturbance present in existing RARE II areas and possibly not meeting minimum criteria for wilderness due the level of existing development.

Figure 57. RARE II areas and existing disturbance.

RARE II Area/Mechanical Units	RARE II Acres	Existing disturbances within RARE II Areas
Sleeping Giant RARE II/ M10, M11, M17, M18, M19, M23, M30	5,173	Most of these units are within the ski area permit boundary (M10, M11, M17, M18, M19, M20 and a powerline unit), units 10, 17 18, and 19 have facilities of the ski area within the boundaries (lifts, buildings, lodge). Heavily disturbed with boundary and management conflicts due to ski area and structures within the boundary. Past logging, old roads and skid trails are present in M10, M11.
Wapiti Valley North/ M2, M12, M13, MR2	18,335	Past logging, old roads and skid trails are present in M2, M12, M13.
Wapiti Valley South M4, M7, M26, M27, M28, M29, M31, MR9	43,492	Past logging, old roads and skid trails are present in M4, M31, and MR9 have been logged previously. M7 in Pagoda Creek is heavily disturbed with boundary and management conflicts due to an existing system road and 11 structures within the boundary.

Prescribed burning. In Alternative 2, treatments are proposed to minimize the risk of wildfire by reducing the accumulation of hazardous fuels to enhance fire suppression capability in RARE II and wilderness since they are integral to the purpose and need and project goals/objectives. Treatment units in wilderness that involve prescribed burning are R6, R15, R20, R23, R43, R44, R46, and R48 and total 1655 acres. These eight units range from 5 acres to 553 acres, with the average being 206.8 acres. Approximately 10, 072 acres in 43 units would be prescribed burned in RARE II areas for fuel reduction and/or wildlife habitat enhancements (see Section 2.2). Helicopter ignition for prescribed fire would occur pending approval of a minimum tool analysis.

Mechanical treatments. In Alternative 2, Fuel reduction treatments are also proposed for small portions of RARE II areas to meet fuel reduction objectives. Mechanical treatment units that involve RARE II areas are M2, M4, M7, M10, M11, M12, M13, M17, M18, M23, M26, M27, M28, M29, M30, M31, MR2 and MR9 (MR are both mechanical and prescribed burning treatments). About four miles of temporary roads would be needed. These 18 units range from 1 acre to 159 acres, with the average being 27.8 acres. Figure 58 summarizes these treatment units.

Effects. The action alternatives include project design features (*see* Section 2.2.4) to minimize effects of activities to RARE II. Skid distances would be increased, if necessary, rather than constructing any temporary facilities or lengthening any temporary roads wherever possible. In RARE II areas, prescribed fire control lines would be constructed by hand, if needed, and not with motorized equipment and would have minimal effect.

Direct effects were measured by determining the area changed from an undeveloped to developed condition and identifying areas which would be effectively isolated and less than 5,000 acres in size. Activities that would develop an area were determined by applying the criteria established in the Wilderness Act of 1964, section 2 (c), and the Forest Planning Roadless Area Re-evaluation process (FSH 1909.12, Chapter 7). The criteria are applied to evaluate if proposed activities would affect an area to such a degree that the area may be omitted from any subsequent roadless area re-evaluation.

Direct effects were measured by size and a determination of the extent the area changed from an undeveloped to developed condition in the both the short term and long term. A key factor in analyzing the effects of specific management activities to RARE II areas is the degree of physical disturbance. Disturbance is the noticeable alteration of the area's undeveloped character due to evidence of human interference (mechanical fuel treatments and temporary roads) in an otherwise natural environment.

Figure 58. Affected Environment-Summary of mechanical treatments for the No Action and two action alternatives that involve R ARE II acreage.

Treatment Unit	Treatment	Primary Purpose	Location	RARE II Acres	Non-RARE II Acres	Wilderness Acres	Total Acres	Alt. 1	Alt. 2	Alt. 3
M2	Mechanical	Fuels Reduction	Libby Creek	10	16	0	26	0	26	16
M4	Mechanical	Fuels Reduction	June Creek	19	87	0	106	0	106	87
M7	Mechanical	Fuels Reduction	Pagoda Cr	9	12	0	21	0	21	21**
M10	Mechanical	Fuels Reduction	Sleeping Giant	45	28	0	73	0	73	28
M11	Mechanical	Fuels Reduction	Sleeping Giant	159	12	0	171	0	171	0
M12	Mechanical	Fuels Reduction	Absaroka Lodge	20	19	0	39	0	39	19
M13	Mechanical	Fuels Reduction	Elephant Head	1	29	0	30	0	30	29
M17	Mechanical	Fuels Reduction	Sleeping Giant	15	0	0	15	0	15	0
M18	Mechanical	Fuels Reduction	Sleeping Giant	17	0	0	17	0	17	0
M23	Mechanical	Fuels Reduction	Eagle Cr	3	15	0	18	0	18	15
M26	Mechanical	Fuels Reduction	Mesa Cr	5	24	0	29	0	29	24
M27	Mechanical	Fuels Reduction	Mesa Cr/Fishhawk	3	28	0	31	0	31	28
M28	Mechanical	Fuels Reduction	Goff/Gunbarrel	2	49	0	51	0	51	49
M29	Mechanical	Forest Health	Fishhawk	10	43	0	53	0	53	43
M30	Mechanical	Fuels Reduction	Middle Fork	82	0	0	82	0	82	0
M31	Mechanical	Fuels Reduction	Whit Creek	28	0	0	28	0	28	0
MR2	Mechanical/RX	Fuels Reduction	Aspen Cr	5	21	0	26	0	26	21
MR9	Mechanical/RX	Fuels Reduction	Blackwater	68	22	0	90	0	90	22
			Total =	501	405	0	906	0	501	405

***** - current road and cabin group within RARE II, needs WUI treatment***

Under Alternative 1, there would be no additional effects to the RARE II areas, designated wilderness, or wilderness characteristics, as there would be no fuel treatments (mechanical or prescribed burning) or need for temporary roads. No new actions resulting in direct or indirect effects on the RARE II or wilderness areas would result, as no fuel reduction actions would occur in RARE II areas. No additional changes (aside from existing developments) would result that would cause any areas to no longer qualify for wilderness designation. There would be no direct, indirect, or cumulative effects to the wilderness attributes of apparent naturalness, natural integrity, solitude, primitive recreation, special features, or manageability and boundaries of the RARE II areas. Only the forces of natural events such as a large wildfire could change the recreation setting, vegetation succession or visual landscape.

Under Alternative 2**,** proposed mechanical treatments for fuel reductions areas and temporary roads are included in RARE II areas. The project design feature for not substantially altering the undeveloped character of RARE II areas stated that proposed actions such as temporary roads and mechanical fuels reduction could only affect a small percentage (less than 5%) of each of the RARE II areas. As described, much of the involved RARE II acreage lacks undeveloped character.

Most mechanically treated units are within the wildland-urban interface (WUI), (*see* Figures 59 and 60), and are primarily for fuel reduction purposes. Units M27, M28, M29 and M30 are partially in and MR9 is outside of the WUI. In RARE II areas, prescribed fire control lines would be constructed by hand and not with motorized equipment and would have minimal effect.

Implementation of an action alternative would result is mosaic pattern of lightly burned and unburned vegetation from prescribed burning, emulating the natural fire process. An increase in the Forest's ability to implement fire use strategies in RARE II or wilderness areas in the future would result. This would have the beneficial effect of restoring wildfire as a natural disturbance process by allowing the natural role of fire in wilderness areas for remote parts of the North Fork drainage.

In RARE II areas, prescribed fire control lines would be constructed by hand and not with motorized equipment and would have minimal effect.

Implementation of an action alternative would result is mosaic pattern of lightly burned and unburned vegetation from prescribed burning, emulating the natural fire process. An increase in the Forest's ability to implement fire use strategies in RARE II or wilderness areas in the future would result. This would have the beneficial effect of restoring wildfire as a natural disturbance process by allowing the natural role of fire in wilderness areas for remote parts of the North Fork drainage.

Figure 59. Effects to RARE II acreage from mechanical treatments under Alternative 2.

RARE II Area*/Treatment Unit	Treatment	Primary Purpose	Location/Comments	RARE II Acres Treated	RARE II Acres Affected by Temporary Roads	Percent of total RARE II acres (77,719 acres) that No Longer Qualifies as Wilderness	Percent of individual RARE II acres that No Longer Qualifies as Wilderness
WVN/M2	Mechanical	Fuels Reduction	Libby Creek, entirely in WUI	10	10	.01%	.05%
WVS/M4	Mechanical	Fuels Reduction	June Creek, entirely in WUI	19	19	.02%	.04%
WVS/M7	Mechanical	Fuels Reduction	Pagoda Cr, entirely in WUI	9**	9**	.01%	.02%
SG/M10	Mechanical	Fuels Reduction	Sleeping Giant, entirely in WUI	45	45	.05%	.87%
SG/M11	Mechanical	Fuels Reduction	Sleeping Giant, entirely in WUI	159	159	.2%	3.07%
WVN/M12	Mechanical	Fuels Reduction	Absaroka Lodge, entirely in WUI	20	20	.02%	.10%
WVN/M13	Mechanical	Fuels Reduction	Elephant Head, entirely in WUI	1	1	.0001%	.005%
SG/M17	Mechanical	Fuels Reduction	Sleeping Giant, entirely in WUI	15	15	.019%	.28%
SG/M18	Mechanical	Fuels Reduction	Sleeping Giant, entirely in WUI	17	17	.02%	.32%
SG/M23	Mechanical	Fuels Reduction	Eagle Cr, entirely in WUI	3	3	.003%	.05%
WVS/M26	Mechanical	Fuels Reduction	Mesa Cr, entirely in WUI	5	5	.006%	.01%
WVS/M27	Mechanical	Fuels Reduction	Mesa Cr/Fishhawk, partially in WUI	3	3	.003%	.006%
WVS/M28	Mechanical	Fuels Reduction	Goff/Gunbarrel, partially in WUI	2	2	.002%	.004%
WVS/M29	Mechanical	Forest Health	Fishhawk, partially in WUI	10	10	.012%	.022%
SG/M30	Mechanical	Fuels Reduction	Middle Fork, partially in WUI	82	82	.10%	1.58%
WVS/M31	Mechanical	Fuels Reduction	Whit Creek, entirely in WUI	28	28	.03%	.06%
WVN/MR2	Mechanical/RX	Fuels Reduction	Aspen Cr. entirely in WUI	5	5	.006%	.02%
WVS/MR9	Mechanical/RX	Fuels Reduction	Blackwater, entirely outside WUI	68	68	.08%	.37%
			Total =	501	501	N/A	N/A

*SG=Sleeping Giant, WVN=Wapiti Valley North, WVS=Wapiti Valley South

**-current road and cabin group within RARE II, needs WUI treatment

There is some question whether all or parts of the RARE II areas would be classified as a RARE II area(s) if a new inventory were completed due to the developments that are present; the answer to that question is beyond the scope of this analysis. Nevertheless, it is important to remember that this discussion is based upon the conditions that exit now and how they will be modified and

not upon the conditions that existed when the area was designated a RARE II area. The existence of ski area facilities, ski are permit boundary, ski runs and associated development would likely make a large portion of this area (Sleeping Giant) unsuitable for Wilderness designation (FSH 1909.12 Section 7.1). Removing unsuitable acreages would reduce it below 5,000 acres.

Figure 60. Magnitude of Mechanical Treatment for Fuels Reductions in Affected RARE II areas

RARE II AREA	Acres Treated in RARE II	Percent of RARE II Treated	% if Units 17 and 18 are removed from consideration in Sleeping Giant RARE II area due to ski area development.	% if all units within the ski area boundary are removed
Wapiti Valley North	36	0.2%		
Wapiti Valley South	144	0.3%		
Sleeping Giant	321	6.2%	5.5%	4.7%

The following discussion describes the effects on the wilderness attributes of natural integrity, apparent naturalness, opportunities for solitude and primitive recreation, special features or values and wilderness manageability and boundaries that would result from implementation of the alternatives.

Apparent Naturalness and Natural Integrity

Alternative 1 would not change apparent naturalness or natural integrity.

Sleeping Giant and Wapiti Valley South RARE II areas contain portions that lack apparent naturalness due to recreation residences, ski area facilities, roads, and past logging. This level of disturbance is a noticeable alteration of the area's undeveloped character due to evidence of human interference in an otherwise natural environment.

Under the action alternatives, there would be changes to the natural integrity or natural appearance from mechanical treatments and temporary roads. While there would be short term changes in the appearance of the landscape, this may be an efficient tradeoff to achieve the benefits of fuel treatment actions to reduce fire hazards to other resources. In the long term, (10 to 20 years or longer depending on soils, vegetation type, aspect, etc.), effects of the action alternatives would gradually return to a more natural appearing landscape. The project's mechanical treatments would likely influence the determination of any potential wilderness boundaries. Boundaries may need to be redrawn in some cases; such actions would effectively reduce the size of the Sleeping Giant Rare II area below 5,000 acres but would not isolate it.

There would be little to no impact on the natural integrity or natural appearance from prescribed burning, as this activity is a controlled introduction of a natural landscape process (fire occurrence). While there would be short term changes in the appearance of the landscape, it would mimic the natural pattern of a low to moderate intensity fire with a mosaic pattern of burned and unburned areas. Treatments in RARE II with prescribed fire would result in a vegetative mosaic with a low to moderate intensity burn, with a mosaic pattern of lightly burned and unburned vegetation that would emulate the natural fire processes. No temporary roads are needed for the prescribed burning actions. The intensity, magnitude and duration of prescribed burning in RARE II does not cross the "threshold of significance" for apparent naturalness and natural integrity.

Opportunities for Solitude and Primitive Recreation

Alternative 1 would not change opportunities for solitude and primitive recreation.

Sleeping Giant and Wapiti Valley South RARE II areas contain portions that lack opportunities for solitude and primitive recreation due to recreation residences, ski area facilities, and roads.

There would be impacts to solitude and primitive recreation from mechanical treatments and temporary roads during the period of operations, which would exist during salvage harvest under the duration of a one to three year timber sale contract. While there would be short term reductions on solitude and primitive recreation, in the long term these opportunities would again be present. Temporary roads would be rehabilitated.

In considering prescribed burning, there would be short term effects on solitude in the immediate area of treatments from use of a helicopter for aerial ignition for a duration of three to five days. It is anticipated that burning would occur during the spring season or fall season. Impacts on recreation use would be negligible due to the small area directly impacted. No special features would be impacted. In the long term, effects to solitude or primitive recreation would be negligible.

The project's prescribed burning would not influence the determination of any potential wilderness boundaries; there would be no effect on the existing boundaries. The intensity, magnitude and duration of prescribed burning in RARE II does not cross the "threshold of significance" for opportunities for solitude and primitive recreation.

Manageability and Boundaries

Alternative 1 would not change manageability and boundaries.

Sleeping Giant and Wapiti Valley South RARE II areas contain portions that present manageability and boundary concern due to recreation residences, ski area facilities, and roads.

The project effects from mechanical treatments would possibly influence the determination of any potential wilderness boundaries. There would be potential effects on the existing boundaries. Boundary adjustments may be needed in units within RARE II areas mechanically treated for fuel reductions; however, much of this acreage is already developed to the extent that wilderness values are compromised and boundaries may need adjusted under existing conditions.

The project effects from prescribed burning would not influence the determination of any potential wilderness boundaries. There would be no effect to existing boundaries from burning.

Mechanical treatments for fuels reductions in RARE II totals 501 acres or 0.6 percent of the total 77, 719 RARE II acreage. The 18 units to be treated range from 1 acre to 159 acres in size, with the average being 27.8 acres. The average size of units and the small total percentage of the total RARE II area affected (0.6%) in the analysis area by mechanical treatment would not substantially alter the undeveloped character of RARE II areas.

The effects of Alternative 2 are localized, with implications primarily for the immediate project area. The cumulative effects analysis of past, present and future activities along with the current proposal are considered and analyzed in the EA. These effects were considered in any determinations and findings.

The intensity, magnitude, and duration of the disturbance determine whether the area affected may be considered developed and may affect qualifications for wilderness. The effects of activities in alternative 2 were evaluated in terms of intensity, magnitude and duration, the documentation shows that entry into RARE II areas does not cross the "threshold of significance" established in 40 CFR 1508.27(b)(3-9).

Special Features

Alternative 1 would not effect special features.

Under the action alternatives, there would be no impact to special features from mechanical treatments or prescribed burning.

Alternative 3

Under Alternative 3, mechanical treatment areas for fuels reductions and temporary roads are designed to remain outside the RARE II areas. The exception is Unit M7, which is 21 acres total. Other than nine acres treated in RARE II in a portion of Unit M7, there would be no acres within RARE II mechanically treated for fuel reduction. Other than Unit M7, no effects to RARE II areas from treatments or temporary roads would result. In the long term, no changes would result that would cause any areas to no longer qualify for wilderness designation.

The exception is unit M7, which is in the WUI and has developments within a RARE II area in need of fuels treatment. It would be treated under both action alternatives due to the presence of recreation residences adjacent to a system road and the potential for loss of property due to wildfire. No temporary roads would be needed. Minor changes would result if the nine acres were treated that would cause a small area to possibly no longer qualify for wilderness designation. However, due to the current level of roads and developments this small acreage is not likely to qualify for wilderness designation under the existing conditions.

In RARE II areas, prescribed fire control lines would be constructed by hand, if needed, and not with motorized equipment and would have minimal effect. The indicators for RARE II areas and major differences between the action alternatives are summarized in Figure 61.

Figure 61. Summary Comparison of Potential Effects of the Alternatives

Indicators	Alt. 1	Alt 2	Alt. 3
Acres/% of RARE II areas with mechanical treatment for fuel reductions	0 acres/0%	501 acres/0.6%	9 acres/.01%
Miles of new temporary roads within RARE II	0 miles	Approximately 4 miles	0 miles

3.7 Visuals

Because of the insect epidemic and extensive acres of dead and dying trees, existing visual condition is currently declining. Primary Forest Plan direction relates to the 2B management area direction listed on page III-125 and the 3A direction on page III-133 of the Forest Plan: "*Do not exceed an Adopted Visual Quality Objective (VQO) of partial retention*" and Forest Plan general direction on page-25: "*Meet the visual quality objectives of retention and partial retention one full growing season after completion of a project.*"

The Absaroka mountain range is the dominant landscape feature surrounding the scenic North Fork corridor with the North Absaroka and Washakie Wilderness areas adjacent to the corridor. U.S. Highway 14/16/20 (the Buffalo Bill Scenic Byway, also called the North Fork Highway) provides access for developed and dispersed recreation as described in Section 3.6 Recreation. The glaciated volcanic cirques, mountain slopes, and landslides, with the following vegetation types, compose the natural appearing, characteristic landscape. Natural vegetation conditions include: Engelmann spruce, Douglas-fir, lodgepole pine, limber pine forests, aspen, meadows, sage brush and juniper shrub lands, riparian zones and small water bodies and wet areas.

The project area, especially the corridor, has been modified by human activities such as developments and infrastructure, fire suppression, prescribed burning, roads, developed recreation, limited timber management, firewood cutting and minimal livestock grazing. Natural events—wildfires, winds, insects and disease—have also played a part in shaping the landscape.

The majority of roads in the project area were constructed years ago and have a history of use for recreation and resource purposes. Most roads were put in place before the development of the Visual Management System (VMS). The casual observer, due to the high visual absorption capability of the diverse landform and vegetative landscape character, does not notice most existing project roads.

Each of the action alternatives involves management activities that would result in a change from the existing character of the area. The action alternatives include project design features (*see* Section 2.2.4) to meet the Visual Quality Objectives (VQOs) where possible, minimize activity impacts, and assist in forest restoration to return visual conditions to retention and partial retention in the long term.

Project design features offer positive, long term values: 1) accelerated succession of the forested landscapes of primarily Douglas-fir, and 2) accelerated regeneration of riparian, aspen, and deciduous vegetation enhancement for viewing opportunities of seasonal vegetation color and wildlife. The project proposes active management with mechanical treatments for fuel reductions and prescribed burning as the primary tools, project design features will be applied to soften immediate effects while attempting to speed up the overall succession of the stands to achieve long term scenic objectives. The affected environment and the effects are discussed in terms of the foreground, the middleground and the background.

- ***Foreground.*** Views from the foreground of the North Fork Highway include a diverse landscape character within the partial retention, visual quality objective identified in the Forest Plan. Even though a very high percentage of the tree stands are recently dead and dying, most of the Scenic Byway continues to meet retention VQO. Retention VQO is the desired condition for this Scenic Byway corridor; retention is currently prevalent.
- ***Middleground***. Systematically a typical middle ground view ranges from three to five miles. Currently with a forested foreground, most of this Scenic Byway viewshed is encompassed within a near distance of a half mile to a mile; however, some distant views (mountains forming either the scenic backdrop ridges and side canyons as seen from the highway and recreation facilities) range from one mile and greater. Views originating from along the Byway and from surrounding historical cabins/residences and lodges, campgrounds and other recreation facilities currently meet the visual conditions of retention to partial retention.
- ***Background.*** This view zone blends with the middleground and for the sake of this analysis, the middleground effects will proxy for the minor amount of fragmented background viewsheds.

Implementation of an action alternative is important for two reasons. First, the acreages involved represent only a small percentage of the analysis area; this fuel reduction project would create contrasts from mechanical and burning treatments in the short term. It will not have a substantial effect on visual quality in the long term. Mechanical treatments in the foreground view will create the highest contrast reducing the scenic integrity. Within approximately 20 to 30+ years after these treatments, visual enhancement is anticipated with forest regeneration and increased diversity.

Second, the fuels reduction plan for the area is designed to provide a strategic fuels reduction and defensible space for enhanced fire suppression capabilities throughout the area. Not removing the insect-killed and infested conifers to reduce fuels would compromise the purpose and need for the project, greatly lowering its effectiveness and the desired enhanced fire suppression capabilities.

In considering trade-offs, the long term benefits of reducing the risk of a large, high intensity wildfire that would remove much more of the forest cover and threaten resource values, properties, tourism, human health and safety overrides exceeding the visual quality objectives on the relatively small acreage of the project area. Likewise, prescribed burning is worth the long

term benefit of reducing the risk of a large wildfire that would remove much more of the forest cover and threaten resource values, properties, tourism and human health and safety.

Forest Plan management area direction for the majority of the project area emphasizes rural and roaded natural recreation opportunities (2B) and semiprimitive nonmotorized recreation in roaded and unroaded areas (3A) and maintaining/enhancing visual diversity. While this direction emphasizes visual resources, hazardous fuels reduction needs to take precedence in the project area, based on the risk of wildfire to developments, tourism, resources and human health and safety.

Effects. With the No Action Alternative, tree stands will continue to die, and visual quality will continue to deteriorate. The foreground views will be most affected. Within the foreground, existing visual conditions will deteriorate from the severe insect infestation and tree mortality below partial retention in the near future (3-5+ years). Whether or not fire occurs, the form, line, texture, and especially color of the vegetative landscape will change and negatively alter the existing visual condition because of the insect epidemic. Middle ground/background views will be strongly altered in color; however, with the landscape diversity and other visual absorption factors, the effects will probably go unnoticed to the casual observer.

Under Alternative 1, the deteriorating effects would be rapid in the next few years, from insect-killed trees. Long term recovery rates (30 to 50+ years) would be expected. Wildfire is a potential outcome of the no action alternative due to fuel loading and the associated negative impact to visual resources.

Forest Plan standard of partial retention is the visual quality objective while the desired condition for this Scenic Byway is retention. Realizing the visual quality will continue to deteriorate as described in the effects of Alternative 1 above, long term scenic recovery and enhancement becomes the primary goal other than allowing natural wildfire to recycle the vegetation.

Under the action alternatives, the scenic character and integrity will be altered and decline in the short term. The casual observer will notice the change, especially in the short term after treatment. Immediate foreground views will be the most negative impacts to the visual senses.

The immediate visual impact of the action alternatives would be a tradeoff to speed up the vegetative recovery period. The duration of the effects is anticipated to extend through 20 to 30+ years; within some harsh sites the recovery may take more than 30 years to achieve a recovered forest effect.

Project design measures to soften immediate effects, while attempting to speed up the overall succession of the stands to achieve long term scenic objectives, are found in Section 2.2.4. Reduction of hazardous fuels can have benefits to the scenery within the project area, especially in the long term (20 to 30+ years). In the long term, the action alternatives would result in a net positive scenic benefit. With vegetative recovery, enhanced visual diversity is anticipated over the next succession cycle.

Foreground Effects Under Alternative 2 - The mechanical treatments would exceed the VQO of partial retention for a longer period than one growing season after project implementation. Within the project area, long term visual diversity and forest health of vegetation will be improved, the short term (<10 years) effect is minimal and necessary and is not irreversible. The long term benefits of hazard fuels reduction outweigh the short term effects.

An almost immediate and dramatic negative visual effect will occur. Compared to the corridor's existing forested character, the foreground of the viewshed will be highly modified appearance. Foreground views within mechanical and prescribed fire treatments will not meet partial retention

and probably will reduce the visual conditions to the VQO standard of modification and/or maximum[18] modification in much of the area for the first few years after the work.

Most ground level disturbances to vegetation and soil begin to recover within the first growing season. The duration of this process is directly related to the extent of disturbance. In two or three years, herbaceous vegetation would cover most sites. Herbaceous and native grasses would assist to visually soften and heal the foreground views from the road.

Within foreground aspen treatments and where aspen tree stems are to be left in a jack straw configuration to protect regeneration, the visual condition would have a short duration (10 to 15 years) impact reducing the VQO standard of modification and/or maximum modification.

For long-term scenic quality enhancement, mechanical treatment and prescribed burning is practical to speed up the transition from a forest with high mortality to a visually enhanced scenic resource; wildfire is the only other method of fast transition. Over the long term, Forest Plan goals and direction relating to visual diversity and forest health would be improved.

Foreground Benefits Under Alternative 2 - Foreground settings (immediately after treatment) will have: more defined view openings from the highway and recreation facilities, vistas of geologic formations and expanded open meadows; this is not expected to reduce visual changes to the landscape due to tree stump patterns and large burn areas.

In the long term (20 to 30 years and possibly more in harsh sites) and with continued management, the benefits include:

- Rejuvenation of some of the aspen stands and riparian areas for enhanced seasonal foliage contrast.
- Increased stand structure variability.
- More irregular "edge" pattern defined by the contrast of reforested areas against managed opening for wildlife and structure protection.
- Defined meadow settings.
- "Park-like" settings and defined openings will surround historical residences/lodges and other recreation facilities.
- Enhanced color contrast with surrounding mountainsides and primarily a healthier and more robust vegetative landscape with less wildfire propensity during the next century and until the next succession cycle.

Middleground/Background Effects Under Alternative 2 - Few background views exist where they are not superceded by either wilderness values (no mechanical treatments) or overlying middleground views from other observation locations. Therefore, this study will analyze background in combination with the middleground portion of the viewshed.

Due to the amount of the forested foreground under mechanical treatment and burning, the view will extend beyond to the middle/background viewsheds. With the burn units planned throughout the viewshed, the visual impacts will be highly visible and of great magnitude in the early years after treatment.

Middleground/background settings (mountains forming the backdrop as seen from the highway and foreground views from recreation facilities) will vary after the action alternatives treatments depending on exposure. Generally, north facing slopes will change from a forested character to a relatively open landscape with standing burnt trees and with remnant insect killed trees.

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[18] **Modification**-Category of Visual Quality Objective (VQO) where human activity may dominate the characteristic landscape but must, at the same time, follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in the foreground or middleground.. **Maximum modification**-VQO where human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Overtime (approx. 10-20 years), the standing trees will rot and fall over. In areas of concentrated dead trees a "jackstraw effect" within natural regeneration re-establishment will potentially occur In the distant future (approx. 20-30+ years), most of the slopes will naturally regenerate forested character and fully meet retention VQO standards.

North facing slopes overall visual impact will appear more substantial than south facing slopes as the contrast of broad areas of standing, black tree skeletons and the form, color and texture contrasts against adjacent non-treated areas.

Most of the planned burn areas on south facing slopes are currently covered with sporadically, scattered individual trees and groups of trees, junipers and others shrub species. In contrast to the north facing slopes, the south facing slopes are currently more visibly open as seen from the highway and other facilities. After the planned burning, the landscape will be predominately open with scattered burned and insect killed trees. Some remnant isolated individual trees and small clusters of trees are anticipated to remain. How many will survive after the pest attacks and burning is undetermined.

Middleground/Background - Benefits Under Alternative 2 - Reduction of hazardous fuels can have benefits to the scenery within the project area, especially in the long term (approx. 20-30+ years). After the forested portion of the landscape recovers and attains retention VQO levels, more visual diversity is anticipated. Many of the benefits will be the same as the "Foreground Benefits Under Alternative 2" in the above bulleted items. Other long-term, benefits to middle ground and background viewsheds are:

- Enhanced and more diverse mosaic patterns at a broad landscape scale.
- Younger regenerated stands provide accentuated and fine textures across the slopes while enhancing the chromatic forest hues inherent to each species and exposure.
- Possibly less damage to the landscape and quicker recovery with prescribed burning versus wildfire.

Alternative 3 activities are very similar to the proposed actions in Alternative 2 except approximately 500+ more acres are included with Alternative 2.

3.8 Heritage Resources

A cultural resources survey of the treatment area was initiated in the summer of 2003. The Forest will contract the survey and ensure that all survey work is completed to Wyoming SHPO standards. No ground disturbing activities will occur prior to completion of a cultural resource survey and consultation with Wyoming SHPO. At this time, there are no known paleontological, archaeological, or historical sites that are affected by the project.

Effects. Implementation of the No Action Alternative would not directly or indirectly affect heritage resources since there would be no change to the integrity of eligible heritage resources.

No direct effects would result from implementation of any action alternative. Adherence to the regulations for implementing the National Historic Preservation Act ensures that eligible heritage resources are identified before project implementation and that heritage resources are identified and either avoided through project design/redesign or mitigated. New sites discovered during the course of project implementation would be protected from ground disturbance while on-site evaluations of their significance and treatment are made. Site significance and project effects are determined through consultation with the Wyoming SHPO.

The portions of this project that would be implemented through a timber sale contract under any action alternative would include the #C6.24 clause which enables the Forest Service to modify or cancel a timber sale contract to protect heritage resources, regardless of when they were identified.

3.9 Socio-Economic

Economic uses of the Forest Service lands include limited commercial livestock grazing, limited timber harvest and forest products, recreation, (including outfitting and guiding), and hunting and fishing. Community economic health benefits come from commodity production related primarily to recreation and tourism. Developed and dispersed recreation, hunting, camping, fishing, wildlife watching and driving for pleasure occur in the corridor provide economic benefits to local communities.

Trees salvaged as proposed in the action alternatives have economic value in the manufacture of wood products; removal of these trees and logs contributes to local employment and an improvement in regional economies. The analysis area has social value to inhabitants of local communities. People can spend the weekend or a day in this area of the Forest with family or friends participating in either a motorized or non-motorized experience.

Effects. Under Alternative 1, there would be no short term economic effects. Long term effects would include continued risk for wildfire; in the event of a wildfire, economic losses would occur. Direct losses could occur from property damage, loss of structures including historic lodges, loss of infrastructure, etc. Tourism could be affected during a wildfire, especially if access is restricted or if smoke obscures views or makes visitors uncomfortable. Indirect losses would include reduced future visitation if people avoid visiting the area.

Alternative 1 does not allow the capture of any commercial sawtimber-sized products. Under Alternatives 2 and 3 timber would be salvaged to reduce fuels and utilize forest products. This harvest would salvage dead and dying trees and at-risk live trees with an estimated volume yield of seven to ten mmbf.

Under the action alternatives, reductions in fuel loading would help to protect recreation developments such as campgrounds and lodges that serve tourists and lessen adverse economic impacts caused by wildfire. The action to reduce fuels in the wildland-urban interface achieve these benefits: enhanced firefighter safety and protection of irreplaceable historic structures. The costs of fuel reduction treatments is a concern; however, the costs of suppression would be far greater.

Alternatives 2 and 3 are the only alternatives that produce monetary returns from timber receipts. Regionally, there are businesses in the wood products industry that could handle the volume: Cody Lumber in Cody, Wyoming; Wyoming Sawmills in Sheridan, Wyoming and RY Timber in Livingston, Montana to name a few. Local economies and the job market would benefit the most if a local company purchased the sale(s) and the timber was not hauled out of the local area for processing. However local economies would realize some benefits form the purchase of supplies to support the logging operation.

Local economies benefit by recreation use in the area as people purchase local goods and services. Outputs of forest products, range revenues, etc. provide jobs and economic inputs to the local communities. Commercial recreation service providers, such as resorts and outfitters, also provide economic benefits from both motorized and non-motorized areas of the Forest.

Financial effects of the alternatives are displayed in Figure 62. This analysis incorporates only real costs and revenues. Quantifying resources that are not typically valued in terms of dollars can be misleading due to the difficulty in assigning monetary value to resources such as wildlife, vegetation diversity, scenic quality, watershed condition, and recreation opportunities. For this reason, these resource values were not quantified in terms of dollar values and were not included in the financial analysis. The values of other resources are considered qualitatively in specific resource discussions elsewhere in this document.

Alternative 1 would not meet the purpose and need to address fuel reduction and modify fire behavior. The No Action Alternative would not involve mechanical treatments such as salvage sales or implement any other fuel reduction actions; therefore, it would not directly contribute to employment or the local county economy through revenues from receipts on National Forest timber sales or generate any substantial additional employment or income in the local economy.

Figure 62. Financial analysis by alternative.

	Alternative 1 (in millions of dollars	Alternative 2 (in millions of dollars)	Alternative 3 (in millions of dollars)
Present Value Revenues	*0*	*$4.660*	*$3.262*
Present Value costs	*-$13.334*	*-$6.428*	*-$4.898*
Net Present Value[19]	*-$13.334*	*-$1.768*	*$1.636*
B/C Ratio[20]	*$0.00*	*$0.72*	*$0.67*

Environmental Justice

Presidential Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, was issued in February 1994. This directed federal agencies to consider, as part of the NEPA analysis process, how their proposed actions or projects might affect human health and environmental conditions on minority and/or low-income communities.

Two fundamental questions are posed by the CEQ (Council of Environmental Quality) to help agencies address these and related factors: 1) Does the potentially affected community include minority and/or low-income populations? And, 2) Are the environmental impacts likely to fall disproportionately on minority and/or low-income members of the community and/or tribal resources?

In answering the first question, we used 1990 census data[21] to examine the minority and low-income populations in Park County, the county where the proposed action occurs. The minority populations for Park County represent less then 2.5% of the total population for the county. This compares to 5.8% minority populations for the whole of Wyoming. CEQ guidance identifies a minority population as one where either: a) the minority population of the affected area exceeds 50 percent or b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population. For this analysis, the affected area is identified as Park County and the state of Wyoming is used as the geographic reference for the general population. Park County meets neither of the above conditions, so no minority populations were identified.

The percentage of persons below the poverty level for Park County is 9.5 percent as compared to 11.9 percent for Wyoming. Those persons are generally dispersed throughout Park County; no specific communities are predominantly low income. For this analysis no low-income populations were identified.

Given that no minority or low-income populations are identified in the affected area, there will be no disproportionate effect from any alternative on such populations regarding environmental justice concerns or factors.

[19] Net present value = the difference between the discounted value of all outputs to which market prices are assigned and the total discounted costs.
[20] *B/C ratio = discounted values divided by the discounted cost.*
[21] *The 200 census data will be used to update this analysis in the final EA.*

3.10 Cumulative Effects

3.10.1 Past, Present, and Reasonably Foreseeable Future Actions

The cumulative effects analysis documented here examined the effects of the no action and two action alternatives in conjunction with the incremental effects of past, present, and future projects that may occur near the analysis area. Past, present, and foreseeable future actions include special-use permits, recreation and tourism, timber harvest, firewood harvesting, livestock grazing, wildfire, prescribed burning, fire suppression, roads, and motorized and non-motorized recreational uses.

The analysis area, along with past, present, and future actions is shown in Figure 2. The period within which cumulative effects are analyzed is roughly from the 1970s through 20 years from project implementation, or about 2025. This is related to the time over which this analysis is conducted, the decision made, and anticipated follow-up actions are implemented and completed.

Some changes are always taking place in the condition of the Forest, with or without human activity. Many of these, such as changes set in motion by wildfires, insects and disease, storms, and floods can cause major changes and would continue even if all human activity ceased. An activity that overlaps the analysis area in time and space does not necessarily contribute to cumulative effects. The cumulative effects discussion that follows summarizes the effects of those items that contribute to cumulative effects.

The IDT determined that the action alternatives would have no appreciable cumulative effects on transportation and heritage resources. Resources of concern needing further elaboration regarding cumulative effects are discussed below.

Past Activities

- Past timber management and prescribed burn activities are summarized in Figure 64.
- The Clover Mist Fire, part of the 1988 Yellowstone Fires, burned 43,921 acres in the watershed.
- Pheromone capsules installed around campgrounds, cabins and lodges.
- In 2000, 150 dead trees were removed by horse logging south of the west loop of Newton Creek Campground. In 2001, hazard trees were removed from the Eagle Creek Campground.
- There are two recently completed small sales around Blackwater Lodge and the Boy Scout Camp to remove dead, dying and high-risk hazard trees.
- The Eagle Creek Area Hazardous Fuels Reduction project was approved in January and associated award of timber sale contracts occurred in February 2004. An estimated volume yield of 2.5 to 3.0 mmbf will be removed for fuel reduction on approximately 393 acres.
- Limited commercial and personal use firewood cutting, house logs sales, and Christmas tree permits have occurred.
- Until about 1999, insects and disease were at endemic levels.
- Grazing by commercial livestock and large ungulates has occurred.
- Weed infestations and invasive weed control efforts have occurred.
- Watershed improvement projects have occurred.
- 2. 5 miles of road in Kitty Creek was obliterated as part of grizzly bear mitigation plan for reconstruction of the North Fork Highway project
- Since 1940, wildfires have burned approximately 57, 577 acres.
- Wildfire suppression occurred.
- North Fork Highway reconstruction project was completed (US Highway 14-16-20).
- Big game hunting and associated nonmotorized, motorized and stock use activity has occurred.
- Dispersed motorized recreation, including ATVs and snowmobiles.
- Fishing in the North Fork and tributaries.
- Development, infrastructure and sites include lodges, cabins, campgrounds and trailhead sites.
- Existing uses of nearby private lands, primarily irrigation, ranching, and cattle grazing have occurred.

Present Activities/Conditions

- Buffalo Bill Cody Scenic Byway (US Highway 14-16-20) provides access to the east gate of Yellowstone Park.
- Commercial and personal use firewood cutting, house logs sales, and Christmas tree permits are occurring.
- The ongoing insect and disease epidemic is affecting most timber stands in the analysis area.
- Limited grazing by commercial livestock grazing is occurring in a small percent of the analysis area.
- Grazing by wild ungulates is occurring.
- Weed infestations and invasive weed control efforts are continuing.
- Fire suppression, when wildfires occur.
- Big game hunting and associated motorized activity occurs.
- Dispersed motorized recreation, including ATVs and snowmobiles, occurs.
- Fishing in the North Fork and tributaries.
- Development and sites include lodges, cabins, historic buildings, and the east entrance to Yellowstone National Park created a wildland-urban interface.
- Existing uses of nearby private lands, primarily irrigation, ranching, and cattle grazing continue.

Reasonably Foreseeable Future Actions

Highway reconstruction project over Sylvan Pass in Yellowstone National Park to begin in 2004.

- Commercial and personal use firewood cutting, house logs sales, and Christmas tree permits will continue.
- The insect and disease epidemic will continue to spread to suitable and non-suitable stands.
- Grazing by commercial livestock and wild ungulates will continue at or near existing levels.
- Weed infestations and invasive weed control efforts will continue at or near present levels.
- Wildfire suppression will occur.
- There is the potential for wildfire in the area, including a chance for a large stand replacement fire under the right weather conditions.
- Big game hunting and associated motorized activity will continue at or near existing levels.
- Fishing, dispersed motorized recreation, including ATVs and snowmobiles, will continue near current levels.
- Existing uses of private lands, primarily irrigation, ranching, cattle grazing and housing will continue.

3.10.2 Cumulative Effects to Resources

This section discloses cumulative effects from past and present activities, the effects of the action alternatives, and effects of reasonably foreseeable activities that are likely to occur on federal, state, and private land within the analysis area over the next 20 years. Cumulative effects are primarily a result of wildfire suppression, developments, roads and infrastructure, previous logging, insect and disease infestations, recreation uses, along with the effects from the action alternatives and any activities likely to occur in the near future.

Cumulative Effects on Vegetation

Vegetative Diversity

Cumulative effects come from previous roading, the North Fork Highway Reconstruction Project, wildfires, past and present fire suppression, past and current grazing, vehicle traffic and recreation uses, along with the effects from the action alternatives. Considered in concert, the past, present, and future activities do not carry a risk of cumulative effects to vegetation from the acreage being treated. Wildfires and wildfire locations from 1910-2003 are portrayed in iSection 3.4 and Figure 33.

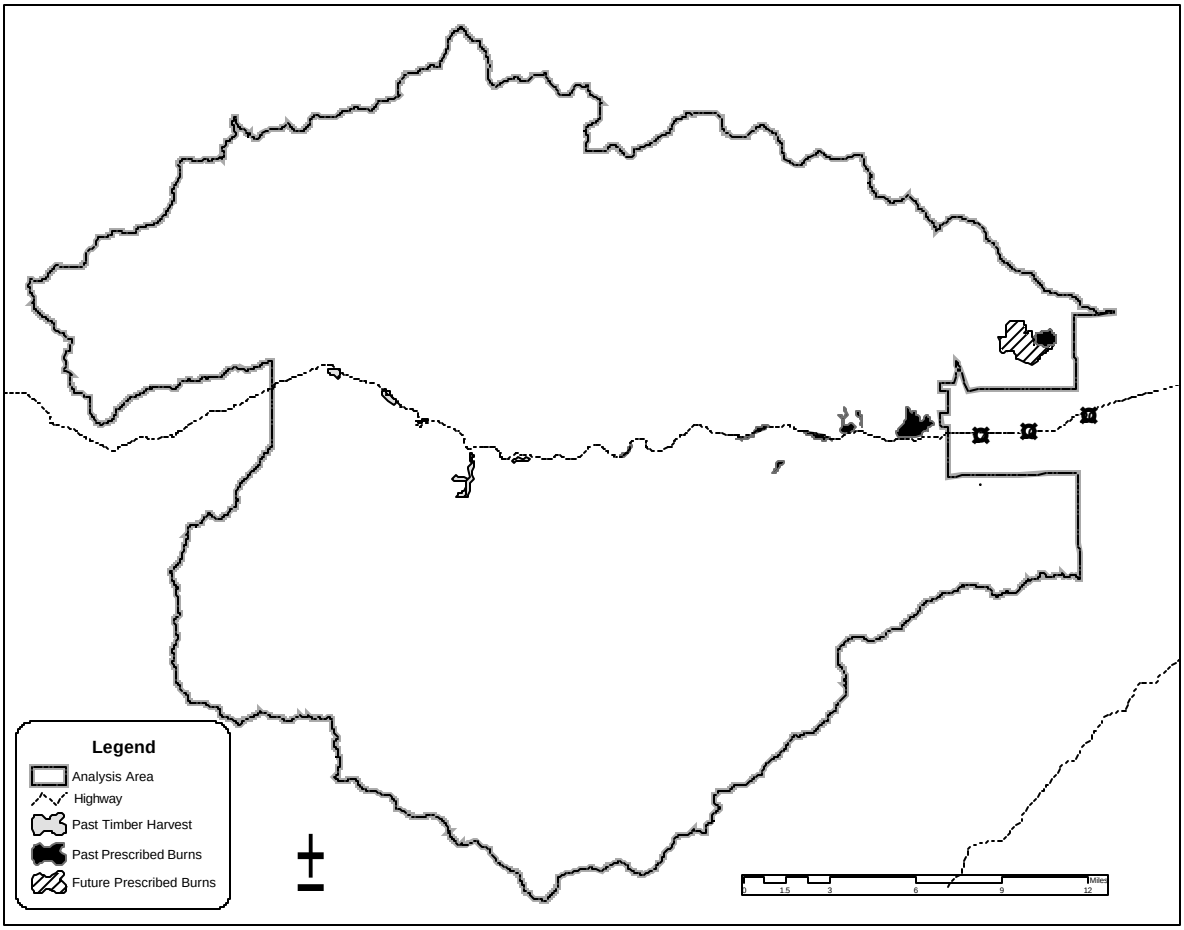
Incremental effects from past, present and future activities that may occur in the analysis area were considered. For example, recreation, fire suppression and grazing management were considered and would continue under Forest Plan direction, standards, and guidelines.

Past activities that affected vegetation primarily include: 1) timber harvest on National Forest Service lands; 2) insects and disease, and 3) prescribed burning. These activities created some stand diversity in a landscape dominated by mature timber stands (*see* Figure 63 and 64).

Figure 63. Past vegetation treatments in the analysis area.

Project Name	Year	Treatment	Acres
Fishhawk	1965	Timber Harvest	41
Kitty Creek	1977	Timber Harvest	194
Grass House	1978	Sanitation (salvage)	61
Tabby	1980	Seed Cut-Shelterwood	10
50 Mile	1977	Sanitation (salvage)	78
Pahaska	1983	Timber Harvest	52
Hwy/Powerline ROW clearance	1996-2000	ROW clearance	100+
Wapiti	1998	Prescribed Burn	77
Elk Fork	1998	Prescribed Burn	45
Clearwater	1998	Prescribed Burn	83
Blackwater	1998	Prescribed Burn	29
Horse Creek	1999	Prescribed Burn	152
Newton/Eagle Creek CG Hazard Trees	2000-2001	Sanitation-Mortality Salvage	25
Pagoda Salvage	2000	Sanitation-Mortality Salvage	189
Signal Peak	2001	Prescribed Burn	481
Mormon Creek	2002	Fuels/Salvage	20
Kitty Creek	2002	Fuels/Salvage	17
Green Creek	2002	Fuels/Salvage	13
Blackwater Lodge	2003	Fuels/Salvage	50
Jim Mountain	2003	Prescribed Burn	212
Boy Scout Camp	2004	Fuels/Salvage	69
Future Projects			
Jim Mountain	2004	Prescribed Burn	948
Eagle Creek	2004	Fuels/Salvage	393

Figure 64. Major past, present, and future on- Forest vegetation treatment activities considered in the cumulative effects analysis.



The current insect epidemic has completely overshadowed the effects of these past activities. The current epidemic is resulting in the conversion of the area from one dominated by mature stands to an area dominated by immature stands. The past treatments have made some stands somewhat resistant to the epidemic, but the severity of the epidemic is even resulting in the death of many of the mature trees in those stands.

These stand conditions have created hazardous fuel conditions and increased wildfire risk, and salvage/sanitation opportunities. In considering past, present and future actions, the potential future activity that could have an additional cumulative effect on the area is wildfire. The area has had threatening fires in the recent past, but the heavy fuel loadings could lead to larger and more intense fires as evidenced in 2003. Smaller wildfires would contribute to increased stand diversity, resulting in patches of grass/forb habitat where advanced regeneration and immature trees are killed. Considering the beetle epidemics and fuels, the likelihood that all fires can be kept small is decreasing.

There is also the potential for large stand replacement fires under the right weather conditions. (*See* discussion in Section 3.4 Fire and Fuels). This is more likely to happen given the heavy fuels loads caused by the insect epidemic. If a large stand replacement fire occurs, the vegetation will be set back to an early grass/forb seral stage. In this situation, stand diversity would be decreased even further than is happening under the current insect epidemic, as much of the advanced regeneration and immature trees would be killed. In addition, much of the standing and down dead material would be burned.

The effects of the proposed action, when added to past and planned actions, would contribute to the cumulative beneficial effects in terms of fuel reductions and the risk of wildfire. The treated areas where fuels have been reduced make it more likely that fires could be controlled at smaller sizes. This is particularly true for the action alternatives, where the treatments are designed to provide fuel breaks to help with containing fires. The result is that the more treated acres, the more likely that fires could be held to smaller sizes, and a greater range of stand diversity would be maintained. The No Action Alternative is the greatest risk for not being able to control wildfires to smaller areas.

A large wildfire would contribute to a further loss of limited stand conditions, such as old growth, vertical diversity, and thermal cover. It would also increase the length of time that such conditions would take to reestablish.

Rangelands

The effects from the project, when combined with other past, present, and reasonably foreseeable future activities are not expected to have any substantial cumulative effects. The selected alternative will have a minor specific cumulative effect when added to the existing conditions. Under Alternative 1, the potential future activity that could have an additional cumulative effect on rangelands in the area is wildfire. The analysis area had fires in the recent past, but the heavy fuel loading that could lead to larger and more intense fires has the greatest potential for adverse cumulative effects on rangelands.

When considering past, present and reasonably foreseeable future activities, the accessibility and amount of forage may be slightly higher under the actions alternatives. Tree removal and/or prescribed burning could increase forage species availability and amount on treatment areas, by removing dead trees that eventually would fall in a jackstraw pattern, restricting foraging accessibility. Future changes in grazing strategies would be analyzed through Allotment Management Plan revisions. Invasive weeds would be monitored and treated as needed. In the foreseeable future, livestock grazing management would continue under Forest Plan direction and standards and guidelines.

Sensitive Plants

Under the No Action Alternative, there would be no substantial adverse cumulative effects as there are no additive effects from Alternative 1.

The effects from the project, when combined with other past, present, and reasonably foreseeable future activities are not expected to have any substantial cumulative effects. The selected alternative will have a minor specific cumulative effect when added to the existing conditions. Forest Plan goals and supporting standards and guidelines affirm maintaining sensitive plant species and their habitats and provide a framework for implementation and monitoring. No inconsistencies with Forest Plan direction for sensitive plant species and noxious weeds were identified and there would be no substantial adverse cumulative effects as long as sensitive plants and noxious weeds areas are avoided.

Invasive Weeds

In considering past actions, the historical presence or extent of invasive plant species is difficult to determine; they were probably less extensive than current conditions due to the lack of activity in the area. The primary carriers of invasive plant species, vehicles and livestock, were less intrusive in this area in the past compared to the present. Many of the past activities listed above have contributed to the current level of infestations and the spread of invasive weeds.

In considering present actions, current management such as any recent fuel treatment activities increase the risk of the spread of invasive or noxious weeds by disturbing soil. Loss of canopy cover, such as from insect infestation or fire, increases the potential for future establishment of invasive weeds.

The combination of past and present actions has created the current conditions for noxious weeds and other invasive plants. Infestations will continue to exist and could increase in the future, especially if recreation use of the area and the role of fire are allowed to expand.

The mechanical treatments and prescribed burning on Forest Service lands under the proposed action, impact about 3.8% of the analysis area. Project design/mitigation measures included with the action alternatives are designed to control any potential future expansion; weed control programs conducted by counties and the Forest Service attempt to control such increases. If a large wildfire occurs in the future, the potential for the spread of weeds will be much greater due to the large area suitable for invasive weed establishment. The risk of this situation is greatest in the No Action Alternative, where wildfires are less likely to be controlled.

A small increase in weeds such as spotted knapweed, whitetop and yellow and dalmation toadflax is likely due to vegetation removal and soil disturbance. Considering the small percentages of the analysis area involved with treatment areas and current weed treatment on these species, this planned action combined with past actions would result in a moderate increase in weeds. Overall, the potential weed spread, consequences, and adverse effects, for the analysis area has a moderate rating. Therefore, future actions to monitor and treat weeds would need to be adequate to address the moderate rating for the risk of weed infestation. Project design for up to two years of noxious weed suppression treatments would help to preclude establishment of noxious weeds in densities sufficient to jeopardize vegetation diversity, productivity, and forage values.

Cumulative Effects on Wildlife

Cumulative Effects of the Action Alternatives on Wildlife In General

Cumulative effects are effects that increase by successive addition, or incrementally by a series of actions. Cumulative effects are the effects that result from the incremental impact of the planned action when added to past, present, and reasonably foreseeable actions. In order to get a general perspective of how this action relates to overall cumulative effects on wildlife, it is imperative to assess how this single action relates to potential threats from all sources to the species over time (is it additive or cumulative to existing threats making things worse, does it contribute to negating a threat and make the situation better, or does it have no bearing or have no measurable influence on the threats).

Past land management actions and activities both on and off Forest that have had major adverse influence on wildlife habitat and populations in the North Fork area are roading, site development, fire suppression, and high levels of recreation use. Most development and roading on-Forest occurred decades ago, and wildlife acclimated and adapted use patterns accordingly.

The largest recent impact on-Forest was the construction of the North Fork highway, and adverse impacts to wildlife and their habitat appear to be negligible. The impact of fire suppression has resulted in the majority of forested wildlife habitat areas being late succession with high fuel loads and a high risk of epidemic stand replacing insect infestation and stand replacing wildfire.

Present activity on-Forest is primarily a reflection of historical activity. The number of developments, the acreage affected by developments, and the amount of permanent roading on-Forest has been curtailed, and is not expected to increase. Recreation use continues to increase.

Present activities off-Forest are related primarily to urban sprawl, land conversion, and development that is occurring at an ever-accelerating rate adjacent to the boundary, with crucial wildlife habitat steadily declining and numerous conflicts with wildlife routinely occurring. These are very real threats that contribute to direct loss of crucial habitat, fragmentation of habitat, loss of individuals, and possible loss of population segments dependent on these lands. Off-Forest development has reached the "impact threshold" and as such much of the off-Forest area can no longer be considered effective wildlife habitat. Impact threshold is that level of activity, development or disturbance that impairs key habitats' ability to function as effective

habitat by directly eliminating habitat, by disrupting access to habitat, or by causing avoidance of the habitat, or by causing chronic stress.

Reasonably foreseeable future land management actions and activities in the North Fork that have the potential to have major influence on wildlife habitat and populations are land conversion and subdivision of private lands, increased recreation use on both private and public lands, and vegetative management on both private and public lands. These actions are in addition to the reasonably foreseeable continuation of the natural disturbance processes of epidemic levels of forest insect infestation and high intensity stand replacing wildfire.

No additional permanent roading or new developments are foreseen on the Forest due to terrain, scenic byway status, special land designations such Wilderness, and constraining mandates such as the "no net increase in roads" policy, the *Final Conservation Strategy for the Grizzly Bear in the Yellowstone Ecosystem*, and the Biological Opinion relative to recreation development in the North Fork.

Additional activities that would likely occur in the area adjacent to the Forest include actions on State and private lands adjacent to the Forest. On State lands these activities include timber harvest, livestock grazing, and increased recreation. On private lands, these activities include timbering, grazing, and continuation of road construction, construction of homes, and development of residential subdivisions. Land conversion and development would continue to reduce, or fragment and isolate available wildlife habitat off-Forest and reduce its effectiveness due to human disturbance. Loss of, displacement from, or decrease in value of available habitat has been and would likely continue to occur from increased development on private lands in the North Fork related to subdivision and recreation.

With these increases in developments on the periphery of the Shoshone National Forest, there would be increases in recreational activities on both private and public lands, which can lead to increases in wildlife/human conflicts, especially with bears, and adverse cumulative effects to most all wildlife species. In these human activity areas, bears can become human-habituated and food-conditioned which would lead to increases in bear/human conflicts, particularly as bears increase in numbers and distribution.

Increases in wildlife/livestock/pets conflicts can be expected due to the increase in the number of livestock kept as pets in developed areas. Depredation on horses, dogs, cats, etc. by bears, wolves, lions, coyotes, etc. will undoubtedly increase, and property, forage, and fence damage will result in loss of wildlife. Development and habitat fragmentation off-Forest, and mortality resulting from conflicts on private land pose the greatest threat to all species of wildlife in the North Fork area.

As the intent of this action is to contribute to the long term maintenance of sustainable conditions for wildlife, this single action makes a beneficial contribution toward conservation of species when considering cumulative effects. However, this action cannot offset or compensate for past, present, and reasonably foreseeable adverse cumulative effects caused by non-federal actions or actions on non-federal lands.

Cumulative Impacts of the Action Alternatives Relative to General Habitat Conditions

Wildlife species are directly impacted by changes in vegetation conditions. Species react differently to vegetation changes based on their individual needs. When considering all the past, present, future, and proposed "natural resource management activities" in all jurisdictions, their cumulative impact on wildlife habitat conditions in general is relatively minor when considered in the context the ongoing natural disturbances (insect, wildfire, drought, etc.), and the human-caused disturbance associated with development on private land.

The insect epidemic is reducing the availability of mature closed canopy stands across the North Fork area, both on and off Forest. Large wildland fire has the potential to further reduce older aged stands of forested cover across the area. The large-scale loss of mature closed canopy stands

reduces cover, old growth, vertical diversity, and the availability of habitat connectivity corridors in the short term. The additional impact of the salvage logging and prescribed fire that is being proposed in either action alternative will add to this loss of canopy in a very negligible manner.

Snag availability across the area is increasing dramatically as a result of natural disturbances. The additional incremental impact of either action alternative in conjunction with all past, present, and future management activity is inconsequential when considering the numbers of snags in the analysis area.

Habitat effectiveness is being reduced by a number of activities in the area. Harvest activities cause short term disturbance that occur only for the duration of the activity. In all situations, the majority of the on-Forest analysis area would be free of disturbance and could provide security areas for many species. The one activity that is contributing, and will continue to have more of a long term adverse cumulative impact on habitat effectiveness is the land development on private land. Such development will continue to permanently reduce the winter range acres and put more pressure on undeveloped areas on the Forest.

Neither action alternative would result in any additional permanent reduction in habitat effectiveness. The other major impact on habitat effectiveness is disturbance associated with additional motorized recreation on Forest roads. Even though the amount of open roads on the Forest is not expected to change, the level of motorized use is expected to increase on all ownerships in the North Fork area during the next 20 years. The action alternatives will not contribute in any additive manner to causing increased recreation impacts or reductions in habitat effectiveness.

Cumulative Impacts of the Action Alternatives Relative to Threatened and Endangered Species

The cumulative effects discussion for Threatened and Endangered Species is found in the wildlife section (see Section 3.2.2) by individual species.

Cumulative Impacts of the Action Alternatives Relative to Sensitive Species

Sensitive species will be discussed in three groups. The first group includes species related to mature forest and include the marten, goshawk, and other species that prefer mature timbered stands. These species are being most impacted by the natural disturbances that are reducing mature stands, such as the insect epidemic and stand replacement wildfires. Neither of the action alternatives would have any substantial cumulative effect on survivability of mature stands. Increased snag levels positively affect some of these species, so the loss of mature live trees is being partially offset by snag recruitment. Timber salvage operations across the area, including the action alternatives being considered, would reduce the snags available to these species within treated areas. The high numbers of snags being recruited outside of treatment areas would be available for these species.

The second group includes land species associated with water, riparian, and wetlands such as amphibians and otters. The action alternatives do not generate any measurable additive or cumulative effects on those species, since these areas are avoided except for stream crossings and during the period when they are frozen or snow covered.

There may be some positive cumulative effects to these species overall because the loss of conifer tree cover may increase water availability in some areas and enhance deciduous species. A large stand replacement fire could have a negative impact in these areas if fire intensity is high enough to cause an extreme fire in these areas.

The third group is sagebrush related species such as the Brewer's sparrow. Habitat for sagebrush related species such as the Brewer's sparrow would be improved by the prescribed burning in the action alternatives as stands of sagebrush in the timber sagebrush fringe areas that are being out competed by coniferous types would be maintained in the sagebrush type long term. Grazing of sagebrush areas by livestock and wildlife on ownerships throughout the area has some negative

effects on sagebrush, especially during this existing drought. The action alternatives would offset some of this effect by enhancing forage and invigorating decadent patches of sagebrush.

Cumulative Impacts of the Action Alternatives Relative to Management Indicator Species

Species such as elk, moose, grouse, and hairy woodpecker are being negatively impacted by natural disturbances that result in the loss of live-forested cover in the short term, but there are simultaneous benefits occurring relative to increased amounts of forage, deciduous types, and numbers of snags. The action alternatives would not contribute substantially to this loss of live-forested cover. The salvage harvest and prescribed fire as proposed in the action alternatives would have a positive effect by reducing the spread rates and intensity of large stand replacement fires in portions of the area.

These same species are being positively affected by the increase in grass/forb habitat (elk, moose), aspen (grouse), and snags (hairy woodpecker). Any salvage in the area would have a negative effect on the availability of snags in treated stands, but there are still large areas with high levels of snags. Aspen stands would be improved under the action alternatives. Given the combination of positive and negative benefits being contributed by the various disturbances and activities, the best situation is that which would provide a diversity of habitat conditions.

The only natural disturbance that would have a major negative impact on habitat diversity would be an extremely large stand replacement wildfire such as occurred in 1988. When considering that scenario, the various resource management activities currently occurring in conjunction with the action alternative provide the best opportunity to address the threat.

Species such as elk and moose are also adversely affected by human-caused disturbance resulting from development. As discussed earlier, the action alternatives provide the best opportunity for helping to offset the human caused disturbance that is occurring on private lands adjacent to the Forest.

Cumulative Effects on Watershed Resources

The cumulative effects analysis for watershed resources focuses on these general areas:

- Soil Productivity (soil erosion, soil compaction and rutting hazard, soil health and long term productivity, soil fertility, and regeneration hazard)
- Geologic Hazard (landslides)
- Aquatic Ecosystems (sediment, bed/bank stability, flow regimes, temperature/oxygen, water purity, aquatic life, and aquatic management indicator species)
- Special Areas (riparian ecosystems, wetlands, and floodplains)

This cumulative effects analysis focuses on aquatic ecosystems, soil productivity, and riparian ecosystems. Cumulative effects are spatial and/or temporal environmental effects to soils, hydrology, and aquatic/fisheries resources that result from the additive, repeated, and synergistic effects of other actions. These actions include historic and ongoing activities such as grazing, roads, wildfires, fire suppression, developments and infrastructure, wildlife browsing, weed control, and recreation use activities that may affect watershed values. In addition to these considerations, it is widely recognized that watersheds experience periodic disturbance events that vary in size, duration, intensity, and frequency. Because these events are random, some level of risk is implied when implementing a management project. This risk is a product of event probability and its consequences.

A large portion of the analysis area is operating under natural conditions. The human caused soil-disturbing activities are mostly concentrated along the North Fork corridor and include roads, the North Fork Highway, timber harvesting, recreational developments and facilities, summer homes, and lodges. Human caused soil disturbances within the backcountry include trails and recreational sites. Past management activities in the analysis area have not caused detrimental erosion,

sedimentation, or compaction, and did not remove excessive ground cover, organic matter, or nutrients from the sites.

A major cumulative effects component within the analysis area is past wildfires. One fire alone, the 1988 Clover Mist Fire, was a stand replacing fire that burned approximately thirteen percent of the North Fork drainage. Post-fire sediment discharges continue to move through the North Fork system. The fire was naturally ignited and the burn area is in wilderness. Severely burned areas within the watershed can be subject to debris flows. That fire has had considerable effects within the subwatersheds burned, but the cumulative effects are not substantial when considered at the basin scale. More recent intense burns include the Blackwater and Norris Fires that occurred in 2003. The Sweetwater fire in the 1970's burned in the Douglas-fir zone. Recovery in these types has generally been slow; however, this fire has produced excellent forage for wildlife. Wildlife habitat enhancement from prescribed burning should replicate these results. Habitat enhancement is a project goal. The possibility for future large-scale catastrophic wildfire within the analysis area has the greatest potential for adverse cumulative effects.

Johnson et al (2001) defined baseline water quality and aquatic biota in the North Fork Shoshone River and selected tributaries. They conducted thorough physical, chemical, and biological testing and concluded that the aquatic system is healthy and productive.

There are various reaches of stream in the North Fork corridor that have been impacted by highway construction. Primary impacts were highway encroachment into the river floodplain, which adversely affected fish habitat. Identified highway construction impacts to fish habitat have been mitigated. In a few areas, rock was blasted and removed to make room for highway realignment. As a result, some large rock that would have fallen into the river channel and create future fish habitat is no longer available.

Under Alternative 1, the past and present actions, along with the present conditions, would continue. The potential for large landscape scale fires to occur exists. The aquatic system would continue to be healthy and productive.

Under the action alternatives, any potential increases in sediment loads and turbidity resulting from the actions would be short term. Reducing the fuels load within the treated areas would decrease the potential for fire spread within treatment units, but the potential for large wildfires to occur in other areas of the analysis area would remain. Future wildfires could result in adverse cumulative effects to the water resource. Implementation of an action alternative could increase the Forest's ability to implement fire use strategies on wildfires.

Cumulatively, the effects of the action alternatives are much smaller in magnitude than potential wildfire effects. Mechanical treatments have been designed to incorporate the proper BMPs for watershed conservation. Prescribed fire would be applied only when a treatment unit is within prescription, which means soil and weather conditions would be such that the fire severity is somewhat controlled. Implementation of the prescribed burns would reduce fuel loads in the treated areas, without causing detrimental erosion and sedimentation. The mosaic burn patterns desired would not remove excessive ground cover, organic matter, or nutrients from the sites. Conversely, severe wildfires can result in watershed conditions that possibly could result in expensive rehabilitation needs to reduce the post fire threats flooding/debris flow risks to life and property, loss of long term soil productivity and deteriorated water quality.

In summary, the action alternatives would not adversely contribute to watershed cumulative effects. The actions do carry some risk because of the temporary road construction, mechanical ground disturbances, and prescribed burning that would occur. However, analyses of the action alternatives demonstrate that the BMPs factored into the design would provide adequate controls to reduce potential direct and indirect effects to a level of insignificance. Thus, any contribution to cumulative effects, within design limitations, have either been eliminated or adequately

mitigated. Therefore, neither action alternative is expected to contribute to watershed cumulative effects.

Cumulative Effects on Fire and Fuels

Past actions, particularly, fire exclusion policies and fire suppression have created unnatural fuel conditions. Present actions, such as the National Fire Plan and Forest Plan goals and objectives and supporting standards and guidelines affirm fuels and fire management, and provide a framework for implementation and monitoring.

The future vegetative treatments will have a substantial effect on corridor fire behavior but little effect on the rest of the analysis area. Wildfires starts outside the corridor will burn as seen today but as they approach the corridor their intensity will decline and the acreage growth in the corridor will decrease. Corridor developments will have a much higher probability of survival with this alternative.

Once the corridor treatments are completed, fire use within wilderness areas will have a higher probability of being used and effective. Cumulatively over time, the analysis area fire behavior will experience reduce effects as more wildfires modify extreme fuel loading and canopy continuity, producing a patchwork of varying age classes and species that will limit large fire growth.

The likelihood of a wildfire resulting in removal of entire stands of vegetation is dependent on numerous factors such as fuel moisture content, weather conditions, topography, fuel loading, stand density, and the presence of multiple vegetation layers that provide ladder fuels. Management of the last three factors, as in the action alternative, can greatly influence fire severity and intensity. If not managed, over time the increases in understory species and fuel loads can lead to uncharacteristically intense wildfires. The action alternative would reduce fuel continuity and fuel accumulation and contribute directly to the reduced likelihood of large, intense wildfires. Indirectly, public health and safety and the viewshed benefit from the reduced risk of large, uncontrollable wildfires.

The treatments would result in reduced fire severity within the treated areas due to fire reduction benefits 1) decreased fuel load, 2) modified fire behavior (spread rate, size, and severity of wildfires), and 3) increased of fire suppression capabilities.

Fire risk could be exacerbated by periods of severe drought conditions, but these conditions would be difficult to predict.

The effects from the project, when combined with other past, present, and reasonably foreseeable future activities are not expected to have any substantial cumulative effects. The selected alternative will have a minor specific cumulative effect when added to the existing conditions. No inconsistencies with Forest Plan direction for fuels, air quality, smoke management, and fire management/wilderness management plans were identified and there would be no adverse cumulative effects.

Cumulative Effects on Recreation Resources

The effects from the project, when combined with other past, present, and reasonably foreseeable future activities are not expected to have any substantial cumulative effects. The selected alternative will have a minor specific cumulative effect when added to the existing conditions. Recreation in the area is primarily associated with scenic viewing, fishing and hunting, wildlife viewing, dispersed and developed recreation, lodge operations, and use of recreation residences. The insect epidemic may have reduced the desirability of this area for some recreation users, given the large amount of dead and dying timber. It is not anticipated that any of the other activities on other ownerships will decrease current use, except that there may be some short term displacement of use during harvest activities, and there is the possibility that private land

development would make some area unavailable to recreation users. The treatments in the action alternatives would not decrease recreation use, except for some short term displacement during operations. This would most likely concentrate use, but not decrease it. In the long term, both motorized and non-motorized dispersed recreation would be relatively unchanged in the corridor.

Present and future uses, such as dispersed recreation, primarily State-regulated wildlife hunting and fishing, would continue during the 20-year timeframe. In combination, the proposed project and any future projects are not expected to have any influence on or be affected by non-Forest Service regulated activities such as hunting and fishing. Firewood gathering would continue.

Cumulative Effects on RARE II Areas. The cumulative effects of the proposal, when added to the level of development already present in some of the RARE II, would have an additive effect to alter the undeveloped character of the RARE II areas as discussed in Section 3.6.1.

Cumulative Effects on Visual Resources

Management activities were reviewed for cumulative effects on visual resources. Considered in concert the past, present, and future activities help to define the future environment of the treatment and analysis area. Cumulative effects would be negligible for all alternatives. In the long term, the proposed action alternative would meet the visual quality objective of remaining visually subordinate (page III-132) and remain consistent with the Forest Plan.

The choices of where, when, and how to reduce fuels is a tradeoff, balancing the effects of removing vegetation to reduce fire hazards, with visual resources, watershed protection, wildlife habitat and other resources.

Some short term impact to visual resources may result; this may be an efficient tradeoff to achieve the benefits of fuel treatment actions to reduce fire hazards to the visual resource and other resources. However, the benefits of preventing a large, intense fire within the project area and/or analysis area are far greater.

The probability of large-scale wildfire affecting all jurisdictions within the analysis area in general has the greatest potential for adverse cumulative effects. Such an event would likely reduce the desirability of the area for many recreation users. The likelihood of this occurring is greatest under Alternative 1, the No Action Alternative, as no management actions are implemented to reduce fuels and wildfire risk.

Considering the 20-year timeframe, the cumulative effects of the action alternatives would not substantially alter the recreation setting or visual integrity as both motorized and non-motorized dispersed recreation would be relatively unchanged in the long term. None of the future activities would likely impact recreation use.

Visual changes resulting from the insect epidemic will occur gradually, unless a stand replacement fire sweeps through the area. Such a fire would create a maximum visual modification. Without fire, cumulative effects would be most visible in the foreground as travelers and hikers experience primarily dead standing trees without needles or leaves, creating a visual condition of modification.

In the long term (10 to 20 years depending on soils, vegetation type, aspect, etc.), the two action alternatives should comply with the Visual Management System desired visual condition of retention and would meet partial retention. Cumulative effects would be negligible for all alternatives. In the long term, the proposed action alternative would meet the visual quality objective of remaining visually subordinate.

Cumulative Effects on Socio-Economics

This section discloses past, present, and reasonably foreseeable effects from federal and private land activities in the analysis area over the next 20 years. Many elements influence and affect

local economies. Population growth, economics, and economic diversity and dependency of counties and communities all affect local economies.

The effects from the project, when combined with other past, present, and reasonably foreseeable future activities are not expected to have any substantial cumulative effects. The selected alternative will have a minor specific cumulative effect when added to the existing conditions. Generally, a single project does not have a measurable impact on employment and income. Due to the scope of this project, it is not expected to add any measurable cumulative effect to the local economy. In this analysis and evaluation of trade-offs, many things cannot be easily quantified with a monetary value, such as effects on wildlife, aesthetics, public safety, etc.

In the case of the North Fork, the issues identified in Chapter 1 were integrated into the project design and analysis. The project has been designed with safety and viewshed protection in mind by decreasing the potential for wildfires threatening National Forest System lands and life and property by reducing the buildup of hazardous fuels.

Also, in the project design is the protection of scenic values, the improvement of vegetative conditions, promotion and maintenance of disturbance dependent plant communities, and reduction of the buildup of hazardous fuels. All of these elements, in the long term, potentially influence and benefit local economies.

In wildland urban interface areas the cost of suppressing large uncontrollable wildfires and rehabilitating watershed if needed to reduce post-wildfire threats to life and property, loss of long term soil productivity and deteriorated water quality in municipal watersheds can exceed millions of dollars.

The two aspects of socio-economics that are potentially the most impacted by cumulative effects are tourism and recreation use. Highway 14/16/20 is one of the most important travel corridors in the region. In 2003, when the east entrance to Yellowstone Park was closed due to wildfires and public safety, businesses west of Cody were affected by cancelled reservations and reduced traffic from customers coming from Jackson through the east gate. Lodge owners reported 60 to 70 percent reductions in business in August and 15 to 20% drop in summer revenues (Billings Gazette, Sunday, September 21, 2003).

The long term opportunity for this area to provide timber harvest to help support the local community has been severely reduced by the insect epidemic. The resulting loss of a live mature overstory will severely limit harvests options on federal lands in the future. The only option at this point is to salvage some of the dead and dying volume while it still has value. The only future activity that could further impact this recovery would be a large fire that consumes the timber before it is harvested with the increased likelihood that the effects would be environmentally, socially, and politically undesirable.

The probability of large-scale wildfire within the analysis area has the greatest potential for adverse cumulative effects on recreation and socio-economics. Under these conditions, fire sizes, intensities, rates of spread, and hazards to firefighters all increase. Aesthetics and recreation values, particularly tourism, hunting and dispersed recreation, would be adversely affected with associated effects to the local economy. Such a fire could make the area undesirable for many recreation users, and may require that portions of the area be closed to protect resource values. The likelihood of this occurring is greatest under Alternative 1, as no fuel reduction actions would be implemented to reduce wildfire risk.