Soil Resources

Key Points

- The alternatives would increase the acreage of detrimental soil disturbance from timber harvest, road construction, and fuels treatments by 13 to 30 percent of current amounts during the first decade.
- The BLM would be able to reduce the acreage of detrimental soil conditions from timber harvest, road construction, and fuels treatments through sound management practices that would limit initial compaction levels, remove existing or created compacted surfaces, and improve soil water and organic matter levels.
- Detrimental soil disturbance from OHV use would be highest under the No Action alternative because none of the action alternatives would allocate any areas as open for OHV use.

Summary of Analytical Methods

Soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support ecosystem health. Management practices can reduce soil quality through declines in two ecosystem properties - site organic matter and soil porosity (Powers *et al.* 1990).

In this analysis, the BLM evaluated reductions in soil quality based on acres of detrimental soil disturbance. The BLM evaluated the acres of detrimental soil disturbance from several sources of management-induced changes, and the cumulative total of all sources, as a decrease in the innate ability of a soil to function and provide ecosystem services. Detrimental soil disturbance is the limit where the innate soil properties change and the inherent capacity to sustain growth of vegetation is reduced (Powers *et al.* 1998). Detrimental soil disturbance generally represents unacceptable levels of erosion, loss of organic matter, soil compaction, soil displacement, lethal soil heating, or a combination.

Evaluating soil quality is complicated by the diversity of soil properties that drive the functional processes, appraisal techniques, and soil uses (Page-Dumroese *et al.* 2000). This analysis measured soil quality using acres of detrimental soil disturbance, rather than other measures, such as changes to soil quality index or site index, as discussed below.

Amacher *et al.* (2007) introduced the Forest Inventory and Analysis (FIA) program that measured a number of chemical and physical properties of soils in order to address specific questions about forest soil quality or health. This soil quality index integrated 19 measured physical and chemical properties of forest soils into a single number that could serve as the soil's "vital sign" of overall soil quality. The concept monitors changes in forest soil properties with time, but this index requires specific data that is not available at this scale of analysis across the decision area.

Site index class characterizes soil productivity by tree height growth over a set time. Across the decision area, there is a distinct differentiation between the high productivity soils in the north (predominately Site Class 2 and 3) and the lower productivity soils in the south (predominately Site Class 4 and 5). However, this traditional measure of soil productivity does not encompass the full spectrum of the functions that define soil quality, which requires a more holistic measure that defines growth as it relates to functional processes in the soil.

For several aspects of this analysis, the BLM categorized the decision area into the coastal/north (the Salem, Coos Bay, and Eugene Districts, and the northern portion of the Roseburg District) and the

interior/south (southern portion of the Roseburg District, the Medford District, and the Klamath Falls Field Office). This division represents a general divide in forest productivity and soil conditions within the planning area.

Issue 1

How would timber harvest under the alternatives affect soil quality?

Summary of Analytical Methods

Timber harvest causes detrimental soil disturbance most often from displacement of surface material and soil compaction. The extent of detrimental soil disturbance varies with the type of yarding method and the mitigation measures employed.

The intensity, location, and extent of compaction differ under different yarding systems. In this analysis, the BLM assumed that determining the proper design measures to reduce or eliminate adverse effects could not be applied at this level of analysis. Therefore, the different yarding methods would result in detrimental soil disturbance of the following percentage within each harvest unit:

- Ground-based – 35 percent
- Cable – 12 percent
- Aerial – 6 percent
  (Heilman *et al.* 1981, Fleming *et al.* 2006, Froehlich 1976, Han *et al.* 2009, Miller *et al.* 1989).

Ground-based yarding systems have the greatest detrimental soil effect. Ground-based yarding equipment include, for example, rubber-tired skidders, tracked dozer equipment, cut-to-length harvesters, and multi-wheeled forwarders. The extent of an equipment's coverage across a harvest unit can vary from several well-spaced skid trails to operating over the entire harvest unit. Typically, only slope conditions that exceed machine capabilities prevent compaction from occurring because the equipment cannot operate on steeper slopes. In addition, repetitive tracking across the same trail causes the depth of compaction to go deep into the soil.

Cable yarding systems typically cause compaction at the landing area as well as within the harvest unit. Compacted areas stretch out like spokes from the landing, but are only as wide as sweeping tail end of a yarded log. Since there are many logs pulled to the landing along one yarding corridor, they create a compacted trail that ranges from 3 to 8 feet wide.

For aerial yarding, most compaction is in work areas adjacent to the harvest unit, and these areas generally undergo rehabilitation after harvest. Compaction from falling and yarding activities inside harvest units is typically negligible.

The BLM used data from the BLM Timber Sale Information System, which includes a listing for the type of yarding system employed during timber harvest, to provide information current levels of detrimental soil disturbance. The BLM used the final harvested acres from timber sale contracts from 1990 to 2012 to characterize current levels of detrimental soil disturbance. Using this 22 years of timber harvest data provides only a partial indication of the current amount of detrimental soil disturbance, because compaction from past harvesting may last more than 22 years. However, the BLM does not have sufficient information to quantify continuing detrimental soil disturbance from older timber harvests.

The Woodstock model provided outputs on acres of each yarding method by alternative for the first decade (the Vegetation Modeling section contains more information)

In this analysis, the BLM calculated the amount of detrimental soil disturbance from each timber harvest method by multiplying the areal extent of that yarding method for each alternative by the percentages listed above.

Background

Soil compaction occurs when soil particles are pressed together, reducing the pore space between them. This increases the weight of solids per unit volume of soil (bulk density). Soil compaction occurs in response to pressure from above (e.g., from animals or equipment). The risk for compaction is greatest when soils are wet (USDA NRCS 1996). Compaction is usually described as an increase in bulk density and results in plants increasing root strength in order to penetrate the soil for growth. Studies showing an increase of bulk density greater than 15 percent have varied impacts to plant growth depending on soil texture, plant species, and competing vegetation (Tan *et al.* 2009). Powers *et al.* (2005) found that soil compaction effects depended upon initial bulk density; vegetation growth declined on compacted clay soils but increased on sands.

In general, soil compaction that reduces water infiltration rates and large pore space for gas and water movement constitutes detrimental soil disturbance and can last many years (Froehlich and McNabb 1984, Cafferata 1992). Compaction restricts rooting depth, which reduces the uptake of water and nutrients by vegetation. Compaction decreases the soil pore size that can absorb water and decrease the soil temperature. Soil organisms respond to compaction by decreasing their soil organic matter decomposition, which then decreases their release of nutrients back into the soil. Smaller pore spaces decrease the infiltration of both water and air into a soil, and runoff increases with a corresponding increase of water erosion risk or hazard. The degree of soil compaction depends on the type of equipment used, number of equipment passes over the same location, and site conditions such as soil texture, water content, and temperature (Tan *et al.* 2009). Powers *et al.* (1990) hypothesized that the two most important site disturbances that reduce forest productivity are soil compaction and organic matter removal.

Soil compaction reduces tree growth, but the relationship between compaction and tree growth is complex and difficult to predict because it is dependent on many variables. For example, Miller *et al.* (1996) found early growth reductions of seedlings planted on compacted skid trails compared to uncompacted locations, but growth of most seedlings on compacted locations caught up to uncompacted locations after eight years. Tan *et al.* (2009) also found variable responses of three-year-old seedlings, depending on level of compaction, species, organic matter removal, and intensity of amelioration of compacted surfaces. Removing competition for site resources (e.g., water and nutrients) may offset severe compaction, and tree growth may not be affected (Sanchez *et al.* 2006).

A vast array of microbiotic organisms exist in the soil that can potentially be affected by detrimental soil disturbance. Most of these organisms are the decomposers of organic matter, which return nutrients to the soil for use by plant roots or other organisms. However, little research has been done on the effects of detrimental soil disturbance on microbiotic organisms other than the fungal and bacteria components. Most research on soil compaction in forests has focused on tree growth in skid trails or tree growth response after some amelioration treatment. Only recently did Shestak and Busse (2005) compare microbial composition, community size, activity, and diversity on compacted forest soils. They noted their results show tolerance or resilience by microbial communities. These authors suggest the reconfiguration of pores following compaction resulted in reduced total porosity and a near elimination of large pores, but an increase in habitable pore volume use by bacteria and fungi. Therefore, with the exception of poorly drained soils or for those regions receiving high annual precipitation where saturation

is a concern, changes with compaction appear to be of little consequence to the microbial community. Previous studies have identified negative, neutral, or positive responses, yet there are few unifying concepts (Busse *et al.* 2006).

Ground-based yarding equipment has changed since the signing of the 1995 RMPs. Ground-based yarding equipment in use today are more mechanized, using fewer workers, and are capable of traversing more of each harvest unit. Soil compaction is a common consequence of using mechanized equipment, especially when soil moisture is high, for particular soil types. At high soil moisture content, cut-to-length and whole-tree harvesting cause a greater degree of soil compaction in skid trails. The cut-to-length system causes less compaction in the center of the trail, especially when operators minimize compaction by placing heavy slash loads on forwarding trails before traversing a unit. Whole-tree harvesting disturbs a larger area, sweeping slash from trails, and causing a high degree of compaction in the center of the track (Han *et al.* 2009). To summarize, heavy equipment operates directly on forest soils with a high potential to affect soil quality negatively, especially soil density, which then affects plant and tree growth (Labelle and Jaeger 2011). Soil compaction during harvesting generally occurs in the first few passes of the equipment, but compaction reaches a maximum within the first ten passes (Han *et al.* 2006). Bustos and Egan (2011) noted that compaction is a function of mass, number of trips (i.e., passes), and total mass transported per trip. Using historic skid trails and a designated trail system is recommended as soils with high initial bulk densities compact less than those with a low initial bulk density (Han *et al.* 2009).

In the 1995 RMPs, the BLM used a percentage of compacted surface area within a harvest unit to set a threshold for acceptable impacts to soil productivity. The districts initially set this threshold level at 10 or 12 percent of the harvested area, depending on the district. Instruction Memoranda OR-2010-009 provided guidance to adopt the revised Best Management Practices (BMPs; as contained in Appendix I of USDI BLM 2008) for use when designing individual projects and for water quality restoration planning activities. Specifically, BMP TH-9 states a 12 percent level of compaction, and provided a consistent approach for all of the districts. Thus, this analysis used a 12 percent level for the No Action alternative.

In the 1995 RMPs, the BLM also anticipated treating compacted surfaces after use, typically with a winged sub-soiler implement pulled behind a dozer to treat skid trails in final harvest units. Treating compacted skid trails in thinning units has proven problematic, and has generally been deferred until final harvest, as the sub-soiler damages roots of the residual stand.

Affected Environment and Environmental Consequences

Current levels of detrimental soil disturbance from past timber harvest are 29,564 acres in the decision area: 12,688 acres are in the coastal/north and 16,876 acres are in the interior/south (**Figure 3-152**). The 29,564 acres of detrimental soil compaction from past timber harvest constitutes approximately 1 percent of the decision area as a whole.

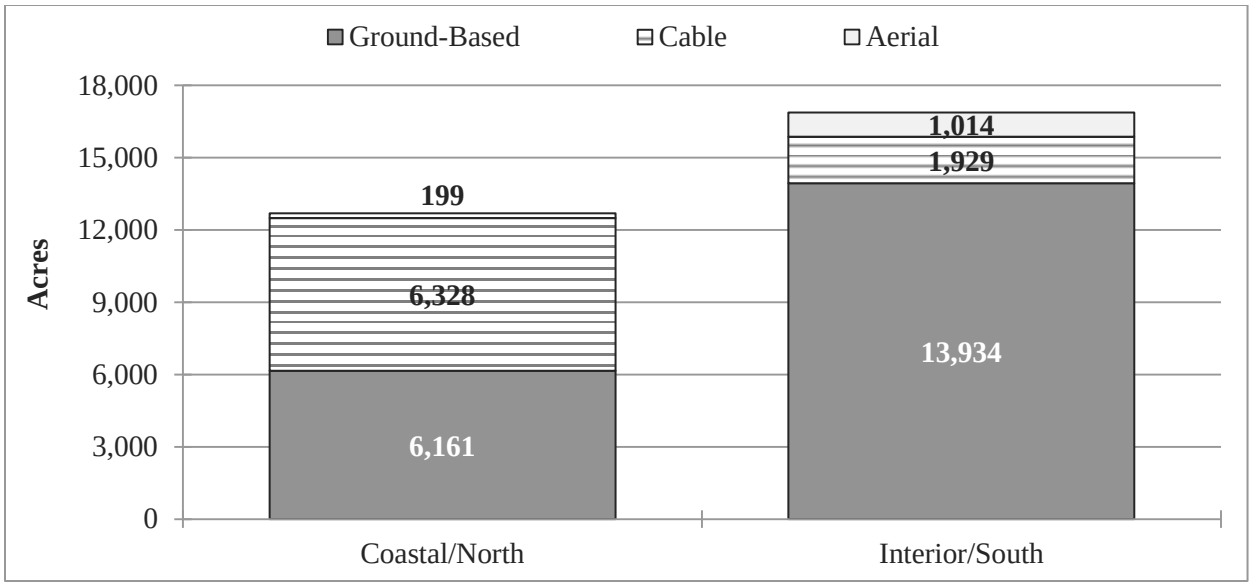

Figure 3-152. Detrimental soil disturbance from timber harvest by yarding system, 1990-2012.

This acreage of detrimental soil disturbance constitutes 20 percent of the harvested acres in the decision area: 17 percent in the coastal/north, and 23 percent in the interior/south. The interior/south has detrimental soil disturbance on a higher percentage of harvested acres because of the more extensive use of ground-based yarding systems, which result in more detrimental soil disturbance within each harvest unit.

In the first 10 years, the alternatives would result in approximately 12,000-27,000 acres of detrimental soil disturbance from timber harvest (**Figure 3-153** and **Table 3-208**). Alternative C would result in the most acreage of detrimental soil disturbance (27,000 acres), with only slightly smaller acreage in Alternative B (25,217 acres), the No Action alternative (24,172 acres), and Alternative D (21,742 acres). In contrast, Alternative A would result in substantially smaller acreage of detrimental soil disturbance compared to the other alternatives (12,036 acres) (**Table 3-208**). The amount of detrimental soil disturbance largely reflects the total acreage of timber harvest and, specifically, the acreage of timber harvest in the interior/south, where ground-based yarding predominates.

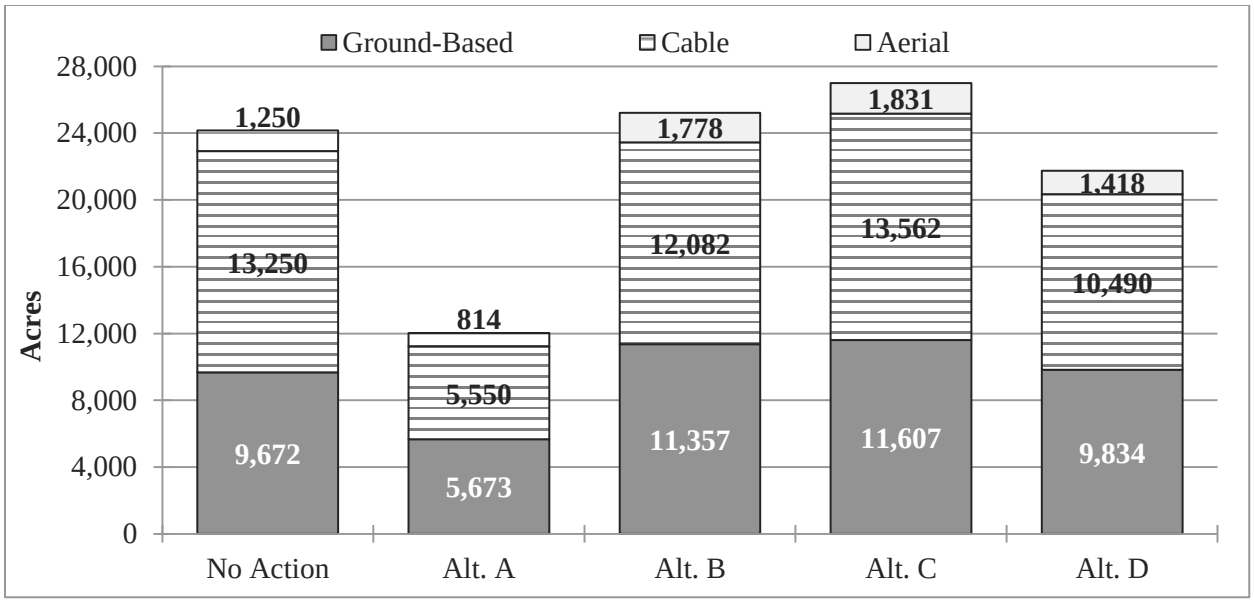

Figure 3-153. Detrimental soil from timber harvest by yarding system and alternative during the first decade.

Table 3-208. Detrimental soil disturbance from timber harvest by alternative and harvest method during the first decade for the coastal/north and interior/south.

Detrimental Soil Disturbance	No Action		Alt. A		Alt. B		Alt. C		Alt. D	
	Coastal/ North	Interior/ South	Coastal/ North	Interior/ South	Coastal/ North	Interior/ South	Coastal/ North	Interior/ South	Coastal/ North	Interior/ South
Ground-based (Acres)	5,496	4,176	2,285	3,388	4,847	6,510	5,633	5,975	4,411	5,423
Cable (Acres)	9,320	3,930	3,304	2,246	7,368	4,715	8,812	4,750	6,760	3,730
Aerial (Acres)	777	473	349	465	676	1,102	873	958	580	839
Area Totals (Acres)	15,594	8,578	5,938	6,098	12,890	12,327	15,318	11,682	11,750	9,992
Alternative Totals (Acres)	24,172		12,036		25,217		27,000		21,742	
Current Condition* (Acres)	29,564		29,564		29,564		29,564		29,564	
Totals (Acres)†	53,736		41,600		54,781		56,564		51,306	
Percentage of Current Condition	80%		41%		85%		91%		74%	

*This acreage is derived from **Figure 3-152** which only described detrimental soil disturbance from the years 1990-2012.
†This number does not account for detrimental soil disturbance that is ameliorated over time.

The detrimental soil disturbance from timber harvest during the first decade under the alternatives would range from 41-91 percent of the current detrimental soil disturbance from past timber harvests (**Table 3-208**). As a result, the alternatives together with past timber harvest would result in a cumulative total of detrimental soil disturbance ranging from 41,600 acres to 56,564 acres.

Each alternative would result in detrimental soil disturbance on an average of 15 to 16 percent of the total area harvested in the first 10 years.

Detrimental soil disturbance could result in some reduction in future tree growth. At this scale of analysis and with the data available, it is not possible to quantify the reduction in future tree growth from detrimental soil disturbance, in part because of the influence of site-specific and project-specific factors on the extent and intensity of detrimental soil disturbance. The BLM would be able to ameliorate detrimental soil disturbance by reducing soil compaction after harvest; however, because the extent and effectiveness of such amelioration depends heavily on site-specific and project-specific factors, the BLM cannot quantify those reductions in detrimental soil disturbance in this analysis.

Issue 2

How would road construction under the alternatives affect soil quality?

Summary of Analytical Methods

In this analysis, the BLM assumed that both permanent and temporary road construction would result in detrimental soil disturbance. It is not possible to forecast in this analysis whether how much decommissioning might mitigate detrimental soil disturbance, or how long after decommissioning detrimental soil disturbance would continue. Therefore, this analysis assumed that road construction would result in detrimental soil disturbance, even though eventual decommissioning might mitigate these soil effects for some roads.

The BLM assumed that road construction would result, on average, in detrimental soil disturbance across a 45-foot width, from upper cutbank to the lower toe of fill (Brian Thauland, BLM, personal communication, July 2013).

The calculation of the mileage of road construction under each alternative is described in the Trails and Travel Management section in this chapter.

The BLM calculated the acreage of detrimental soil disturbance from road construction by multiplying the length of roads by the 45-foot road width.

The Planning Criteria identified that this analysis would also address landings (USDI BLM 2014, p. 156). However, most of the landing area would be included in road construction and is therefore not included here as a separate analysis.

Background

Road construction results in detrimental soil disturbance, which decommissioning can potentially ameliorate. However, the effectiveness of decommissioning in reducing detrimental soil disturbance is not clear. Tan *et al.* (2009) note better growth on compacted sites with coarse sandy soils. Most of the decision area does not have coarse sandy soil types, with the exception of some areas in the Medford District.

As noted by Powers *et al.* 1990, soil compaction and organic matter removal are the two most important site disturbances caused by forest management practices. These have the greatest potential to reduce forest productivity. Replenishing the organic matter and reducing the amount of compaction both within the depth of a road surface and across the surface are key ingredients to providing a quality soil-growing medium for future tree growth. Lloyd *et al.* (2013) describes the effectiveness of different road decommissioning techniques for rehabilitation of ecological and hydrological systems in densely roaded forest ecosystems. Their overarching hypothesis is that restoration designs that fail to address explicitly both above- and below-ground ecosystem structure and function may result in recovery to an alternative state that has diminished ecological and hydrological functions relative to a "never-roaded" forest.

Affected Environment and Environmental Consequences

There are currently 14,416 miles of roads in the decision area. This constitutes a detrimental soil disturbance on 79,311 acres, approximately 3 percent of the decision area.

Over the first decade, the No Action alternative would create the largest acreage of detrimental soil disturbance from road construction (5,167 acres;) while Alternative D would create the least (1,388 acres; **Figure 3-154)**.

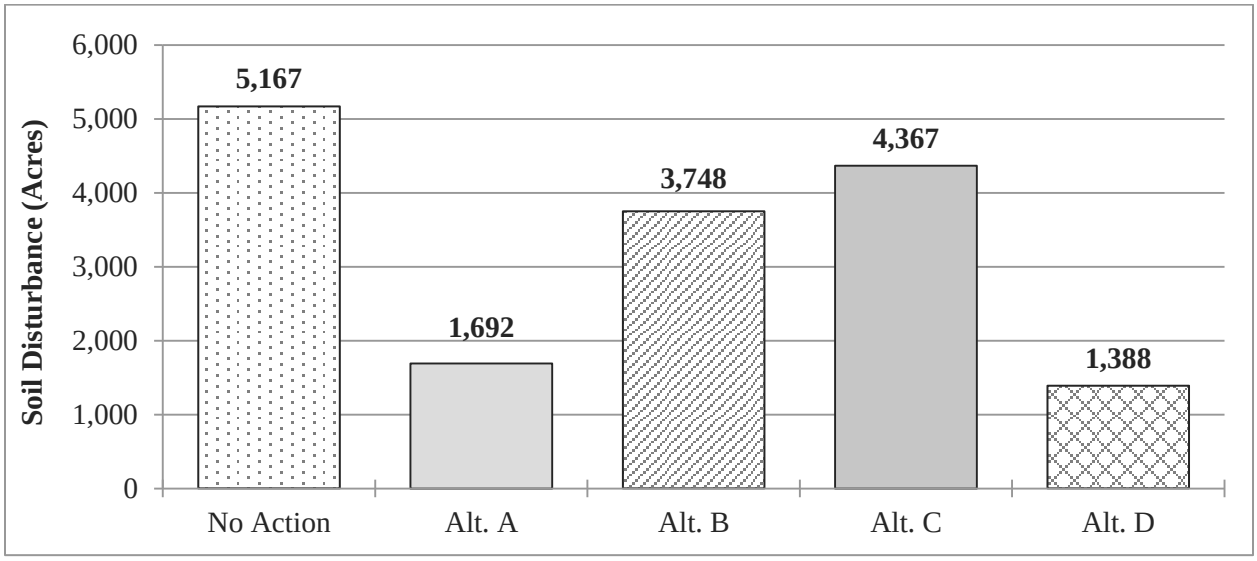

Figure 3-154. Detrimental soil disturbance from road construction by alternative during the first decade.

The detrimental soil disturbance from road construction during the first decade under the alternatives would be approximately 2 to 7 percent of the current detrimental soil disturbance from past road construction (**Table 3-209**). As a result, the alternatives together with past road construction would result in a cumulative total of detrimental soil disturbance ranging from 80,699-84,478 acres.

Table 3-209. Acres of detrimental soil disturbance from road construction by alternative during the first decade.

Detrimental Soil Disturbance From Road Construction	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Current Condition (Acres)	79,311	79,311	79,311	79,311	79,311
Effects of the Alternatives (Acres)	5,167	1,692	3,748	4,367	1,388
Totals	84,478	81,003	83,059	83,678	80,699
Percentage of Current Condition	6.5%	2.1%	4.7%	5.5%	1.8%

Under all alternatives, approximately 60 percent of the new road construction would likely be permanent roads and 40 percent temporary roads. Temporary roads include both native-surfaced and rock-surfaced roads. The BLM could potentially decommission or obliterate temporary roads to ameliorate detrimental soil disturbance, including removing rock, loosening the compacted sub-grade, replenishing some of the organic matter, and implementing erosion-control measures.

Given the vast size of the planning area and the complexity of road construction, not all temporary roads would undergo decommissioning adequate to ameliorate detrimental soil disturbance. However, temporary roads disturb less of the subsoil and have lower traffic volumes and so would be the most likely to be decommissioned or obliterated. Under all alternatives, decommissioning of temporary roads would provide some reduction in the acres of detrimental soil disturbance, but it is not possible at this scale of analysis with the data available to quantify this potential reduction in this analysis.

Even if all newly constructed roads were permanent, the increased acreage of detrimental soil disturbance from new road construction in the first decade under the alternatives would range from 1.8-6.5 percent (**Table 3-209**). This would be an increase from the current condition of 3.2 percent of the decision area with detrimental soil disturbance from road construction, to 3.26 to 3.41 percent after 10 years, depending on alternative. This represents a very minor increase in the acreage of detrimental soil disturbance from road construction, and represents an overestimation, because the BLM does not quantitatively account for potential reductions from road decommissioning and obliteration.

Issue 3

How would fuel reduction treatments under the alternatives affect soil quality?

Summary of Analytical Methods

Fuel reduction treatments can result in detrimental soil disturbance from soil compaction, soil displacement, erosion of bare soils, excessive heating of soil, or production of a thick mulch of chopped or chipped vegetation. The portion of treated areas experiencing detrimental soil disturbance varies by fuel reduction methods.

In this analysis, the BLM grouped together fuel reduction treatments for activity fuels (the slash remaining after timber harvest) and for hazardous risk fuels not associated with timber harvest. This is a change from the discussion in the Planning Criteria, which presented separate issues for the effects of treatment of activity fuels and hazardous risk fuels (USDI BLM 2014, pp. 166-171). At this scale of analysis with the data available, fuel treatments for activity fuels or hazardous risk fuels do not have a discernible difference in creating detrimental soil disturbance.

This analysis evaluated fuel reduction treatments over a 22-year period. Fuel reduction by any method is temporary in nature, as vegetation resprouts and needs retreatment in 5 to 15 years. In some instances, the type of fuel treatment changes from removal of larger diameter trees to the reduction of understory shrubs or small diameter trees, which increase the fuels component after overstory removals.

The BLM derived the acreage of past fuel reduction treatments for activity fuels by querying the Mechpoly and Burnpoly corporate BLM data.[91] The BLM used the Woodstock model outputs to obtain acreages for each alternative for the six different silvicultural treatments of broadcast burns, hand piles, machine piles, landing piles, lop and scatter, and mastication during the first decade.

The BLM derived the acreage of fuel reduction treatments for hazardous risk fuels by querying the district fuel specialists for the level of treatment in the past two decades, and then the BLM projected a future decadal level of treatment. The BLM assumed in this analysis that the amount of fuel reduction treatments for hazardous risk fuels would be the same among all alternatives. Based on the management objectives and management direction in all of the alternatives, the BLM concluded that there is no basis for predicting a change in treatment of hazardous risk fuels from current and recent practices, regardless of how other land management decisions may change under the alternatives.

The BLM assumed that detrimental soil disturbance would occur on 25 percent of areas treated with excavator machine piling, 35 percent of areas treated with heavy machinery mastication methods, and 5 percent of areas treated with broadcast burning. These estimations are based on the amount of travel equipment make across the units, the length of the boom on the equipment, the size of the piles, the material size to burn, and conclusions from literature describing negative effects to the soil.

In this analysis, the BLM assumed that hand pile burning, landing pile burning, and lop and scatter methods of fuel reduction treatment would not result in measurable detrimental soil disturbance at this scale of analysis. Hand-piling material that is smaller in diameter and in smaller piles typically does not generate lethal soil temperatures. Landing piles can be large enough to generate lethal temperatures but the area already has detrimental soil disturbance from the road construction. The BLM has used two methods of lop and scatter; 1) Using manual labor to cut and disperse excess vegetation in the area treated, or 2) Using mechanical grinders to cut and disperse excess material (Busse *et al*. 2014). Grinding equipment remains on existing roads, limiting the potential for detrimental soil disturbance. Neither method would result in detrimental soil disturbance that would be measureable at this scale of analysis.

In this analysis, the BLM assumed that machine pile burning and broadcast burning have the potential to cause some detrimental soil disturbance, especially where concentration of slash would cause deep heating of the soil, or where large wood would be allowed to smolder for long periods of time. However, these circumstances would constitute only a small portion of the broadcast burn area, and quick mop-up after burning would limit the scope and extent of any detrimental soil disturbance. For machine piling, the scattered nature of constructing piles is reliant on the excess fuel loading. Less fuel equals larger distances between piles and potentially less compaction and lethal temperatures during ignition of the piles. The burning of machine piles causes detrimental soil disturbance from both the soil compaction around the pile from the equipment and the heating of the soil beneath the center of the pile.

[91] These are two layers in the BLM's corporate GIS database. As fuel reduction treatments are completed, specialists input the activity into these layers. However, not all specialists have input the data do these layers are incomplete.

Generally, mastication involves using mechanical equipment to grind cut vegetation and distributing treated material by spreading or blowing it out on the ground (Busse *et al.*, 2014). For mastication of fuels, the BLM assumed that most machines would be mobile across the treatment area. The impact to the soil resources would come from compaction, displacement, and some concentration of chipped material deeper than three inches. The BLM has employed boom excavators and horizontal bar type machines that need to traverse most of the unit for mastication. Grinding of heavy fuel loads has, in the past, built up chipped material that impedes plant growth.

The Planning Criteria provides more discussion of the analytical methods for detrimental soil disturbance from prescribed burning and is incorporated here by reference (USDI BLM 2014, pp. 157-161).

Background

Prescribed fire can heat the soil to a lethal temperature that kills the microbial activity, which process organic matter in the soil to provide nutrients to growing vegetation. These same organisms connect roots and soil, which provide additional water and increase the water uptake for the plant. Inadequately populated soils that lack the corresponding diverse bacterial and fungal communities demonstrate reduced growing capacity and function, which results in less vegetative growth.

The effects of prescribed burning on soil physical, chemical, and biological properties depend on the specific properties or species. Threshold temperatures classed by Busse *et al.* (2014) for soil physical, chemical, and biological properties fall into low, moderate or high classes. Mortality of bacteria or fungal components, as well as seeds and fine roots of plants within the soil, occurs in the low class, between 100 and 300 °F degrees. Most soil structure and organic matter changes occur in the moderate class, between 390 and 930 °F. The high class is where nutrient volatilization proceeds and occurs between 700 and 2,700 °F. The lethal threshold for roots is approximately 140 °F, while that of many soil organisms is between 122 and 392 °F.

Chemical and biological effects to soils from prescribed burning include oxidation of surface and soil organic material, changes in nutrient availability and pool size, changes in pH, and lethal heating to biota and fine roots. Soil properties most indicative of detrimental changes differ between fuel reduction practices, making comparisons among treatment types problematic.

Soil heating is a particular concern given anticipated changes to soil nutrient content and availability, microbial composition and function, soil carbon content, soil mineralogy, and water repellency, and infiltration following severe burning (Neary *et al.* 2005). Busse *et al.* (2013) determined that, regardless of pile size or fuel composition, the soil heat pulse during burning was quenched rapidly with soil depth. The greatest soil heating occurred in the surface 4 inches, whereas benign temperatures registered at the 12-inch depth; mean maximum values were 104 °F for slash piles and 167 °F for woodpiles. Soil moisture plays a key role in heating dynamics, particularly when burning natural fuels or scattered slash. Heat penetration is substantially lower in moist soil than in dry soil due to the additional energy required to heat water (Busse *et al.* 2010).

Soils in the interior/south are generally lower in organic matter and nutrients and are more susceptible to degradation by prescribed fire than soils in the coastal/north. Detrimental soil disturbance from prescribed burning is particularly severe with machine piling, because piled fuel concentrates heat in the center of the pile, and the equipment compacts the soil around the pile. Smaller hand piles or the use of broadcast burning generally results in less detrimental soil disturbance than machine piling.

Mastication involves cutting and grinding vegetation. Mastication occurs with various types of equipment, including wheeled or tracked equipment, equipment with a rotary head attached to a boom,

and equipment with the rotary mechanism attached directly to the front of the equipment. Boom-mounted masticators can reach areas such as deep ditches and steep embankments and can treat more area with less compaction than machines with the rotary mechanism on the front of the machine (Ryans and Cormier 1994). Tracked equipment can work on steeper slopes and softer soils than wheeled equipment. Mastication may cause some soil compaction and displacement, depending on the type of equipment, soil conditions and type, operator experience, and stand conditions. Limiting masticators to designated trails or using low-ground-pressure equipment can reduce the extent and intensity of physical soil disturbance (Busse *et al.* 2014). Most mastication fuel treatments are fundamentally different from ground-based harvest yarding systems, in which yarding concentrates traffic to trails that receive multiple passes. Most masticators track over broad areas to treat fuels, especially if using a horizontal fixed bar design. Boom-mounted masticators are more similar to ground-based yarding; for this type of mastication treatment, confining the equipment to trails, operating on a deep slash mat, and using low ground pressure equipment reduces or avoids detrimental soil disturbance.

Mastication produces a coating of cut vegetation debris across the forest floor. Because the resulting debris is unlike the natural forest floor in terms of particle size, composition, bulk density, and moisture regime, there are few direct comparisons to natural wildland systems or processes. There are so few studies of mastication impacts on soil resources within the planning area that it is difficult to interpret long-term ecological consequences. Short-term studies published in the last 5 years have found few detrimental effects, but the majority of these studies are conducted on sandy soils in California and juniper woodland vegetation types in Colorado. Those soils do not compact in the same negative manner as the clay-textured soils in the planning area. Most short-term impacts center around compaction, mycorrhizal reductions, and nutrient loss or tie up, but long-term consequences or indirect effects from mastication remain largely unstudied (Busse *et al.* 2014). These same studies caution that results are very site-specific, taking the results to other treatment areas needs to be conducted with caution, and much more research is needed to understand the variability across landscapes. Thus, the BLM has cautiously assumed that mastication will affect soil resources in a manner similar to timber harvesting with mechanical type systems.

Mastication can substantially modify soil temperature and moisture regimes by creating mulch that insulates the soil and traps moisture at the soil surface. This mulch may keep soils cooler in the summer and warmer in the late fall and early winter. The extent the cut vegetation debris is incorporated into the soil during mastication determines the degree that soil temperature changes and water content increases. Masticated debris can act as a barrier against both water infiltration into the soil and evaporative losses from the soil.

Reducing fuels through mastication has limited short-term effects on soil microbial communities, largely because of the insulating and buffering effect of the cut vegetation debris. Mastication removes vegetation, which opens treated areas to the sun, but the resultant mulch reduces soil drying. Studies of mastication treatments in pinyon-juniper woodlands did not find differences in abundance, species richness, or community composition of arbuscular mycorrhizal fungi 2.5 years after treatment (Busse *et al.* 2014).

Mastication may reduce soil nitrogen availability. Mulch is generally low in nitrogen and high in carbon. After the mulch is added to the soil, microbes will use inorganic nitrogen from the soil in order to decompose the added carbon-rich material. Under such circumstances, this nitrogen immobilization could temporarily reduce the amount of soil nitrogen available for plant growth. While such effects on soil nitrogen are possible, few studies have examined nitrogen transformations and dynamics following mastication. The depth of mulch influences the effect of these treatments on plant available nitrogen. Ryan *et al.* (2011) found that patchy mulch 0.5 to 1.5 inches thick had no negative impact on soil nitrogen at the stand level, but uniform mulch 3 to 6 inches thick had substantial effects on soil nitrogen.

While the depth of the mulch layer was not identified, in a comparison of fuel treatments in the Sierra Nevada Mountains, commercial thinning followed by mastication did not significantly alter available nitrogen or net nitrification rates two years after treatment, compared to untreated control stands (Moghaddas and Stephens 2007). The soil moisture content of the study area is drastically less than the coastal/north portion of the decision area, and the microbial processes may not come into equilibrium in the same manner of the studies.

A study conducted from 2003 to 2008 on the southeastern edge of the Klamath Mountains in northern California, found that overall the community composition and species richness of mycorrhizal fungi were not significantly altered by any of the mastication and burning treatments (Southworth and Gibson 2010). In addition, soil nutrients at the depth of fine roots and mycorrhizal fungi were not significantly changed due to mechanical mastication followed by burning, and soil nutrient composition did not vary among treatments. Reduction in the fruiting bodies of truffles did occur if the masticated fuels were burned. This study area comes closest to soil and weather conditions found in the interior/south portion of the decision area. Limited research in this area, particularly on clay-textured soils that are well-drained, makes it difficult to determine that similar results will occur in the decision area, particularly in the coastal/north area.

Fuel reduction through biomass removal can remove both carbon and nutrients. Long-term productivity can be reduced by removing these materials, particularly where soils are low in these nutrients in the first place (Poggiani and Couto 1983, Swank and Reynolds 1986). The risk of reduction in soil quality due to nutrient loss is greatest in the areas of lower productivity in the interior/south. Removal of material to meet hazard reduction goals may conflict with long-term site productivity.

Under the 1995 RMPs, the BLM has placed greater emphasis on removing hazardous fuel in the interior/south than in the coastal/north (**Table 3-210**). Fuel reduction for hazard risk has included removal of material along roadsides or pulling material into treated harvest units, which the BLM may not have recorded in the data as fuel reduction treatments. Many areas recorded as burn treatments in another database do not reflect in the totals as hazardous fuels reduced.

Table 3-210. Fuel treatments by method, 2003-2012.

Fuels Treatment	Coastal/North			Interior/South			Totals (Acres)
	Activity Fuel (Acres)	Hazardous Risk Fuel (Acres)	Total Area Treated (Acres)	Activity Fuel (Acres)	Hazardous Risk Fuel (Acres)	Total Area Treated (Acres)	
Underburn/Broadcast Burn	81,142	2,725	81,414	57,095	33,053	90,148	**171,562**
Machine Pile and Burn	310	16,690	17,000	33,976	25,018	58,994	**75,994**
Mastication	-	2,773	2,773	-	5,359	5,359	**8,132**
Total Treatment Acres	**81,452**	**22,188**	**101,187**	**91,071**	**63,430**	**149,677**	**250,864**

Affected Environment and Environmental Consequences

Fuel treatments over the past 20 years have resulted in detrimental soil conditions on 30,424 acres in the decision area: 9,292 acres in the coastal/north and 21,132 acres in the interior/south (**Table 3-211**).

Table 3-211. Detrimental soil disturbance from fuel treatments by method, 2003-2012.

Fuels Treatment	Coastal/North (Acres)	Interior/South (Acres)	Totals (Acres)
Underburn/Broadcast Burn	4,071	4,507	**8,578**
Machine Pile and Burn	4,250	14,749	**18,999**
Mastication	971	1,876	**2,847**
Totals	**9,292**	**21,132**	**30,424**

For each alternative, the total detrimental soil acres from treatment disturbance ranges from approximately 10,100 to 4,400 acres (**Figure 3-155**). This acreage equals from 5 to 7 percent of the acres treated in each of the alternatives. Alternative C would result in the greatest amount of detrimental soil disturbance from fuel treatments (10,139 acres), and Alternative D would result in the least (4,346 acres). The No Action alternative and Alternatives A and B would result in only slightly more detrimental soil disturbance from fuel treatments than Alternative D, and substantially less than Alternative C.

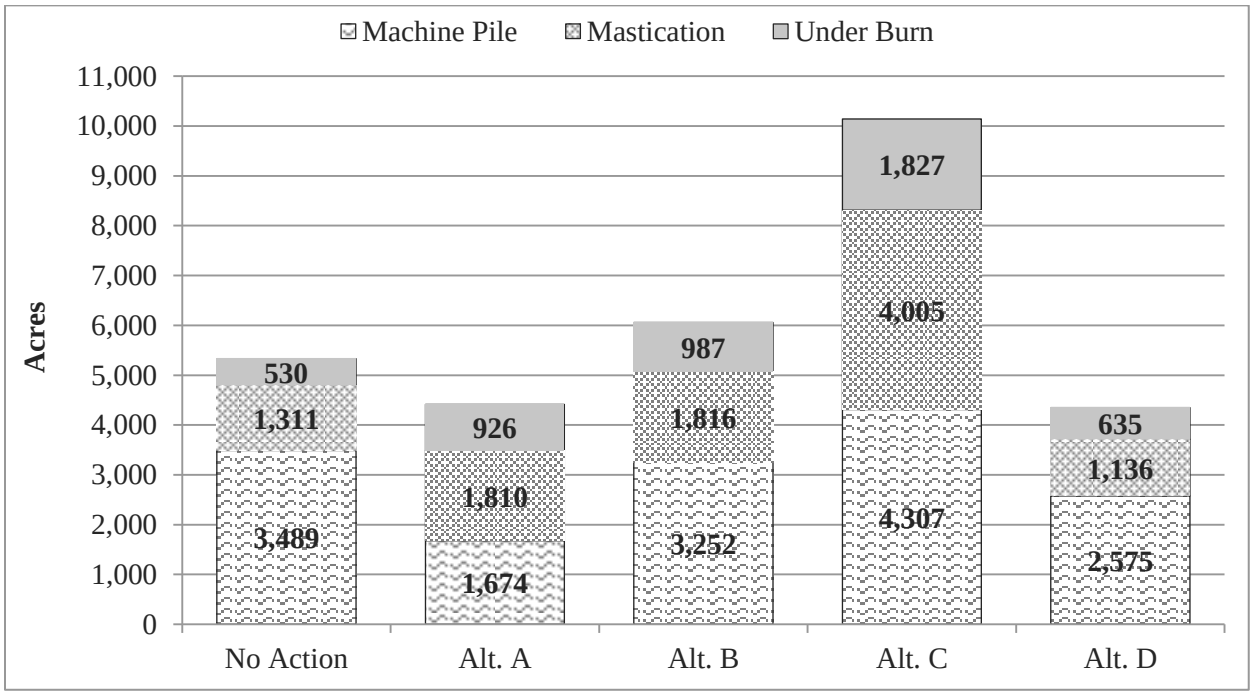

Figure 3-155. Detrimental soil disturbance from fuel treatments by alternative during the first decade.

The detrimental soil disturbance from fuel treatments during the first decade under the alternatives would be approximately 14 to 33 percent (**Table 3-212**) of the current detrimental soil disturbance from past fuel treatments. As a result, the alternatives summed with past fuel treatments would result in a cumulative total of detrimental soil disturbance ranging from 34,770 acres to 40,563 acres.

Table 3-212. Detrimental soil disturbance from fuels treatments compared to the current condition.

Detrimental Soil Disturbance From Fuel Reduction Treatments	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Current Condition (Acres)	30,424	30,424	30,424	30,424	30,424
Effects of the Alternatives (Acres)	5,330	4,410	6,055	10,139	4,346
Totals	**35,754**	**34,834**	**36,479**	**40,563**	**34,770**
Percentage of Current Condition	**18%**	**14%**	**20%**	**33%**	**14%**

There are differences between alternatives based on the method of treatment that would produce different detrimental effects. In all alternatives except Alternative A, machine piling would be the largest contributor to detrimental soil disturbance (**Figure 3-155**). Mastication would be the largest contributor to detrimental soil disturbance in Alternative A. Where machine piling would occur, there would be compaction that may reduce seedling growth or vegetative cover of native plants. Where soil is heated above lethal temperatures, there may be loss of microbial activity and potential attachment to roots to improve growth. If masticated materials accumulate in layers greater than 3 inches, the mulch layer would impede transpiration, water infiltration, and seedling growth.

Issue 4

How would off-highway vehicle use under the alternatives affect soil quality?

Summary of Analytical Methods

In this analysis, the BLM assumed that areas allocated as *open* for off-highway vehicle (OHV) use would experience detrimental soil disturbance. Areas designated as *closed* would not experience detrimental soil disturbance, because the BLM would not permit off-highway vehicle use. Areas designated as *limited* would not experience measurable additional detrimental soil disturbance, because the BLM would limit off-highway vehicle use to existing or designated roads and trails, which have already experienced detrimental soil disturbance through the construction of the roads or trails. Until the BLM completes route designations through implementation level planning, the BLM cannot identify which routes would be designated in any alternative. Therefore, the BLM cannot quantify these more site-specific effects in this analysis, and the BLM would address these effects as part of the analysis supporting the implementation level decisions.

In this analysis, the BLM assumed that OHV users would operate vehicles consistent with BLM decisions about OHV use. Although the BLM has some site-specific and anecdotal information about illegal OHV use, the BLM does not have a basis for predicting the location or effects of any widespread or systematic illegal OHV use. In addition, much of the decision area has physical limitations to potential illegal OHV use, including dense vegetation, steep slopes, and locked gates. In most of the interior/south, the ability to track numerous different routes across the open spaces can lead to degradation and erosion in a greater proportion than most of the coastal/north. However, the BLM lacks a basis for characterizing current illegal OHV use or forecasting such potential illegal OHV use in the future under any of the alternatives at this scale of analysis.

Background

Off-highway vehicle use can cause detrimental soil disturbance as vehicle traffic compacts or displaces soil (Ouren *et al*. 2007). The effects can be vary based on the type of vehicle. Off-highway vehicles

include 2- and 4-wheel all-terrain vehicles, large 4-wheel drive trucks, sport utility vehicles, and any other vehicle capable of off-road travel. Depending on the type of soil, there will be different effects. Relatively uniform sandy or clay soils are less vulnerable to compaction than loamy sands or coarse-textured, gravelly soils characterized by variability in particle size (Lovich and Bainbridge 1999). In addition, soils capable of holding greater water content are more susceptible to compaction than soils containing less moisture (Webb 1982). However, even soils in semi-arid and arid lands experience problematic compaction, because the texture of these soils is slow to recover through natural soil-loosening processes, including shrinking, swelling, drying, wetting, freezing, and thawing (Webb 1982).

Off-highway vehicle use can cause soil erosion, which occurs when fine-grained particles blow off in the wind or wash off when precipitation occurs on the unprotected surface. The removal of the top layers of soil, particularly the organic matter, degrades the potential for soil function. The result can range from a barren surface or very deep gullies, depending on soil type, slope gradient, and amount of exposure to precipitation.

Affected Environment and Environmental Consequences

Under the No Action alternative, approximately 85,000 acres (3.3 percent) of the decision area would remain *closed* to OHV use, and approximately 330,400 acres (12.8 percent) would remain *open* to OHV use (**Table 3-213**). On the remaining 83.9 percent, OHV use would remain *limited* to existing roads and trails or designated roads and trails. On some portion of the 330,400 acres open to OHV use, detrimental soil disturbance has been, and will continue, to occur. It is not possible for the BLM to determine at this scale of analysis with the data available how much of the 330,400 acres open to OHV use is actually experiencing detrimental soil disturbance or will in the future. However, within areas open to OHV use, such effects could occur throughout the open area without future analysis or decision-making by the BLM.

Table 3-213. OHV categories of use by alternative.

Trails and Travel Management	No Action		Alt. A		Alt. B		Alt. C		Alt. D	
	Acres	% of Total Acres	Acres	% of Total Acres	Acres	% of Total Acres	Acres	% of Total Acres	Acres	% of Total Acres
Closed	84,589	3.3%	128,757	5.2%	148,551	6.0%	178,001	7.2%	153,305	6.2%
Limited	2,156,712	83.9%	2,345,574	94.8%	2,325,763	94.0%	2,296,313	92.8%	2,320,987	93.8%
Open	330,394	12.8%	-		-		-		-	

Under all action alternatives, no areas would be open to OHV use. The entirety of the decision area would be closed to OHV use, or OHV use would be limited to existing roads and trails. As such, there would be no additional detrimental soil disturbance from OHV use measurable at this scale of analysis with the data available under any of the action alternatives.

Issue 5

How would the combination of timber harvest, road construction, and fuel reduction treatments[92] under the alternatives affect soil quality?

Summary of Analytical Methods

In this analysis, the BLM combined the individual levels of detrimental soil disturbance from timber harvesting, road construction, and fuels treatments. For the purposes of this analysis, the BLM considered all acres of detrimental soil to be equal: acres of detrimental soil disturbance from timber harvesting are equivalent to those from road construction or fuels reduction. There are differences in how detrimental soil disturbance from different management actions would affect soil quality. However, it is not possible to distinguish quantitatively these differences in detrimental soil disturbance at this scale of analysis with the data available. In addition, there would likely be some overlap in the acres of detrimental soil disturbance from these three sources (e.g., the same location within a harvest unit would experience detrimental soil disturbance from the ground-based yarding equipment during harvesting and from machine piling and burning during fuels treatment). However, it is not possible at this scale of analysis to separate the acres of detrimental soil disturbance from each source and identify overlapping acres. Therefore, these estimates overestimate the acres of detrimental soil disturbance, in part, because of overlapping acres.

The BLM compared the combined amount of detrimental soil disturbance to a threshold of 20 percent of areas treated. The BLM derived this analytical threshold, in part, from a U.S. Forest Service, Pacific Northwest Region standard, in which overall soil quality is considered negatively impacted and amelioration must ensue when detrimental soil disturbance exceeds 15 percent of an area treated (USDA FS 2010). However, this 15 percent standard does not account for road construction. The BLM increased this analytical threshold to 20 percent to account for detrimental soil disturbance from road construction. This 20 percent threshold only provides an approximate analytical threshold at this scale of analysis. Comparing the amount of detrimental soil disturbance as a percentage of total area treated across the decision area over 10 years to this 20 percent analytical threshold provides only limited and approximate information, it does not reveal whether or not any particular site or treatment area would exceed this 20 percent threshold. The relevant scale for evaluating detrimental soil disturbance and determining the need for mitigation or amelioration is at the site scale, such as an individual timber harvest unit or individual treatment area.

Affected Environment and Environmental Consequences

Currently, 139,299 acres in the decision area have experienced detrimental soil disturbance from past timber harvest, road construction, and fuel reduction treatments (**Table 3-214**).

Table 3-214. Detrimental soil disturbance from all sources, by the current condition and under all alternatives during the first decade.

Management Action	Current	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Fuels Treatments (Acres)	30,424	5,330	4,410	6,055	10,139	4,346
Road Construction (Acres)	79,311	5,167	1,692	3,748	4,367	1,388

[92] While there is detrimental soil disturbance from OHV use, at this scale of analysis the BLM cannot quantify an amount. Therefore, the BLM did not combine detrimental soil disturbance from OHV use with these other sources because of this uncertainty.

Management Action	Current	No Action	Alt. A	Alt. B	Alt. C	Alt. D
Timber Harvest (Acres)	29,564	24,172	12,036	25,217	27,000	21,742
Totals	**139,299**	**34,669**	**18,138**	**35,020**	**41,506**	**27,476**
Total Alt. Combined with Current	**-**	**173,968**	**157,437**	**174,319**	**180,805**	**166,775**
Percentage of Current Condition		**25%**	**13%**	**25%**	**30%**	**20%**

Through the first decade, the alternatives would increase detrimental soil condition amounts by 13 to 30 percent of current amounts. Alternative C would result in the largest combined increase in detrimental soil disturbance (41,506 acres), and Alternative A would result in the smallest combined increase in detrimental soil disturbance (18,138 acres). Although detrimental soil disturbance from timber harvest has been the smallest source of detrimental soil disturbance in the past, it would be the largest source of detrimental soil disturbance under all alternatives in the future. New road construction would be low under all alternatives, as most of the required transportation system is currently in place. Fuel treatments under the proposed alternatives would use less of the treatment methods likely to result in detrimental soil disturbance than in past management.

As noted in the issues above, the BLM would be able to reduce the acreage of detrimental soil conditions from timber harvest, road construction, and fuels treatments through sound management practices that would limit initial compaction levels, remove existing or created compacted surfaces, and improve soil water and organic matter levels. Best management practices are listed and described in Appendix I. However, because the extent and effectiveness of such mitigation or amelioration depends heavily on site-specific and project-specific factors, the BLM cannot quantify those reductions in detrimental soil disturbance in this analysis.

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Sustainable Energy

Key Points

- Under all alternatives, the majority of the land in the decision area is available for the potential development of sustainable energy resources.
- Alternative C would make available the greatest amount of biomass.
- While Alternative A would have the greatest acreage in exclusion areas, the BLM concluded that Alternative D would be the alternative most likely to constrain wind energy and transmission line development substantially by designating over a third of the decision area as avoidance areas.
- While there is no current geothermal development and limited potential in the decision area, all action alternatives would be less constraining to geothermal development than the current condition, with Alternative A being the least constraining.

Background

For the purposes of this Draft RMP/EIS, the BLM uses the term sustainable energy in lieu of the term renewable energy, which is more commonly used in laws and policies guiding the management of the resources addressed in this section. The term "renewable" implies that an energy resource undergoes a *cycle* of availability, (i.e., a cycle that alternates between energy depletion and energy replenishment). For the purposes of this document, the BLM believes that it is more accurate to characterize these resources as sustainable.

Issue 1

How would management alternatives for forest treatment affect the availability of slash as a biomass energy source?

Summary of Analytical Methods

The BLM evaluated the alternatives and quantified them by projected volume of timber harvest under each alternative in MMbf. Using this harvest data, the BLM quantified the maximum quantities of slash that would be produced using the assumption, described more fully in the Planning Criteria, that 450 green tons of slash would be made available for every million board feet of harvest.

While other types of biomass exist, the BLM focused this analysis on slash (i.e., wood residue from timber harvest) since this is the specific type of biomass that provides the most practical opportunity for sustainable energy development in the planning area. Slash consists primarily of the branches and treetops of harvested merchantable timber. Slash excludes other biomass present in abundance but more difficult to transport such as snags, downed logs, and stumps (Cross *et al.* 2013, p. 1).

The Planning Criteria provides more detailed information on analytical assumptions, methods and techniques, and geographic and temporal scales, which is incorporated here by reference (USDI BLM 2014, pp. 164-165).

Background

While the availability of 450 tons of green slash per million board feet of timber is an acceptable assumption for the purposes of this analysis, the precise amount of biomass produced would vary based on several factors including the location and type of harvested stand. Other factors include the amount of non-merchantable hardwoods, the amount of sub-merchantable material designated for cutting and

removal in fire-prone stands, and the level of defect within a given stand. Thinning would typically produce biomass that consists mainly of tops and sub-merchantable stems, whereas regeneration harvest would produce more cull material and broken pieces.

Topography, vegetation, and yarding systems would affect the accessibility of biomass produced through timber harvest. Areas suitable for ground-based equipment would have a higher recovery level. Areas of steep, dense brush would have a lower recovery level due to the difficulty of locating the material and bringing it to a landing with cable yarding systems.

The sale of biomass also depends on market conditions. The amount sold is generally less than the available biomass would allow because this resource typically lacks sufficient energy density for economical transport as a fuel for electrical power generation except where generating plants are close to harvest areas.

There are wood fiber biomass combustion boilers at 21 industrial or institutional sites in the planning area. The boilers supply heat for industrial processes. At nine of these sites, steam-driven generators produce electric power. Private individuals and commercial companies also cut firewood on BLM-administered lands, which the BLM includes in the definition of biomass available on BLM-administered lands, but do not come from slash.

Affected Environment

Biomass occurs in abundance throughout the planning area, but as described above, factors such as the distance from harvest areas to power generation sites influence its production and sale. Based the harvest level, in 2012, 91,669 green tons of biomass were available as slash from BLM-administered lands within the planning area. In addition to its use for energy generation, biomass currently harvested in the decision area is also sold as landscaping material, raw manufacturing material for fiberboard, or charcoal briquettes.

Environmental Effects

Table 3-215 provides the biomass available as slash from BLM-administered lands under each alternative. As described above, a number of additional factors affect the biomass actually produced, as opposed to simply made available, from BLM-administered lands. These factors would almost certainly cause the production of less biomass from BLM-administered lands than is described as available in **Table 3-215**. These factors would be consistent across alternatives, so the results in the table provide a reasonable basis for comparing the relative levels of biomass made available under each alternative. Alternative C would make available the most biomass of the alternatives, followed by the No Action alternative, Alternative B, and Alternative A. Alternative D would make available the least amount of biomass from BLM-administered lands.

Table 3-215. Biomass available from BLM-administered lands as timber harvest slash by alternative.

Alternative	Green Tons
No Action	180,629
Alt. A	112,893
Alt. B	149,471
Alt. C	250,623
Alt. D	81,283

Issue 2

How would ROW avoidance and exclusion areas in the alternatives affect the potential siting of wind energy developments and sustainable energy corridor designations?

Summary of Analytical Methods

As presented in the Planning Criteria (USDI BLM 2014, pp. 164-165), the BLM intended to use the existing wind energy resource data compiled in the 2005 *Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Land in the Western United States* (USDI BLM 2005) to assess how the alternatives interacted with the potential for wind energy development in the planning area of this RMP. However, the BLM found that the data in the 2005 Wind EIS is not detailed enough to reveal specific areas of high energy potential within the planning area.

Instead, the BLM compared acres of right-of-way (ROW) avoidance and exclusion across the alternatives to determine the extent to which each alternative might constrain the development of wind energy and sustainable energy transmission. The BLM administers both wind energy and transmission lines on BLM-administered lands through the granting of a ROW, so avoidance and exclusion areas would directly affect the potential for developing wind energy and transmission lines on BLM-administered lands. For the purposes of this analysis, the BLM assumed that ROW avoidance areas would preclude wind energy and transmission lines in most cases.

Background

According to the American Wind Energy Association, Oregon, as a whole, currently has approximately 435 megawatts (MW) of installed wind power generating capacity with another 140 MW proposed. The 2005 Wind EIS projected that by 2025, 196 MWs of wind energy will originate from BLM-administered land throughout Oregon (USDI BLM 2005, p. 5-104).

The NREL wind resource map for Oregon indicates that Oregon has wind resources consistent with community-scale production. The good-to-excellent resource areas for community-scale production are concentrated on ridge crests throughout the State. None of the good-to-excellent non-ridge crest areas with at least good wind resource potential are located in the planning area of this RMP. There are a few sites with wind resources of this quality along the ridge peaks of the Cascade Range on the eastern border of the planning area and scattered along the Pacific coast. Current NREL mapping resolution does not reveal the presence of utility-scale wind resources in the decision area (DOE EERE 2014, 80-Meters).

Wind energy development on BLM-administered lands is permitted through right-of-way (ROW) authorizations in accordance with requirements of FLPMA and the 2008 BLM Wind Energy Development Policy (2008 Wind Policy).

Affected Environment

There is no current wind energy production, or proposals for wind energy production, on BLM-administered lands in western Oregon. As noted in the background section, there are no known sites with potential utility-scale wind development for within the decision area for this RMP.

In addition to limited potential, the lack of infrastructure critical to development limits the development of sustainable energy resources, including wind, in western Oregon. There are currently no transmission lines that could easily transmit energy collected from wind energy on BLM-administered in the planning

area. There are no current plans to construct transmission lines that could fill this need. Any transmission line through BLM-Administered land would require a ROW.

Environmental Effects

The alternatives being considered change the acreage of both Exclusion Areas and Avoidance Areas. **Table 3-216** compares the ROW exclusion acreage associated with each alternative. Since the BLM is unable to grant ROW for energy transmission corridors in exclusion areas, Alternatives A, B, and C all slightly increase the percent of the decision area on which the BLM could not grant a ROW for wind power under any situation short of a legal mandate. Alternative A would exclude wind energy and transmission line development from the greatest percentage of the decision area. Alternative D would very slightly decrease the current acreage of exclusion areas.

Table 3-216. Right-Of-Way Exclusion Area acres by alternative.

Exclusion Area Criteria	No Action (Acres)	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Lands Designated as Wilderness	14,309	14,309	14,309	14,309	14,309
Lands Managed to Protect their Wilderness Characteristics	-	88,029	50,706	50,706	-
Designated and Suitable Wild and Scenic Rivers (Wild Only)	5,937	5,937	5,937	5,937	5,937
Visual Resource Management Class I	22,136	21,114	21,114	21,114	21,114
Totals	**42,382**	**129,389**	**92,066**	**92,066**	**41,360**
Percent of Decision Area	**1.66%**	**5.06%**	**3.60%**	**3.60%**	**1.62%**

The BLM is able to grant a ROW in Avoidance Areas if such a ROW is compatible with the protection of the values for which the BLM designated the Avoidance Area or no other route is possible. However, it is unlikely that the development of wind power would be compatible with the values for which the BLM would designate the Avoidance Areas. These Avoidance Areas would thus likely constrain the development of wind energy and sustainable energy transmission corridors on these BLM-administered lands. **Table 3-217** compares the ROW Avoidance acreage associated with each alternative. Alternative A would decrease the acres of Avoidance Areas compared to the No Action alternative, while Alternatives C and D would substantially increase this acreage. While Alternative A would have the greatest acreage in Exclusion Areas, the BLM concludes that Alternative D would be the alternative most likely to constrain wind energy and transmission line development substantially by designating over a third of the decision area as Avoidance Areas.

Table 3-217. Right-Of-Way Avoidance Area acres by alternative.

Avoidance Area Criteria	No Action (Acres)	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Areas of Critical Environmental Concern	94,657	105,990	99,427	98,104	105,784
Recreation Management Areas	8,217	18,543	164,141	416,616	666,862
Wilderness Study Areas	1,208	1,208	1,208	1,208	1,208
Designated and Suitable Wild and Scenic Rivers (Scenic and Recreation only)	20,414	20,414	27,557	27,557	64,083
Visual Resource Management Class II that is not included in ROW Exclusion Areas	123,756	48,185	48,958	48,999	58,309
Total Avoidance Acres*	**243,928**	**179,436**	**326,510**	**575,444**	**871,713**
Percent of Decision Area	**9.54%**	**7.02%**	**12.77%**	**22.50%**	**34.08%**

* Right-of-way avoidance total acreage are not a direct sum from the individual criteria acres due to criteria that overlap geographically with each other. Areas that overlap with Right-of-Way Exclusion Areas are subtracted from the sum of the total avoidance acres due to right-of-way exclusion is more restrictive than right-of-way avoidance.

Issue 3

How would the alternatives affect the development of geothermal as a sustainable energy source?

Summary of Analytical Methods

To assess the effect of each alternative on the development of geothermal energy resources in the planning area, the BLM compared the extent to which each alternative would condition the development of fluid minerals; geothermal energy is managed as a fluid mineral. The BLM assumed that leasable stipulations (such as no surface occupancy) would negatively affect, though not entirely preclude, the potential for geothermal development on BLM-administered lands.

Background

Although Oregon has yet to achieve commercial generation of electricity from geothermal energy, the potential exists. A U.S. Department of the Interior report identifies 7 sites within Oregon as having the highest geothermal potential out of 35 sites on public lands throughout the country (Kirby *et al*. 2003). Among these sites, only the area within, and in the immediate surroundings of Klamath Falls, is within the planning area.

Affected Environment

There is no current geothermal development occurring on BLM-administered lands within the planning area. Geothermal potential exists in Oregon; however, it is primarily located in the eastern portion of the State. Some potential exists in the south-central part of the State on the eastern border of the planning area of this RMP (USDI BLM and USDA FS 2008, p. I-9).

There are currently 692,100 acres of BLM-administered lands to which the BLM has applied no surface occupancy stipulations.

Environmental Effects

The alternatives would impose requirements for fluid mineral stipulations on differing acreages of BLM-administered lands within the planning area. The differing arrangement in each alternative of ACECs,

RMAs, suitable Wild and Scenic Rivers, and lands managed for their wilderness characteristics drives these differences. **Table 3-218** compares acres for which the BLM would require stipulations across the alternatives. It is important to note that while the No Action alternative acreage includes only acres to which the BLM has applied no surface occupancy stipulations, the action alternative acreages include all areas the BLM has identified as requiring stipulations, but these stipulations may include items such as timing stipulations in addition to no surface occupancy.

Table 3-218. Acres that would have leasable stipulations across alternatives.

	No Action (Acres)	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Leasable stipulations	692,100*	190,389	211,638	318,915	498,525

* This includes only acres that are no surface occupancy

Under all action alternatives, the BLM would substantially reduce the acreage requiring leasable mineral stipulations compared to the No Action alternative. Alternative A would have the least acreage requiring stipulations. Thus, all action alternatives would be less constraining to geothermal development than the current condition, with Alternative A being the least constraining.

Issue Considered but Not Analyzed In Detail

How would management alternatives affect the development of solar radiation as a sustainable energy source?

In the joint BLM-DOE analysis, NREL could not demonstrate a potential for solar energy development to be a notable sustainable energy resource on BLM-administered lands in the planning area (USDI BLM and US DOE 2003, pp. 13-14, 19-20, A2-A3, E9). The BLM cannot assess the effects of the alternatives on this resource since the resource does not exist within the BLM-administered lands in the planning area.

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Trails and Travel Management

Key Points

- All action alternatives increase the number of closed area designations when compared to the No Action alternative.
- All Action Alternatives decrease the number of open area designations when compared to the No Action alternative.
- Alternative D provides the greatest number of trail based opportunities for both motorized and non-motorized recreation activities.
- Easements and Reciprocal right-of-way agreements secure access for BLM forest management activities. Reciprocal right-of-way agreements over O&C and Coos Bay Wagon Road lands do not grant rights for public access and recreational use. For this reason, a substantial portion of BLM-managed roads and BLM-administered lands lack legal public access.
- The overall replacement value of the BLM's transportation system exceeds $10 billion. Approximately 30 percent of the road mileage is in fair or poor condition, primarily due to depleted surfacing aggregate and worn-out minor culverts. Currently the deferred maintenance backlog exceeds $300 million.

Background

BLM-Administered Travel and Transportation System

The BLM manages a complex and well-utilized travel system within western Oregon. The BLM owns and manages approximately 15,000 miles of roads and 395 miles of designated trails within the decision area. The primary purpose for the development and uses of the BLM transportation system are access for resource management, recreation use, and the transportation of forest products. Given the BLM's checkerboard land ownership pattern, the road network has developed in concert with neighboring private timberland owners. The result is a joint-use BLM/private road network. The BLM currently has designated a network of trails and travel management areas within the planning area to address particular concerns and prescribe specific management actions for a defined geographic area. Travel management areas are a tool to frame transportation issues and help delineate and manage travel networks to address specific uses and resource concerns.

Long-term or perpetual reciprocal right-of-way agreements provide legal access to Federal and private timberlands for BLM administrative use and private timberland owners as authorized by the FLPMA and other Federal regulations. A reciprocal right-of-way agreement provides both the BLM and the private landowner with a non-exclusive right to use, construct and maintain logging roads on each other's property for forest management and harvest of forest products. These agreements are in effect on nearly 75 percent of BLM-administered lands in the planning area.

Reciprocal right-of-way agreements over O&C and Coos Bay Wagon Road lands under 43 CFR 2812 do not grant rights for public access and recreational use. For this reason, a substantial portion of BLM-managed roads and BLM-administered lands lack legal public access. Current commercial use of the BLM's portion of the joint-use network consists predominantly of log hauling.

Implementation Level Travel Planning

The BLM is deferring implementation-level Travel Management Planning (TMP) during the current RMPs for Western Oregon planning effort. Implementation-level TMP is the process of establishing a

final travel and transportation network that includes route-specific designations within the broader land use planning level area designations. **Table 3-219** displays the existing off-highway vehicle area designations within the Western Oregon Planning area.

Table 3-219. Existing OHV designations within the decision area.

District/ Field Office	1995 RMP Travel Management Area Designation (Acres)						
	Open	Limited to Existing Roads and Trails	Limited to Existing Roads and Designated Trails	Limited to Designated Roads and Trails	Limited to Designated Roads	Closed	Totals
Coos Bay	-	-	-	318,676	-	3,489	322,165
Eugene	-	320,883	-	-	-	3,547	324,430
Klamath Falls	29,902	137,154	-	47,222	-	10,702	224,980
Medford	139,878	26,514	-	661,357	-	46,371	874,120
Roseburg	-	416,560	-	6,731	-	3,283	426,574
Salem	160,614	48,771	87,144	16,192	69,508	17,197	399,426
Totals	**330,394**	**949,882**	**87,144**	**1,050,178**	**69,508**	**84,589**	**2,571,695**

In the future, implementation-level travel planning will follow a site-specific process for selecting a final road and trail network. The BLM will make final route designations for the decision area in a comprehensive, interdisciplinary Travel and Transportation Management Plan scheduled to be completed within five years after the completion of the western Oregon RMPs. The BLM's geo-database will provide information for identifying roads and trails for both motorized and non-motorized recreation activities. The BLM began on-the-ground route inventories across the decision during the summer of 2014. Route inventories will continue throughout 2015. The BLM estimates that there are approximately 1,000 miles of non-designated user created routes within the decision area. The BLM will develop proposed future route designations through public scoping and NEPA analysis, utilizing the draft route inventories to evaluate amendments to the existing travel network during an implementation-level TMP. **Appendix P** includes interim OHV management guidelines that would be implemented in *limited* to existing designations until subsequent TMPs are complete.

R.S. 2477 Assertions

Section 8 of the Mining Act of 1866 provided: "and be it further enacted, that the right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted." The statute was self-enacting; rights being established by "construction" of a "highway" on unreserved public lands, without any form of acknowledgement or action by the Federal government. This section of the statute was later re-codified as Revised Statute 2477 (R.S. 2477). The FLPMA repealed R.S. 2477 in 1976, with a savings provision for rights established prior.

A Travel Management Plan is not intended to provide evidence bearing on or addressing the validity of any R.S. 2477 assertions. R.S. 2477 rights are determined through a process that is entirely independent of the BLM's planning process. Consequently, travel management planning does not take into consideration R.S. 2477 assertions or evidence. Travel management planning is based on an independently determined purpose and need that is based on resource uses and associated access to public lands and waters. When a decision is made on R.S. 2477 assertions, the BLM will adjust its travel routes accordingly.

Issue 1

How would the alternatives affect the BLM's ability to provide trail and travel opportunities in western Oregon?

Summary of Analytical Methods

The BLM classified lands use allocations (i.e., *open*, *closed*, and *limited*) for travel and trail use by alternative. The BLM evaluated the alternatives and compared the number of acres, allowable uses, travel limitations, and modes of travel allowed under each travel designation. The BLM analyzed the effects that off-highway vehicle allocations would have on other affected resources within the planning area.

In this analysis, the BLM assumed that OHV users would operate vehicles consistent with BLM decisions about OHV use. Although the BLM has some site-specific and anecdotal information about illegal OHV use, the BLM does not have a basis for predicting the location or effects of any widespread or systematic illegal OHV use. In addition, much of the decision area has physical limitations to potential illegal OHV use, including dense vegetation, steep slopes, and locked gates. In most of the interior/south, the ability to track numerous different routes across the open spaces can lead to degradation and erosion in a greater proportion than most of the coastal/north. However, the BLM lacks a basis for characterizing current illegal OHV use or forecasting such potential illegal OHV use in the future under any of the alternatives at this scale of analysis.

The Planning Criteria provides additional information on analytical assumptions, methods and techniques, and geographic and temporal scales, which is incorporated here by reference (USDI BLM 2014, pp. 115-119).

Descriptions of Indicators Used for Analysis

The analysis used the following indicators:

Travel Management Area Impact Indicators

The BLM manages motorized access under three possible categories based on BLM land use planning decisions that take into account natural resource protection and public safety. The off-highway vehicle categories are (1) *open*, which allows for unlimited travel, including cross-country, (2) *limited*, where OHV use is restricted to meet specific resource management objectives, and (3) *closed* to motorized use.

- Indicators: Travel Management Area designations: (1) the number of acres, allowable uses, travel limitations and modes of travel designated as *open*, *limited*, or *closed*; (2) the number of acres of recreation management areas where motorized or non-motorized trails are a primary recreation activity; (3) the management actions that result in short-term and long-term elimination, restriction, or reduction of travel opportunities to meet resource and resource use objectives for various programs. The BLM quantifies effects to these indicators where possible. For resources for which the BLM lacks quantitative data, it relies on professional judgment.

Background

Off-Highway Vehicle Area Designations

During this planning effort the BLM will make decisions about how it will generally manage OHVs in different parts of the planning area. As required by Executive Order and regulation, this RMP classifies all BLM-administered lands as *open*, *limited*, or *closed* to motorized travel activities. Definitions of *open*, *limited*, and *closed* areas are as follows:

- ***Open* areas**. Areas where the BLM does not limit of OHV use since there are no issues regarding resources, visitor conflicts, or public safety to warrant limiting cross-country travel.
- ***Limited* areas**. Areas where the BLM has restricted OHV use in order to meet recreational and resource management objectives. Restrictions may include the number or types of vehicles; the time or season of use; permitted or licensed use only; and limiting use to existing or designated roads and trails.
- ***Closed* areas**. Areas that the BLM has closed to all motorized vehicle use to protect resources, ensure visitor safety, or reduce visitor conflicts.

For areas classified as *limited*, the BLM would designate the types or modes of travel, such as pedestrian, equestrian, bicycle, motorized, etc.; limitations on time or season of use; limitations to certain types of vehicles (e.g., OHVs, motorcycles, and all-terrain vehicles); limitations on BLM administrative use only; or other types of limitations.

The BLM applied designation criteria in 43CFR 8342 when designating lands as *open*, *limited*, or *closed* to off-road vehicles. All designations are based on the protection of the resources of the public lands, the promotion of the safety of all the users of the public lands, and the minimization of conflicts among various uses of the public lands. These designations are in accordance with the following criteria:

1. Areas and trails shall be located to minimize damage to soil, watershed, vegetation, air, or other resources of the public lands, and to prevent impairment of wilderness suitability.
2. Areas and trails shall be located to minimize harassment of wildlife or significant disruption of wildlife habitats. Special attention will be given to protect endangered or threatened species and their habitats.
3. Areas and trails shall be located to minimize conflicts between of-road vehicle use and other existing or proposed recreational uses of the same or neighboring public lands, and to ensure the compatibility of such uses with existing conditions in populated areas, taking into account noise and other factors.
4. Areas and trails shall not be located in officially designated wilderness areas or primitive areas. Areas and trails shall be located in natural areas only if the authorized officer determines that off-road vehicle use in such locations will not adversely affect their natural, esthetic, scenic, or other values for which such areas are established.

Plan Maintenance and Changes to Route Designations

The RMPs that the BLM will adopt at the end of this RMP revision process will include indicators that guide future plan maintenance, amendments, or revisions related to OHV area designations or the approved road and trail system within “Limited to Existing” areas. Future conditions may require the designation or construction of new routes or closure of routes to better address resources and resource use conflicts. Actual route designations with the “Limited to Existing” category can be modified subsequent to RMP adoption without completing a plan amendment, although NEPA compliance will still be required.

Plan maintenance would be accomplished through additional analysis and implementation-level travel planning (e.g., activity level planning). The BLM would collaborate with affected and interested parties in evaluating the designated road and trail network for suitability for active OHV management and envisioning potential changes to the existing system or adding new trails that would help meet current and future demands within “Limited to Existing” area designations and broader Recreation and Travel

Management Areas that emphasize motorized OHV use. In conducting such evaluations, the BLM will apply designation criteria in 43 CFR 8342. The following factors would also be considered:

- Routes suitable for various categories of OHVs (e.g., motorcycles, all-terrain vehicles, full size 4-wheel drive vehicles) and opportunities for shared trail use.
- Needs for parking, trailheads, informational and directional signs, mapping and route profiles, and development of brochures or other materials for public dissemination.
- Opportunities to connect into existing or planned route networks.
- Measures needed to meet the objectives stated in the Western Oregon RMP (e.g., cultural resources, soil resources, special status species, and recreation).
- Affects to cultural resources in compliance with Section 106 of the National Historic Preservation Act.
- Public land roads or trails determined to cause considerable adverse effects or to continue a nuisance or threat to public safety would be considered for relocation or closure and rehabilitation after appropriate coordination with applicable agencies and partners.
- Those areas managed as closed will not be available for new motorized designation or construction.

Affected Environment and Environmental Consequences

Motorized and Non-Motorized Trails

The BLM manages 63 individual trails and trail systems that total over 395 miles in the western Oregon decision area. Trail-based recreation opportunities within the decision area include trail systems for motorized and non-motorized users, providing a range of available activities across various recreation settings. Popular activities include hiking, mountain biking, horseback riding, and OHV use. **Appendix P** contains an overview of the existing trail opportunities within the planning area.

Off-Highway Vehicle Area Designations

This section is an analysis of potential impacts on travel from implementing management actions and allowable uses to meet resource and resource use objectives for various programs. Travel designations support resource programs and are designed to help achieve their objectives. For example, a *closed* designation could be applied to protect sensitive wildlife or other special values. Impacts resulting from the travel system on other resources and resource uses are discussed in those specific resource sections of Chapter 3. **Table 3-220** summarizes proposed OHV area designations across the decision area by alternative. *Limited* area OHV designations would reduce cross-country OHV travel in an area, but would not eliminate it from existing and designated routes. A *closed* area OHV designation would completely prohibit motorized travel in the entire area.

Table 3-220. OHV area designations in western Oregon by alternative.

Trails and Travel Management Designations	No Action (Acres)	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Closed to OHV Use	84,589	128,757	148,551	178,001	153,305
Limited to Designated Routes	1,119,686	13,874	13,874	13,874	13,874
Limited to Existing Routes	1,037,026	2,331,701	2,311,789	2,282,439	2,307,113
Open to Cross-country Travel	330,394	-	-	-	-

Table 3-221 shows types of areas *closed* to OHV travel by alternative and other land use allocations or special designations.

Table 3-221. Closed OHV areas by alternative and by land use allocation or designation..

District/Field Office	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Coos Bay				
Recreation Management Areas	102	101	101	1,234
Areas of Critical Environmental Concern	2,645	2,645	2,645	2,645
Protected Lands with Wilderness Characteristics	2,467	-	-	-
Subtotal	5,214	2,746	2,746	3,879
Eugene				
Recreation Management Areas	52	294	2,893	3,955
Areas of Critical Environmental Concern	20,513	20,515	20,497	20,905
Subtotal	20,565	20,809	23,390	24,860
Klamath Falls				
Recreation Management Areas	9	7,061	16,167	13,884
Areas of Critical Environmental Concern	607	470	470	470
Subtotal	616	7,531	16,637	14,354
Medford				
Recreation Management Areas	17,096	30,045	26,320	35,754
Areas of Critical Environmental Concern	916	916	916	916
Protected Lands with Wilderness Characteristics	83,079	50,670	50,670	-
Subtotal	101,091	81,631	77,906	36,670
Roseburg				
Recreation Management Areas	158	6,913	9,018	10,408
Areas of Critical Environmental Concern	3,675	3,675	3,675	3,675
Subtotal	3,833	10,588	12,693	14,083
Salem				
Recreation Management Areas	97	15,730	32,724	40,231
Areas of Critical Environmental Concern	6,294	6,294	5,690	6,294
Protected Lands with Wilderness Characteristics	2,524	58	58	-
Subtotal	8,915	22,082	38,472	46,525
Grand Total	**124,002**	**145,387**	**171,844**	**140,371**

In all action alternatives, the BLM would increase the acreage of areas *closed* to OHV use compared to the No Action alternative; this acreage increase totals 49,244 acres between alternatives, ranging from 128,757 acres in Alternative A to 178,001 acres in Alternative C. The total amount of *closed* area designation varies by alternative because of corresponding Areas of Critical Environmental Concern and Recreation Management Area designations. Even under the most restrictive alternative for OHV use (Alternative C), the BLM would close less than 1 percent of BLM-administered lands in the decision area to OHV use. This small increase in closed area designations would not measurably affect OHV opportunities when considering the overall planning area. However, it would result in a loss of site-specific OHV opportunities, while improving non-motorized recreational experiences in these areas.

In all action alternatives, the BLM would designate 330,000 acres that are currently open as either *limited* or *closed*. The reduction in acres open to OHV travel would not directly equate to a loss of OHV opportunities, this is because a majority of the areas that are currently *open*, and which would remain *open* under the No Action alternative, are located on steep, densely-forested terrain, which is not conducive to cross-country motor vehicle travel. For example, the BLM classifies only 7 percent of these currently open areas as non-forest habitat. For this reason, OHV use is generally *limited* to existing roads and trails due to conditions in these areas despite their current *open* designations. The existing routes that have shifted from *open* to *limited* would continue to be available to OHV use until route designations are completed through subsequent implementation-level Transportation Management Plans.

In all action alternatives, the BLM would designate a large percent of BLM-administered lands in the decision area as *limited* to existing roads and trails (**Table 3-220**) All action alternatives would designate as *limited* to existing roads and trails, at a minimum, a 51 percent increase from the No Action alternative. For the action alternatives, this change would reduce the amount of area designated as *limited* to designated roads and trails from 1,119,686 acres. Alternative A has the greatest number of acres in the *limited* to existing category followed by Alternatives B, D, and C respectively.

Effects from Recreation and Visitor Services Management

Improving OHV recreation under all action alternatives would primarily be accomplished through subsequent route designations within *limited* to existing areas, which identify specific roads and trails to provide OHV opportunities for the public. Designated routes would be improved or expanded to enhance visitor experiences or to meet increasing demand. Areas not designed or suitable for OHV use (or are only compatible for certain types of motor vehicles) are closed or restricted in order to reduce visitor conflicts and improve public safety.

An important differentiator among the alternatives is designation of some RMAs for exclusion of OHV use. The restrictions identify areas that would be designated for more primitive recreation opportunities. Closure acreages correspond proportionally to RMA total acreages by alternative. **Table 3-222** shows acres restricted to OHV recreation by alternative.

Table 3-222. Off-highway vehicle recreation opportunities, acres restricted within Recreation Management Areas.

Recreation Opportunities	Alt. A (Acres)	Alt. B (Acres)	Alt. C (Acres)	Alt. D (Acres)
Off-Highway Vehicle Use	17,517	49,969	87,261	105,474

Alternative A

Under Alternative A, nearly all of the decision area (98 percent) would be limited to existing OHV use until the BLM completed implementation level travel planning. Alternative A has the smallest amount of acreage closed to OHV use (128,757 acres, less than 1 percent). Under Alternative A, the BLM would not establish any Recreation Management Areas that emphasize motorized use. Compared to the No Action alternative, Alternative A would designate more areas as *closed* to OHVs and would designate more Recreation Management Areas for non-motorized trail use. Compared to Alternatives B, C, and D, Alternative A would restrict the fewest number of acres within RMAs as closed to motorized recreation. However, Alternative A would establish the highest proportion of RMAs as closed to motorized use (87 percent) when compared to the other action alternatives.

Alternative A would result in the eventual decrease of non-motorized recreation opportunities within the planning area due to the decrease in acres designated as RMAs for motorized recreation. Since RMAs

provide targeted recreation experiences and protect unique recreation settings, visitors seeking motorized forms of recreation would experience reduced opportunities in Alternative A when compared to all Action Alternatives. In the long-term under Alternative A, as visitor use increases, conflicts between motorized and non-motorized visitors are expected to increase in popular use areas, resulting in lower quality recreation experiences for non-motorized/motorized visitors. User conflicts would continue to increase over the long-term, without a recreation setting established, and no management controls to separate uses.

Alternative B

Under Alternative B, most of the decision area (93 percent) would be *limited* to existing OHV use until the BLM completed implementation level travel planning. Alternative B has approximately 20,000 more acres closed to OHV use than Alternative A and fewer acres closed to motorized use than Alternatives C and D. The majority of these closures would occur within ACECs to protect relevant and important values and within RMAs to protect setting characteristics and provide for targeted recreation outcomes that are not compatible with the presence of motorized use. Alternative B would designate more RMAs for both motorized and non-motorized trail uses when compared to Alternative A. Compared to Alternatives C and D, Alternative B would restrict fewer acres within RMAs as *closed* to motorized recreation. Alternative B would establish the highest proportion of RMAs as c*losed* to motorized use (87 percent) when compared to the other action alternatives.

Under Alternative B, the most significant reduction in recreational OHV use occurs within the existing Timber Mountain OHV area. This RMA is located approximately 30 miles east of Medford, Oregon, on BLM-administered lands intermingled with privately owned lands. Approximately 375 miles of OHV trails and roads, within the 10,160 acres of the Timber Mountain RMA, would be *closed* to motorized recreation use under Alternative B; these acres would continue to be *limited* to existing under all other alternatives. Existing trails proposed as closed to OHV use on BLM-administered lands, are proposed for non-motorized recreation use (hiking, horseback riding, and mountain biking) under Alternative B. Implementation-level travel planning would include designation of the final non-motorized route system within the Timber Mountain RMA.

The current estimated visitor use levels for Timber Mountain RMA are 16,000 to 20,000 riders per year. This range is based on BLM recreation staff observations of OHV use since 2005 in the Timber Mountain RMA. Under Alternative B, the closure of the Timber Mountain RMA would result in a decrease of approximately 375 miles of motorized OHV roads and trails open to the public. The decrease in available miles of roads and trails for OHV use would likely result in a decrease in the quality of the experience for resident and non-resident OHV users who frequently use the area. This decision would negatively affect the approximately 16,000 to 20,000 annual visitors to the Timber Mountain RMA. Non-motorized trail based recreation users would see increased opportunities to recreate on the existing 375 miles of routes that would be closed to OHV use.

Designated motorized and non-motorized trail riding opportunities would be provided on public lands designated for motorized use under RMA designations. These designations would increase opportunities over the long-term compared to Alternative A by facilitating increased funding for motorized routes and trails and non-motorized trails. Public access to public lands would continue to be very restricted, so very limited motorized recreation opportunities would exist in these areas under all alternatives.

Alternative C

Under Alternative C, most of the decision area (92 percent) would be limited to existing OHV use until the BLM completed implementation-level travel planning. Alternative C has approximately 50,000 more acres *closed* to OHV use than Alternative A and fewer acres *closed* to OHV use than Alternatives C and D. The majority of these closures would occur within ACECs to protect relevant and important values and

within RMAs to protect setting characteristics and provide for targeted recreation outcomes that are not compatible with the presence of motorized use. Alternative C would designate more RMAs for both motorized and non-motorized trail uses when compared to Alternative A. Compared to Alternative D, Alternative C would restrict fewer acres within RMAs to motorized recreation. Alternative C would establish 21 percent of RMAs as *closed* to motorized use. When compared to the other Action Alternatives, Alternative C closes less RMA acres then Alternative A and B and more than Alternative D. Motorized recreation opportunities would be available on 329,556 acres of RMAs, which is more acres compared to Alternatives A and B and less then Alternative D.

Increased visitation due to these new proposed RMAs would increase the use of roads and trails and would increase the demand for new travel opportunities. Managing new RMAs could constrain or restrict public access in certain recreation management zones. Special Recreation Management Areas targeting OHV and non-motorized trail-based recreation would provide the greatest benefit. In RMAs that are specially managed to accommodate OHV activities, visitors seeking non-motorized forms of recreation would be dissuaded from using these areas. If these visitors did engage in non-motorized activities within these emphasis areas, the quality of their experiences would be diminished because of the limited compatibility of their activity with OHV use. In general, however, OHV RMAs help segregate these user groups, resulting in an overall improvement in the quality of experiences for all visitors.

Non-motorized recreation visitors may find other locations to recreate, if competition occurs to ride or use the same area, or if sounds from OHV use intrude on the quality of the desired non-motorized recreation experience. Hikers and horseback riders may also be displaced if no designated areas exist for their preferred use, or if OHV use and OHV sound increase in the future.

Alternative D

In Alternative D, impacts would be similar to those identified in Alternative C. Alternative D provides the greatest number of RMAs that would provide OHV recreation opportunities. Under Alternative D, a total of 561,677 acres of RMAs would provide opportunities for OHV recreation within the decision area. This would result in an increase in acres of OHV areas as compared to the No Action alternative and Alternatives A, B, and C.

By emphasizing OHV use in these areas, there would eventually be an improvement in off-highway vehicle opportunities that would result from an increase in developments. This would result in more concentrated levels of OHV use within these areas and likely cause a reduction in dispersed OHV use on other BLM-administered lands. It is assumed that dispersed OHV use would decrease because riders would be attracted to greater opportunities within these managed areas that provide targeted OHV recreation opportunities.

Effects from Wildlife Management

Under all action alternatives, OHV use is prohibited within 330 feet of bald eagle and golden eagle nest sites during the breeding season. Under all action alternatives, OHV use would be prohibited within 660 feet of bald eagles and golden eagle nest sites in areas without forest cover or topographic relief.

Effects from Cultural Resource Management

The BLM would close cultural sites to visitation if the BLM determined that travel-related activity threatens cultural site integrity. Site-specific decisions to protect a threatened site will affect travel management opportunities in the short- and long-term. Compared to the No Action alternative, the action

alternatives could have more long-term adverse effects on travel opportunities because access would be limited to protect cultural resources.

Effects from Visual Resource Management

Management to protect visual resources would restrict new routes or trail plans in areas identified for such development (some RMAs, for example). Visual Resource Management (VRM) classifications would affect the location of new transportation systems. The BLM would design projects to meet the objectives of the VRM class established in the RMP for the project area. The development of travel assets (roads, trails) would be compatible with VRM Classes III and IV. Transportation actions would be limited in VRM Class I and Class II areas. Alternative A has 147,245 acres designated VRM Class I and Class II and is the most restrictive to transportation asset development. Alternatives B and C have 111 and 115 acres respectively, designated as VRM Class I and Class II, resulting in slightly less of an effect to transportation asset development when compared with Alternative A. When compared to the other action alternatives, Alternative D is least restrictive to travel management based on VRM class designations. Alternative D has the least impact on future transportation asset development with only 63,684 acres designated VRM Class I and Class II.

Issue 2

How will the alternatives affect the use, maintenance, and condition of the BLM's transportation system?

Summary of Analytical Methods

The BLM used road ratios (feet/Mbf) developed for the 2008 RMP/EIS to estimate miles of new road construction required for the No Action alternative and all the action alternatives. These road ratios reflect different road requirements for different types of harvest. Uneven-aged management and thinning harvest types require more new road construction than the regeneration harvest type. The average road ratios (feet/Mbf) across all offices for uneven-age management harvest are 20 percent higher than the road ratios for regeneration harvest and the road ratios for thinning harvest are 70 percent higher than for regeneration harvest.

The BLM also computed road ratios (feet/Mbf) for thinning harvests, using six years (FY2007-FY2012) of harvest volume sold data and timber sale contract data, as a reasonableness check against the 2008 RMP/EIS road ratios. The BLM found the 2008 RMP/EIS ratios to be somewhat higher than the FY 2007-2012 computed ratios thus yielding perhaps a slightly overestimated new construction mileages for thinning harvests. The BLM has no similar new road construction data for either regeneration or uneven-aged management harvests.

The BLM assumed that current trends in road closures would continue into the future since road closure mileage may not be sensitive to harvest levels given that most BLM-administered lands are encumbered by reciprocal right-of-way agreements. In other words, even if the harvest level would indicate an opportunity for road closure, the BLM may not be able to accomplish these closures due to the need to protect reciprocal right-of-way holders' rights to use BLM-owned roads.

The BLM projected miles of road renovation and purchaser renovation value, miles of road improvement, and miles of road closure for each of the alternatives using six years (FY2007-FY2012) of harvest volume sold data and timber sale contract data. The BLM projected total miles of the road network utilized for each alternative using eight years (CY2005-CY2012) of BLM timber sale contract haul data. Analytical conclusions drawn for each alternative include:

- Miles of permanent and temporary new road construction
- Miles of permanent and long-term road closure
- Road network mileage changes
- Miles of road renovation and improvement
- Miles of the existing road network utilized
- Road maintenance fees collected as a percentage of annual maintenance need
- Value of purchaser renovation as a percentage of the BLM's deferred maintenance backlog

The Planning Criteria provides more detailed information on analytical assumptions, methods and techniques, and geographic and temporal scales, which is incorporated here by reference (USDI BLM 2014, pp. 127-130).

Affected Environment

Road Network Description

The following functional classifications describe the BLM's western Oregon transportation system:

- Collector roads—Roads that primarily provide access to large blocks of public land, accommodate multiple uses, have BLM's highest traffic volumes, and connect with state and county road systems
- Local roads—Roads that normally serve smaller areas than collectors, accommodate fewer uses, have lower traffic volumes, and connect with collectors or State and County road systems
- Resource roads—Roads that provide point access to public lands, typically exist for a single use, carry very low traffic volumes, and connect with local or collector roads

These classifications indicate the character of service the roads provide and the appropriate road maintenance intensity levels (i.e., from basic custodial care to annual scheduled and preventative maintenance programs). **Table 3-223** shows the distribution of functional classifications within the BLM's western Oregon transportation system. Currently, slightly less than 5 percent of the transportation system falls into the "collector" classification, while about 21 percent of the system is "local," and nearly 75 percent "resource."

Table 3-223. Functional classification of roads within the decision area.

District/Field Office	Collector (Miles)	Local (Miles)	Resource (Miles)	Totals (Miles)
Coos Bay	186	408	1,302	1,896
Eugene	71	422	1,524	2,017
Klamath Falls	47	154	323	524
Medford	156	981	3,452	4,589
Roseburg	94	581	2,193	2,868
Salem	101	546	1,789	2,436
Totals	**655**	**3,092**	**10,583**	**14,330**

Total inventoried transportation system mileage has remained steady since 2007; there are currently 14,330 miles compared to 14,394 miles in 2007. Additionally, the BLM owns approximately 600 miles of non-inventoried roads, typically short (< 500') logging spurs, within the boundaries of the decision area.

Eighty-one percent of the BLM transportation system has some form of surfacing (aggregate or bituminous surface treatment) with 97 percent built to a single lane width.

Road Network Condition

The overall replacement value (the current cost to rebuild the network from scratch) of the BLM transportation system exceeds $10 billion. Approximately 30 percent of the road mileage is in fair or poor condition, primarily due to depleted surfacing aggregate and worn-out minor culverts. Currently the deferred maintenance backlog exceeds $300 million. However, 85 percent of bridges and 97 percent of major culverts are in good condition.

Tables 3-224, **3-225**, and **3-226**, summarize western Oregon road, bridge, and major culvert condition data respectively.

Table 3-224. Road condition, mileage, replacement value, and deferred maintenance backlog.

District/Field Office	Road Condition	Mileage	Replacement Value	Deferred Maintenance
Coos Bay	Fair/Poor	397	$314 million	$20 million
	Good	1,499	$1.216 billion	$1 million
	Totals	1,896	$1.530 billion	$21 million
Eugene	Fair/Poor	537	$361 million	$23 million
	Good	1,480	$1.267 billion	$2 million
	Totals	2,017	$1.628 billion	$25 million
Klamath Falls	Fair/Poor	66	$47 million	$6 million
	Good	458	$241 million	$1 million
	Totals	524	$288 million	$7 million
Medford	Fair/Poor	1,540	$1.061 billion	$123 million
	Good	3,049	$2.016 billion	$4 million
	Totals	4,589	$3.077 billion	$127 million
Roseburg	Fair/Poor	1,176	$730 million	$85 million
	Good	1,692	$934 million	$5 million
	Totals	2,868	$1.664 billion	$90 million
Salem	Fair/Poor	575	$408 million	$46 million
	Good	1,861	$1.347 billion	$1 million
	Totals	2,436	$1.755 billion	$47 million
Totals	Fair/Poor	4,291	$2.921 billion	$303 million
	Good	10,039	$7.021 billion	$14 million
	Grand Total	**14,330**	**$9.942 billion**	**$317 million**

Table 3-225. Bridge condition, replacement value, and deferred maintenance backlog.

District/Field Office	Bridge Condition	Count	Replacement Value	Deferred Maintenance
All Offices	Fair/Poor	53	$34.5 Million	$7.1 Million
	Good	306	$249.9 Million	$1.5 Million
	Grand Total	**359**	**$284.4 Million**	**$8.6 Million**

Table 3-226. Major culvert condition, replacement value/deferred maintenance.

District/Field Office	Major Culvert Condition	Count	Replacement Value	Deferred Maintenance
All Offices	Fair/Poor	18	$1.8 Million	$1.2 Million
	Good	526	$57.3 Million	-
	Grand Total	**544**	**$59.1 Million**	**$1.2 Million**

Road Maintenance

The BLM is responsible for maintaining roads under the BLM's ownership. Maintenance provides for resource protection, safe accommodation of users, and protection of the government's investment. Road maintenance on BLM roads is primarily for timber management/extraction, recreation, and fire management activities.

Each year the offices identify and prioritize annual maintenance work. Currently the BLM maintains about 14 percent of the western Oregon transportation system each year. The miles of annual maintenance the BLM conducts has declined in recent years. From 2007 to 2013, annual maintenance mileage declined about 47 percent, from 3,926 miles in 2007 to 2,064 miles in 2013. Annual maintenance work ranges from aggregate surface blading and roadside brush removal, to pothole repair and culvert replacement. The BLM funds annual maintenance of roads from a combination of appropriated funds and a collected account. Commercial timber haul, both BLM and private, generates funds paid into the collected account based on a maintenance fee charged on a volume hauled and mileage used basis.

While appropriated funding has remained flat over the last two decades, the BLM's collected account has declined dramatically, from $8 million annually 25 years ago, down to only about $3 million annually currently. This reduction is due entirely to BLM's declining timber sale offerings since private use of the network has remained constant over the last two decades. This BLM funding shortfall creates a gap between annual maintenance need and actual annual maintenance expenditure resulting in a large and growing deferred maintenance backlog, currently exceeding $300 million.

Road Closure

There are times the BLM determines that a road closure or travel restriction may be warranted. The objectives of road closure are typically for safety or resource protection, such as to reduce sedimentation, restore hydrological processes, reduce total road maintenance cost, and reduce impacts to fish or wildlife habitat, botanical resources, or special areas. The BLM offices coordinate in advance with potentially affected reciprocal right-of-way permittees on decisions to close roads for the purpose of protecting permittee rights to use BLM-owned roads. Should permittees not concur on BLM proposed long-term or permanent closures, these proposals must be dropped, thus limiting the BLM's opportunities to reduce road densities.

The BLM currently has about 900 miles (6 percent) of the transportation system in a long-term decommissioned status. These are all resource roads that have been closed to vehicles and left in an erosion-resistant condition; they may be re-opened in the future as needed. Slightly more than half of these miles have a natural surface type.

Environmental Effects

New Road Construction

Timber harvest operations would require construction of additional resource roads under each of the alternatives. No new collector or local roads would be needed as this portion of the transportation network was fully built out decades ago. **Table 3-227** summarizes the estimated new permanent and temporary road construction by surface type for the first decade.

Table 3-227. First decade new road construction by road surfacing and status.

Alternative	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Total (Miles)
No Action	76	272	514	88	**950**
Alt. A	32	89	157	33	**311**
Alt. B	71	187	362	68	**688**
Alt. C	78	229	424	75	**806**
Alt. D	27	72	128	27	**254**

In the first decade, total resource road new construction mileages range from 254 miles for Alternative D to 806 miles for Alternative C. Approximately 40 percent of new road miles are temporary for each of the alternatives.

In the first decade, new construction of permanent resource roads ranges from 155 miles for Alternative D to 499 miles for Alternative C. This represents 1.0 percent of the existing western Oregon road network for Alternative D and 3.3 percent for Alternative C. Approximately 85 percent of these new road miles are surfaced with aggregate for all of the alternatives, similar to the existing network. All new construction would be single lane width.

Table 3-228 contains a summary of the estimated new road construction by harvest type for the first decade.

Table 3-228. First decade new road construction associated with harvest methods.

Alternative	Regeneration Harvest (Miles)	Thinning Harvest (Miles)	Uneven-Aged Harvest (Miles)	Totals (Miles)
No Action	312	638	-	**950**
Alt. A	235	18	58	**311**
Alt. B	151	351	186	**688**
Alt. C	470	214	122	**806**
Alt. D	92	29	133	**254**

The amount of new construction attributable to each harvest type varies greatly between the alternatives; regeneration harvest ranges from 22 percent (Alt. B) to 76 percent (Alt. A), thinning harvest ranges from 6 percent (Alt. A) to 51 percent (Alt. B), and uneven age management harvest ranges from 15 percent (Alt. C) to 52 percent (Alt. D).

Tables 3-229 to **3-233** contain a summary of the estimated new permanent and temporary road construction by office and surface type for the first decade.

Table 3-229. No Action first decade new road construction by road surfacing and status.

District/ Field Office	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Totals (Miles)
Coos Bay	27	40	67	6	140
Eugene	21	12	195	4	232
Klamath Falls	-	-	-	3	3
Medford	10	81	112	60	263
Roseburg	2	55	94	-	151
Salem	16	84	46	15	161
Totals	**76**	**272**	**514**	**88**	**950**

Table 3-230. Alternative A first decade new road construction by road surfacing and status.

District/ Field Office	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Totals (Miles)
Coos Bay	11	15	26	2	54
Eugene	5	2	44	1	52
Klamath Falls	-	-	-	1	1
Medford	9	27	45	24	105
Roseburg	1	16	27	-	44
Salem	6	29	15	5	55
Totals	**32**	**89**	**157**	**33**	**311**

Table 3-231. Alternative B first decade new road construction by road surfacing and status.

District/ Field Office	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Totals (Miles)
Coos Bay	20	30	50	4	104
Eugene	13	8	126	3	150
Klamath Falls	-	-	-	2	2
Medford	24	46	87	47	204
Roseburg	2	39	64	-	105
Salem	12	64	35	12	123
Totals	**71**	**187**	**362**	**68**	**688**

Table 3-232. Alternative C first decade new road construction by road surfacing and status.

District/ Field Office	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Totals (Miles)
Coos Bay	27	40	67	6	140
Eugene	14	8	136	3	161
Klamath Falls	-	-	-	4	4
Medford	19	54	89	49	211
Roseburg	3	54	92	-	149
Salem	15	73	40	13	141
Totals	**78**	**229**	**424**	**75**	**806**

Table 3-233. Alternative D first decade new road construction by road surfacing and status.

District/ Field Office	Temporary Rock (Miles)	Temporary Natural (Miles)	Permanent Rock (Miles)	Permanent Natural (Miles)	Totals (Miles)
Coos Bay	9	9	15	1	34
Eugene	4	2	39	-	45
Klamath Falls	-	-	-	1	1
Medford	10	20	39	21	90
Roseburg	-	17	24	-	41
Salem	4	24	11	4	43
Totals	**27**	**72**	**128**	**27**	**254**

The Medford District would require more new permanent road construction than the other western Oregon offices for all harvest types and for each of the alternatives. The average road ratios (feet/Mbf) across all harvest types are about 2.5 times greater in Medford than the average of the other offices since Medford harvest volumes per acre are typically lower than the other offices. Medford accounts for 28 to 39 percent of the new road miles for each of the alternatives.

Road Closure

The BLM would accomplish both permanent and long-term road closures under each of the alternatives. **Tables 3-234 and 3-235** summarize estimated permanent and long-term road closures by surface type for the first decade. The BLM assumed that road closure mileages would be consistent across alternatives since even if the harvest volume projected for a given alternative would indicate an opportunity for road closure, the BLM may not be able to accomplish these closures due to the need to protect reciprocal right-of-way holders' rights to use BLM-owned roads.

Table 3-234. First decade permanent road closure, all alternatives.

District/Field Office	Rock (Miles)	Natural (Miles)	Totals (Miles)
Coos Bay	2	29	31
Eugene	4	38	42
Klamath Falls	-	-	-
Medford	1	7	8
Roseburg	-	10	10
Salem	1	1	2
Totals	**8**	**85**	**93**

Table 3-235. First decade long-term road closure, all alternatives.

District/Field Office	Rock (Miles)	Natural (Miles)	Totals (Miles)
Coos Bay	35	96	131
Eugene	49	4	53
Klamath Falls	-	9	9
Medford	-	10	10
Roseburg	7	75	82
Salem	27	61	88
Totals	**118**	**255**	**373**

Permanent road closures, aimed primarily at natural surface roads, would affect significantly less than 1 percent of the western Oregon road network in the first decade.

Long-term road closures, implemented at a 2:1 ratio of natural surface type to rock surface type, would increase the percentage of the BLM road network in a long-term closure status from its current 6 percent to 8 percent by the end of the first decade.

In the first decade, net permanent road mileage changes range from an increase of 62 miles for Alternative D to an increase of 406 miles for Alternative C. This represents a 0.4 percent increase in the existing western Oregon road network for Alternative D and a 2.7 percent increase for Alternative C.

Road Renovation and Road Improvement

The BLM will accomplish both renovation and improvement of existing roads needed for timber sale use under each of the alternatives to support anticipated use, provide for safety, and protect adjacent lands and resources.

Renovation consists of restoring a degraded road to its original design standard (e.g., replacing both worn out cross drain culverts and depleted rock surfacing). Improvement consists of upgrading the original design standard, e.g., adding cross drain culverts and rock surfacing to an existing natural surface road.

Table 3-236 summarizes the estimated existing road renovation and improvement for the first decade.

Table 3-236. First decade existing road renovation and improvement.

Alternative	Renovation (Miles)	Improvement (Miles)
No Action	6,667	311
Alt. A	3,669	223
Alt. B	5,098	287
Alt. C	7,495	526
Alt. D	2,685	161

In the first decade, road renovation mileages range from 2,685 miles for Alternative D to 7,495 miles for Alternative C, approximately 80 percent of which occurs on rock surface roads. Renovation of some roads will occur more than once in the first decade. Renovation tasks typically include roadside brushing, ditchline and culvert cleaning, culvert replacement, rock surface replacement, and pot hole patching on paved roads.

In the first decade, road improvement mileages range from 161 miles for Alternative D to 526 miles for Alternative C, virtually all of which will consist of rocking natural surfaced roads, thus increasing the percentage of surfaced roads by 1 percent to 3 percent from the current 81 percent.

Road Utilization, Maintenance, and Condition

Table 3-237 contains a summary of estimated road utilization by surface type for the first decade for each of the alternatives.

Table 3-237. First decade existing road utilization by surface type.

Alternative	Paved (Miles)	Paved (%)	Rock (Miles)	Rock (%)
No Action	2,667	191%	4,115	40%
Alt. A	1,666	120%	2,561	25%
Alt. B	2,222	159%	3,416	33%
Alt. C	3,734	268%	5,741	56%
Alt. D	1,206	87%	1,854	18%

In the first decade, rock road utilization percentages range from 18 percent for Alternative D to 56 percent for Alternative C. Similarly, the first decade paved road utilization percentages range from 87 percent for Alternative D to 268 percent (i.e., meaning each paved road mile will be used 2.68 times) for Alternative C.

Tables 3-238 and **3-239** summarize estimated road maintenance fee collections by surface type for the first decade for each of the alternatives. The BLM based these estimates on both road utilization ratios developed from eight years (CY2005-FY2012) of BLM timber sale road use activity, at a western Oregon scale, and BLM's current road maintenance fee rate schedule. Additionally, the tables compares maintenance fee collections to the annual maintenance need for roads as reported in the Facility Asset Management System (the BLM's constructed asset inventory).

Table 3-238. First decade road maintenance fee collections compared to annual maintenance (AM) need.

Alternative	Paved Roads ($)				
	Road Use (Mbf-Miles)	Maintenance Fee/Mbf-Mile	Maintenance Fee Collected	AM Need	Percent of AM Need
No Action	11.9 M	$0.71	$8.4 M	$80 M	10%
Alt. A	7.4 M	$0.71	$5.3 M	$80 M	6%
Alt. B	9.9 M	$0.71	$7.0 M	$80 M	9%
Alt. C	16.6 M	$0.71	$11.8 M	$80 M	15%
Alt. D	5.4 M	$0.71	$3.8 M	$80 M	5%

Table 3-239. First decade road maintenance fee collections compared to annual maintenance (AM) need.

Alternative	Rock Roads ($)				
	Road Use (Mbf-Miles)	Maintenance Fee/Mbf-Mile	Maintenance Fee Collected	AM Need	Percent of AM Need
No Action	5.4 M	$1.46	$7.9 M	$88 M	9%
Alt. A	3.4 M	$1.46	$4.9 M	$88 M	6%
Alt. B	4.5 M	$1.46	$6.6 M	$88 M	7%
Alt. C	7.5 M	$1.46	$11.0 M	$88 M	12%
Alt. D	2.4 M	$1.46	$3.6 M	$88 M	4%

In the first decade, rock road maintenance fee collection ranges from 4 percent of annual maintenance need for Alternative D to 12 percent for Alternative C; similarly, the first decade BST road maintenance fee collections range from 5 percent of annual maintenance need for Alternative D to 15 percent for Alternative C.

When combined with the BLM's other first decade sources of annual maintenance funding, which are common to each of the alternatives, 1) assumed annual maintenance appropriation of $63 million, and 2) private commercial timber haul maintenance fee collections of $25 million, the total amount available for annual maintenance expenditures for both rock and BST surfaced roads ranges from $95 million for

Alternative D (57 percent of annual maintenance need) to $111 million for Alternative C (66 percent of annual maintenance need).

Under all alternatives, the road utilization rates are insufficient to close the gap between annual maintenance expenditure and annual maintenance need, with the shortfall greatest for Alternative D and least for Alternative C. The BLM is likely to continue to accrue new deferred maintenance in the first decade under any of the alternatives. Given the higher utilization rates for paved roads relative to rock roads, new deferred maintenance would likely skew towards rock roads.

Table 3-240 contains a summary of the estimated value of timber sale purchaser renovation for the first decade for each of the alternatives. Additionally, the table compares renovation expenditures to the deferred maintenance backlog for roads as reported in the Facility Asset Management System (the BLM's constructed asset inventory).

Table 3-240. First decade renovation expenditures compared to the deferred maintenance (DM) backlog.

Alternative	Paved and Rock Surfaced Roads ($)				
	Total Harvest Volume (Mbf)	Renovation Expenditure/Mbf	Renovation Expenditure	Current DM Backlog	Percent of DM Backlog
No Action	3,995,556	$9.55	$38.2 M	$317 M	12%
Alt. A	2,486,143	$9.55	$23.7 M	$317 M	7%
Alt. B	3,316,594	$9.55	$31.7 M	$317 M	10%
Alt. C	5,573,610	$9.55	$53.2 M	$317 M	17%
Alt. D	1,800,457	$9.55	$17.2 M	$317 M	5%

Renovation expenditures will therefore reduce the BLM's $317 million deferred maintenance backlog. In the first decade, renovation expenditures range from 5 percent of the deferred maintenance backlog for Alternative D to 17 percent for Alternative C.

When combined with the BLM's deferred maintenance program assumed appropriation of $30 million, the only other first decade source of deferred maintenance funding, the total amount available for deferred maintenance expenditures on surfaced roads ranges from $47 million for Alternative D (15 percent of the deferred maintenance backlog) to $83 million for Alternative C (26 percent of the deferred maintenance backlog).

In the first decade, **net** deferred maintenance backlog changes are likely to range from a small increase for Alternative D to a small decrease for Alternative C. Across alternatives, reductions in the deferred maintenance backlog due to timber sale purchaser renovation expenditures and deferred maintenance program spending are largely offset by accruing new deferred maintenance generated by the gap between annual maintenance need and actual annual maintenance expenditure.

References

USDI BLM. 2014. Resource management plans for western Oregon planning criteria. Bureau of Land Management, Oregon/Washington State Office, Portland, OR. http://www.blm.gov/or/plans/rmpswesternoregon/plandocs.php.