<u>Section B</u>
<u>Forest Roads</u>

Issue: What are the effects of forest roads on the sediment regime and on aquatic habitat? Are these effects preventing the recovery of salmon and what might be done to reduce possible adverse effects?

Forest Practices Advisory Committee on Salmon and Watersheds

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I. Current Scientific Findings and Monitoring Results

All streams under natural conditions have sediment inputs at varying levels from terrestrial sources (background levels) depending upon soil, topography, vegetation and rainfall. Sediment enters water through various processes that include soil surface erosion, channel erosion and mass movements (landslides, debris flows), and these inputs can be either chronic or episodic. Studies have indicated that high sediment levels can affect fish by increasing mortality, reducing growth rates, causing physiological stress, impairing homing instincts, and reducing feeding rates.

Efforts to relate sediment concentration to fish response had mixed results (Everest et al., 1987). Some studies have found that increased sedimentation reduces egg and alevin survival. However, not all sediment increases have detrimental effects and there are cases where fish have maintained large and viable populations in streams with high chronic loads of fine sediment (Everest et al., 1987). Fish appear to react most negatively when fine sediment concentrations are both high and persistent (Newcombe and MacDonald 1991). Whether effects of increased sediment are adverse depends upon the nature and timing of the delivery, the type of material delivered, and the prior condition of the stream.

Massive levels of fine sediment delivery can produce changes in channel habitat by reducing pool frequency, depth and volume (Coats et al., 1985; Megahan et al., 1980). Streams that have a limited supply of coarse sediments, or minimal ability to retain these materials, can experience reductions in habitat quality through channel degradation, sometimes resulting in channels scoured to bedrock in mountain streams. Habitat can potentially be enhanced if mass erosion delivers material to streams where coarse sediment is limited (Botkin 1995; Everest et al., 1987). Fine sediment can also affect the production of aquatic insects (fish food organisms) (Hicks et al., 1991).

The effects of increased sediment delivery from roads depend upon numerous factors. Most fine sediment from surface erosion processes is delivered during common rainfall events and is relatively chronic. Road-related landslides and stream crossing failures can result in significant sediment impacts from the volume of material in the failed fill and also by scouring headwater channels for some distance. These types of sediment inputs tend to be episodic and are often the result of large rainfall events. The IMST report also includes similar findings on the differences between chronic and episodic sources of road sediment (pp. 23-26).

It is roads rather than timber harvesting that historically have been the primary source of sediment from forest management activities in the western United States (Megahan and Ketcheson, 1996). High-risk factors for forest roads include road surface erosion, road-fill failure, and the proximity and hydrologic connection of road segments to streams. Roads can also directly alter stream channels and fish habitat, especially when roads are constructed parallel to streams and within the floodplain. The effects of roads on fish passage are covered in another issue paper.

Research has shown newly constructed or reconstructed roads may have ten times more surface erosion the first winter after construction as compared to subsequent years (Megahan and Kidd, 1972; Megahan, 1974; Luce and Black, 1999). This results from increased erodibility because of soil disturbance during construction, and the lack of erosion pavement and vegetation to protect the soil surface, which can in large part be mitigated by applying Best Management Practices (BMPs) to protect the soils immediately after construction.

During periods of wet weather, road surfaces that are not constructed with adequate surface materials and spacing of drainage structures are a potential source of fine sediment delivery by allowing sediment-laden waters to enter stream channels directly. Hauling operations conducted on roads with poor drainage can further increase the risk of sediment delivery (Bilby et al., 1989; Reid and Dunne, 1984). Fill failure is also a risk, especially for those roads not constructed to current standards. Sidecast roads, roads built on old railroad crossings with relatively deep fills, and stream crossings with inadequately designed and sited culverts are examples of forest road features with increased fill failure risk. Road segments that are close to streams and stream crossings also have an increased risk of sediment delivery. The likelihood of road surface runoff, fill failure, and washouts delivering sediment to the stream channel increases the closer a road segment is located to a stream.

Different studies report variable effects of forest roads on the hydrology of forested basins. Adams and Ringer (1994) reviewed the results of 14 published research reports that examined the relationship between forest roads and water quantity. The findings of these studies were mixed. The reviewers state the following:

> "Some studies have shown no effects of roads, while others found that forest road construction increased peak flows in small, upland watersheds. In these locations, streamflow effects appear to be directly related to the total area within the watershed of roads and other heavily compacted surfaces that are relatively impermeable to water. In larger watersheds, little or no effect on streamflows is expected because forest roads and other impermeable areas on forest lands typically represent a relatively small area."

King et al. (1984), examined a number of streamflow variables following forest road construction (maximum streamflow, date of maximum streamflow, annual minimum streamflow, annual water yield, and the 5 percent, 25 percent and 75 percent exceedance flows). No significant changes in the above parameters were detected, with the exception that an increase occurred in the 25 percent exceedance flow in one watershed and a decrease in the 5 percent exceedance flow in another watershed. Thomas and Megahan (1998) re-examined a study by Jones and Grant (1996) examining road building and harvesting effects on peak flows. For large watersheds (60-600 km^2), no peak flow effects were detected on one watershed and the results were inconclusive for two others. For small watersheds, (60-101 hectares[1]):

> "Peak flows were increased up to 90 percent for the smallest peak events on the clear-cut watershed and up to 40 percent for the smallest peak flows on the patch-cut and

[1] 1 hectare = 2.47 acres.

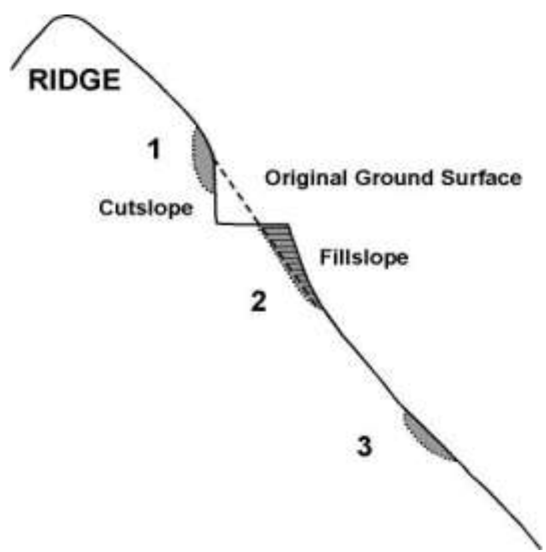
> roaded watershed. Percentage treatment effects decreased as flow event-size increased and were not detectable for flows with 2-year return intervals or greater on either treated watershed." (Thomas and Megahan, 1998)

Roads create a contiguous linear physical alteration to hillslopes, as shown in Figure 1. To create the running surface, or tread, it is necessary to excavate into the natural hillslope. On less steep slopes, this excavated material can be used as fill to make a portion of the running surface. Prior to the mid-1980s, excavated soil and rock from full-bench road construction was generally sidecast onto very steep slopes immediately below the road prism. These steeply sloped sidecast fills were often associated with landslides. Both cut- and fillslopes are steeper than the natural slopes, and, at least for some period of time after construction, are not vegetated. Thus, cut- and fillslopes have a higher landslide potential than the native hillslopes. Roads also alter the flow of water. Road cuts may intercept shallow groundwater, and the road surface normally collects surface water. This water is routed along the road to a location where it is discharged downslope of the road. Roads must also periodically cross streams. While most forest stream crossing structures are culverts, other designs include fords and bridges. During high flows, stream flows and/or road runoff can exceed culvert capacity, and/or bedload and floating debris may reduce or block the flow of water through the culvert. When drainage system capacity is exceeded, fill washouts, gullies, or landslides may occur in, or below the fill, or further down the road.

Stream crossing culverts and bridges are subject to plugging by woody debris and sediment and/or their capacity being exceeded by high flows. If water backs up and flows over the surface, a washout-type failure similar to a dam breaching may occur. When a road grade climbs through the stream crossing, there may be a high potential for channel diversion down the road (Weaver and Hagans, 1994). Such diversions can cause large gullies running long distances down the road and can cause additional landslides and washouts as well. The concentration of road drainage can also be associated with interactions between road systems and channels in steep terrain, causing gullies or increasing the risk of landslide occurrence at culvert outfalls (Montgomery, 1994).

Road systems may have the potential to block the downstream movement of large wood (LW). Where a stream crossing blocks the passage of LW there is the potential for a dam-break flood to occur as debris and water back up behind the crossing. Dam-break floods can result in a debris torrent causing significant impacts to the downstream reach in the form of scour and deposition. While debris torrents are a naturally occurring phenomenon that can add needed wood and sediment to a stream reach, an increase in the frequency and magnitude of debris torrents caused by human activity can have negative effects on aquatic habitat and riparian functions. The blockage of LW can also have downstream effects even if a dam-break flood does not occur. Where a downstream reach depends on a supply of large wood delivered during peak flows, road crossings not designed to pass LW can reduce upstream sources of wood and have a negative effect on riparian functions and aquatic habitat conditions.

Figure 1. Typical Locations of Road Associated Landslides Surveyed: In the Cutslope (1), In the Fillslope (2), and Associated with Drainage Discharge and Below the Fill (3). Note: The road construction depicted in this figure is not allowed under current FPA road construction rules. New roads built on steep slopes require full-bench and end-haul construction.



Landslides are typically the dominant erosion mechanism in areas with steep slopes. Landslide frequency can be greatly accelerated by road management practices (Sidle et al., 1985). For example, Megahan and Kidd (1972) found that 70 percent of accelerated sediment production in an Idaho batholith study site was associated with road-related landslides. Piehl et al., (1988) found only two landslides at culvert outlets, yet they comprised 72 percent of the total outlet erosion associated with 515 cross drainage culverts.

The location of landslide initiation in relation to the road prism has a significant influence on potential sediment delivery to streams. Landslides affecting the cutslope portion of the road are typically deposited in the road. While road surface runoff may erode the deposits of cutslope landslides, the landslide deposit may also divert surface waters away from designed drainage structures or divert water onto fillslopes. Fillslope failures are more likely to become debris flows, increasing in size and then entering intermittent and perennial channels.

For slopes that are considered at high risk for landslide potential, a technique known as end-hauling can be used to transport excess excavated materials to more stable waste area locations (this is required in Oregon). Using steeper grades to keep roads on ridgetops can be a significantly less expensive road system design as compared to having to end-haul for steep slopes. Relocating roads in lower-risk areas is also an effective means of landslide prevention. However, where these practices are not possible, end-hauling may be an effective, albeit expensive, technique for reducing landslides (Sessions et al., 1987).

II. Watershed-Scale Effects

Forest Roads

Forest road systems can have watershed-scale effects. These effects can be similar to natural processes, or may be related to non-naturally occurring physical and chemical alterations. Determining the specific causes of watershed-scale effects can be difficult or impossible, especially in watersheds with a history of multiple disturbances. However, it may be possible to associate some of the aforementioned conditions with certain road practices at specific locations.

Watershed-scale effects of forest road systems may include chronic turbidity during wet periods from repeated truck use (Bilby et al., 1989); changes in channel morphology and substrate composition; changes in peak flows in small basins; addition of certain pollutants (petroleum products, accidental spills); and the prevention of downstream movement of large wood and/or sediment.

Cumulative sedimentation impacts from timber harvesting and other forest management activities are often overshadowed by those of roads (Reid, 1993). Cumulative effects have been the focus of much modeling. Watershed-scale effects, or cumulative effects within a watershed, may be the result of a single source, the additive result of many sources, or the complex interactions between a number of different sources.

The dominant road-related sources for direct watershed-scale effects include road runoff delivery to stream channels (chronic erosion and potential peak flow changes in small watersheds); landslides (which tend to have larger volumes than nonroad landslides) (Robison et al, 1999); washouts related to stream crossings; and streams adjacent roads.

Indirect effects of forest roads are sometimes considered cumulative effects. These depend in large measure on control of access to recreational and unauthorized road users and are considered uncommon on many private lands where access is controlled. These indirect effects can include increased fishing pressure (legal and illegal); access for fish stocking or illegal introduction of non-native species; traffic damage to the surface and drainage system; garbage dumping; and accidental petroleum and chemical spills.

Other examples of watershed-scale effects include landslides that become larger debris torrents that scour long lengths of stream channel; road fills failing when impacted by up-slope landslides increasing the volume of debris flows; debris flows stopping at road fills and plugging drainage structures; stream crossing structures that do not pass large wood to fish bearing streams downslope; traffic-turbidity sources related to multiple forest operations; cascading washouts (where one culvert becomes plugged, sending the stream down the road, and exceeding culvert capacity at every culvert encountered along the road); and synchronous connection of ditches to waterways.

Past models have often evaluated cumulative effects using road density (USFS, 1988). Reid (1993) describes a number of problems with the use of the Equivalent Roaded Area (ERA) model and other older cumulative effects models. The Distributed Hydrology-Soil-Vegetation Model (DHSVM) is designed to look at hydrologic changes (peak flows) associated with roads and other forest practices (Storck et al., 1998). Models are being developed to evaluate the generation of surface erosion from roads. These include SEDMODL through the efforts of Boise Cascade Corporation (George Ice, personal communication, 1999) and WEPP under development by the U.S. Forest Service (Tysdal et. al., 1997).

One problem with using road density to evaluate potential watershed-scale effects is that, depending on road size, design, location, construction and maintenance techniques, roads can have very different effects on water resources. Road-related landslides that enter stream channels are uncommon if hillslope steepness is less than 50 percent (Robison et al., 1999). Chronic delivery of sediment to stream channels is rare on ridge top roads, while most stream adjacent roads have a high potential for chronic sediment delivery (ODF, 1996). Washouts are more common on roads with undersized drainage structures, high fills and long steady grades (Weaver and Hagans, 1994; ODF, 1997). All of these factors can be independent of road density. For example, the greatest road densities identified in the "Storm Impacts of 1996" study was found in the Vernonia and Estacada study areas (4.6 and 3.3 miles per square mile). Nevertheless, these areas had the fewest road washouts, and the lowest volume of road-associated sediment delivery to streams as compared to the other six study areas (Robison et al. 1999). Therefore, the road area disturbed in "critical locations" is probably a much better indicator of cumulative effects than is road density. The IMST report concludes, "The reported relationships between road density and sedimentation provide only qualitative guidance for landscape-level planning and management. Monitoring and more case history analyses will provide a stronger basis for policy."

Watershed-scale effects depend on the length and characteristics of roads in critical locations, and on the timing of both the disturbance and subsequent effects of the disturbance. Historical practices further complicate the assessment of the watershed-scale effects of forest roads. Logging railroads required the construction of high fills, often using logs for drainage structures. These structures are very susceptible to major washouts that resemble dam-break floods. Roads next to streams were a common practice in the past and have resulted in the loss of side-channel habitat. Stream relocation to reduce the number of road crossings was also a common historical practice (for example, the East Fork of the Millicoma River and the Luckiamute River).

Specific watershed-scale effects that can be attributable to increased sedimentation from roads include:

- Aggradation or degradation (both processes can change channel morphology and in-stream habitat);
- Debris flow or dam-break-flood scour or deposition;
- Straightened channels and increased gradients;
- Chronic high turbidity;
- Channel bed instability; and
- Deposition of fine sediment in gravels, especially during low flow periods.

Indicators of high potential for possible watershed-scale effects from roads may include:

- A higher amount of roads connected to stream channels (over 40 percent is above average), especially on watersheds with "high" traffic levels;
- Many fill or sidecast constructed roads on steep slopes;
- A large number of older stream crossing fills over 15 feet deep;
- Wide distances between road cross drains;
- Active winter hauling on a large percent of a watershed where roads are connected to streams and the road surface is not adequately rocked with durable materials; and
- Road drainage directed onto unstable slopes.

Most roads will have some effect on their watersheds. Determining when this effect is at a level that is degrading water quality is difficult to determine without some understanding of the following issues:

- The background variability in the disturbance parameter;
- The nature of the channel system and streamflows;
- The size of sediments supplied to the channels;
- The effects of the disturbance parameter on aquatic life;
- The extent of the disturbance in streams; and
- The recovery period.

Watershed-scale effects related to current practices can be mitigated by:

- Alternative BMPs;
- Avoiding or limiting the extent of certain practices (i.e., roads in steep terrain and adjacent to channels); and
- Limiting the timing of disturbance (i.e., reducing heavy truck traffic during very wet periods on roads that pose an unacceptable risk of delivering fine sediment).

Watershed-scale effects that have already occurred are often difficult or impossible to mitigate over short time periods (relative to several generations of the fish species of concern). Watershed-scale effects that have not occurred (e.g., potential fill-related landslides and subsequent debris flows from roads on steep slopes) can be prevented in many cases through certain road management techniques.

Most of the potential watershed-scale effects of roads are likely related to roads designed and constructed under older administrative rules. These make up the majority of the roads on the landscape and were often constructed with practices that present a greater risk of adverse effects to aquatic habitat. These practices included:

- Placement of fills and waste materials on very steep slopes;
- Construction of roads up "stream bottoms;"
- Undersized and deteriorated stream crossing structures;
- Inadequate cross drainage; and
- Inadequate surfacing.

Treatment of older roads may be the most effective means of reducing watershed-scale effects. Sidecast pull-back, road vacation and relocation, replacement of undersized culverts, installation of additional cross drains, resurfacing, and other practices are methods available to mitigate impacts from older roads. Effectiveness of these treatments probably depends on many factors, including original road construction practices, proximity to stream channels, slope steepness, soil properties, on-site vegetation, and channel morphology.

The IMST report states "3. Develop policy that brings roads not constructed to current standards, and other hazardous settings in critical locations into compliance with current standards. This means having the current OFPA Rules applied to actions taken before the current Rules were in force. In many cases, the operator acted in good faith and within the rules of the day, but the outcome is not scientifically consistent with the mission of the Oregon Plan; thus, a provision by which remediation is accomplished is needed."

Other Land-Uses

Forest roads should be viewed within the context of all roads. Historical settlement patterns and ease of construction (relative to mountainous slopes) have resulted in many miles of roads built in valley bottoms near streams to access agricultural, rural and urban areas. These roads often parallel low gradient streams (which historically tended to have very productive salmonid habitat) and cross numerous tributaries. Culverts in these areas that are barriers to fish passage may block many miles of stream habitat on these low gradient streams. In a recent survey of county and state highways in western Oregon, over 1,200 culverts were found to be barriers to fish passage (Office of the Governor, 1999). These highways are typically located downstream of forestlands and therefore may limit or block access to upstream fish habitat. Many of the same road construction practices that occurred historically on forestland also occurred on other lands, and thus will have similar potential watershed-scale effects. The relatively large network of nonforest roads in close proximity to streams that are currently providing, or have the potential to provide, quality fish habitat are likely to have significant impact on the maintenance and recovery of salmonids.

III. Objectives of Current Measures and Rules

Oregon Plan Objectives

The following are interim habitat objectives for substrate conditions (sediment) under the Oregon Plan:

> i.) In cooperation with local groups and federal agencies, refine, by reach or stream type, all the substrate elements needed to support healthy salmonid stocks in all coastal streams by 2002.
>
> ii.) In the interim, habitat objectives for substrate conditions are to provide:
> For streams that have from 1 - 4 percent stream gradient, the objective is 35 percent gravel availability in 70 percent of the stream length - that is, deposits predominately gravel sized with less than 10 percent fines (% area). For streams outside this gradient range, available gravel is expected to be lower because of natural processes.

iii.) In cooperation with watershed councils, private landowners, and local, state and federal agencies, create watershed assessments and action plans in every basin in all steelhead ESUs that gives the status of current channel substrate conditions and prioritizes options for further study, restoration, and protection by 2002.

iv.) Ensure that existing programs prevent, minimize, or mitigate the effects of human activities that would modify substrate composition in coastal streams, or the upstream and upland processes that generate instream substrate diversity, to the detriment of salmonids beyond present (1997) conditions.

v.) Restore substrate abundance and distribution elements necessary for healthy salmonid stocks, and/or the upstream and upland processes that would replenish them naturally in 2 to 5 percent of altered stream miles per biennium. Altered streams would be identified via published reports and watershed assessments.

FPA Objectives

Purpose 629-625-000

(3) "The purpose of the road construction and maintenance rules is to establish standards for locating, designing, constructing and maintaining efficient and beneficial forest roads; locating and operating rock pits and quarries; and vacating roads, rock pits, and quarries that are no longer needed, in manners that provide the maximum practical protection to maintain forest productivity, water quality, and fish and wildlife habitat."

IV. Description of Measures and Rules

Oregon Plan Measures

The Oregon Plan Road Hazard Identification and Risk Reduction Projects (measures ODF 1S and ODF 2S) are currently being implemented. Many forest roads built prior to the Oregon Forest Practices Act, or prior to the current BMPs, continue to pose increased risk to fish habitat. Industrial forest landowners and state forestlands are currently implementing a voluntary program to identify risks to salmon from roads and address those risks. The purposes of this project are:

1. Implement a systematic process to identify road-related risks to salmon and steelhead recovery.
2. Establish priorities for problem solution.
3. Implement actions to reduce road-related risks.

The Road Hazard Identification and Risk Reduction Project is a major element of the Oregon Plan. The two major field elements of this project are (1) surveying roads using the Forest Road Hazard Inventory Protocol, and (2) repairing problem sites identified through the protocol. Road repairs conducted as a result of this project include improving fish passage, reducing washout potential, reducing landslide potential, and reducing the delivery of surface erosion to streams.

Roads assessed by this project include all roads on Oregon Forest Industry Council (OFIC) member forestland, plus some other industrial and nonindustrial forestland, regardless of when they were constructed. Industrial forest landowners have estimated spending approximately $13 million a year, or $130 million over the next 10 years, on this project for the coastal ESUs alone. However, the effort is not limited to, nor bound by, this funding estimate. Funding for the implementation of this measure within the other ESUs will be reflective of road problems found.

Under ODF 2S, the State Forests program has spent over $2.5 million during the last biennium (1997-1999) for the restoration of roads, replacement of culverts and other stream crossing structures damaged by the 1996 storm. State Forests program is also proposing to spend an additional $2.5 million dollars in each of the next two biennia to improve roads, including stream crossing structures. This effort will upgrade approximately 130 miles of road in each biennium.

In addition to ODF 1S and 2S, there are additional measures under the Oregon Plan that address road management concerns:

ODF 16S - Evaluation of the Adequacy of Fish Passage Criteria: Establish that the criteria and guidelines used for the design of stream crossing structures pass fish as intended under the goal.

ODF 34S - Improve Fish Passage BMPs on Stream Crossing Structures: Ensure that all new stream crossing structures on forestland installed, or replaced, after the fall of 1994 will pass both adult and juvenile fish upstream and downstream.

FPA Standards and Rules

For the purposes of this issue paper, the following definitions will apply. A “road” normally refers to truck (sometimes called “haul”) roads. Skid roads or trails (used by tracked or wheeled skidding machines to move logs from the stump to the landing) are only addressed in relation to ground-based harvesting on steep slopes in this issue paper. The Forest Practices Rules recognize three types of roads:

- Active: Roads used for removing commercial forest products (regardless of the year constructed).
- Inactive: Roads used for forest management purposes other than log hauling (regardless of the year constructed).
- Vacated: Roads that have been purposely “put to bed”, stabilized, and are impassible.

Current road maintenance rules (see Attachment A) require maintenance of both “active” and “inactive” roads. The term “legacy” road is not defined in the administrative rules. It is widely used in the public dialogue regarding forest road issues and has a different meaning depending on when and where it is used. ODF considers “legacy” roads to be synonymous with “abandoned” roads. Regardless of when a road was built, if it has been used for hauling logs or forest management since 1972, it is subject to regulation under the Forest Practices Act. The term "older" road is also used sometimes. The administrative rules continually evolve in response to changes in scientific knowledge; since the creation of the 1973 administrative rules, major revisions to the road rules occurred in 1978, 1983, and 1994. ODF considers "old" roads to be those built prior to the 1983 rule changes (i.e., roads built before end-hauling of material excavated from the road prism on steep slopes).

On nonfederal forestlands, BMPs within the Forest Practices Act regulate road design, construction, and maintenance. The bulk of the BMPs are directed at minimizing sediment delivery to channels. The primary goals of the road rules are to protect: (1) the water quality of streams, lakes, and wetlands; (2) fish and wildlife habitat; and (3) forest productivity.

The Board of Forestry revised several BMPs related to road design when the new Water Protection Rules were adopted in the fall of 1994. Significant changes made to the road construction rules include the following:

- The requirement for operators not to locate roads in riparian management areas, flood plains, or wetlands unless all alternative locations would result in greater resource damage.
- The requirement for operators to design stream crossings to both minimize fill size **and** minimize excavation of slopes near the channel. A mandatory written plan is required for stream crossing fills over 15 feet deep.
- The requirement to design stream crossing structures for the 50-year flow with no ponding, rather than the 25-year storm with no specification of allowable ponding.
- The requirement that stream crossing structures be passable by juvenile fish as well as adult fish.
- The requirement that fish must be able to access side channels.
- The requirement that stream structures constructed under these rules must be maintained for fish passage.

In determining the location of a new road, operators are required to avoid steep slopes, slides, and areas next to channels or in wetlands to the extent possible. Existing roads should be used when possible, and stream crossings should be used only when essential. The design of the road grade must vary to fit the local terrain and the road width must be minimized. The operator must also follow specific guidelines for stream crossing structures (listed above). Cross drainage structures must be designed to divert water away from channels so that runoff intercepted by the road is dispersed onto the hillslope before reaching a channel. The specific method used is up to the operator, but the end result should be the dispersal of water running off of the road and the filtering of fine sediment before the water reaches waters of the state.

Construction and maintenance activities should be done during low water periods and when soils are relatively dry. Excavated materials must be placed where there is minimal risk of those materials entering waters of the state, and erodible surfaces must be stabilized. Landings must be built away from streams, wetlands, and steep slopes.

Road maintenance is required on all active and inactive roads. Regardless of when a road was constructed, if the road has been used as part of an active operation after 1972, it is subject to all maintenance requirements within the current rules. Culverts must be kept open, and surface road drainage and adequate filtering of fine sediment must be maintained. If the road surface becomes unstable or if there is a significant risk of sediment running off of the road surface and entering the stream, road activity must be halted and the erodible area must be stabilized. Abandoned roads constructed prior to 1972 and not used for forest management since that time are not subject to Forest Practices regulatory authority.

All roads in use since 1972 must either be maintained or vacated by the operator. Vacated roads must be effectively barricaded and self-maintaining, in terms of diverting water away from streams and off of the former road surface, where erosion will remain unlikely. Methods for vacating roads include pulling stream crossing fills, pulling steep side cast fills, and cross ditching. It is up to the landowner to choose between vacating a road and maintaining a road. If a road is not vacated, the operator is required to maintain the road under the current rules whether it is active or inactive, however they are not required to bring the design up to current standards outside of the normal maintenance and repair schedule.

Many active and inactive roads were constructed prior to current BMPs. The design standards of these older roads pose a higher sediment delivery risk than roads constructed under current design standards. Roads built under older standards are not required to be brought up to current design standards until either a segment needs to be reconstructed or the road shows immediate signs of failure that would damage waters of the state (i.e., collapsing culverts, actively moving hillslopes, drainage waters causing gullying, etc.). For example, design standards for stream crossings were recently changed. This change did not immediately require that operators replace all older culverts with new larger culverts. However, as the older culverts are replaced as part of the overall road maintenance required under the rules, they must be replaced with culverts that meet the new standards.

The department estimates that the majority of existing forest roads were constructed prior to 1983 (in other words, prior to rule changes which improved construction practices on steep slopes).

One area not directly addressed by the rules is sediment problems related to road use. Increased turbidity can be associated with the use of roads during rainy or thawing periods (Bilby et al., 1989; Reid and Dunne, 1984). Currently, within the guidance for the road maintenance rules, operators are directed to stop hauling when FPFs observe high levels of turbidity entering streams. However, there are currently no rules that address the specific level of turbidity that is considered acceptable during wet season hauling.

V. Evaluation of Measures and Rules

Voluntary Measures

Evaluation of the Oregon Plan voluntary measures is limited since the Plan has been in effect for less than two years. It is difficult to assess the effectiveness of measures that have not been given a chance to work. The Oregon Plan measures must be examined in light of what they attempt to achieve, and some assessment of risk must be determined in terms of how likely it is that the current measures will achieve the stated goals.

The Oregon Plan Road Hazard Identification and Risk Reduction Project (measures ODF 1S and ODF 2S) is currently being implemented within the Core Areas, on State Forest Lands, and on private forestlands. Table 1 is a summary of all road and culvert improvement activities that have occurred under the Oregon Plan in 1996-97. Table 2 shows the trend in the miles of roads surveyed.

Table 1: Summary of 1996-97 Road Improvement Activities (From: The Oregon Plan Watershed Restoration Inventory, 1998)

Road Improvements	Miles of Road*
Roads Surveyed	3769
Roads Upgraded/Improved (Legacy Road Reconstruction)	843
Roads Closed/Vacated	52
Roads Obliterated/Decommissioned	9
Roads Relocated	5
Culvert Improvements	**# of Structures***
Culverts replaced, upgraded, or installed for peak flow passage/surface drainage	3350
Culverts removed, replaced, upgraded or installed for fish passage	530

*Miles of road and number of structures are underestimated. Depending on the activity, between 2 percent and 20 percent of road improvement projects did not provide information on mileage or number of structures.

Table 2: Trends in Road Miles Surveyed 1995-1998 (From: S. Maleki, Governors Watershed Enhancement Board)

Year	Miles of Road
1995	308
1996	703
1997	3007[1]
1998	7629

1 Discrepancy in miles surveyed for this year compared to Table 1, due to differences in database.

How much these and future improvement activities will affect the recovery of salmonids is uncertain. This must be evaluated over time through continued implementation and effectiveness monitoring.

Current Rules

Evaluation of current rules is based in large part on the results of ODF monitoring since practices used in other regions may be very different, and also because road management practices have changed significantly over time.

How effective are the current BMPs at minimizing the delivery of sediment to channels? The latest ODF monitoring data shows that about one-third (29 -39 percent) of active and inactive roads on state and private lands can deliver sediment to streams by ditch delivery (ODF, 1996). There is the potential for significant amounts of sediment to be delivered from these sources during hauling operations, especially during the wet season. For the portions of the road network where sediment delivery is occurring, a number of issues have been identified that are contributing to the problem:

1. Monitoring has shown that there is a general lack of filtering of drainage waters near streams. A number of cases were observed where cross drainage structures where not in place to filter road runoff before reaching stream crossings.
2. Steep-gradient roads tend to have cross drainage structures at wider spacing than lower-gradient roads. Under the current rules, road design and maintenance practices should result in steep-gradient roads having cross drainage structures with narrower spacing relative to lower-gradient roads.
3. There are inconsistencies in drainage practices between georegions, with special concerns in the Siskiyou georegion.
4. In some areas, road maintenance and repair is inadequate according to the rules.

The following are conclusions from Robison et al. (1999). These findings include the most current information addressing the adequacy of the forest practice rules related to landslides and forest roads.

1. Landslides associated with forest roads made up a smaller percentage of the total landslides in the ODF study than road-associated landslides did in most previous studies.
2. The road-associated landslides identified during the ODF study were smaller, on average, than road-associated landslides in past studies. However, these road-associated landslides were four-times larger on average than those landslides not associated with roads.
3. Landslides that delivered sediment to stream channels rarely occurred on roads crossing slopes of less than 50 percent, especially when those roads had well spaced drainage systems and fills of minimal depth.
4. Road fill placed on steep slopes creates an increased landslide hazard even where no drainage water is directed to those fills.
5. Road-drainage waters directed onto very steep slopes create an increased landslide hazard even when there is no road fill placed on those very steep slopes.
6. In the ODF study, washouts were a significant problem in Tillamook, and to a lesser extent in Vida study areas. Washouts were often related to undersized culverts (installed prior to current rule requirements).
7. Based on the lower numbers of road-associated landslides surveyed in the ODF study and on the smaller sizes of these landslides (as compared with previous studies), current road management practices are likely reducing the size of road-associated landslides as well as the number of landslides.

In addition to the conclusions from Robison et al. (1999), there are three other studies that examined current road construction standards. A road damage inventory conducted in Washington found that roads constructed in the last 15 years survived a landslide-inducing storm with minimal damage, while roads constructed earlier had very high damage rates (Toth, 1991).

Department of Forestry landslide monitoring has made similar findings (Mills, 1991). Although most surface erosion tends to occur in the first few years after construction, or during periods of heavy traffic use, landslides can occur many decades after original construction. Roads built using current construction practices (steep grades, full-bench design, and end haul construction) have been found to reduce landslide frequency and size relative to roads constructed using pre-1984 practices (Sessions, 1987).

Independent Multidisciplinary Science Team (IMST) Recommendations

The IMST made a total of 19 recommendations in its forestry project report of September 14, 1999. Ten of their recommendations are directly or indirectly related to the effects of forest roads on the sediment regime or on aquatic habitat. These ten recommendations are listed below, followed by the applicable issue paper options.

Recommendation 2. ODF should develop a policy framework to encompass landscape (large watershed) level planning and operations on forests within the range of wild salmonids in Oregon.

Roads Issue Paper Option(s):
Option #13 - Watershed-Scale Effects
Option #16 - Cooperative Road Use and Planning (Combination of Options 16 and 53)

Recommendation 7. Provide enhanced certainty of protection for “core areas”.

Roads Issue Paper Option(s):
Option #10 - New Roads in High-risk Sites/Sensitive Areas (Combination of Options 10, 49, 50, and 51)
Option #11 - More Specific Rule Objectives
Option #57 - Ground-based harvesting on steep slopes.

Recommendation 8. Develop and implement standards or guidelines that reduce the length of roadside drainage ditches that discharge into channels.

Roads Issue Paper Option(s):
Option #7 – Cross Drainage Structures

Recommendation 9. Implement the standards and guidelines for the length of roadside drainage ditch between cross drainage structures, especially on steep-gradient roads.

Roads Issue Paper Option(s):
Option #7 – Cross Drainage Structures

Recommendation 10. Require the flow capacity of cross drainage structures and stream crossing structures and culverts to meet current design standards.

Roads Issue Paper Option(s):
Option #6 - Road Maintenance and Repair (Combination of Options 6, 9, 14, 17, 52, and 55)

Recommendation 11. Provide for the stabilization of roads not constructed to current standards (including "old roads and railroad grades") in critical locations. Stabilization means reduction or elimination of the potential for failure.

Roads Issue Paper Option(s):
Option #6 - Road Maintenance and Repair (Combination of Options 6, 9, 14, 17, 52, and 55)

Recommendation 12. Require durable surfacing on wet-season haul roads and require that hauling cease before surfaces become soft or "pump" sediment to the surface.

Roads Issue Paper Option(s):
Option #8 - Wet-Weather Hauling

Recommendation 14. Continue to apply the current best management practices (BMP) approach to the management of forestlands with significant landslide potential, and develop a better case history basis for evaluating the effectiveness of BMP in this area.

Roads Issue Paper Option(s):
Option #10 - New Roads in High-risk Sites/Sensitive Areas (Combination of Options 10, 49, 50, and 51)

Recommendation 16. Oregon Department of Fish and Wildlife (ODFW) and ODF should develop a collaborative program of monitoring to quantify the linkages between parameters of ecosystem condition and wild salmonid recovery.

Roads Issue Paper Option(s):
Option #18 - Roads Monitoring Program

Recommendation 19. The Oregon Forest Research Laboratory (FRL) in collaboration with ODFW, should develop forest road stream crossing strategies that facilitate the passage of large wood at stream crossings.

Roads Issue Paper Option(s):
Option #12 – Stream Crossing Designs

This issue paper includes options that deal with all of the IMST recommendations that are related to roads. Two options in this issue paper are not directly addressed in the IMST recommendations (Options 15 and 19). It is recognized that all options require further technical policy development.

VI. Possible Additional Measures and/or Rules

Option #6: Road Maintenance and Repair (Combination of Options 6, 9, 17, 52, and 55, with portions of 5, 7, 12 and 60 proposed for inclusion)

Objective:
This option is intended to address old roads that were constructed using past practices or methods. Existing roads are to be systematically evaluated and mitigated where appropriate for negative impacts or risks to:

1. Waters of the state (turbidity/sedimentation)
2. Passage of juvenile/adult fish
3. Downstream passage of habitat elements (wood and gravel)

This broadened option number 6 also includes the portions of these following options:

#5 - encourage the use of bridges (in the fish passage paper)
#12 - stream crossings to pass large wood
#60 - upstream/downstream program
#7 - cross drain spacing

Description:
Currently, there exists a large network of active roads across forested lands that were not built to current FPA design standards. This situation has been recognized by a number of landowners that have implemented a voluntary program under the Oregon Plan to inventory roads and mitigate problems. Protocol for this process has been developed and priorities have been established.

There appears to be consensus that action should be taken to reduce this risk and remedy those roads that are likely to deliver sediment to streams and result in adverse effects. These actions might include, but are not limited to, comprehensive road maintenance plans, improved road maintenance guidelines, and the prioritization of current and future road maintenance and repair activities. This proposal would include a suite of improved practices that would be applied to roads needing improvement.

"Legacy " roads includes those built prior to 1972 and not used since then (and therefore not subject to current FPA regulations). "Old" roads are those built prior to the 1983 rule changes (i.e., roads built before end-hauling of material excavated from the road prism on steep slopes). Since legacy roads have not been used for at least 25 years, they often support stands of trees. In many cases, it will be necessary to reconstruct the road in order to provide equipment access to repair the segment in question.

While old roads may be functioning adequately, it is believed that a significant portion of these roads pose an increased risk of fill failure and/or washouts that can adversely effect water quality and the maintenance and recovery of salmonids. Where necessary, ODF and others would develop, and make available, guidance to landowners/operators and regulators on methods to achieve the improved practices. The technology would need to be developed for several of these improved practices; most could be implemented with current knowledge.

Past Practice	Improved Practices
1. Sidecast construction on steep slopes.	**1. Full-bench design, end-haul construction on steep slopes.**
2. "High" fills.	**2. "Low" fills.**
3. Stream crossing culverts sized to pass Q25 or whatever fit.	**3. Steam-crossing culverts sized to pass Q50.**
4. Downstream side of stream crossing fills not armored with riprap.	**4. Downstream side of stream crossing fills armored with riprap.**
5. Fills not designed to allow for overtopping by high stream flow.	**5. Stream crossing fills designed to allow overtopping by stream flow.**
6. Passage of large wood hindered by stream crossings.	**6. Facilitate passage of large wood over/through stream crossings.**
7. Passage of gravels hindered by stream crossings.	**7. Facilitate passage of gravel over/through stream crossings.**
8. Fish passage through culverts may be problematic for adults and juveniles.	**8. Adult and juvenile fish passage through culverts and maintenance of passage required.**
9. Road cross drain spacing may not meet standard spacing criterion: **a. ditch erosion** **b. discharge onto steep slopes** **c. ditch water drains directly into streams**	**9. Cross drain spacing is such that ditch erosion is minimized, drain water not directed onto steep slopes, ditch water not directed into streams.**
10. Unneeded roads abandoned "as is."	**10. Unneeded roads stabilized and vacated.**

Current FPA Administration:
This option includes a number of practices that fall under the current FP rules. It also includes some options which should be considered new and require further development before implementation in the field can occur. There are a number of practices operators are required to comply with in the Road Maintenance rules (629-625-600). In the field administration of these rules, the forest practices forester is sometimes required to determine if maintenance or repair is required to reduce risk to waters of the state. Administration of the maintenance rules is often reactive; in some cases the problem may not be identified until resource impacts occur. In addition, legacy roads do not fall under the regulatory umbrella of the FPA, at least as currently understood.

Methods/Approaches:
There are many different ways in which this option can be implemented. Listed below are specific methods that have been deliberated by the committee:

Method 1

Immediately after the time of harvest, road segments within or bordering the harvest unit should be inspected and remedied for fill failure and washout risks. ODF and the operator would review roads (old and legacy) within the harvest unit. This option could be implemented on either a mandatory or voluntary basis (possibly as a stewardship plan provision).

Benefits:
Commercial harvest often creates positive cash flow (note: some harvests may not result in positive cash flow, e.g., hardwood conversions, salvage operations, etc). This may be viewed as an opportunity to use a portion of those funds to improve existing roads. Thus the link to harvesting.

Costs:
Timing of mitigation activities may interfere with harvesting or be limited to in-stream work period. Practical access to legacy road segments may not exist, as these roads may have been abandoned by previous landowners several decades ago.

Method 2

The same as above, except also include those roads used as part of the hauling route.

Benefits:
Same as above.

Costs:
Same as above. In addition, timber owner may not own haul route.

Method 3

Landowner to develop and implement a road maintenance plan by ownership or operating areas that includes a systematic road survey to identify and prioritize road maintenance needs. This option could be implemented on either a mandatory or voluntary basis. There may be an opportunity for a landowner to include a road maintenance plan as a component of a stewardship plan.

Method 4

Create financial incentives (probably a tax credit) to encourage vacating roads in sensitive areas and relocating these roads to lower-risk areas.

Method 5

Create specific road maintenance guidelines for high hazard locations by developing and making improved guidance available to operators and regulators.

Method 6

In the prioritization of road maintenance and repair, those roads that pose the greatest risk to waters of the state should be given a high priority.

Method 7

Give ODF general authority to require additional cross drainage installation as a maintenance requirement prior to an operation when current road condition and a proposed use will impair water quality.

Benefits:
This option could bring existing roads up to improved standards. Road maintenance plans will result in a systematic means for remedying road problems. Creating financial incentives will encourage operators to be proactive. A prioritization scheme will help to ensure that those areas that are most in need of repair get tended to first. This option has the potential to reduce sedimentation to streams, allow for a higher level of road maintenance, decrease the number of citations for FPA violations, and reduce long-term road management costs through the more efficient allocation of limited resources for road repairs and maintenance.

Costs:
This option could potentially increase short-term operating costs associated with a harvesting operation. Additional resources will be needed to build and maintain a road survey program and the personnel necessary to manage such a program. Linking "problem" roads to harvest operations may not address those road segments that most need attention, and will not address those road systems where harvest entry is not planned for some time. The party that controls the haul route may not be the same party that owns the timber, creating potential operational problems. Additional ODF resources will be needed to implement some of these methods.

Option #7 – Cross Drainage Structures on New Roads

Objective:
To minimize the risk of sediment delivery by ensuring that adequate cross drainage design and construction occurs on new roads. Existing roads are included under Option 6. Cross drains should not be confused with stream crossing culverts. Cross drains take water from the inboard side of the road and route it under/across the road and discharge the water downslope from the road.

Description:
The objectives of cross drains are:

1. To protect the road surface from erosion and retaining water.
2. To reduce erosion of the roadside ditch. Soil eroded from a ditch may be delivered to waters of the state.

3. To prevent ditch water from discharging onto unstable slopes.
4. To reduce the amount of ditch water (and associated ditch water sediment) discharging directly into a stream.

Recent monitoring studies have found that many existing roads have drainage systems that are not designed to filter sediment. A secondary finding (less commonly associated with sediment delivery to streams, was that steep roads (>12 percent grade) often have inadequate spacing of cross drainage structures (excessive distance between cross drains) (ODF, 1996). These conditions existed on both older and more recently constructed roads. There are two spacing issues: cross drain spacing based on road slope and soil type, which could be an erosion problem; and cross drain spacing based on the delivery of ditch water to a stream where the ditch discharges directly into a stream, which could be a sediment delivery problem.

Among other things, an insufficient drainage design can result in unfiltered surface runoff entering streams and have adverse effects on the maintenance and recovery of salmonids. This option would require specific criteria for the spacing of cross drains on steeper-gradient roads to provide for adequate drainage. Applying a strict spacing criterion on any given road may be problematic. Site-specific judgement is necessary in determining the best place to locate a cross drain. Applying cross drain spacing without regard to where the water will discharge may exacerbate slope instability. These criteria would be applied to new roads and during the maintenance and repair of existing roads. This option could be implemented on either a mandatory or voluntary basis.

Current FPA administration: OAR 629-625-330 (1) through (5) address road drainage practices. The rule states:

(1) Operators shall provide a drainage system using grade reversals, surface sloping, ditches, culverts and/or waterbars as necessary to effectively control and disperse surface water to minimize erosion of the road.
(2) Operators shall not divert water from channels except as necessary to construct stream crossings.
(3) Operators shall locate dips, waterbars, or cross-drainage culverts above and away from stream crossings so that road-drainage water may be filtered before entering waters of the state.
(4) Operators shall provide drainage when roads cross or expose springs, seeps, or wet areas.
(5) Operators shall not concentrate road drainage water into headwalls, slide areas, or high-risk sites.

The rule is not especially clear about the objectives for cross drainage, nor does it provide specific standards or examples of cross drainage spacing or the maximum length of ditch that should drain into a stream.

FPFs currently have the authority to require installation and maintenance of cross drains. Monitoring has shown that there is room for improvement. Training and improved guidance could be developed and implemented for operators/landowners and regulators that would emphasize the need for adequate spacing and installation of road cross drains.

Methods/Approaches:
There are several different approaches which may be taken, as described below:

Method 1

Make changes to existing rules so that they include specific criteria for installation and spacing of cross drainage structures. This would include the maximum culvert spacing by road grade, and maximum distance to cross drains above stream crossings. Both cases would include exceptions for steep fills and high-risk sites.

Method 2

Provide better guidance and training for use of the existing rules. Current rules provide authority for installation and maintenance of road cross drains. Training and improved guidance could be developed and implemented for operators/landowners and regulators that would emphasize the need for adequate spacing and installation of road cross drains.

Method 3

Provide changes in existing rules to better clarify the objectives for cross drainage. For example, the rules might state that the objectives of cross drainage are to ensure that cross drainage in number and location so that:

- Road surfaces are protected from erosion and retaining water.
- Erosion of the roadside ditch is minimized.
- Ditch water is not discharged onto unstable slopes.
- The amount of ditch water (and associated sediment) discharging directly into a stream is minimized.

Benefits:
These methods will reduce the risk of fill failures, washouts, and direct delivery of road runoff to streams on existing roads where the cross drain spacing is currently inadequate, and on new roads where the current maintenance guidelines would not have resulted in adequate cross drainage spacing.

Costs:
There will be increased operating costs associated with harvesting in areas where additional cross drains are needed. It will be difficult to develop ‘universal’ spacing criteria appropriate for the various soil and landform conditions across the state. If the spacing criteria are not developed and implemented correctly, there is a risk that water could be discharged onto unstable slopes, increasing the potential for sediment delivery to streams.

Option #8 – Wet Weather Hauling

Objective:
To address road surfaces that are at risk of delivering sediment to streams during hauling operations in wet weather.

Description:
Require durable rocking of roads during winter use in locations where there is a higher likelihood of sediment entering waters of the state. Prohibit hauling during periods of wet weather on road systems that have not been constructed with specific standards for surface materials, drainage systems, or other alternatives (paving, increased numbers of cross drains, sediment barriers, settling basins, etc.) that will minimize delivery of sediment to waters of the state.

Methods/Approaches:
Specific criteria for determining if a road was at risk of sediment delivery, which might include precipitation amounts necessary to trigger hauling prohibition, would be developed. Develop specific construction and maintenance standards for wet weather hauling roads and require these standards for roads determined to be at risk for sediment delivery.

There are two methods which are probably needed to implement this option, as described below:

Method 1

Develop criteria for winter-use roads, probably in rule form, to ensure that durable rock is used on road segments that can deliver sediment to streams.

Method 2

Develop a second criteria, probably also in rule form, that requires operators to cease heavy truck traffic on roads when the road surface is breaking down (only for segments that are delivering sediment to streams). Breaking down would be defined by both depth of ruts and by depth of surface "slop" on the road.

Benefits:
This will further minimize the risk of sediment entering waters of the state during the wet season from active hauling roads.

Costs:
There may be increased operating costs associated with harvesting in areas where quality rocking of roads is needed. The availability of durable rock in parts of the central Coast Range is problematic. Additional rock pit development is a potential source of chronic point-source sediment.

Option #10 – Locating New Roads and Road Reconstruction in Locations with High Potential Resource Impacts (Combination of Options 10, 49, 50, and 51)

Objective:
To reduce the potential of sediment delivery, or other undesirable effects, to streams from new roads located where there is a high risk of landslides, surface erosion, or of direct physical alteration to streams, riparian areas, lakes, or wetlands.

Description:
Roads that are built on some steep slopes above streams, or that directly fill or excavate in streams, floodplains, lakes, or wetlands can have much greater impacts on water quality and aquatic resources than roads elsewhere across the landscape. If these roads are constructed, action should be taken to minimize or eliminate the risks they pose to aquatic resources to the maximum extent practicable. There are also cases where roads should not be constructed. Current rules require that operators shall "avoid locating roads on steep slopes, slide areas, high-risk sites, and in wetlands, riparian management areas, channels, or floodplains where viable alternatives exist." Prior approval of the State Forester is required before roads can be constructed or reconstructed in such locations.

This current rule language allows ODF to require written plans and to not approve construction or reconstruction when the risk of such action is too "great." However, the application of this rule requires a "conservative" interpretation to ensure that the desired level of resource protection is consistently achieved. It is not clear to some on the committee what the basis for decision-making is under this rule. However, the field site visited in eastern Oregon where ODF denied road reconstruction represents the type of decision-making supported by all the committee members present on the tour.

Methods/Approaches Explored:
Several different specific sub-options to address concerns about locating roads in high-risk sites and other sensitive areas were deliberated by the committee including:

1. Ensure roads constructed across high-risk sites are constructed with no fill and also with 'fail-safe' drainage systems.
2. Require that written plans for road construction and timber harvesting operations on landslide-prone locations be prepared by a geoscience professional.
3. In areas where roads constructed using current BMPs are likely to degrade water quality, create additional restrictions on the locations of new roads in riparian management areas, high-risk sites, unstable slopes, flood plains, wetlands, and side channels.
4. Prohibit construction of roads on high-risk sites.
5. Develop clear and specific criteria for road location in these sensitive areas, which includes preferred locations, and criteria to "say no" when there are better alternatives, or when the road poses very high risk to fish, especially in "core" areas. Roads should be built in the location with the lowest overall impact to water quality and fish habitat while meeting land management objectives.

Agreement on methods 1-4 did not occur during the October 14-15, 1999, meetings. From one perspective there is a belief that the current rules are adequate (in part because ODF can apply any of the sub-options listed above under some conditions). Another perspective is the belief that the department does not or will not say "no" to some proposed roads (in part because it is not clear if, or when ODF may apply any of the sub-options). The committee agreed that rule or guidance clarification supportive of ODF's current "conservative" or "stringent" interpretation of the existing rules as demonstrated by the eastern Oregon example was an appropriate action. Therefore, option 5 above is proposed for committee recommendation. In this context it is expected that specific rule language may be adopted about when, if ever, reconstruction of creek bottom roads might be approved.

Benefits:
Method 5 will reduce the risk of major impacts to streams and water quality. This proposal is likely to result in the "removal" over time of high-impact (especially creek bottom) roads that are proposed for reconstruction.

Costs:
Costs to landowners will increase slightly as compared to current practices. Road construction and timber harvesting costs will be increased in some steep slope areas. Long-term costs may be reduced by vacating creek bottom roads that require "reconstruction" to maintain their use. Based on past experience, these situations will be relatively uncommon. Costs could be reduced and progress enhanced by providing some grants to assist in vacating some roads. Costs could be reduced by developing equitable procedures for the use of roads on other ownership, particularly federal lands.

Resources needed:
The resources needed depend upon how the criteria will be applied in approving or disapproving roads. The focus of the rules will be to require that "roads are located or reconstructed in the location with the lowest overall impact to water quality and fish habitat while meeting land management objectives." These criteria will most likely require additional oversight and review by ODF, and/or professional design by the landowner. While these situations are relatively uncommon, they can require substantial ODF and landowner resources on a case-by-case basis.

Option #11 - More Specific Rule Objectives

Objective:
Provide more specifics in regard to the rule objectives through more specific rule language, guidance, and/or training.

Description:
Objective-based rules, such as "minimizing sediment delivery," allow flexibility but sometimes lack the specificity needed to insure that objectives are met. For example, in regards to meeting the objectives of the Forest Practice Rules, there may be room for improvement in the areas of wet weather hauling, constructing and maintaining effective cross drainage structures, and "public" roads. This option proposes to use more specific language within the rules to help ensure that the objectives are being met.

Methods/Approaches:
Rewrite those road construction and maintenance rules where the flexibility of generalized, objective-based language is precluding an effective evaluation of whether or not specific objectives are being met. The revised rules would spell out specific objectives that operators must meet in order to be in compliance. Note that Options 7, 8, 10, and 57 deal with most of these issues. Adopting specific practices under these options, and adding additional information in the "purpose" rules will provide a great deal more specificity in rules and rule objectives.

Benefits:
There will be a higher likelihood of success at achieving the objectives if they are more clearly defined.

Costs:
This will reduce the flexibility of the rules and could result in the requirement of forest practices that do not provide optimal resource protection for a given operation.

Option #12 – Stream Crossings that Pass Large Wood and Gravel

Objective:
To construct stream crossings that will pass large wood and gravel downstream, and to provide other means for passage of large wood and sediment at those crossings which restrict this passage. The transport mechanisms for large wood and gravel may be either stream storm flows or channelized debris flows.

Description:
Most stream crossing culverts restrict or prevent the passage of large wood. New culverts in Type F streams, and designed with streambed simulation, will pass gravel, but their ability to pass large wood is also limited. Stream crossing structures have been designed primarily to pass water. In the last few years, there has been an increased effort to design stream crossings so that they effectively pass fish as well. There is an increasing body of scientific evidence that supports the idea that the movement of large wood downstream is an important function that provides for, and maintains, fish habitat. This option proposes to provide a broader range of engineering options for stream crossing designs that will pass large wood and sediment, both during high flows, and for steep channels, when debris flows occur.

Methods/Approaches:
ODF would research and compile descriptions of the most current engineering options for designing stream crossings to pass large wood. These designs could be included as part of the rule guidance and recommended to operators to use where appropriate. These designs would not be appropriate in areas where large wood is not mobilized by the stream (i.e., where average annual flow is too low or debris flows are not likely to occur).

Strategies for passage of large wood and gravel may depend upon the crossing type, e.g., a ford may easily pass large wood and gravel, while a traditional fill with culvert installation may require machine activity to remove material from the upstream side and deposit on the downstream side. Financial incentives could be provided to encourage the use of more effective options that may have a higher cost. Additional designs might include approaches that are better at preventing stream flow diversions down roads, be able to withstand debris torrents by passing such events, and be able to allow for the downstream delivery of large wood to fish bearing streams.

For existing culverts, this should include methods to allow movement of sediment and large wood that have been trapped above culverts. These provisions would probably be in rule form. Material would not be removed from, or placed in, water (where the risk of increased turbidity is high). Sediment and wood would be replaced outside of the active channel (normal bed and streambanks), and where it does not restrict the culvert outlet. Since most activity occurs during routine road maintenance, prior approval would not be required for these operations.

Benefits:
These practices would reduce the influence of roads and road-fill on the delivery of sediment and large wood to fish bearing streams, helping to restore the natural disturbance regime that has maintained salmonid habitat in the past.

Costs:
These practices are largely undeveloped and untested. They would have to be monitored over time to ensure they are performing as expected. These types of stream crossings may also be more expensive to construct as compared to traditional methods, resulting in a potential increase in short-term costs. The use of fords as a stream crossing structure may conflict with ODFW and/or DEQ policy related to their use.

Option #13 - Watershed-Scale Effects

Objective:
To address the potential compounding effects of road-related sediment inputs from a watershed perspective.

Description:
Current BMPs aim to reduce the risk of sediment delivery from roads by addressing road issues on a site-specific scale. The assumption is that if the risk of sediment delivery is being minimized on a site-specific scale, then it is being minimized on the watershed-scale as well. However, BMPs do not eliminate all potential sediment sources, and even if every ‘site’ (i.e., road segment) within a given watershed that has the potential to deliver sediment to the stream has a low risk for delivery, additional road building in certain areas could still increase risk. The higher the number of sites that exist, even if the risk is minimized at each site, the higher the cumulative risk that increased sedimentation will occur. To address this potential problem, this option proposes that a watershed-scale analysis be conducted of combined watershed effects of both existing roads and new road construction in moderate- to high-risk areas. This option will allow for potential watershed-scale effects to be evaluated before additional road building occurs in certain portions of the landscape.

Methods/Approaches:
For new roads proposed in moderate- to high-risk areas, landowners would provide a written plan that examines the current status of roads within the watershed in terms of the cumulative risk of sediment delivery. The current status of existing roads would be determined using the Oregon Plan Road Hazard and Risk Reduction procedure. Depending on the findings from this examination, the written plan may also discuss alternatives to new road construction, examine the decommissioned roads that are at high risk of delivering sediment to waters of the state, and/or discuss why new road construction is the most practicable option. This might also be accomplished through voluntary stewardship agreements. Specific implementation criteria would need to be developed. "Watersheds of concern" could probably be identified. If field work verified these concerns, ODF could work with landowners to:

1. Focus on road repairs.
2. Encourage vacating of unneeded or unrepairable roads.
3. Prevent construction of new roads where viable alternatives exist.
4. Prevent new construction where risk to resources is high and cannot be effectively mitigated.

Benefits:
This has the potential to minimize the construction of unnecessary new roads that may increase the risk of sediment entering waters of the state. It would also be a vehicle towards addressing older roads on the landscape that may be high risk. By targeting only those roads that have the potential to deliver sediment or water to the stream, this option could be an efficient means to reduce adverse watershed-scale effects.

Costs:
This will increase short-term costs to the landowner. If mandatory, it would also increase FPF workloads by adding another step in the notification processes. Evaluation of risk to the watershed could be very time-consuming.

Option #15 – Geographic Information Systems (GIS) Database

Objective:
Build and maintain a GIS database of all roads in forestlands for the state of Oregon.

Description:
The ODF has maps for most of the major roads that exist in forestlands in Oregon. The department does not, however, maintain digital maps (i.e., GIS) that identify every single road segment that exists in forestlands, nor does it have data on the condition of those roads (year built, maintenance history, risk assessment results, etc.). The acquisition of this data could be used to help the ODF assess road systems and prioritize restoration efforts. (Note: the SEDMODL described above utilizes this type of data for estimating sediment yield to streams). This option proposes to build such a database to enable the ODF to effectively keep an inventory of forest roads and potentially aid in the management of those roads.

Methods/Approaches:
The database could be compiled and maintained either in a central location like Salem, or at the field offices where each district would be responsible for maintaining the database for their area. An adequate full-time staff would be needed to conduct annual updates and maintain the database.

Benefits:
The database would provide the ODF with up-to-date reliable road data to be used as needed.

Costs:
Substantial resources would be needed to provide the personnel and equipment necessary to create and maintain such a database for the state of Oregon. Where private landowners are not willing to provide the ODF with their current road maps, aerial photographs would need to be taken on a regular basis to acquire the information needed to keep the database current. It may not be possible to obtain useful ground-based information without landowner cooperation.

Option #16 - Cooperative Road Use and Planning (Combination of Options 16 and 53)

Objective:
To encourage cooperative road system planning, design and use between different landowners in order to minimize the duplication and construction of unnecessary forest roads.

Description:
Forestland in Oregon is often in a checkerboard pattern of mixed ownership. There are situations where a landowner may have the opportunity to access their property using another landowner's road system and thereby reduce the length of new road that must be built for an operation. Current rule (OAR629-625-200(5)) states:

"[t]o reduce the duplication of road systems and associated ground disturbance, operators shall make use of existing roads where practical. Where roads traverse land in another ownership and will adequately serve the operation, investigate options for using those roads before constructing new roads."

Historically, this rule has been applied as an advisory rule. Guidance does not establish a specific threshold for "investigate options" or "where practical" to apply this rule.

Currently, a number of disincentives exist, especially for federal lands, which prevent private landowners from using road systems on another ownership. Sometimes this results in the duplication of road systems and parallel roads being built on opposite sides of property lines. When these duplicate roads are built in high risk or sensitive areas, it can increase the risk of sediment delivery and other adverse effects to streams. This option proposes taking action to minimize the construction of unnecessary forest roads that are built due to existing disincentives for cooperative road system planning, design, and use.

Methods/Approaches:

Develop incentives for cooperative road system planning, design, and use between different landowners. Landowners could also be asked to make existing roads available to other landowners as needed.

To be effective, there would probably need to be strong incentives for landowners to share road use. Many landowners have already established such agreements. However, development of new agreements with the federal agencies appears to be problematic. It appears that the current system rewards federal agencies for not cooperating with private landowners.

In other cases, neighboring private landowners (sometimes, but not always, those who are using their lands for other purposes) may set unreasonable conditions on road use (typically costs that are so inflated that it is cheaper for the affected landowner to construct a new road). This occurs even when new road construction is expensive (over $100,000 per mile of road). Conflicts related to rural residential uses versus forest management cause road-use problems in more developed areas.

Benefits:
There is the potential to reduce the length of new roads built and decrease the risk of sediment delivery to streams where this option prevents unnecessary roads from being built in high-risk or sensitive areas. Landowners will also reduce operational costs if they do not have to build and maintain additional unnecessary roads as a result of this option.

Costs:
Private property rights are likely to be a barrier to compelling some landowners to make their roads available to others. State government may have [has] limited influence on federal policies that act as a disincentive to cooperative road system planning, design, and use between federal and private land managers.

Option #18 – Roads Monitoring Program

Objective:
Evaluate the need for further road compliance and effectiveness monitoring.

Description:
Road BMP compliance and effectiveness monitoring is currently being conducted as part of the Oregon Forest Practices' BMP compliance monitoring project. The BMP pilot study has already identified a need to more specifically monitor BMP effectiveness during rainy-season hauling. The pilot study results and recommendations will be considered within the context of the strategic monitoring plan and prioritized in context with available monitoring resources and other monitoring needs.

Methods/Approaches:
Roads are generally considered the single greatest chronic source of fine sediment associated with forest practices. However, currently available information also confirms that when properly

implemented, BMPs are effective at reducing delivery of sediment from roads. Instream measures of water quality are an integration of everything upslope. Consequently, instream measurements can be a diluted or exaggerated version of what is occurring higher up in the channel network or on adjacent slopes. It is usually easier to accurately identify a road drainage-related sediment source and to quantify the volume of sediment it produced than it is to measure sediment in the stream and work backwards to the source.

Currently, as part of the BMP Compliance Audit Project, ODF is monitoring compliance with the road construction and maintenance rules along with a large number of other harvesting and water protection rules. This project is a two-year effort to provide a systematic, random "audit" of forest practice rule compliance. ODF will assess the need to continue and expand on this project based on the study results and through a review process that involves key stakeholders. ODF is not currently monitoring road sediment associated with winter road use, nor is it gathering information on road repairs completed under road hazard and risk reduction projects.

Benefits:
Monitoring can provide the most current information on compliance and effectiveness of the construction and maintenance rules over time.

Costs:
Additional resources would be needed to prioritize and maintain a long-term monitoring effort devoted specifically to road issues. However, should the monitoring effort be considered within the current monitoring strategy and prioritized accordingly, no additional resources would be needed.

Option #19 - Continuing Education

Objective:
Provide continuing education for landowners and operators specific to the road construction and maintenance rules.

Description:
Use outreach efforts to achieve this objective.

Methods/Approaches:
Workshops and other types of outreach efforts could be organized by the ODF and coordinated with organizations like the OFIC to provide continuing education for landowners. ODF and OSU held a "Road Stewardship Workshop" in March 2000.

Benefits:
Those landowners and operators that currently do not have a thorough understanding of the rules and their objectives will potentially be better informed.

Costs:
Additional resources will be needed to implement such a program. Depending on the mechanism used to provide continuing education, there is a risk that this type of program will be "preaching

to the choir."   Those landowners and operators that may need information the most (i.e., those who have not been proactive in the past about gaining a complete understanding of rules and their objectives) may not take advantage of continuing education unless concerted efforts are made to reach them.

Option #57 – Ground-Based Harvesting on Steep Slopes

Objective:
To reduce the potential of sediment delivery or other undesirable effects to streams from skid roads constructed on steep slopes.

Description:
Ground-based harvesting on steep slopes has a higher risk of sediment delivery to streams, and has direct impacts to aquatic habitat compared to ground skidding on less-steep slopes, or cable yarding. The current rule is neither clear nor specific.

Methods/Approaches:
Add a prior approval requirement for ground skidding in high-erosion hazard locations. This could be based on slope steepness, or combination slope steepness and soil criteria. This approach could be used everywhere, or only for "core" areas. For example, prior approval could be required for ground skidding on slopes over 45 percent (i.e., if over 200 feet or if a skid trail is located on these slopes). Prior approval could also be required for slopes over 50 percent (average soils) and 40 percent (high-erosion hazard soils).

Benefits:
This will reduce the risk of sediment delivery to waters of the state. It will also help operators to better plan operations in these locations, and to modify operations where risk of sediment delivery is greatest. In some cases, planning activity may reduce operational costs.

Costs:
For those cases where prior approval would be required (a minority of current operations), there would be a moderate increase in operational costs. In some cases, operating costs would be reduced. In other cases (where the operator must switch to cable yarding and wood volume is low), costs could increase significantly.

Option #58 – License Plate Funding to the "Forest Incentive Fund"

Objective:
To create a special license plate that would contribute to a fund that specifically supports stream restoration, fish passage, or road improvement projects on forestland.

Description:

First, a fund would be established. This proposed fund would be called the "Forest Incentive Fund" (referred to in Options #59 and #60). Second, proceeds from the sale of Oregon license plates that have a forestry theme would be used to help support the fund.

Methods/Approaches:
Idaho has implemented such a license plate program. Idaho has several special designs dedicated to specific natural resource categories including big game, nongame, parks, and forestry. The forestry plate appears to attract mainly forestland owners. Many industrial and small landowner vehicles have the plate. One advantage of this program is that each time the license is renewed some revenue is generated.

Landowners with limited financial resources to implement the Oregon Plan's voluntary measures could apply for cost-sharing grants from the fund. Project examples include the cost of fixing, or removing, legacy roads or culverts, or using heavy machinery to place large wood in streams. Alternately, the funds might be used to buy portable bridges for use by landowners.

Grants would be administered at the local ODF offices, requiring the coordinated input from ODF service foresters or forest practice foresters, and ODFW biologists. Watershed council involvement would be encouraged.

The design phase of the plate could be used to attract attention to the forestland restoration efforts.

One alternative to a new plate would be to allow purchasers of the "salmon" plate to specify whether the additional funding should go to the "Forest Incentive Fund" or to the general (Oregon Watershed Enhancement Board) OWEB fund.

Benefits:
Financial incentives will encourage more landowners to implement the voluntary measures that are key to the success of the Oregon Plan. It would create an identity for, and ownership of, the effort to restore salmon on forestlands.

Costs:
There would be a cost of establishing the license plate design and sales with Department of Motor Vehicles (DMV), creating the fund through legislation, and operating the program. This plate might compete with other plates currently available.

Option #59 – Road Closure Program

Objective:
To create a [voluntary] road closure program that forest landowners, the Department of Forestry, and local law enforcement would use to limit [public] vehicle access onto sensitive road systems that have a high risk of delivering sediment to streams or that can directly impact aquatic habitat.

Description:

Legacy roads, roads built on steep slopes and unstable soils, or unsurfaced roads that have the potential to deliver sediment to streams should be closed to public vehicle traffic during the rainy months. Road closure signs would indicate what type of public access in allowed (e.g., foot traffic but no motorized vehicles). It would be a misdemeanor offense subject to uniform citation and civil penalty to violate a road closure, enforceable by local sheriffs or the state police (or possibly by ODF).

Methods/Approaches:
Currently ORS 164.270 allows a landowner to close roads to motor-propelled vehicles. This statute is under the criminal trespass laws and it is not clear what the attached penalty is, but enforcement requires a complaint by the landowner through the local district attorney. Enforcement is difficult under the trespass laws.

Under the proposed approach, landowners would close roads to vehicle access [to the public when not in use during rainy months] for the purposes of protecting water quality. Identifying candidate roads could be done with ODF and ODFW input. User groups, such as motorcycle, or off-road clubs, would be informed. [Agreements for enforcement with local sheriffs or state police would be needed.] [Trespass citations and procedures would need to be clarified.] Violation of a closed road would be subject to citation that could be issued by a law officer and would receive a set civil penalty amount. Assessed [fines] civil penalties would be deposited to the "Forest Incentive Fund".

The "Forest Incentive Fund" (see Option #58) would provide money for gates and posters, plus repairs caused by persons [trespassing on] using closed roads.

Benefits:
Reduce the impact of unauthorized vehicle damage done to roads that results in sediment delivery to streams. The "Forest Incentive Fund" provides a financial incentive to landowners.

Costs:
There would be a cost of establishing the road closure program and allocating the incentive funds to repair damage.

Resources Needed:
Enforcement actions require resources. Moving this out from "trespass law" to a uniform citation with civil penalty would make enforcement much easier. If ODF was to enforce this, additional resources might be needed, particularly in the civil penalty section.

Option #60 – Upstream-Downstream Program

Objective:
To promote the placement of large wood that is removed from the up-stream side of a bridge or culvert (i.e., large wood that has backed up behind a stream crossing structure) to an appropriate location below that bridge or culvert.

Description:
Forest landowners are asked in the Oregon Plan's voluntary measures to place large wood as a part of stream habitat improvement. Large wood, whether placed by humans or transported by the stream, has the potential to threaten the integrity of culverts, bridges, and the road prism during high stream-flow events. If a forest landowner removes this large wood to address this potential threat, this option would have the landowner place that large wood in a suitable down-stream location rather than end-hauling it and removing the wood from the stream system entirely. This option could be implemented on a voluntary, or regulatory, basis.

Methods/Approaches:
Landowners could be encouraged (voluntary, incentive-based) or required (regulatory) to remove large wood from upstream locations and put this material in an appropriate downstream location. Projects would be coordinated with ODF and ODFW. Watershed council involvement would be encouraged. The "Forest Incentive Fund" (see Option #58) could be used to provide money to the landowner.

Benefits:
The removed large wood would be used in a nearby downstream project, possibly on the same stream system. The program would address the concern that large wood can damage human-built structures. The program would provide a financial incentive to the participating forest landowner.

Costs:
Existing agency administration would be used to implement the program. Funds would be needed from the "Forest Incentive Fund."

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ATTACHMENT A

Road Construction and Maintenance Rules

629-625-000 - Purpose

(1) Forest roads are essential to forest management and contribute to providing jobs, products, tax base and other social and economic benefits.
(2) OAR 629-625-000 through 629-625-650 shall be known as the road construction and maintenance rules.
(3) The purpose of the road construction and maintenance rules is to establish standards for locating, designing, constructing, and maintaining efficient and beneficial forest roads; locating and operating rock pits and quarries; and vacating roads, rock pits, and quarries that are no longer needed in manners that provide the maximum practical protection to maintain forest productivity, water quality, and fish and wildlife habitat.
(4) The road construction and maintenance rules shall apply to all forest practices regions unless otherwise indicated.

629-625-100 - Prior Approval

(1) A properly located, designed, and constructed road greatly reduces potential impacts to water quality, forest productivity, fish, and wildlife habitat. To prevent improperly located, designed, or constructed roads, prior approval of the State Forester is required in the sections listed below.
(2) In addition to the requirements of the water protection rules, operators shall obtain prior approval from the State Forester before:
(a) Constructing a road where there is an apparent risk of road-generated materials entering waters of the state from direct placement, rolling, falling, blasting, landslide, or debris flow.
(b) Conducting machine activity in Type F or Type D streams, lakes, or significant wetlands.
(c) Constructing roads in riparian management areas.
(3) In the Northwest Oregon and Southwest Oregon Regions, operators shall obtain prior approval from the State Forester before constructing roads on high-risk sites.
(4) Operators shall obtain written prior approval from the State Forester of a written plan, as described in OAR 629-625-320(1)(b)(B), before constructing any stream-crossing fill over 15 feet deep.
(5) In addition to the requirements of the water protection rules, operators shall obtain prior approval from the State Forester before placing woody debris or boulders in stream channels for stream enhancement.

629-625-200 - Road Location

(1) The purpose of this rule is to ensure roads are located where potential impacts to waters of the state are minimized.
(2) When locating roads, operators shall designate road locations which minimize the risk of materials entering waters of the state and minimize disturbance to channels, lakes, wetlands, and floodplains.
(3) Operators shall avoid locating roads on steep slopes, slide areas, high-risk sites, and in wetlands, riparian management areas, channels, or floodplains where viable alternatives exist.
(4) Operators shall minimize the number of stream crossings.

(5) To reduce the duplication of road systems and associated ground disturbance, operators shall make use of existing roads where practical. Where roads traverse land in another ownership and will adequately serve the operation, investigate options for using those roads before constructing new roads.

629-625-300 - Road Design

(1) The purpose of OARs 629-625-300 through 629-625-340 is to provide design specifications for forest roads that protect water quality.

(2) Operators shall design and construct roads to limit the alteration of natural slopes and drainage patterns to that which will safely accommodate the anticipated use of the road and will also protect waters of the state.

629-625-310 - Road Prism

(1) Operators shall use variable grades and alignments to avoid less-suitable terrain so that the road prism is the least disturbing to protected resources, avoids steep sidehill areas, wet areas, and potentially unstable areas as safe, effective vehicle use requirements allow.

(2) Operators shall end-haul excess material from steep slopes or high-risk sites where needed to prevent landslides.

(3) Operators shall design roads no wider than necessary to accommodate the anticipated use.

(4) Operators shall design cut- and fillslopes to minimize the risk of landslides.

(5) Operators shall stabilize road fills as needed to prevent fill failure and subsequent damage to waters of the state using compaction, buttressing, subsurface drainage, rock facing, or other effective means.

629-625-320 - Stream-Crossing Structures

(1) Operators shall design and construct stream-crossing structures (culverts, bridges and fords) to:

(a) Minimize excavation of side slopes near the channel.

(b) Minimize the volume of material in the fill.

(A) Minimizing fill material is accomplished by restricting the width and height of the fill to the amount needed for safe use of the road by vehicles, and by providing adequate cover over the culvert or other drainage structure.

(B) Fills over 15 feet deep contain a large volume of material that can be a considerable risk to downstream beneficial uses if the material moves downstream by water. Consequently, for any fill over 15 feet deep, operators shall obtain approval of the State Forester of a written plan that describes the fill and drainage structure design. Approval of such written plans shall require that the design be adequate for minimizing the likelihood of surface erosion, embankment failure, and other downstream movement of fill material.

(c) Prevent erosion of the fill and channel.

(2) Operators shall design and construct stream crossings (culverts, bridges, and fords) to:

(a) Pass a peak flow that at least corresponds to the 50-year return interval. When determining the size of culvert needed to pass a peak flow corresponding to the 50-year return interval, operators shall select a size that is adequate to preclude ponding of water higher than the top of the culvert; and

(b) Allow migration of adult and juvenile fish upstream and downstream during conditions when fish movement in that stream normally occurs.
(3) An exception to the requirements in subsection (2)(a) of this rule is allowed to reduce the height of fills where roads cross wide flood plains. Such an exception shall be allowed if:
(a) The stream-crossing site includes a wide flood plain; and
(b) The stream-crossing structure matches the size of the active channel and is covered by the minimum fill necessary to protect the structure;
(c) Except for culvert cover, soil fill is not placed in the flood plain, and
(d) The downstream edge of all fill is armored with rock of sufficient size and depth to protect the fill from eroding when a flood flow occurs.

629-625-330 - Drainage
(1) Operators shall provide a drainage system using grade reversals, surface sloping, ditches, culverts, and/or waterbars as necessary to effectively control and disperse surface water to minimize erosion of the road.
(2) Operators shall not divert water from channels except as necessary to construct stream crossings.
(3) Operators shall locate dips, water bars, or cross-drainage culverts above and away from stream crossings so that road-drainage water may be filtered before entering waters of the state.
(4) Operators shall provide drainage when roads cross or expose springs, seeps, or wet areas.
(5) Operators shall not concentrate road-drainage water into headwalls, slide areas, or high-risk sites.

629-625-340 - Waste Disposal Areas
Operators shall select stable areas for the disposal of end-haul materials, and shall prevent overloading areas which may become unstable from additional material loading.

629-625-400 - Road Construction
OARs 629-625-400 through 629-625-440 provide standards for disposal of waste materials, drainage, stream protection, and stabilization to protect water quality during and after road construction.

629-625-410 - Disposal of Waste Materials
Operators shall not place debris, sidecast, waste, and other excess materials associated with road construction in locations where these materials may enter waters of the state during or after construction.

629-625-420 - Drainage
(1) Operators shall clear channels and ditches of slash and other road construction debris which interferes with effective roadway drainage.
(2) Operators shall provide effective cross drainage on all roads, including temporary roads.
(3) Operators shall install drainage structures on flowing streams as soon as feasible.
(4) Operators shall effectively drain uncompleted roads which are subject to erosion.
(5) Operators shall remove berms on the edges of roads, or provide effective drainage through these berms, except for those berms intentionally designed to protect road fills.

629-625-430 - Stream Protection
(1) When constructing stream crossings, operators shall minimize disturbance to banks, existing channels, and riparian management areas.
(2) In addition to the requirements of the water protection rules, operators shall keep machine activity in beds of streams to an absolute minimum. Acceptable activities where machines are allowed in streambeds, such as installing culverts, shall be restricted to periods of low water levels. Prior approval of the State Forester for machine activity in Type F or Type D streams, lakes, and significant wetlands is required by 629-625-100(2)(c).
(3) For all roads constructed, or reconstructed, operators shall install water crossing structures where needed to maintain the flow of water and passage of adult and juvenile fish between side channels or wetlands and main channels.
(4) Operators shall leave or reestablish areas of vegetation between roads and waters of the state to protect water quality.
(5) Operators shall remove temporary stream-crossing structures promptly after use, and shall construct effective sediment barriers at approaches to channels.

629-625-440 - Stabilization
(1) Operators shall stabilize exposed material which is potentially unstable or erodible by use of seeding, mulching, riprapping, leaving light slashing, pull-back, or other effective means.
(2) During wet periods, operators shall construct roads in a manner which prevents sediment from entering waters of the state.
(3) Operators shall not incorporate slash, logs, or other large quantities of organic material into road fills.

629-625-500 - Rock Pits and Quarries
(1) The development, use, and abandonment of rock pits or quarries which are located on forestland and used for forest management shall be conducted using practices which maintain stable slopes and protect water quality.
(2) Operators shall not locate quarry sites in channels.
(3) When using rock pits or quarries, operators shall prevent overburden, solid wastes, or petroleum products from entering waters of the state.
(4) Operators shall stabilize banks, headwalls, and other surfaces of quarries and rock pits to prevent surface erosion or landslides.
(5) When a quarry or rock pit is inactive or vacated, operators shall leave it in the conditions described in section (4) of this rule, shall remove from the forest all petroleum-related waste material associated with the operation, and shall dispose of all other debris so that such materials do not enter waters of the state.

629-625-600 - Road Maintenance
(1) The purpose of this rule is to protect water quality by timely maintenance of all active and inactive roads.
(2) Operators shall maintain active and inactive roads in a manner sufficient both to provide a stable surface and to keep the drainage system operating as necessary to protect water quality.

(3) Operators shall inspect and maintain culvert inlets and outlets, drainage structures, and ditches before and during the rainy season as necessary to diminish the likelihood of clogging and the possibility of washouts.
(4) Operators shall provide effective road surface drainage, such as water-barring, surface crowning, constructing sediment barriers, or outsloping, prior to the rainy and runoff seasons.
(5) When applying road oil, or other surface stabilizing materials, operators shall plan and conduct the operation in a manner as to prevent entry of these materials into waters of the state.
(6) In the Northwest and Southwest Oregon Regions, operators shall maintain and repair active and inactive roads as needed to minimize damage to waters of the state. This may include maintenance and repair of all portions of the road prism during and after intense winter storms, as safety, weather, soil moisture, and other considerations permit.
(7) Operators shall place material removed from ditches in a stable location.
(8) In order to maintain fish passage through water-crossing structures, operators shall:
(a) Maintain conditions at the structures so that passage of adult and juvenile fish is not impaired during periods when fish movement normally occurs. This standard is required only for roads constructed or reconstructed after September 1994, but is encouraged for all other roads; and
(b) As reasonably practicable, keep structures cleared of woody debris and deposits of sediment that would impair fish passage.
(c) Other fish passage requirements under the authority of ORS 498.268 and 509.605 that are administered by other state agencies may be applicable to water-crossing structures, including those constructed before September 1, 1994.

629-625-650 - Vacating Forest Roads
(1) The purpose of this rule is to ensure that when landowners choose to vacate roads under their control, the roads are left in a condition where road related damage to waters of the state is unlikely.
(2) To vacate a forest road, landowners shall effectively block the road to prevent continued use by vehicular traffic, and shall take all reasonable actions to leave the road in a condition where road-related damage to waters of the state is unlikely.
(3) Reasonable actions to vacate a forest road may include: removal of stream-crossing fills; pullback of fills on steep slopes, frequent cross ditching, and/or vegetative stabilization.
(4) Damage which may occur from a vacated road, consistent with Sections (2) and (3) of the rule, will not be subject to remedy under the provisions of the Oregon Forest Practices Act.