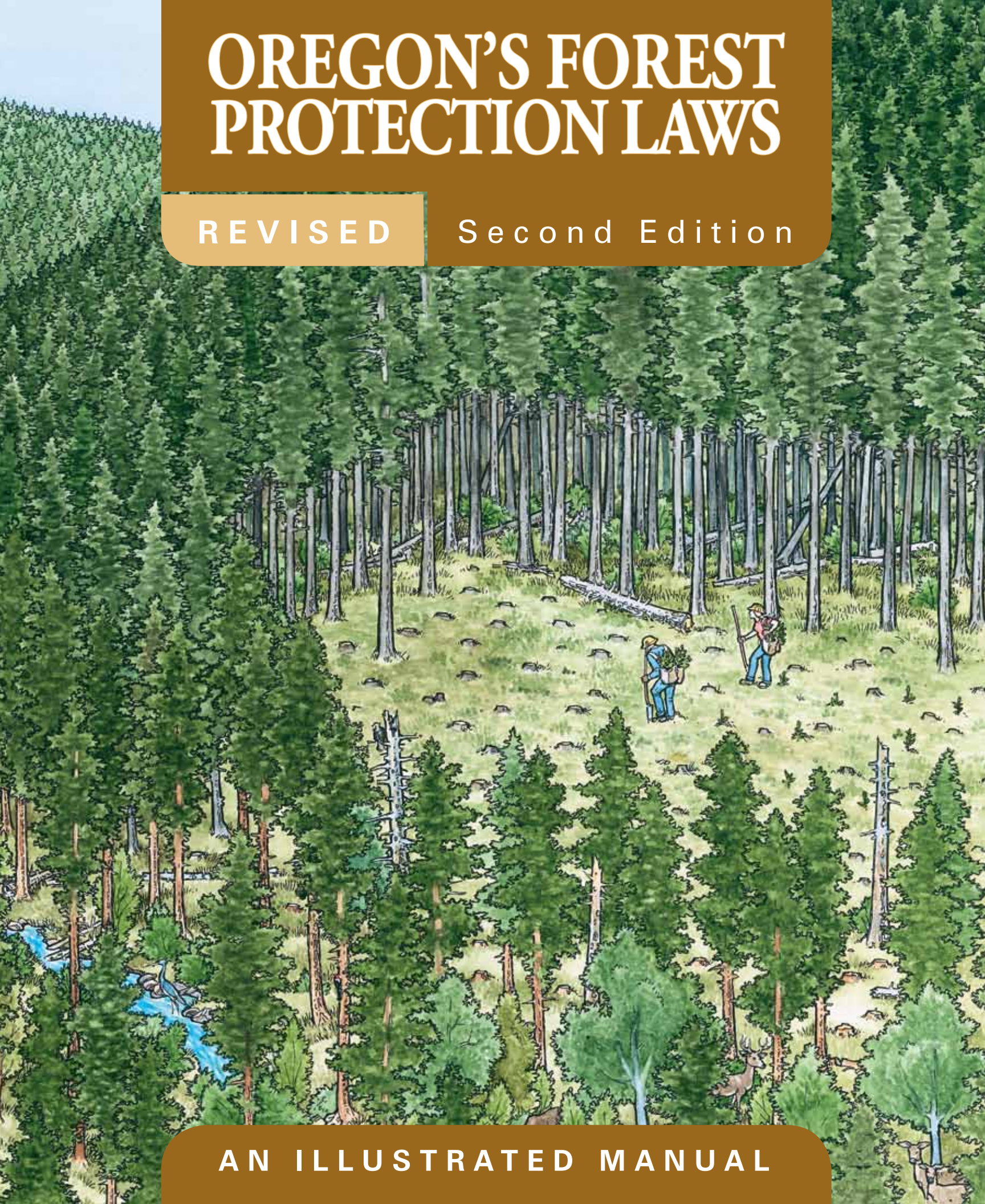
OREGON'S FOREST PROTECTION LAWS

REVISED Second Edition



AN ILLUSTRATED MANUAL

About this book

Who is it for?

- Landowners and operators who manage and work on Oregon forestland
- Foresters who develop management plans for forestland owners
- Anyone interested in learning about the Oregon Forest Practices Act and other protection laws

What is it about?

Protecting forests and meeting the Forest Practices Act requirements when:

- Harvesting trees, especially around streams, lakes or wetlands
- Providing for the needs of wildlife
- Disposing of forest slash
- Building or improving forest roads
- Applying chemicals to forestland

How it should be used.

Use it to plan your forest management objectives while protecting natural resources.

Use it as a quick reference before starting any operation.

Use it to communicate among landowners, operators and Department of Forestry foresters.

Keep it in your vehicle so it's there when you need it.

What it won't do.

It won't send in your notification form to the Department of Forestry 15 days before starting a forestry operation.

It won't substitute for your responsibility to know the laws and regulations of other agencies that govern forestland operations.

It won't exempt you from knowing the details of the Act.

Will the Forest Practices Act and Rules change?

Yes, because the Forest Practices Act and Rules continue to evolve. They respond to new needs and advances in forest research and experience.

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This symbol indicates specific requirements very close to the actual wording in the Act and Rules. Because of potential changes, always verify current requirements and wording.

Since it was first published in 2002, *Forest Protection Laws: An Illustrated Manual* has become a standard reference for those planning and executing timber harvests. It is a visual resource, often found dog-eared and grimy in the vehicles used by those whose work is hands-on forestry. And for good reason, because the publication fosters easy understanding and correct application of the Oregon Forest Practices Act and Rules and the other best management practices, laws and rules that apply to Oregon's forest landowners.

However, this manual is not intended to replace the official version of the rules, which are available from the Oregon Department of Forestry, nor is it intended to replace the advice and resources of an ODF forester. For in the end, it is the two-way communication between the ODF forester and those using this manual that helps the state achieve its goals for best management practices.

The Oregon Forest Resources Institute acknowledges Paul Adams of the OSU Forestry Extension Program for managing the majority of the revisions to this edition. We thank Rex Storm of the Associated Oregon Loggers for major revisions to the new chapter titled "Fire and Chemicals." OFRI also offers thanks to the employees of the Oregon Department of Forestry, faculty of the OSU Forestry Extension Program, staff and members of the Oregon Forest Industries Council, and members of the Oregon Small Woodlands Association, the Oregon Tree Farm System and the Oregon Board of Forestry's Committee on Family Forestlands for input on the reorganization of the manual and reviewing the updated version.

The high quality of this updated manual would have not been possible without a high-quality first edition. OFRI also thanks and recognizes Robert Logan for his vision in producing the original 2002 edition of *Oregon's Forest Protection Laws: An Illustrated Manual*.

The original edition has been extremely useful to loggers, private foresters, woodland owners and forestry educators in their efforts to promote the best management practices that keep our forests sustainable. There have been significant changes in the rules since 2002 when the original edition was published that have been incorporated into this second edition.

One thing that has not changed is the dedication of Oregon's forest landowners, managers and operators to sustainable forest management. We hope this updated edition will be as much of an educational resource to help you manage and protect our valuable forest resources as the first edition.

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Introduction

Why does Oregon have a forest practices act?

Because forests matter.

Forests provide environmental, social and economic benefits that reach beyond their boundaries. They provide clean water, fish and wildlife habitat, and recreation. They provide jobs, products and tax revenues that result in healthy communities. The Oregon Forest Practices Act helps sustain these values in a socially accountable manner.

Because Oregonians value their forests.

Our forests are key to our quality of life as Oregonians. Forest landowners, operators and foresters are stewards of Oregon's forests. Good stewards accept responsibility for sustaining our forests and for protecting soil, air, fish, wildlife, water quality and other resources valued by the public. The Oregon Forest Practices Act and Rules makes clear the stewardship expectations of the public and ensures that landowners operating under its rules can manage their forests for a variety of objectives.

Because Oregon is a national leader.

The Legislature passed the Act in 1971, creating the first Forest Practices Act in the nation. It was prompted by emerging concerns about multiple forest resources, including findings from pioneering research on forest watersheds. The Act provides a statutory framework for a comprehensive program that includes detailed rules, technical assistance and monitoring.

To set standards for all forest landowners.

The Oregon Forest Practices Act and Rules set standards for any commercial activity involving the establishment, management or harvesting of trees on Oregon's forestlands. They regulate these forest operations on all non-federal lands (private, state-owned and county- or city-owned). Operations on lands managed by the USDA Forest Service and USDI Bureau of Land Management are not directly regulated, but both agencies agree to meet or exceed the Oregon Forest Practices Act and Rules requirements.

Who makes the rule requirements?

Oregon law gives the Oregon Board of Forestry primary responsibility to adopt or revise rules for forest practices. The board uses information and input from regional committees and other diverse advisory groups, including recommendations about potential rules changes. This approach helps keep the requirements current and responsive to evolving knowledge and concerns. Occasionally, the Legislature has amended the Forest Practices Act to include some specific requirements for forest operations, such as those for timber harvests near scenic highways.

Who enforces the requirements?

Foresters employed by the Oregon Department of Forestry (ODF), are responsible for reviewing pre-operations plans, overseeing operations, ensuring reforestation, investigating complaints and enforcing corrective actions when violations occur. ODF works with landowners and operators to help them comply with the requirements and avoid problems. However, where necessary, ODF foresters can issue citations leading to civil or criminal penalties.

How do you stay on top of the Forest Practices Act and Rules?

First, spend time planning. For example, if it's a timber harvest you want to do, ask yourself these questions. Consult with those who can help with answers.

- Do you know the site features, including the slopes, drainage and other natural characteristics?
- What could be the effect of the harvest and road construction on water quality?
- Are there soils with potential for compaction and erosion?
- Are there riparian and wetland areas that require special attention?
- What accommodations need to be made to protect wildlife habitat?
- When reforestation is needed after harvest, what is the plan for that?
- What slash treatment and site preparation will be necessary to establish a new forest?

If trying to answer these questions raises more questions for you, this manual is a place to start. Check it out. It will help.

What is an operation or a forest practice?

An operation or forest practice is any commercial activity relating to the establishment, management or harvest of forest tree species. Most forest practices fall into one of the following general categories: road construction and maintenance, site preparation by treating slash, reforestation, harvesting or use of pesticides or fertilizers. Before conducting an operation or forest practice, landowners and operators will usually need to inform the state by completing a Notification of Operation form (see page 6) for ODF. The definition of an operation specifically excludes some activities, to help clarify what is and is not regulated by the Act and Rules. See below.

What operations require a notification?

- road construction
- slash disposal (burning, chipping, biomass processing, etc.)
- precommercial thinning
- harvesting
- applying chemicals and using petroleum products
- quarry site development for rock used in forest operations
- site preparation for reforestation
- changing the use of forestland to non-forest use

What operations do not require a notification?

- tree planting
- routine road maintenance
- personal-use firewood cutting
- collecting tree boughs, cones or similar minor forest products

What activities are specifically not operations?

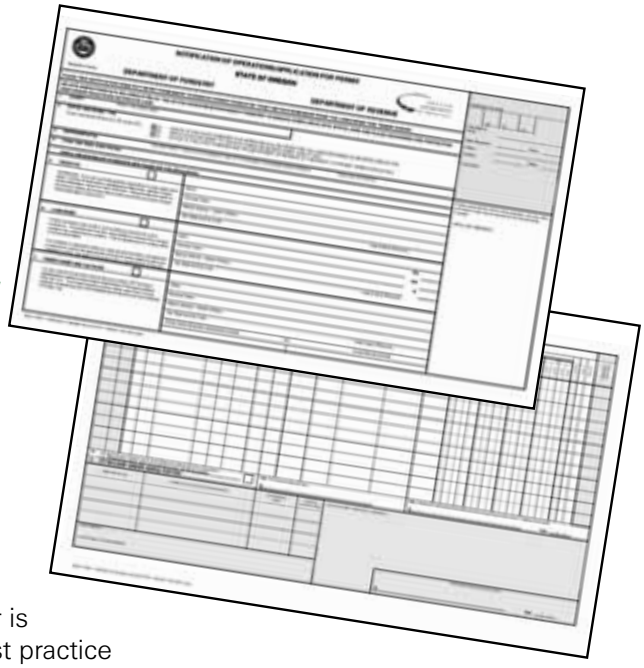
In some cases a permit to operate power-driven machinery may be required for operations that do not require a notification or for activities listed below that are specifically not included as operations under the Act. Operations that do not require a notification must still be conducted in compliance with any applicable forest practice requirements:

- the establishment, management or harvest of Christmas trees on land used solely for their production
- hardwood plantations harvested on a rotation cycle that is 12 or fewer years after planting and subject to intensive agricultural practices
- agricultural tree crops, including nuts, fruits, seeds and nursery stock
- ornamental, street or park trees within an urbanized area
- juniper species management in a unit of less than 120 contiguous acres within a single ownership
- trees intended to mitigate agricultural practices that are established or managed for windbreaks, riparian filters or shade strips immediately adjacent to actively farmed lands

What other requirements are described in this manual?

- when to provide wildlife trees and down logs while harvesting
- limitations on the size of clearcut harvests
- how to protect bird nesting, roosting and watering sites
- ensuring fish passage through stream crossing structures
- how to operate where rapidly moving landslides might occur
- how to harvest and reforest next to scenic highways
- log landing requirements
- the proper disposal of logging waste

How to comply with the Oregon Forest Practices Act and Rules



File a Notification of Operation as required.

After you've planned the operation, file a completed Notification of Operation form at your local Oregon Department of Forestry (ODF) office at least 15 days prior to the start of the operation. Failure to file is a violation under the Forest Practices Act and Rules.

How do notifications work?

- The landowner or operator sends a completed Notification of Operation form to the local ODF office. This form requires maps or aerial photos of the operation area. Be prepared to include them.

Note: If you're cutting and selling timber from farmland or rural residential land, a Notification of Operation is also required.

- ODF must have your Notification of Operation at least 15 days before you expect to start the operation, so schedule activities accordingly.
- Will your operation use power-driven machinery or fire for slash disposal or site preparation? The Notification form is used to apply for a permit to use that machinery and burn. Follow fire prevention requirements on page 81.
- When the Notification is complete and accepted, the Stewardship Forester will send a form that includes a notification number for your operation. This number is important for harvest tax purposes.
- *A notification is not a permit. It is only information to ODF of your intent. The 15-day waiting period and written plan review simply provide for planning to comply with protection rules.*
- Throughout the operation, the landowner or operator is required to follow all forest practice requirements that apply.

What activities require a written plan?

Operators need to submit a written plan to ODF along with the notification before starting some activities. Written plans allow ODF foresters to work with operators to help them meet Forest Practices Act requirements. Written plans are referred to in other parts of this manual, including the Appendix, page 139.

There are three kinds of written plans:

Statutory written plans

ODF foresters cannot waive the requirement or the waiting period for these plans. ODF foresters review these plans but do not provide a formal approval or disapproval. The following activities require statutory plans:

- operations within 100 feet of a Type F or D stream (see page 8).
- operations within 100 feet of a large lake or within 300 feet of a significant wetland (see pages 30-33).
- operations within 300 feet of areas identified by ODF as important for certain wildlife species.

Nonstatutory written plans

These plans are like statutory written plans, except that ODF foresters can waive the requirement or reduce the waiting period. ODF foresters review these plans but do not provide a formal approval or disapproval. A full list of activities requiring this kind of written plan is shown in the Appendix, page 139. Some examples are:

- building road fills deeper than 15 feet
- operating within one-half mile of critical wildlife habitat sites.

Plan for an alternate practice

Operators can use this type of plan to propose methods that are different than what is spelled out in the rules. If the plan will result in equal or better resource protection, ODF foresters will approve the plan. This kind of plan is meant to encourage good ideas for effective actions, and is the only kind of plan ODF foresters approves or disapproves. One example of this kind of plan would be for using natural reforestation methods instead of tree planting after harvest. See page 133.

For other information sources, see the Appendix, pages 183-184.

Oregon is divided into three administrative areas. Each area has Forest Protection Districts. *Know your local ODF district.*

How do I find a local ODF office?

For more information about Oregon's Forest Practices Act or rules, please contact your local ODF district office, or the headquarters office at
2600 State St. Salem, OR 97310;
503-945-7200; Fax 503-945-7212;
TTY 800-437-4490
E-mail: **information@odf.state.or.us**
Web: **http://egov.oregon.gov/ODF**

This manual goes a long way toward explaining the requirements, but it may not be enough. The application of forest practices on specific sites can sometimes be complex. Always verify details with ODF. Get a copy of the Act and Rules. Ask ODF your questions before starting. You may also benefit from educational and technical assistance from the OSU Extension Service, consulting foresters and other specialists and organizations.

EASTERN OREGON AREA	3501 E. 3rd St.	Prineville, 97754	541-447-5658
Central Oregon District	3501 E. 3rd St.	Prineville, 97754	541-447-5658
John Day Unit	400 NW 9th St.	John Day, 97845	541-575-1139
The Dalles Unit	3701 W. 13th St.	The Dalles, 97058	541-296-4626
Sisters Sub-unit	114 W. Washington	Sisters, 97759	541-549-2731
Fossil Sub-unit	45945 Hwy. 19	Fossil, 97830	541-763-2575
Klamath/Lake District	3200 DeLap Rd.	Klamath Falls, 97601	541-883-5681
Lakeview Unit	2290 N. 4th St.	Lakeview, 97630	541-947-3311
Northeast Oregon District	611 20th St.	La Grande, 97850	541-963-3168
Wallowa Unit	802 W. Hwy. 82	Wallowa, 97885	541-886-2881
Pendleton Unit	1055 Airport Rd.	Pendleton, 97801	541-276-3491
Baker Sub-unit	2995 Hughes Ln.	Baker City, 97814	541-523-5831
NORTHWEST OREGON AREA	801 Gales Creek Rd.	Forest Grove, 97116	503-359-7426
Astoria District	92219 Hwy. 202	Astoria, 97103	503-325-5451
Tillamook District	5005 E. 3rd St.	Tillamook, 97141	503-842-2545
Molalla Unit	14995 S. Hwy. 211	Molalla, 97038	503-829-2216
North Cascade District	22965 N. Fork Rd. SE	Lyons, 97358	503-859-2151
Forest Grove District	801 Gales Creek Rd.	Forest Grove, 97116	503-357-2191
Columbia City Unit	405 E St.	Columbia City, 97018	503-397-2636
West Oregon District	24533 Alsea Hwy.	Philomath, 97370	541-929-3266
Dallas Unit	825 Oak Villa Rd.	Dallas, 97338	503-623-8146
Toledo Unit	763 NW Forestry Rd.	Toledo, 97391	541-336-2273
SOUTHWEST OREGON AREA	1758 NE Airport Rd.	Roseburg, 97470	541-440-3412
Coos District	63612 Fifth Rd.	Coos Bay, 97420	541-267-4136
South Cascade District	3150 Main St.	Springfield, 97478	541-726-3588
Sweet Home Unit	4690 Hwy. 20	Sweet Home, 97386	541-367-6108
Southwest Oregon District	5286 Table Rock Rd.	Central Point, 97502	541-664-3328
Roseburg Unit	1758 NE Airport Rd.	Roseburg, 97470	541-440-3412
Grants Pass Unit	5375 Monument Dr.	Grants Pass, 97526	541-474-3152
Western Lane District	87950 Territorial Hwy.	Veneta, 97487	541-935-2283
Florence Unit	2660 Kingwood St.	Florence, 97439	541-997-8713

How waters of the state are classified and protected

The requirements of the Oregon Forest Practices Act are intended to protect fish, wildlife and water quality when forest management activities occur near waters of the state and within riparian management areas. Protection measures are based on how the water body near an operation is classified, as well as the geographic region.

What are waters of the state?

Lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, wetlands, inlets, canals and the Pacific Ocean within the territorial limits of the State of Oregon are waters of the state.

How are streams identified and classified?

A stream is a channel with a distinct bed or banks scoured by water that serves to confine water and that contains flowing water during some portion of the year. There are three stream types, based on use, and three stream sizes, which results in nine possible classifications.

Stream types:

- Type F streams have fish and may also be used for domestic water.
- Type D streams are used for domestic water and have no fish (more likely to be small streams).
- Type N streams include all others.

Stream sizes (see illustration):

- Small streams have an average annual flow of 2 cubic feet per second or less, or have a drainage area less than 200 acres — they generally have widths less than 7 feet.
- Medium streams have an average annual flow greater than 2 and less than 10 cubic feet per second — they generally have widths of 7-12 feet.
- Large streams have an average annual flow greater than 10 cubic feet per second — they generally have widths of greater than 12 feet.

The combination of size and use designates each stream. For example, a medium-sized stream with fish would be called a "medium F" stream.

How are wetlands identified and classified?

Wetlands are areas that are often inundated or saturated by surface or ground water, which results in local vegetation that can tolerate or thrive in saturated soils. There are three major categories of wetlands:

Significant wetlands, which include:

- wetlands larger than 8 acres,
- estuaries,
- bogs, and
- important springs in eastern Oregon

Stream-associated wetlands

These are wetlands less than 8 acres that are next to a stream. Protection requirements are based on the classification of the stream with which they are connected.

Other wetlands (including seeps and springs), which include:

- those greater than one-quarter acre
- those less than one-quarter acre

How are lakes identified and classified?

Lakes are bodies of year-round standing open water. They do not include bodies developed for human needs and not part of a stream, such as farm ponds. There are two kinds of lakes:

- large lakes, which are greater than 8 acres
- all other lakes


Medium stream
Significant wetland
Stream-associated wetland
Small stream
Stream side channel
Stream-associated wetland
Large stream

There are seven geographic water protection regions.

The protection requirements for streams differ according to the geographic region in which the stream is located.

How can you identify the classification of your stream, wetland or lake?

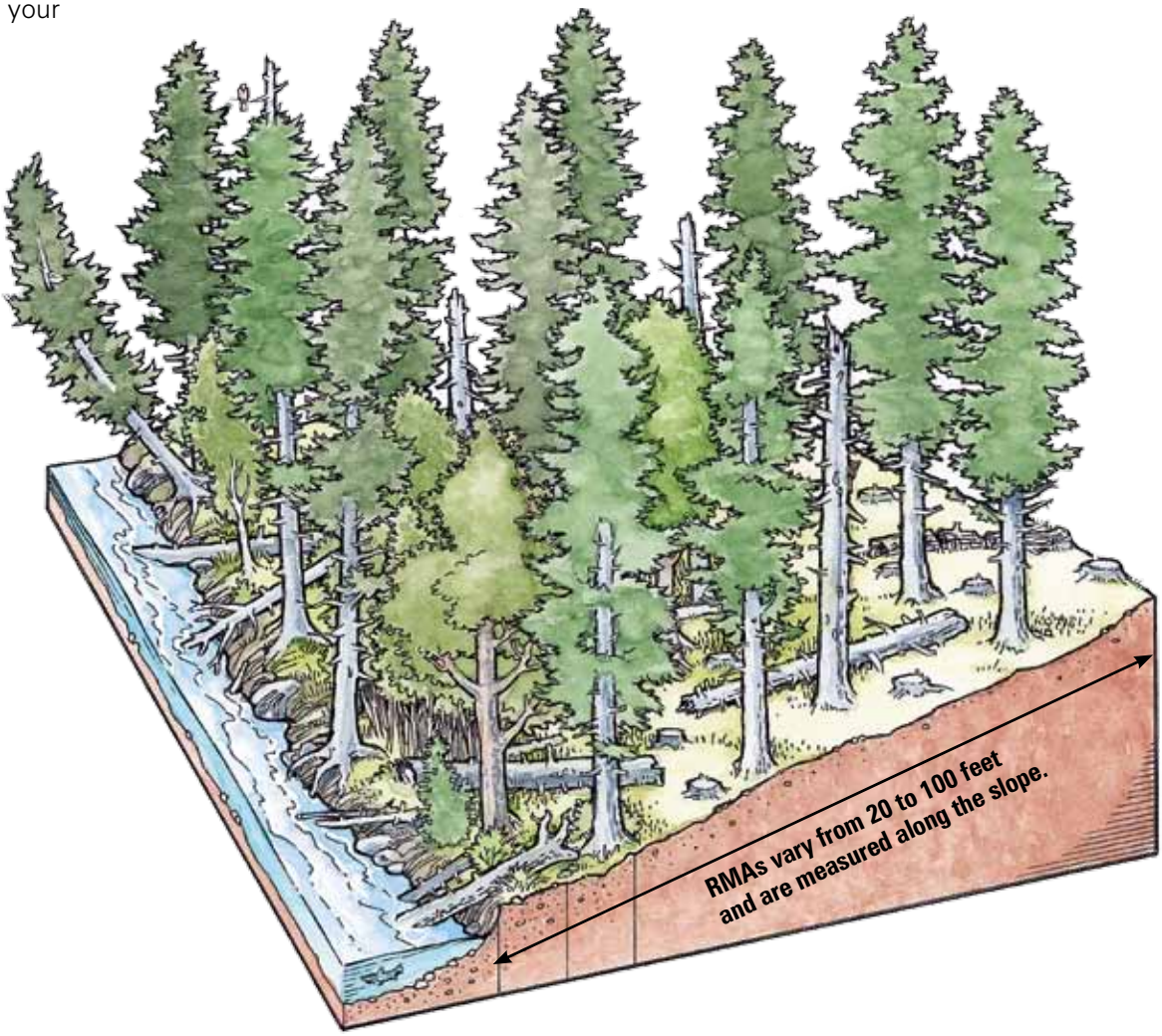
ODF field offices have maps showing the classification of waters within the local area. The maps show known streams, lakes and significant wetlands, along with the size class and extent of fish or domestic water use. It is your responsibility to identify streams in proposed operations areas, including those that might not show up on ODF maps, and bring them to ODF's attention. ODF will tell you the classification of the streams after you file your Notification.

The state is divided into seven geographic water protection regions, each with its own protection requirements. Precise region boundaries can be found on ODF field office maps.

What are RMAs (riparian management areas)?

Unique "riparian" areas are found along the edges of streams, lakes, reservoirs, springs, marshes, bogs, ponds and seeps.

To help protect these water bodies, RMAs are locally specified and have requirements for retaining trees, snags and understory vegetation, and for limited or modified practices.



How RMAs help to protect key resources?

TOP, RIGHT: **RMA plants, down logs and soils serve as a filter, trapping pollutants and keeping them from entering streams, wetlands and lakes.**

CENTER, RIGHT: **Many wildlife species, like this Columbia torrent salamander, rely on RMAs for the necessities of life: food, water, protection from predators and a place to rear young.**

Do RMA widths differ?

Yes, depending on the stream type and size (see page 20).

Yes, depending on the size of the lake (see page 31).

Yes, depending on the kind of wetland (see page 33).

Is an RMA required for all waters of the state?

No, small Type N streams may not require a specific RMA, though some vegetation protection may be necessary — this is similar for other wetlands and other lakes without fish that are one-half acre or less.

What long-term benefits of RMAs are expected?

A primary goal of the RMA protection requirements is to develop more mature streamside forests (80 to 200 years old), especially those with conifer trees. Such forests provide channel shade, large logs that fall into the stream for fish habitat, bank-holding roots, snags for wildlife and quantities of leaves, needles, branches and insects that feed aquatic life. With time, the requirements are expected to promote conifer-dominated RMAs, while allowing for some trees to be harvested.

In the future, more streams will have mature forest in their RMA.

For more information, see:

You want to harvest timber on your property. How do you plan for it? (page 13).

You want to harvest timber along a stream. What do you need to know? (page19).

You want to harvest timber near a lake. How do you meet the requirements? (page 30).

You want to harvest timber in or near a wetland. How do you meet the requirements? (page 32).

For other information sources, see the Appendix, pages 183-184.

In RMAs that are conifer-growing sites but currently dominated by hardwoods, especially red alder, more extensive harvesting may be allowed so conifers can be planted. This requires a written plan (see page 139).

In RMAs where the native tree community is hardwood-dominated stands such as ash, cottonwood or maple, the goal is to retain and grow sufficient hardwood trees. Some harvesting may be needed for successful reforestation to replace dead and dying trees in such stands.

Planning a timber harvest

You want to harvest timber on your property. How do you plan for it?

What can happen when you don't know the requirements?

"A logger harvested the trees on my property last year. Now I've got a letter from the Oregon Department of Forestry (ODF) telling me I need to replant the harvest unit. I've got two years to do the planting, and then four more years to take care of the seedlings. I didn't know about this. I figured the trees would come back on their own. It's going to cost a lot and I used the money from the harvest for something else. If I'd known about all of this before I would have done things differently."

Signed, Uninformed Forest Landowner

How can you prevent this from happening to you?

When you harvest timber or sell or purchase cut-over land, you have a legal obligation to know whether you need to reforest. Sellers of land with reforestation requirements have an obligation to inform potential purchasers about the reforestation responsibility. This obligation goes with the land to the new landowner.

Is there flexibility?

It's your decision to choose between four broad types of harvest (Table 2-2, page 17) and how much timber to harvest on your property.

Your decision will determine if you need to reforest, limit the harvest unit size, or leave wildlife trees and down logs to meet the requirements.

Forest landowners also must protect streams, lakes, wetlands and wildlife sites. These topics, along with harvest slash disposal and forest fire regulations, are discussed later in this manual.

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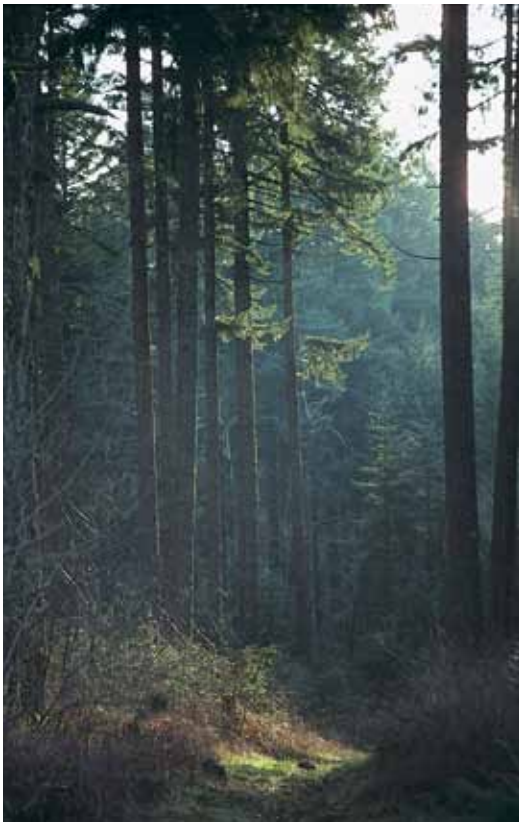
The following pages describe the steps forest landowners can go through to plan timber harvests on their properties. The examples show how the Oregon Forest Practices Act and Rules consider different scenarios and offer flexibility.



Are you a landowner ready to harvest some timber?

Perhaps your goals can be described this way:

You need to sell some timber for some income. You want to thin your trees, but you want what's left to be a healthy, vigorous forest.

Maybe you have the information called for in Steps 2, 3 and 4. You've identified the site class for the harvest unit, the size of the unit and which trees you'll leave. For example:

The harvest unit is Site Class III, the "high" category. Harvest size: 35 acres.

The plan: leave 90 square feet of basal area per acre in trees at least 11 inches in diameter. See this harvest unit on page 15.

Are steps 2-4 new to you?

Be sure to check out information in the appendix. You can learn how to determine this information, but some landowners hire a professional forester for help.

Follow these steps to know what your timber harvest requirements will be.

STEP 1 Determine the kind of harvest (Type 1, 2, 3 or Unclassified) you intend to conduct (Table 2-2, page 17).

Do this before you file your Notification of Operation form with the local ODF office.

To do that you need to know three things:

- the harvest unit site class
- the harvest unit acreage
- the diameters and basal area of the trees you will leave

STEP 2 Determine the site class of your harvest.

Tree growth on Oregon's forestland varies with our changing climate and different soil conditions. Site class is a measure of forestland productivity. Several important requirements in the Oregon Forest Practices Act are based on site class. It is very important that you know the site class of your harvest unit.

For purposes of the Oregon Forest Practices Act, forestland site classes are grouped into three categories:

- Site classes I, II and III are the high category.
- Site classes IV and V make up the medium category.
- Site class VI makes up the low category.

Be careful not to confuse site class with site index, which is a measure of how tall trees will grow at a particular location. For more information on site class and how to determine it for your harvest unit, see the Appendix, page 141.

STEP 3 Determine how many acres the harvest unit will cover.

Harvest unit size determines whether some important restrictions apply. First there's the requirement to leave wildlife trees and down logs on Type 2 harvest units larger than 25 acres. Then there's the requirement to limit Type 3 harvest units to 120 acres, with a few exceptions. As you go through this example you'll understand why knowing your harvest unit size is important.

You can figure out the size of your harvest unit using a scaled aerial photograph, topographic map or global positioning system (see the Appendix, page 141). Accurate acreage measurements are your responsibility.

STEP 4 Determine the diameters and basal area of the trees you will leave on the harvest unit.

This is where you decide and measure which trees you plan to leave in the harvest unit. Tree diameter is measured 4-1/2 feet above the ground, on the uphill side of the tree, and is referred to as diameter at breast height (DBH). Basal area is the cross-sectional area of each tree stem at DBH, for a specific area such as an acre.

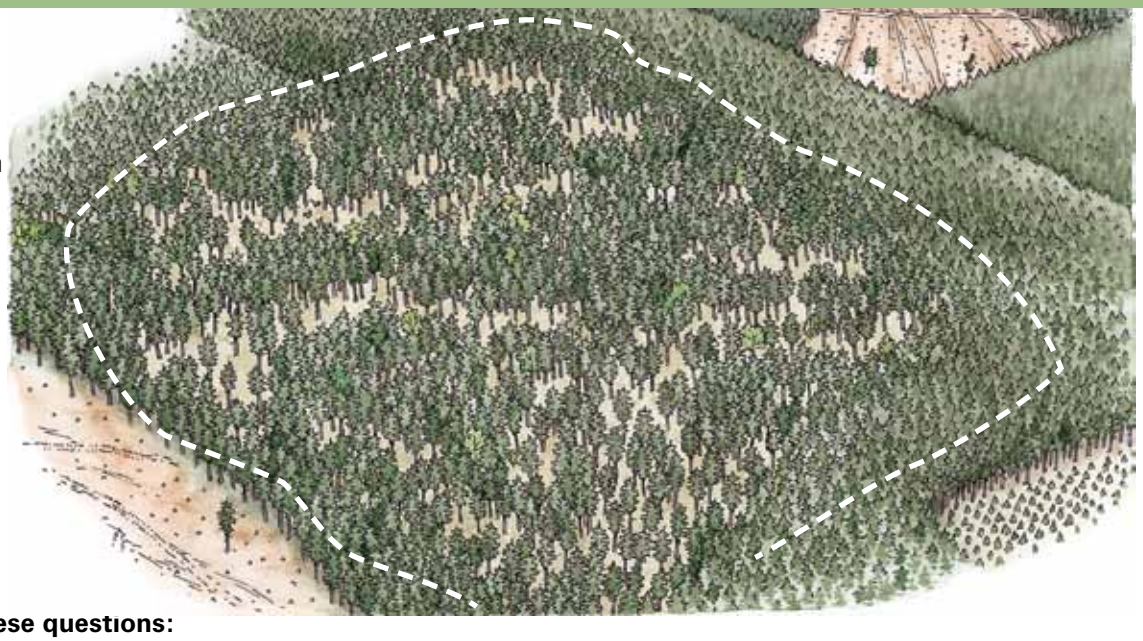
How much basal area you leave and the diameters of the leave trees are two of the keys to determining the type of harvest you intend and the requirements that will apply to the harvest unit. See the Appendix, page 152 for more information on measuring tree diameters and calculating basal area.

STEP 5 Determine if the operation is likely to be active during a "declared fire season."

A "declared fire season" exists when the local risk of wildfire is identified as significant, a period often extending from early July to October. During this time, operators are required to be alert and able to suppress a small fire, including having suppression equipment on-site and meeting daily fire-watch requirements, as well as having additional liability for a fire originating in the harvest unit. See pages 81-86 for more information.

Your harvest unit example:

Site Class III, high; Harvest size, 35 acres, leaving 90 sq. ft./acre in 11" or larger trees.



You now need to answer these questions:

Question 1

How much of this forest will be harvested, and will there be a reforestation requirement after harvest?

Question 2

Will there be a requirement to leave wildlife trees and down logs when harvesting?

Question 3

Will the harvest unit be Type 1, Type 2, Type 3 or Unclassified? The answer to this question is needed to help answer Question 2 and determine if the size of the harvest unit must be limited to 120 acres.

Question #1 rephrased:

After the harvest, will the stocking of seedlings, saplings and poles, and trees 11 inches and larger in diameter, meet the standards for reforestation for Site Class III forestland? The standards are different for each site class; see Table 4-1, on page 73 to find the standards for all site classes. From that table you can see that Site Class III reforestation rule standards are:

Plant or retain 200 seedlings per acre (see sidebar)

Or

Retain 120 saplings and poles per acre (see sidebar)

Or

Retain 80 square feet of basal area per acre in 11 inch DBH and larger trees

Or, as described on page 74:

Landowners can decide to plant or leave an "equivalent combination" determined by the "equivalent calculation" formula

What are seedlings?

Live trees of acceptable species of good form and vigor with a DBH of less than one inch.

What are saplings and poles?

Live trees of acceptable species of good form and vigor, with a DBH of one to ten inches.

An answer to question #1:

Although your forest could be clearcut, you've decided to first thin your trees to provide some income and improve the growth and vigor of the remaining stand. You plan to leave at least 90 square feet of basal area per acre in 11-inch DBH or larger trees. With this decision, you will meet or exceed the reforestation rule standard for Site Class III forestland. No reforestation, which usually involves planting seedlings, will be required.

Question #2 again:

Will you need to leave wildlife trees and down logs? (See more about wildlife trees, snags and down logs on page 34.)

An answer to question #2:

If you had planned a harvest of 25 acres or less, wildlife trees, snags and down logs would not be required. However, if you needed a bit more income this year to cover some expenses, you might consider a harvest of about 35 acres. You now need to determine if the trees you intend to leave after harvest will meet or exceed the standards in Table 2-1.

Your plan is to keep as much as 90 square feet of basal area per acre in trees 11 inches or larger. That is higher than the Site Class III reforestation standard of 80 square feet. By doing that, you are not required to leave wildlife trees and down logs, but you could plan to leave some.

Question #3 again:

Will the harvest unit be Type 1, Type 2, Type 3 or Unclassified? The answer to this question is needed to help answer Question 2 and determine if the size of the harvest unit must be limited to 120 acres.

An answer to question #3:

You can use Table 2-2, on page 17 to determine your type of harvest. You have a vision of how the forest will look after harvest, and it seems to match the illustration and description for the Unclassified category. An Unclassified harvest has no requirement for reforestation or wildlife trees. The Unclassified category matches your planned harvest, and perhaps the following statement also fits:

"My goal was to make some money to pay some expenses this year. I wanted to thin out the stand, but also keep a lot of trees. I want them to keep growing and they give the property a nice feel. I figured out I could do what I wanted by leaving enough trees to make up at least 80 square feet of basal area per acre."

Table 2-1 Leave Trees and Site Class

When planning a harvest of 25 or more acres: leave the amounts in columns 2 or 3, or leave at least two wildlife trees and two down logs per acre.

Site class	# Trees per acre at least 11 inches at DBH or	Square feet of basal area per acre in 11-inch or larger trees
I, II and III	50	33
IV and V	30	20
VI	15	10

What if?

What if you changed your harvest goals and decided to remove most of the trees, leaving some scattered trees that add up to about 10 square feet of basal area per acre? And, because your stand was very dense to begin with, not many saplings or seedlings will remain after harvest.

- In this case, you'll see that the trees that will be left after harvest will be less than the reforestation stocking standards for Site Class III forestland; therefore, reforestation would be required.
- You'll also see that there will be less than 33 square feet of basal area and the harvest unit size is more than 25 acres, so wildlife trees and down logs will have to be left (see Table 2-1).
- Finally, look at the illustrations and descriptions in Table 2-2. Type 2 and Type 3 might match these changed harvest goals. Because both reforestation and wildlife trees are required, it must be a Type 3 harvest.
- Type 3 harvests have one more restriction: They are limited to 120 acres unless ODF reviews a written plan for an exemption before logging.

Is there more to know about wildlife trees and down logs requirements?

Leave at least two wildlife trees and two down logs per acre. Items 1, 2 and 3 below offer a brief overview. Details are on pages 34-36.

1. Green trees or snags, left for wildlife, must be at least 30 feet in height and 11 inches DBH or larger and at least 50 percent must be conifers.
2. Down logs or down trees must be 50 percent conifer and at least 10 cubic feet gross volume, no less than 6 feet long. One downed conifer or hardwood log, at least 20 cubic feet gross volume and no less than 6 feet long, may count as two logs.
3. Wildlife trees and down logs may be left in one or more clusters rather than distributed throughout the unit.

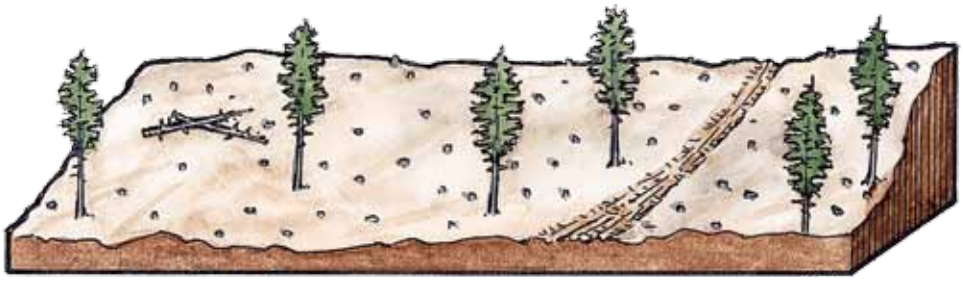
What is the take-home message?

- It is to the landowner's advantage to preplan a timber harvest.
- It is to the landowner's advantage to know the harvest type in advance.
- Landowners need to know the harvest type to understand the reforestation and riparian management area requirements.

Table 2-2 Four Types of Harvest and Their Requirements

TYPE 1 HARVEST

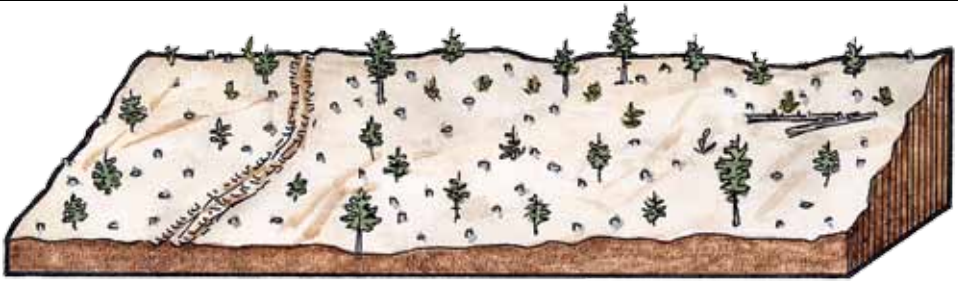
Heavy thinning or shelterwood – few or no seedlings, saplings or poles remaining.



- Does not meet reforestation stocking standards.
- Must plant within two years and have "free-to-grow" seedlings within six years.**
- No wildlife trees or down logs are required if adequate basal area of 11" trees or larger is left (see Table 2-1).

TYPE 2 HARVEST

A clearcut in which the required seedlings, saplings and poles are left. The number of large trees is below Table 2-1 requirements.



Requirements for <25 acre harvests

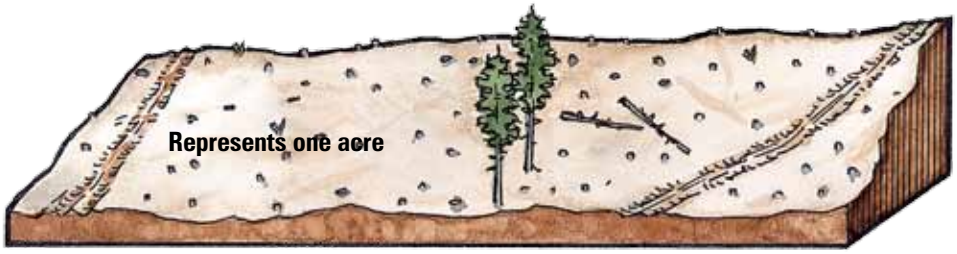
- meets the reforestation stocking standards.
- no reforestation required.

Requirements for >25 acre harvests

- Leave two wildlife trees and two down logs per acre.*
- No reforestation required.

TYPE 3 HARVEST

A clearcut, where few seedlings, saplings or poles remain. The number of large trees is below Table 2-1 requirements.



Requirements for <25 acre harvests

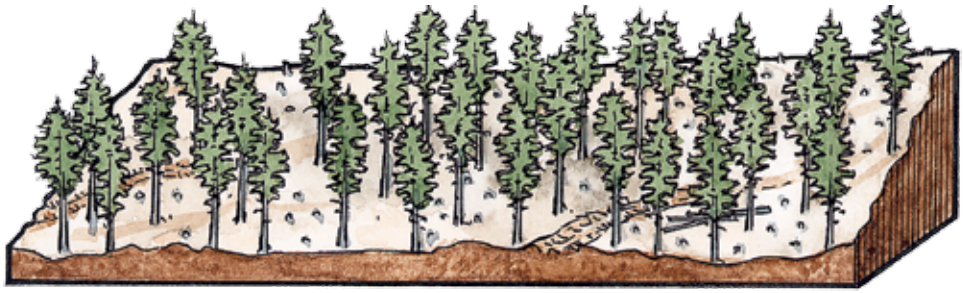
- Does not meet reforestation stocking standards.
- Must plant within two years and have "free-to-grow" seedlings within six years.**

Requirements for >25 acre harvests

- Leave two wildlife trees and two down logs per acre.*
- Subject to 120-acre size limitation.
- Must plant within two years and have "free-to-grow" seedlings within six years.**

UNCLASSIFIED HARVEST

Commercial thinning to space remaining trees or light partial cut.



- Meets the reforestation stocking standards.
- No reforestation required.
- No wildlife trees or down logs are required if adequate basal area of 11" trees or larger is left (see Table 2-1).

*See more about wildlife trees and down logs on pages 34-36. **See full details about reforestation requirements on pages 71-80.

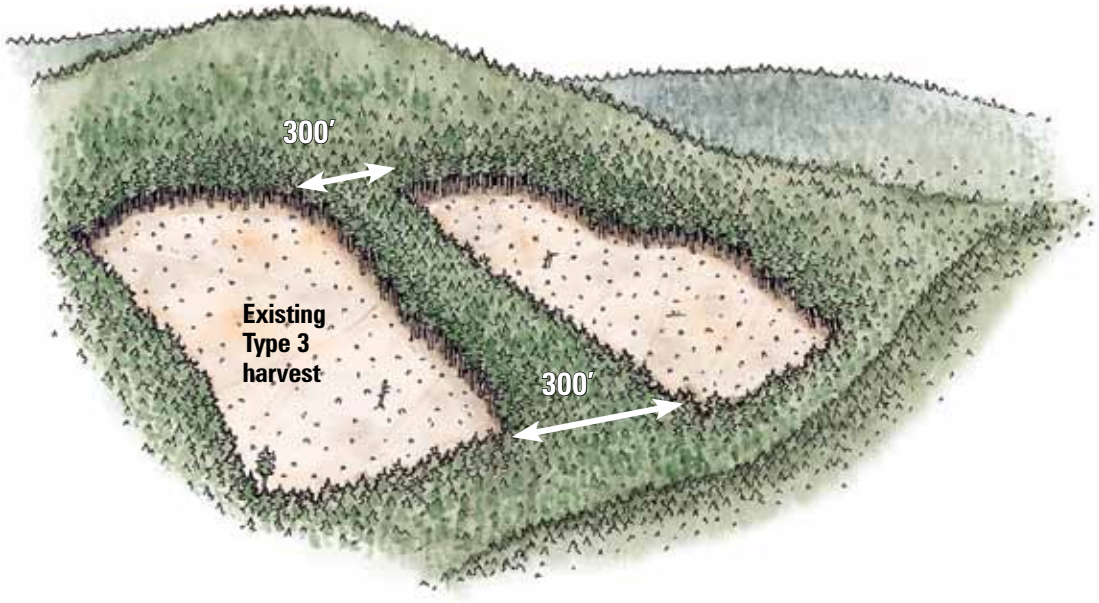
More about harvest size

1. Combined Type 3 harvest units

When a Type 3 harvest unit is within 300 feet of another Type 3 harvest unit on the same ownership, the combined acreage of the two units must not exceed 120 acres. However, this requirement does not continue forever. The acreage of an existing Type 3 harvest unit will not be included in the total once it meets the following standards:

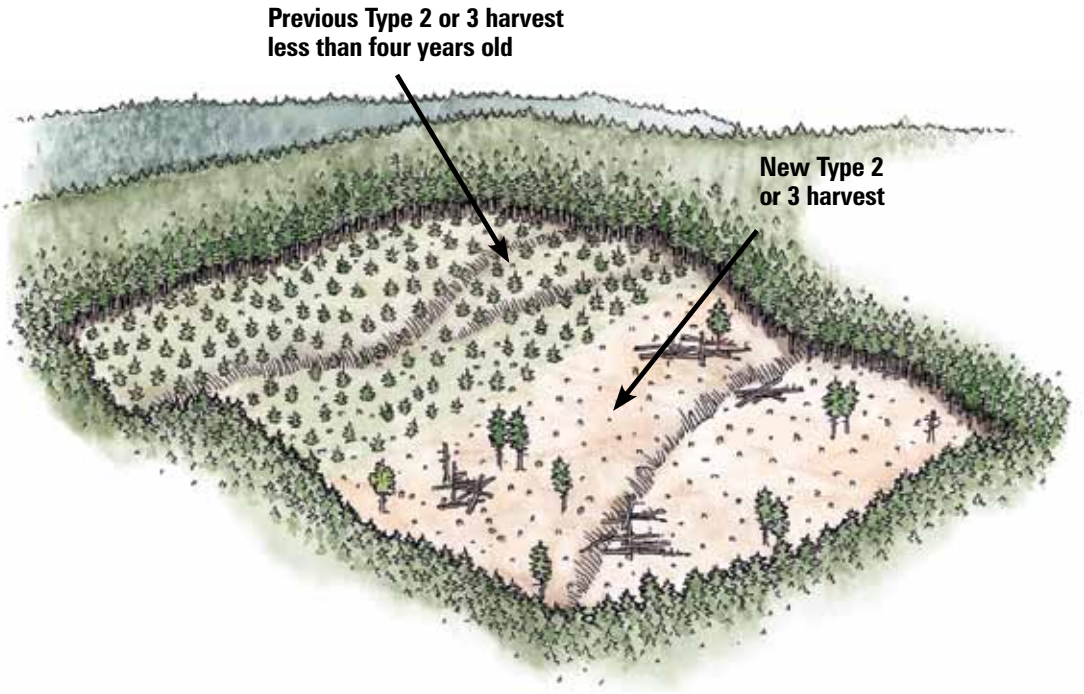
The number of trees per acre required by the reforestation rules is present, and either:

- the trees are at least four feet tall; or
- the unit was planted or seeded at least four years ago and the stand is "free-to-grow" (see page 76 for definition of free-to-grow).



2. Type 2 or 3 harvests next to previous Type 2 or 3 harvests

Wildlife leave trees and down logs must be left on any combination of contiguous Type 2 or 3 harvests over 25 acres on the same ownership, even if the individual harvests are less than 25 acres. For example, if a landowner harvests a 15-acre unit one year and 15 acres next to it two years later, wildlife trees and down logs would be required for the entire 30 acres when the second unit is harvested. They could be provided in either or both units. A landowner who did not leave them in the first unit would need to leave enough for both units in the second one.



For other information sources, see the Appendix, pages 183-184.

You want to harvest timber along a stream. What do you need to know?

This section is a step-by-step process to help you plan for and meet the water protection requirements for fish, wildlife and water quality while harvesting along a stream. This is a complicated part of the Act, but it also allows for flexibility to accommodate different situations. Be sure to read: "How waters of the state are classified and protected," pages 8-12, before proceeding.

When your plan is complete, be sure to review the protection requirements that apply when conducting your harvest. They include: "What you should know when felling, bucking and limbing trees near water," page 51, "What you should know when cable logging near water," page 51, "What you should know when ground yarding near water and using temporary crossings," page 53, and "What are the requirements for log landing requirements," page 64.

Question 1

Do you know the geographic region of your harvest? For more details, see page 10.

Question 2

What is the stream size? For more details, see page 8.

- small
- medium
- large

Question 3

Do you know what type of stream is in the harvest area? For more details, see page 8.

- Type F – has fish, may also be used for domestic water.
- Type D – used for domestic water, no fish.
- Type N – all other streams.

Most medium and large streams are likely to be Type F. Remember, operations within 100 feet of a Type F or D stream require a written plan. See the Appendix, page 139 for an example.

Question 4

What type of harvest do you plan to conduct along the stream?

- Type 1
- Type 2
- Type 3
- Unclassified

If you don't know your harvest type, read: "You want to harvest timber on your property. How do you plan for it?," on page 13. It's important to determine the harvest type and how much stocking will be left after your harvest, or you risk violating tree retention requirements. Know your harvest type before proceeding.

Question 5
What length of stream is affected by your planned harvest?

Either measure its length in the field or figure out the lineal feet of affected stream from a scaled aerial photo or topographic map.

Question 6
How should you mark the Riparian Management Area (RMA)?

If you're not familiar with RMAs, read: "How waters of the state are classified and protected," pages 8-12.

Once you know your stream type and size, check Table 2-3 for the RMA width that's required. You should mark the RMA boundary generally parallel to the stream. Use flagging, marking paint or signs, at intervals frequent enough to avoid confusion during logging.

Table 2-3 Riparian Management Area Widths (for each side of a stream)

Stream Size	Type F	Type D	Type N
Large	100 feet	70 feet	70 feet
Medium	70 feet	50 feet	50 feet
Small	50 feet	20 feet	Specific protection measures (see Table 2-14)

Question 7
How much live conifer basal area is in the RMA?

Once you know how much live conifer basal area is in your RMA, you'll know which trees can be harvested and which you must leave. You don't need this information for small Type D or small Type N streams, which have different protection requirements that are described on page 29.

Measure the basal area of live conifers 6 inches DBH and larger inside your marked RMA. Page 152, "How to know the basal area of your harvest, reforestation area or RMA," describes the procedure.

As you go through the following example, you will learn that you may need to gather additional information while measuring basal area, including:

- the numbers, diameters and species of the hardwoods
- the size of conifer snags and down conifer logs

This information could be important, as you will see on page 24.

Here's an example:

You are planning a Type 3 harvest, 1,500 feet long, along a large Type F stream. It's located in the Interior geographic region, one of the seven water protection regions in the state.

Because the harvest will occur within 100 feet of a Type F stream, you'll need to prepare a written plan for ODF. We'll discuss that later in this section (see page 29). First, let's handle the key planning questions and decisions.

1. **How wide should the RMA be?**

   From Table 2-3, a 100-foot-wide RMA for each side of a large Type F stream needs to be marked.

2. **How is the RMA measured?**

   Measure the RMA as a slope distance from the high-water level of the main channel to the boundary.

   What is the high-water level? This is also called the average yearly high flow (not the highest flood flow level). It's where trees and other year-round plants start growing. On many streams, it's the upper edge of the stream bank.

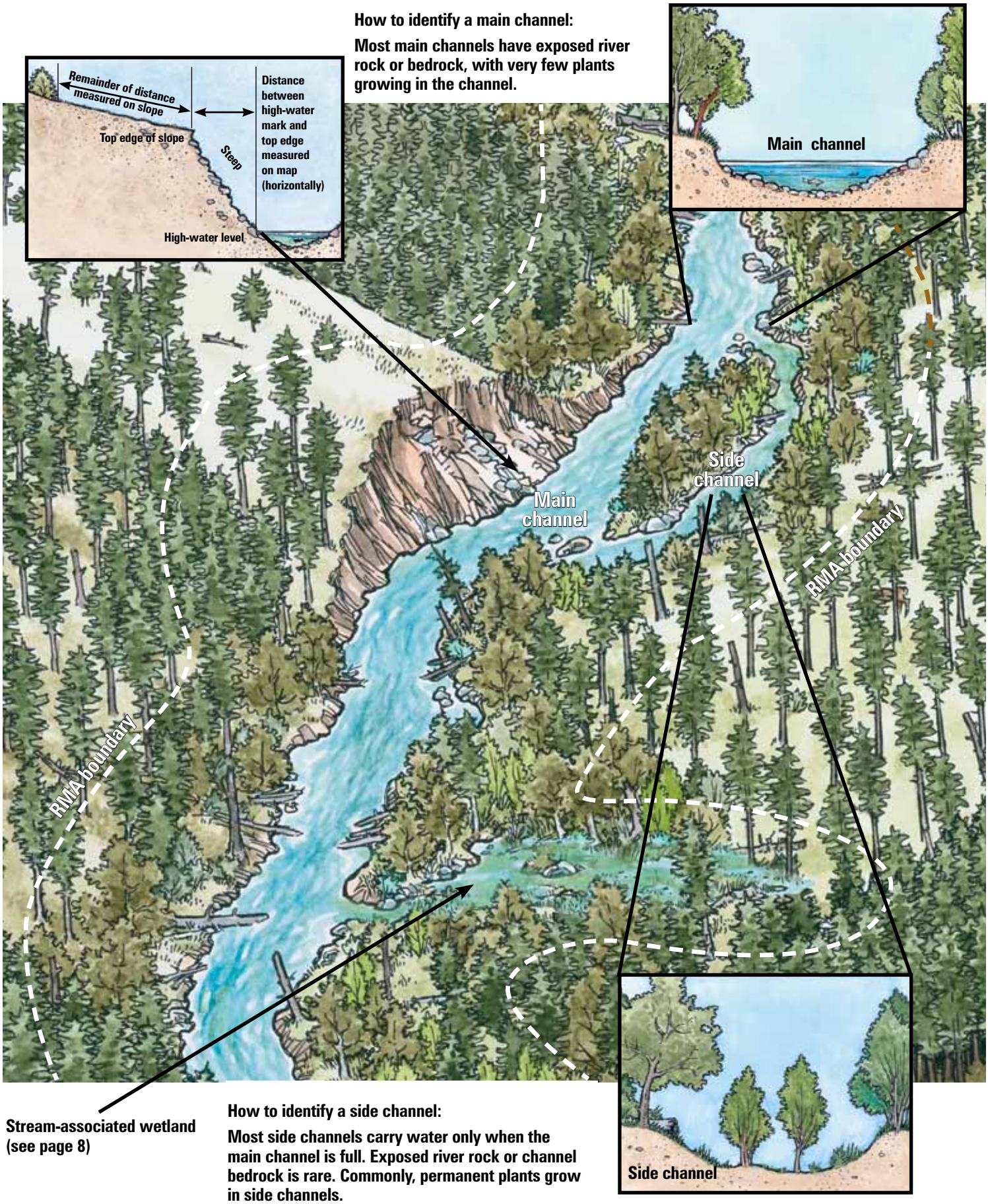
3. **While marking this RMA boundary, you find a stream associated wetland (see page 8) connected to the stream. What protection is needed for this water body?**

   Where wetlands or side channels extend beyond the RMA, expand the RMA to include the wetland or side channel plus 25 additional feet. This does not apply to small Type N streams.

   Notice in the illustration on page 21 how the RMA boundary includes the stream-associated wetland.

4. **There is also a steep slope next to the stream channel in the RMA. How is this situation handled?**

   In the case of steep exposed soil, a rock bluff or talus (loose rock) slope, measure the RMA as a horizontal distance to the top of the exposed bank, bluff or talus slope. From there, measure the rest of the RMA as a slope distance. (See illustration on page 21.)


How to identify a main channel:
Most main channels have exposed river rock or bedrock, with very few plants growing in the channel.
Remainder of distance measured on slope
Top edge of slope
Steep
Distance between high-water mark and top edge measured on map (horizontally)
High-water level
Main channel
Main channel
Side channel
RMA boundary
RMA boundary
Side channel
Stream-associated wetland (see page 8)
How to identify a side channel:
Most side channels carry water only when the main channel is full. Exposed river rock or channel bedrock is rare. Commonly, permanent plants grow in side channels.

5. **If you're interested in harvesting some trees from the RMA, you need to measure the RMA basal area. How is this done?**

   If you don't know how to measure basal area for the RMA see the instructions on pages 152-155.

   For this example, you found that the 1,500-foot RMA had 450 square feet of basal area of 6-inch DBH or larger conifers.

6. **To see what may be available for harvest, you need to know if the basal area is more or less than the standard target for a large Type F stream. What is this value?**

   Table 2-4 on page 23 shows that the standard target requires a basal area of 270 square feet per 1,000 feet of stream for a Type 2 or Type 3 harvest in the Interior region. The standard target is the minimum basal area required for the RMA. Note that it changes with stream type, size and region.

   Most RMAs will be more or less than 1,000 feet, so the standard target must be adjusted. In this example, the RMA is 1,500 feet long, so the adjusted standard target is 405 square feet of basal area for the entire RMA (1,500 feet/1,000 feet x 270 = 405).

   The 450 square feet of basal area in the RMA is more than the adjusted standard target of 405 square feet, so you have the option to harvest trees in the RMA (continue for details).

Read this if you want to know what's coming in the next few pages.

1. If the basal area of live conifers in the RMA is more than the standard target, landowners can use the general prescription when harvesting in an RMA. This requires leaving enough basal area to meet the standard target, and is described under item 8 on page 23 and in the Appendix, page 152.
2. If the basal area of live conifers in the RMA is less than the standard target but still greater than half the standard target, the general prescription still applies, except that landowners must leave the number of trees noted in Situation A on page 24.
3. If the basal area is less than half the standard target, landowners may be able to use alternative prescription #1 for damaged stands, alternative prescription #2 for hardwood stands, or the default standard. These prescriptions are described on pages 25 and 26.

7. **With some RMA basal area available for harvest, what else should be considered?**

   The general prescription can be used when the RMA has more basal area than the standard target. The general prescription calls for the following to be left in the RMA:

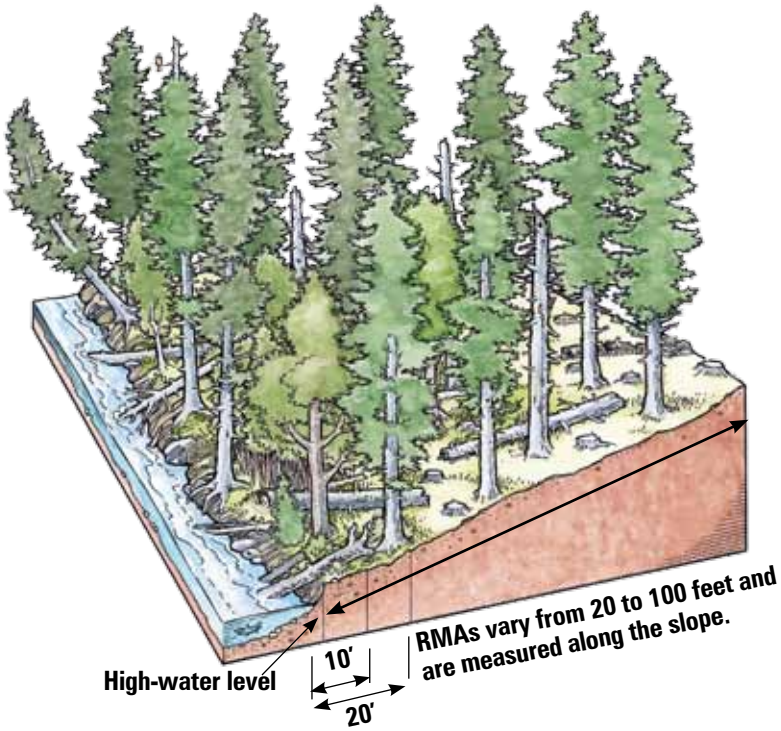
   - all trees within 20 feet of the high-water level
   - all trees in the RMA that lean over the stream
   - all understory vegetation (small trees, brush and smaller plants) within 10 feet of the high-water level
   - all snags and down wood in the channel and RMA; any safety or fire hazard snags may be cut, but can't be removed

   Exception: Trees and other vegetation may be removed as needed for planned stream crossings or cable yarding corridors (see page 53).

   - Enough live conifers 6 inches DBH and larger are required to meet the standard target basal area for the RMA. Hardwoods and snags may count toward the standard target in some cases (see Tables 2-5 and 2-6). Follow this example through for more details.

   In some cases the standard target might be met with a few very large trees. However, this could result in large openings with reduced stream shade or an understocked stand. To avoid large openings, landowners must leave a minimum number of live conifers, depending on stream type and size (see below for details):

   - Large F: 40 per 1,000 feet, minimum 11 inches DBH
   - Large D and N: 30 per 1,000 feet, minimum 11 inches DBH
   - Medium F: 30 per 1,000 feet, minimum 8 inches DBH
   - Medium D and N: 10 per 1,000 feet, minimum 8 inches DBH
   - Small streams: No minimum tree numbers



8. Where should trees be left in the RMA?

You must leave all trees that lean over the stream and all trees within 20 feet of the stream. After that, you can choose which trees to leave, as long as they meet the basal area standard target and the required minimum number. For the benefit of fish and wildlife, you are encouraged to leave:

- trees distributed throughout the stream length for shade and other resource functions
- trees close to the channel that help stabilize the stream bank
- open-grown trees with large limbs and full crown that serve as wildlife habitat

9. Bottom line: What can be harvested from this RMA?

With 450 square feet of basal area and a required 405 square feet to be left in the RMA, you can remove live conifers that add up to 45 square feet (450 – 405) as long as the other requirements are met. For example, if the live conifers average 20 inches DBH, about 20 of them could be harvested (see the Appendix, page 156). You can also remove hardwoods that are outside the 20-foot zone. The stream and RMA must be protected with any of the harvesting work (See requirements for working near streams, pages 53-58).

10. In Table 2-4, the Active Management Target is lower than the Standard Target. What situations allow for more harvesting in the RMA using this lower target?

Some streams can benefit from habitat improvement work, such as placing logs or trees in the channel to create pools or hiding cover for fish. It can also mean constructing fencing or off-channel watering sites to keep livestock away from streams, or other work. For streams that can benefit from such projects, landowners who do stream improvement work may be able to harvest more trees under the active management target.

Here's how to use this option. First, have enough basal area to meet the standard target and enough trees to meet the general prescription requirements. Then, with a written plan reviewed by ODF, agree to contribute logs or boulders to the stream (see "For other information sources" at end of this section). Keep in mind that it's possible to use logs from the RMA or logs from the harvest unit to put in the stream, and at the same time reduce the RMA basal area to the active management target level.

Table 2-4 Streamside Tree Retention for Type F Streams with Type 2 or 3 Harvest

Geographic Region	Square Feet of Basal Area per 1,000 feet of Stream, Each Side					
	Large Type F RMA = 100 feet		Medium Type F RMA = 70 feet		Small Type F RMA = 50 feet	
	Standard Target	Active Management Target	Standard Target	Active Management Target	Standard Target	Active Management Target
Coast Range & S. Coast	230	170	120	90	40	20
Interior & W. Cascade	270	200	140	110	40	20
Siskiyou	220	170	110	90	40	20
E. Cascade & Blue Mountains	170	130	90	70	50*	50**

* The maximum live conifer basal area that must be left is 40 square feet. The other 10 square feet may come from snags, dying trees or hardwood trees if available in the RMA.

** The live conifer basal area may be reduced to 30 square feet for the active management target. The other 20 square feet must come from snags, dying trees or hardwood trees if available in the RMA.

Table 2-5 Hardwood, dead and dying trees or snags in the RMA that can count toward basal area targets for Westside Geographic Regions			
Type F Streams Coast Range, S. Coast, interior, Western Cascades and Siskiyou Geographic Regions	Large	Medium	Small
Cottonwood & Oregon Ash (6 inches or greater DBH) left in the RMA and growing more than 20 feet from the high water level may count toward basal area target	X		
A combination of the following can make up to 10 percent of the basal area target:	X	X	X
1. The basal area of hardwoods (except red alder) retained in the RMA that are greater than 24 inches DBH and grow more than 20 feet from the high-water level 2. The basal area of sound conifer snags (6 inches or greater DBH and at least 30 feet high) that are anywhere in the RMA			

Table 2-6 Hardwood, dead and dying trees or snags in the RMA that can count toward basal area targets for Eastside Geographic Regions			
Type F Streams E. Cascades and Blue Mountains geographic regions	Large	Medium	Small
All live hardwoods (6 inches or greater DBH) left in the RMA may count toward the basal area target	X	X	X
Sound conifer snags (6 inches or greater DBH and at least 30 feet high) left in the RMA may count toward as much as 10 percent of the basal area target	X	X	X
No more than 40 sq. ft. per 1,000 feet of the standard target or 30 sq. ft. per 1,000 feet of the active management target is required to be live conifers. The remaining basal area required may come from the following, if they are 6 inches or greater DBH: retained snags, dying or recently dead trees, or hardwoods if they are available			X

11. Can some logs be placed in the channel for stream enhancement, even if you don't choose to harvest more trees under the active management target?

Yes. If log placement is part of the current forest operation and a written plan, state and federal permits are not required. This approach is one of the easiest ways to do an enhancement project, but be sure to check with your local ODF office before starting log placement work.

12. There are some hardwoods and snags in the RMA. Can any of these be left instead of conifers to meet the RMA equirements under the standard target?

Yes, with some limitations. The basal area of certain hardwood trees, dead or dying trees, or snags can make up a portion of the basal area standard target. See Table 2-5 for west-side and Table 2-6 for east-side geographic regions. This is why you will want to record the number, diameter and species of some hardwoods, along with the size of conifer snags as you measure the basal area of your RMA.

13. Hardwoods are common in many riparian areas, so what happens if the RMA conifer basal area is found to be less than the standard target?

The RMA requirements are based on two possible situations:

- Situation A: The live conifer basal area is less than the standard target but greater than half the standard target.
- Situation B:The live conifer basal area is less than half the standard target.

Situation A: less than the Standard Target, but greater than half of the Standard Target

As noted earlier, you must still leave trees within 20 feet of the high-water level, trees that lean over the stream, understory plants within 10 feet of the high-water level, and all snags and down wood in the channel and the RMA.

- In addition to that, you are required to leave all live conifer trees 6 inches DBH or larger in the RMA up to these maximum numbers:
- 150 conifers per 1,000 feet along large Type F streams
- 100 conifers per 1,000 feet along medium Type F streams
- 70 conifers per 1,000 feet along small Type F streams

The basal area of these conifers is not specified.

Situation B: less than half the standard target

Depending on the local conditions, one of three different prescriptions can be used:

ALTERNATIVE PRESCRIPTION 1

This can be used if the RMA can grow conifers and has been damaged by a catastrophic event such as wind, insects, disease or wildfire.

This prescription protects the stream while a new conifer stand grows.

This prescription cannot be used on small D or small N streams.

Landowners must leave the following:

- all trees that have fallen in the stream

(exception: parts of down trees that lie outside the high-water level may be harvested if it does not make the trees less stable in the stream)

- all live and dead trees within 20 feet of the high-water level of large and medium streams, and within 10 feet of the high-water level on small streams
- *for Type F streams*, enough live trees, dying or recently dead trees, and downed logs within the RMA to meet the active management target (tables 2-4 and 2-8)
- *for Type D and large and medium Type N streams*, enough live trees, dying or recently dead trees, and down logs within the RMA to meet the standard target (tables 2-9 and 2-10)
- all trees that must be left in and near the stream can count towards meeting the basal area requirements, if they are large enough

Table 2-7 Default Standard requirements: Leave all conifers and all hardwoods within these distances of the high-water level.

Stream	Conifers	Hardwoods
Type F Large	100 feet	50 feet
Type F Medium	70 feet	30 feet
Type F Small	50 feet	20 feet

- live conifers left first, with down or dead trees making up the rest of the basal area target if necessary

For this prescription only, landowners may count double the basal area of each dying or recently dead tree or each windthrown tree in the channel to meet the basal area target.

ALTERNATIVE PRESCRIPTION 2

This can be used if the RMA can grow conifers but is dominated by hardwoods; it can be used only in western Oregon. To apply Prescription 2:

- Identify sections of the RMA (minimum 200 feet long) where the basal area and number of trees meet the standard target, and apply the general prescription (page 24) on those sections (as shown in the left portion of the illustration below).
- In sections where the standard target is not met, divide the RMA into "conversion" and "retention" blocks. The purpose of the conversion blocks is to promptly convert them to conifers by harvesting the hardwoods and planting conifers. Only some hardwoods are harvested in the retention blocks, so as to more gradually change this area to conifers. To help achieve these goals,

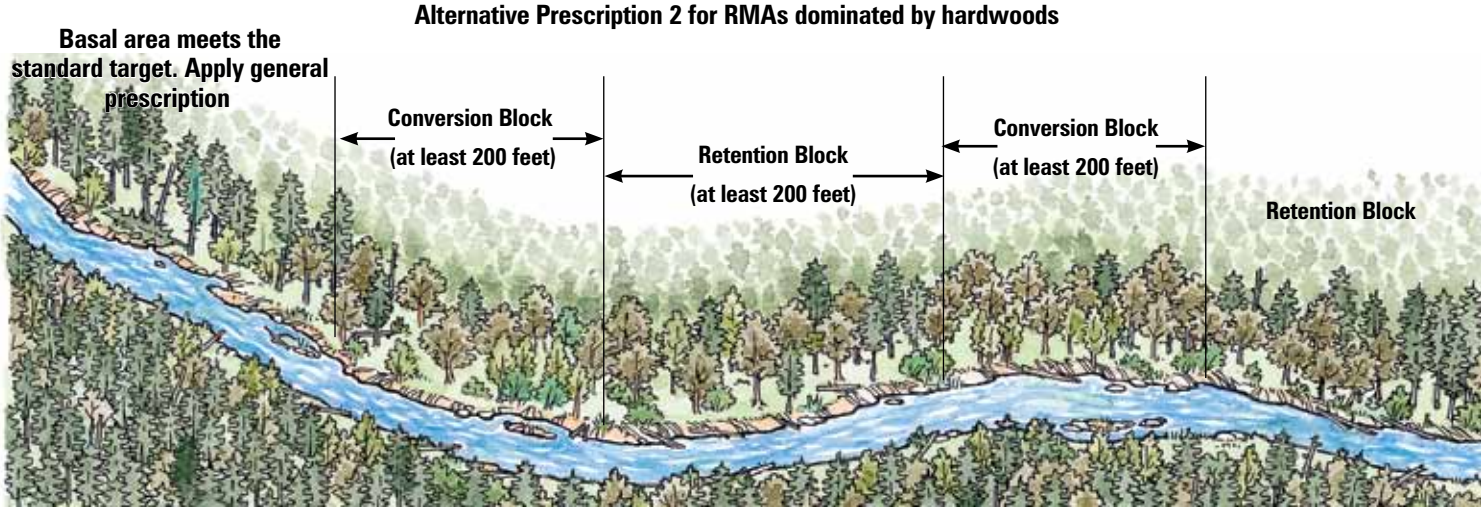
In the conversion blocks:

- Leave all trees growing in the stream or within 10 feet of the high-water level (plus trees within 20 feet that lean over large streams).
- The total length in conversion blocks can't be any more than half the stream length in the harvest unit. Conversion blocks also can't be more than 500 feet long and must be at least 200 feet apart.

In the retention blocks:

- For large streams, leave all conifers within 50 feet of the high-water level and all hardwoods within 30 feet of the high-water level.
- For medium streams, leave all conifers within 30 feet of the high-water level and all hardwoods within 20 feet of the high-water level.
- For small streams, leave all trees within 20 feet of the high-water level.

Alternative Prescription 2 for RMAs dominated by hardwoods



3. DEFAULT STANDARD

If you don't want to – or can't – use Alternative Prescription #1 or #2, or if the RMA is not capable of growing conifers, use the default standard. This requires that, except for cable yarding corridors or stream crossings reviewed by ODF, landowners must leave:

- all understory plants within 10 feet of the high-water level
- all snags and down wood in the channel and RMA (any safety or fire hazards may be cut, but can't be removed)
- all trees leaning over the channel
- all conifers in the RMA and all hardwoods within the high-water level for the distances indicated in Table 2-7.

14. What if you decide to thin the harvest unit instead of doing a Type 3 harvest along the Type F stream?

Depending on the kind of thinning done, the harvest could be Type 1 or Unclassified (see page 13, "You want to harvest timber"). Either way, all the steps for the Type 3 harvest still apply, except that now the target basal area numbers in Table 2-8 are used instead of those in Table 2-4.

15. In another location, let's say you're planning a harvest next to a Type D stream or a medium or large Type N stream (see illustration). What are the requirements?

The process you will follow is the same, but there are a few changes in the requirements. Let's first review the overall process, in which you need to:

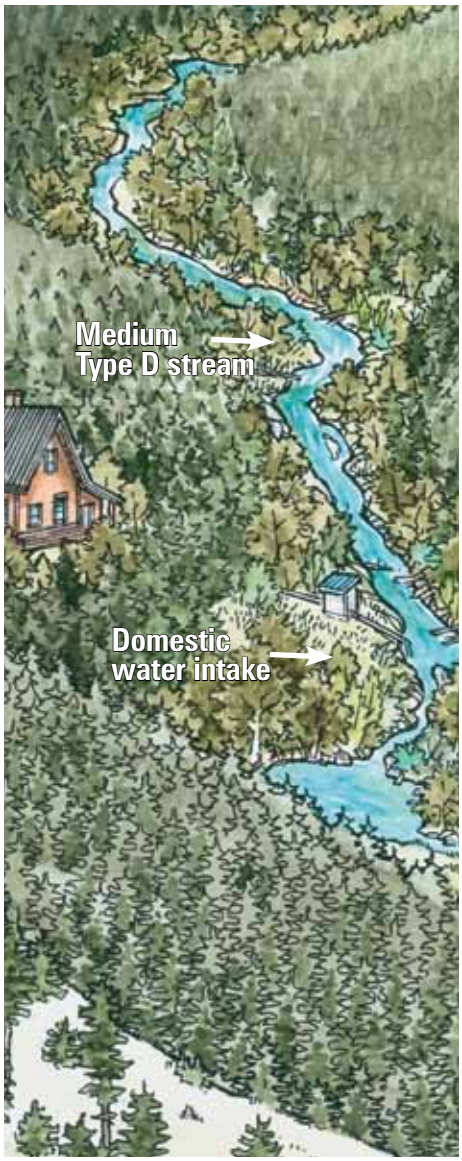
- identify the geographic region and the size and type of stream in your harvest
- identify the type of harvest you plan – Type 1, Type 2, Type 3 or Unclassified
- measure the length of stream within the harvest unit
- measure and mark the RMA width and the live conifer basal area in the RM

Then, answer the following questions:

Question 1

Is your live conifer basal area more than the standard target shown in Table 2-9 or Table 2-10, depending on your type of harvest?

If the answer to Question 1 is yes, you must leave enough trees to meet the standard target shown in Tables 2-9 or 2-10. You must also follow the other



This is a medium Type D stream.

Table 2-8 Streamside Tree Retention for Type F Streams with Type 1 or Unclassified Harvest

Geographic Region	Square Feet of Basal Area per 1,000 feet of Stream, Each Side					
	Large Type F RMA = 100 feet		Medium Type F RMA = 70 feet		Small Type F RMA = 50 feet	
	Standard Target	Active Management Target	Standard Target	Active Management Target	Standard Target	Active Management Target
Coast Range and S. Coast	300	270	160	140	50	30
Interior & W. Cascade	350	310	180	160	50	30
Siskiyou	290	260	140	120	50	30
E. Cascade & Blue Mountain	220	200	120	100	50*	50**

*The maximum live conifer basal area that must be left is 40 square feet. The other 10 square feet may come from snags, dying trees or hardwood trees if available in the RMA.

**Live conifer basal area may be reduced to 30 square feet for the Active Management target. The other 20 square feet must come from snags, dying trees or hardwood trees if available in the RMA.

general prescription requirements in Item 8 on page 23, including the numbers of trees to be left along Type D and N streams.

As with Type F streams, the basal area of certain hardwood trees, dead or dying trees or snags can make up a portion of the basal area standard target. The allowances for Type D and N streams are similar to Type F streams, but there are differences. See Table 2-11, which applies to westside geographic regions, or Table 2-12 for eastside geographic regions. Note also that, without fish, Type D and N streams have no active management target option tied to habitat enhancement work.

Question 2

What if your live conifer basal area is less than the standard target?

As with the Type F example, there are two possible situations:

Situation A: The live conifer basal area is less than the standard target, but greater than one-half of the standard target.

You must leave:

- trees within 20 feet of the high-water level, trees that lean over the stream, understory plants within 10 feet of the high-water level, and all snags and down logs in the channel and RMA, and
- all live conifer trees 6 inches DBH or larger (no basal area is specified) in the RMAs of all large or medium Type N streams up to these maximum numbers:

  100 conifers per 1,000 feet along large Type D or N streams.

  70 conifers per 1,000 feet along medium Type D or N streams.

Table 2-9 Streamside Tree Retention for Type D and Large and Medium Type N Streams with Type 2 or 3 Harvest

Geographic Region	Square Feet of Basal Area per 1,000 feet of Stream, Each Side		
	Large Type D & N RMA = 70 feet	Medium Type D & N RMA = 50 feet	Small Type D RMA = 20 feet
	Standard Target	Standard Target	Standard Target
Coast Range & S. Coast	90	50*	0
Interior & W. Cascade	110	50*	0
Siskiyou	90	50*	0
E. Cascade & Blue Mtn.	70	50*	0

*Hardwoods may count up to 30 square feet per 1,000 feet toward meeting the standard target

Table 2-10 Streamside Tree Retention for Type D and Large an Medium Type N Streams with Type 1 or Unclassified Harvest

Geographic Region	Square Feet of Basal Area per 1,000 feet of Stream, Each Side		
	Large Type D & N RMA = 70 feet	Medium Type D & N RMA = 50 feet	Small Type D RMA = 20 feet
	Standard Target	Standard Target	Standard Target
Coast Range & S. Coast	140	60*	0
Interior & W. Cascade	160	60*	0
Siskiyou	120	60*	0
E. Cascade & Blue Mtn.	100	60*	0

*Hardwoods may count up to 30 square feet per 1000 feet towards meeting the standard target

Table 2-11 Hardwoods, dead and dying trees, or snags in Type D and N stream RMAs that count toward basal area targets for Westside Geographic Regions

Type D and Type N Streams Coast Range, S. Coast, Interior, Western Cascades and Siskiyou Geographic Regions	Large	Medium
Cottonwood and Oregon ash (6 inches or greater DBH) left in the RMA and growing more than 20 feet from the high-water level may count toward basal area target.	X	
A combination of the following can make up to 10 percent of the basal area target: 1. The basal area of hardwoods (except red alder) retained in the RMA that are greater than 24 inches DBH and grow more than 20 feet from the high water level. 2. The basal area of sound conifer snags (6 inches or greater DBH and at least 30 feet high) that are anywhere in the RMA.	X	
1. Hardwood trees retained in the RMA can contribute up to a maximum of 30 square feet of basal area per 1000 feet toward meeting the basal area target. 2. Sound conifer snags (6 inches or greater DBH and at least 30 feet high) can contribute up to 5 percent of the basal area target.		X

Situation B: The live conifer basal area is less than one-half of the standard target.

You can use one of three different prescriptions depending on the circumstances:

ALTERNATIVE PRESCRIPTION 1

Refer to Alternative Prescription 1 under Question 13 on page 25. It is the same for Type D streams and large and medium Type N streams.

ALTERNATIVE PRESCRIPTION 2

Refer to Alternative Prescription 2 under Question 13 on page 25. It is the same for Type D streams and large and medium Type N streams.

DEFAULT STANDARD

If you don't want to – or can't – use Alternative Prescription 1 or 2, or if the RMA is not capable of growing conifers, use the default standard. Except for cable yarding corridors or stream crossings reviewed by ODF, landowners must leave:

- all trees within 20 feet of the high water level and all trees in the RMA that lean over the stream.
- all understory plants within 10 feet of the high water level.
- all snags and down wood in the channel and RMA – any safety or fire hazards may be cut, but can't be removed, and
- all conifers and hardwoods within the high water level for the distances indicated in Table 2-13.

Finally, to be clear about small Type D and N streams (see illustration):

There are no basal area targets for small Type D or small Type N streams. The requirements for small Type D streams are to leave all trees, snags and down logs within 20 feet of the stream and all understory vegetation within 10 feet of the stream. The requirements for small Type N streams are shown in Table 2-14.

Although relatively uncommon, Type N streams subject to rapidly moving landslides have some unique riparian tree retention requirements. Such streams are found primarily in very steep, upland terrain – if you suspect such a situation check with ODF to verify the applicable requirements. See Pages 48-50 for further information about landslide-prone terrain.

General prescription summaries

The Appendix, Pages 156 to 177 includes one-page summaries of the general prescription requirements for streams. Use them when the live conifer basal area in the RMA is more than the standard target.

Table 2-12 Hardwoods, dead and dying trees, or snags in Type D and N stream RMAs that count toward basal area targets for Eastside Geographic Regions

Type D and N streams E. Cascades and Blue Mountains Geographic Regions	Large	Medium
All live hardwoods left in RMA may count toward the basal area target.	X	X
Sound conifer snags (6 inches or greater DBH and 30 feet high) left in the RMA may count toward as much as 10 percent of the basal area target.	X	
Sound conifer snags (6 inches or greaterin DBH and 30 feet high) can contribute up to 5 percent of the basal area target.		X

Table 2-13 Default Standard requirements: leave all conifers and all hardwoods within these distances of the high water level

	Conifers	Hardwoods
Large Type D	70 feet	30 feet
Medium Type D	50 feet	20 feet
Small Type D	20 feet	20 feet
Large Type N	70 feet	30 feet
Medium Type N	50 feet	20 feet

Quick Review

Use one of these:	When RMA basal area is:
General Prescription	More than the standard target
Situation A	Less than but more than half of the standard target
Situation B	Less than half of the standard target
Alternative Prescription 1	Less than half of the standard target and catastrophic damage
Alternative Prescription 2	Less than half of the standard target and dominated by hardwoods
Default Standard	Less than half of the standard target and Alternative Prescription 1 or 2 are not acceptable

16. Can you propose your own idea for stream protection?

Yes. You can always propose a different way of doing things. Such a "plan for an alternate practice" is specifically allowed because written requirements cannot fit every situation and alternatives can sometimes work better. Keep in mind that your plan will need to show ODF how it will protect fish and wildlife and other resources as well or better than the standard requirements. You can't proceed with your alternate plan unless ODF reviews it.

Another issue in some streamside forests in drier regions of Oregon is extensive insect damage when trees are stressed by growing too close together. Also, hardwoods such as aspen and cottonwood can be very important for streams in these regions. In such cases, landowners are encouraged to talk with ODF about site-specific plans that can help both forests and streams.

Is there more to know about written plans when harvesting within 100 feet of a Type F or D stream?

Yes – there is a lot to know.

The requirements when harvesting along Type F or D streams can be somewhat complicated. But this section shows how different options and flexibility are available. If you decide to do a harvest, you must prepare a written plan for review by ODF – an example is shown on pages 139-140.

There is one more option.

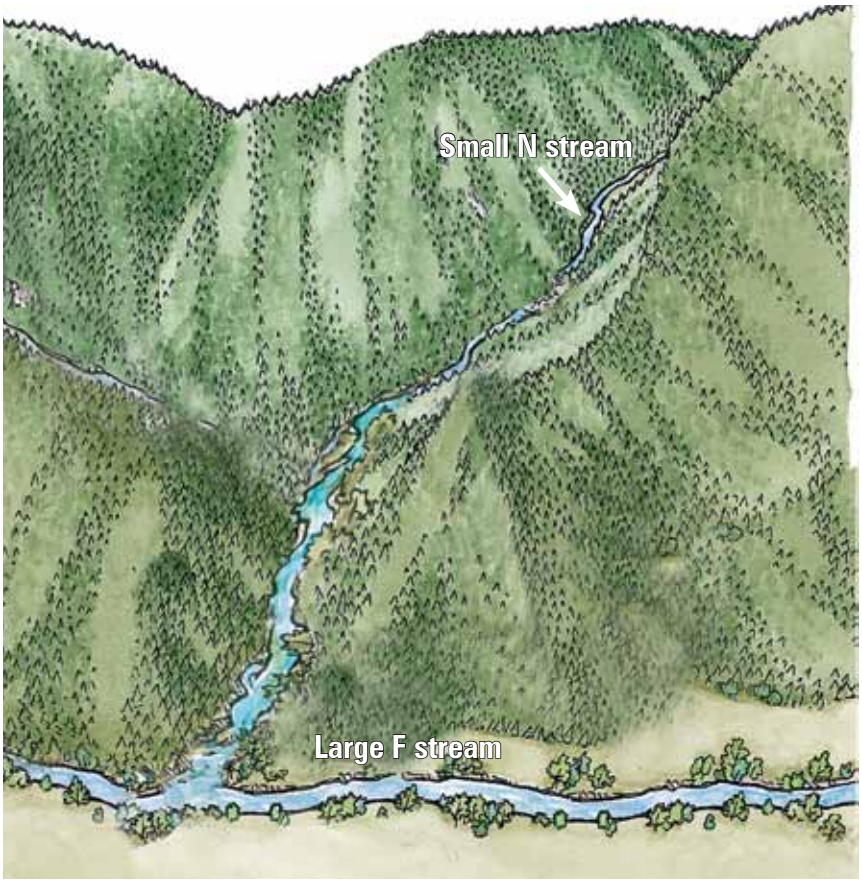
Many landowners choose not to operate in Type F and D stream RMAs when harvesting timber. That way they avoid RMA planning and written plan preparation.

Is avoiding RMAs the way to go?

There is no financial compensation from the government for avoiding RMAs or leaving more trees near streams than is required. Some landowners still choose to do so for various reasons.

While the requirements may seem complicated, they do allow for active management within the RMA. Landowners are encouraged to check out all the options and make an informed choice.

For other information sources, see the Appendix, pages 183-184.



Example of a small Type N stream. Such streams often lack fish due to a waterfall or other natural feature that limits access or favorable habitat.

Table 2-14 Retention for Specified Small Type N Streams

Geographic Region	Retain Understory Vegetation and Unmerchantable Conifers* 10 Feet on Each Side of the Stream for:
E. Cascades & Blue Mountains	All perennial streams
South Coast	Portions of perennial streams where the upstream drainage area is greater than 160 acres.
Interior	Portions of perennial streams where the upstream drainage area is greater than 330 acres.
Siskiyou	Portions of perennial streams where the upstream drainage area is greater than 580 acres.
Coast Range & W. Cascades	No retention required
Protect all small Type N streams in all regions from sediment and disturbance as noted on pages 53, 54, 105 and 182. For small Type N streams subject to rapidly moving landslides, retain trees as described on pages 48-50.	

*Unmerchantable conifers means conifers less than 6 inches DBH.

You want to harvest timber near a lake. How do you meet the requirements?

What is a lake?

Lakes have year-round standing open water. A lake includes the water, vegetation, aquatic life, beds, banks or wetlands below the normal high-water level.

What is not considered a lake?

Water developments that are not part of a natural stream – these include constructed features such as waste treatment lagoons, farm ponds and log ponds.

There are two major classes of lakes:

- large lakes (greater than 8 acres)
- other lakes (two kinds):
  - between one-half acre and 8 acres, or less than 8 acres with fish
  - less than one-half acre with no fish

What are lake protection requirements intended to do?

Protect the following functions and values of lakes:

- water storage
- water quality
- water quantity
- habitats for aquatic plants, animals, fish and wildlife

How are large lakes protected during forest operations?

- A written plan, reviewed by ODF, is required for operations within 100 feet of a large lake.
- The RMA width is 100 feet, as measured from the high-water level.
- RMA retention requirements are specified in Table 2-15.
- Operations must never cause sedimentation or drain lakes.
- Activities in the lake RMA must not impair water quality, disturb natural drainage or affect soil productivity.
- Timber felling, yarding and mechanical site preparation requirements in lake RMAs are covered on pages 51-52 and 70.

How are other lakes protected during forest operations?

See Table 2-15 for specific requirements for other lakes with or without fish.

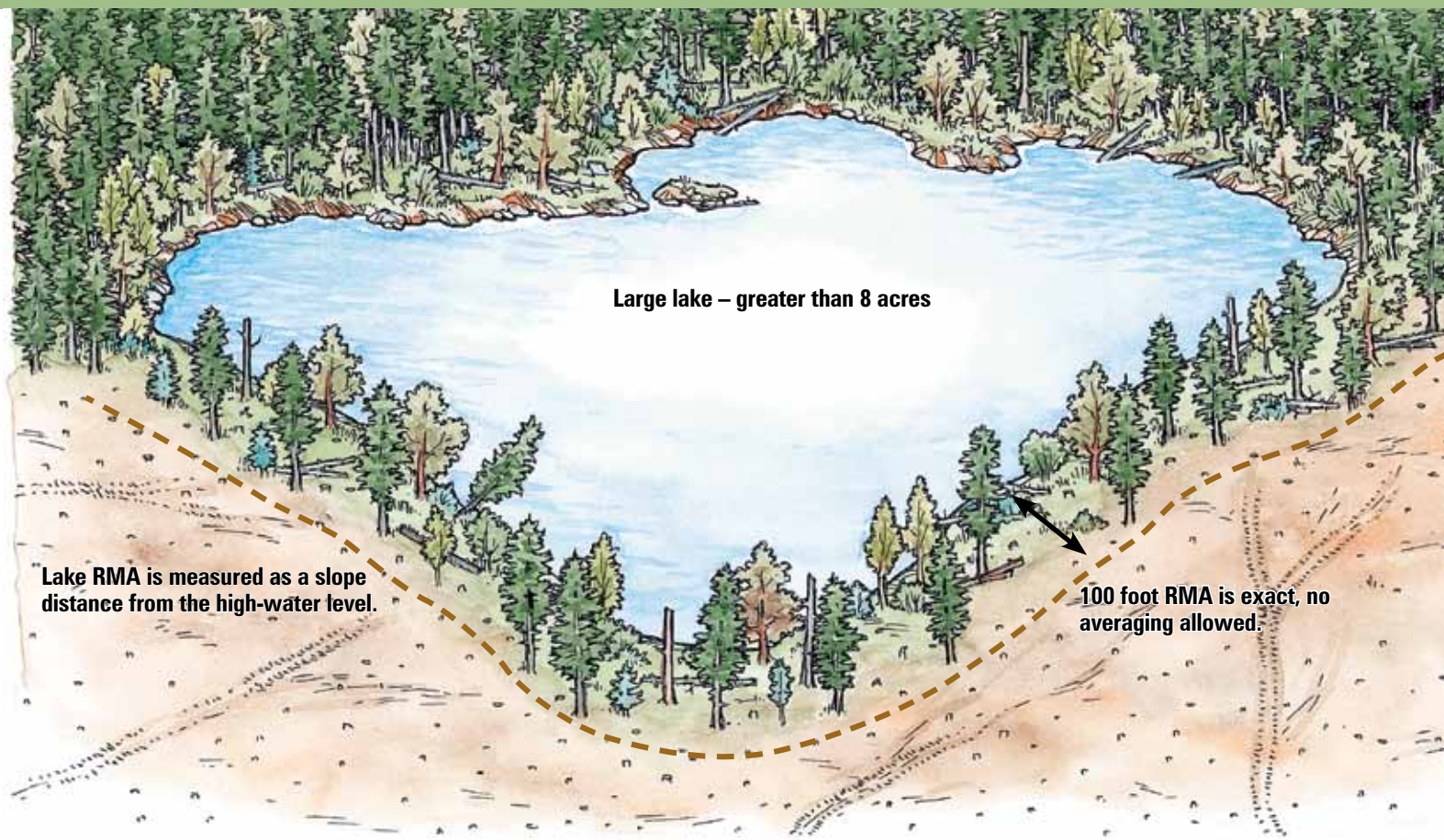


Table 2-15 Lake Protection Requirements

Class of Lake	Riparian Management Area Width (feet)	Retention Requirements
Large lakes (greater than 8 acres)	100	Leave: understory plants, all snags and down wood, and 1/2 of the trees by species and size.*
Other lakes (between 8 acres and 1/2 acre, or less than 8 acres with fish)	50	Same as for large
Other lakes (less than 1/2 acre, no fish)	No RMA	If greater than 1/4 acre, leave snags and down wood.**

*Leave 50 percent of the original live trees, by species in each of the following size classes:

- 6-10 inches DBH,
- 11-20 inches DBH,
- 21-30 inches DBH,
- larger than 30 inches

The goal is to leave approximately the same species and size distribution as before the RMA harvest.

** These can be counted toward requirements for snags and down logs in clearcuts.

Leave all trees along the edge of the lake. Otherwise, leave trees should be well distributed.

All snags and down wood in the lake and RMA must be left. Snags felled for safety must be left on the ground and cannot count toward snag and live tree requirements in adjacent harvest areas.

Protect the lake from disturbance that would damage water quality.

For other information sources, see the Appendix, pages 183-184.

You want to harvest timber in or near a wetland. How do you meet the requirements?

What is a wetland?

Wetlands, especially smaller ones, are not as obvious as streams and lakes. Wet soils, surface or ground water and water-tolerant plants can indicate a wetland. Plants found in wetlands include Oregon ash, Sitka spruce, cottonwood, willow, cattails, skunk cabbage, reed canary grass, rushes and sedges. Terms for specific types of wetlands include swamps, marshes, bogs and seeps.

Don't be fooled. Wetlands may dry out in the summer and have different sizes and shapes. If you're unsure about an area, check with ODF or seek specialized assistance.

Where will you find wetlands?

- natural drainages or swales
- low areas with high water tables
- flat valleys or depressions with poorly drained soils
- near streams, rivers and lakes
- lower slopes where springs or seeps emerge
- mountain meadows watered by snowmelt

What is not considered a wetland?

Water developments that are not part of natural streams or lakes (such as waste treatment lagoons, farm ponds and log ponds) are not considered wetlands.

There are three classes of wetlands:

- **Significant wetlands** are greater than 8 acres, or estuaries, bogs or certain eastern Oregon springs (regardless of size).
- **Stream-associated wetlands** are smaller than 8 acres and located next to streams.
- **Other wetlands** are smaller than 8 acres.

How are significant wetlands protected during harvest?

- the RMA width is measured from the edge of the wetland (see Table 2-16)
- vegetation must be left in the RMA (see Table 2-16)
- operations must never drain or cause sediment to enter the wetland
- a written plan, reviewed by ODF, is required for operations within 300 feet of the wetland

Why protect wetlands?

- They contribute surface and groundwater.
- They can maintain or improve water quality.
- They can reduce flood impacts.
- They can provide habitats for aquatic plants, fish and wildlife.
- They can offer recreational opportunities such as wildlife viewing.

How are stream-associated wetlands protected during harvest?

- Give these areas the same protections as required for the stream type they're associated with.
- Further specifics are shown in Table 2-16.
- Converting or draining is not allowed, even for the purpose of establishing trees.
- Never drain or cause sediment to enter a stream-associated wetland.

How are other wetlands protected?

- Snags and down trees in the wetland must be left. See Table 2-16 for specifics.
- Converting or draining is not allowed, even for the purpose of establishing trees.

Stream-associated wetland and its 25-foot RMA.

Table 2-16 Wetland Protection Requirements

Class of Wetland	Riparian Management (feet)	Area Protection Required (Both wetland & its RMA)
Significant (Greater than 8 acres, or estuaries, bogs or certain E. OR springs)	Estuaries 100 – 200 Bogs 50 – 100 E. OR Springs 50 – 100 Wetlands 100	Leave: understory plants, all snags and down wood, and 1/2 of the trees by species and size*
Stream-associated (Next to a stream)	Stream RMA goes around it ***	Included in stream RMA
Other (Less than 8 acres)	No RMA	If greater than 1/4 acre leave, snags and down wood.** If less than 1/4 acre, no leave requirements.

*Leave 50 percent of the original live trees, by species, in each of the following size classes:
- 6-10 inches DBH
- 11-20 inches DBH
- 21-30 inches DBH
- Larger than 30 inches

Leave trees should be well distributed.

All snags and down wood in the wetland and RMA must be left. Snags felled for safety reasons must be left on the ground and cannot be counted toward snag and live-tree requirements in clearcuts.

** These may be counted toward requirements for snags and down logs in clearcuts.

*** Where wetlands or side channels extend beyond the RMA, expand the RMA to include the wetland or side channel plus 25 additional feet. This does not apply to small Type N streams.

- When possible, avoid operations in wetlands. Ground equipment must not cause rutting or soil compaction, or affect water quality. Successful operations may occur during dry or frozen conditions. Cable harvesting is an alternative, where appropriate.
- Depleting, adding water or draining other wetlands must be avoided.

For other information sources, see the Appendix, pages 183-184.

What are the requirements for leaving wildlife trees, snags and down logs?

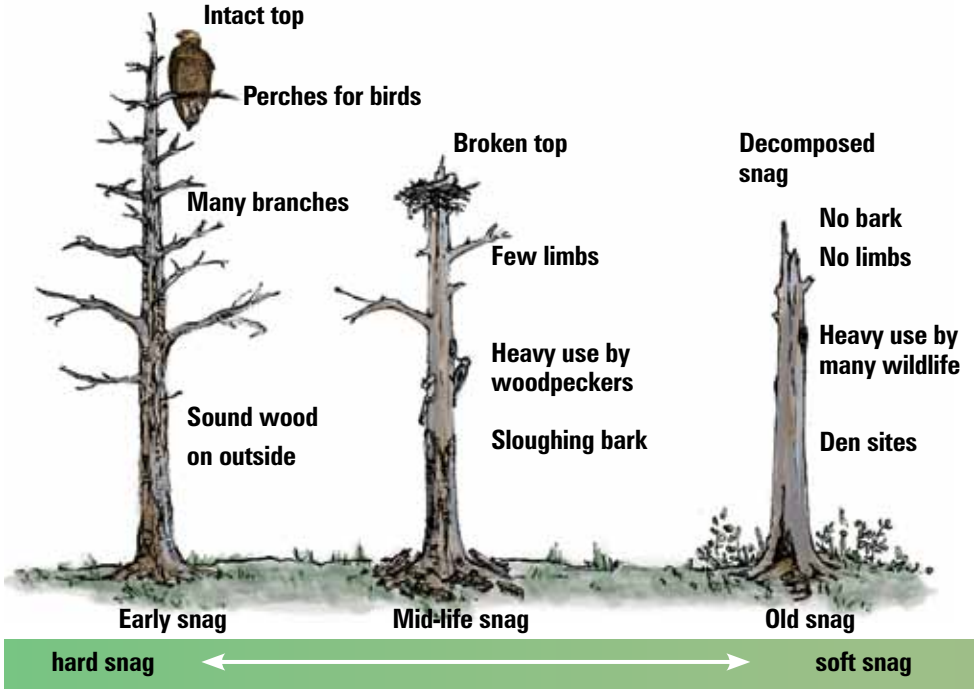
What's the difference?

- Wildlife tree: either a snag or green tree of a minimum size that is required to be left (details below)
- Snag: dead standing tree or section of a tree that has lost its needles and small limbs
- Down log: existing down log or a down green tree of minimum size (details below)

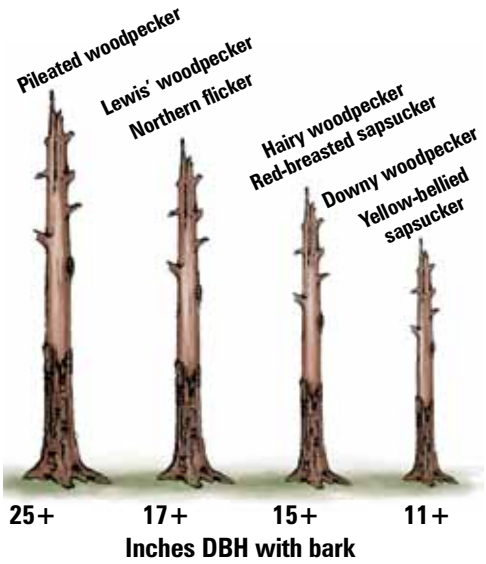
What's so important about snags and down logs?

Snags provide homes to owls, woodpeckers, bats, squirrels, bluebirds, wood ducks, swallows, mergansers, weasels, raccoons and many other animals. More than 50 species of birds and mammals use snags for nesting, feeding and shelter. A lack of snag cavities for nesting can limit populations of some bird species. Snags larger than 20 inches DBH are in short supply on private lands. Snags can be created from live trees, and wildlife respond quickly to their availability.

You can reduce the cost of leaving snags by selecting rotting or deformed trees. In eastern Oregon, down logs are used by 150 species of wildlife, including amphibians, reptiles, birds and mammals. Logs are also important to certain insects, fungi and plants. Be aware that too many down logs can be a fire hazard; however, a forest without down logs may have fewer species of plants and animals. It's not necessary to leave sound logs. Deformed or rotten parts of tree stems left in the forest after a harvest can meet down log requirements, if they would be solid enough to pick up with a log loader (see Table 2-17).



Snag diameters most often used by woodpeckers



Larger-diameter, taller snags stand longer and provide more cavities.

Protected areas under the log are used as nesting cover by grouse and as hiding cover by rabbits and hares.

When the bark loosens, there is hiding cover for tree frogs and amphibians. The trunk is a food source for woodpeckers, particularly pileated woodpeckers.

Small mammals burrow into the interior as the log softens. Bears, raccoons and skunks feed on insects.

How do I know when wildlife trees and down logs are required?

If you are planning a harvest of 25 acres or more and the harvest will leave fewer than the number of trees per acre or basal area per acre indicated in Table 2-1 on page 16, wildlife trees and down logs will be required. Just like the requirements for reforestation, the trees per acre and basal area requirements vary according to site class.

Wildlife trees and down logs must be left in all Type 2 or 3 harvests that are larger than 25 acres (Table 2-2 on page 17) and in some cases when adjacent new and older Type 2 or 3 harvests together exceed 25 acres (see Example 2 on page 18).

Regardless of the size of the harvest unit, snags and down logs must be left in all wetlands, and in all RMAs for wetlands, lakes, Type F and large and medium Type D and N streams (see details below).

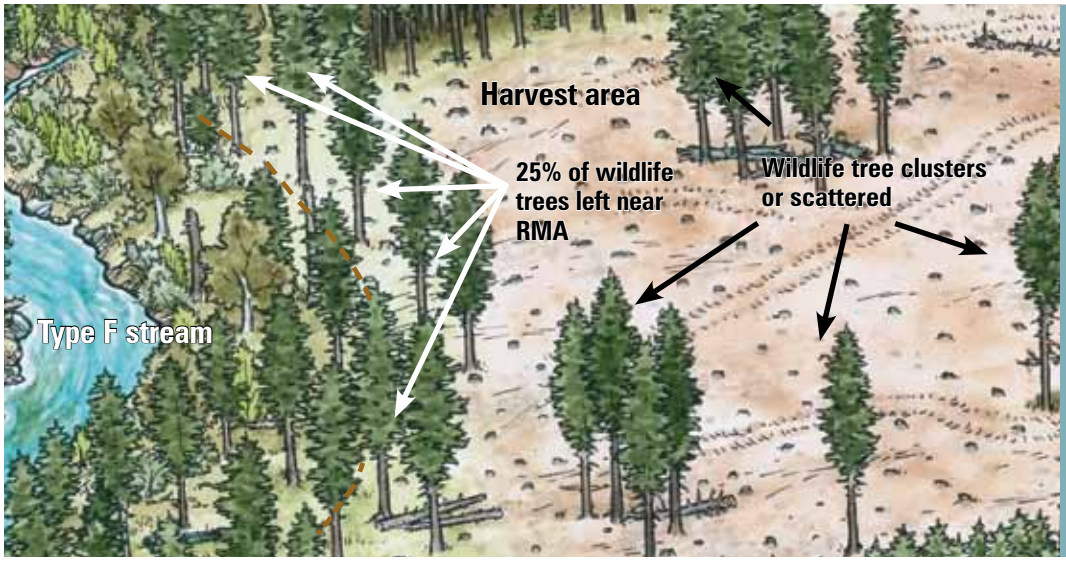
Table 2-17 Down Log Minimum Lengths and Diameters

These sizes = 1 down log (10 cubic feet)		These sizes = 2 down logs (20 cubic feet)	
Length (feet)	Diameter (inches, small end)	Length (feet)	Diameter (inches, small end)
6	17	6	25
8	15	8	21
10	13	10	19
12	12	12	17
14	11	14	16
20	8	20	13
28	6	28	10
		36	8
		44	6

How many wildlife trees need to be left?

On average, per acre you must leave at least:

- two snags or two green trees at least 30 feet tall and 11 inches DBH or larger, at least 50 percent of which are conifers, plus
- two down logs or down trees at least 50 percent of which are conifers. Each must be at least 6 feet long with a total volume of at least 10 cubic feet. Logs containing 20 cubic feet or more count as two logs (see Table 2-17 for sizes that qualify)



Leave these wildlife trees:

two snags or two green trees

- at least 30 feet tall,
- 11 inches DBH or larger, and
- 50 percent must be conifers **and**

two down logs or down trees

- at least 6 feet long,
- at least 10 cubic feet total volume, and
- 50 percent must be conifers

Harvest areas next to Type F streams.

Where should wildlife trees be left?

Wildlife trees, snags and down logs may be left in one or more clusters across the harvest unit or they can be scattered throughout the unit (see illustration).

What are the requirements near certain streams?

To provide increased benefits to fish, ODF may require up to 25 percent of the needed wildlife trees be left near the stream if the harvest unit is next to Type F streams. The trees would be in addition to other trees required to be left in RMAs. Also, to provide extra sources of large wood to streams, wildlife trees must be left along the lower sections of steep, small Type N streams that empty directly into Type F streams. After receiving your notification, ODF will tell you if one of these streams is on your harvest unit.

Can RMA snags and down logs substitute for harvest unit wildlife trees?

Wildlife tree, snag and down log requirements are in addition to other requirements for snags and down logs. However, in some limited situations, the wildlife and down log requirements can be met by counting snags, trees or logs otherwise required to be left in RMAs or other resource sites. For more information, see the stream protection summaries in the Appendix, pages 156-177, or check with ODF.

What if your harvest is less than 25 acres?

Leaving wildlife trees, snags or down logs is not required if your actual harvest, combined with any adjacent prior harvest on the same ownership, is less than 25 acres. However, leaving wildlife trees, snags and logs voluntarily is always encouraged to benefit forest productivity and wildlife habitat.

Can snags create a wildfire hazard?

Yes. They are vulnerable to lightning strikes, and during a wildfire hollow snags also can create a chimney effect where burning embers are sent into the air, starting new fires some distance away. Always consider the wildfire hazard of snags.

Can snags create a safety hazard?

Yes. Snags can collapse or drop limbs without warning. Oregon law (OAR Chapter 437, Division 7 Forest Activities safety rules, administered by the Oregon Occupational Safety and Health Division) requires operators to always identify snags and other danger trees. Danger trees have evidence of rot, excessive lean, spike tops, etc.

Never operate machines near snags – they can be accidentally bumped or the ground vibration can cause unexpected collapse. Always mark the safety hazard area around snags. Isolate snags and notify all workers by marking the area with plastic ribbon.

Before beginning tree felling in harvests larger than 25 acres, identify wildlife trees that will be left. This will ensure a sufficient number of wildlife trees are left in the harvest area.

Workers should know about snag hazard areas, especially when moving cables, during log skidding or when tree felling is occurring nearby.

Minimize worker exposure to wildlife tree hazards by leaving them among a clump of trees, along harvest boundaries, near stream RMAs, between cable corridors, on rock outcrops or at the back-end of the harvest area.

What do you look for when selecting wildlife trees?

The first choice should be to leave safe snags in safe locations, but it is often necessary to leave green wildlife trees that will eventually become snags. What should you look for?

- a broken or dead top
- dead branches in the crown
- old wounds or scars at the base of the tree
- indication of internal rot (fungi, conks or existing woodpecker cavities along the stem)
- the largest-diameter and tallest trees

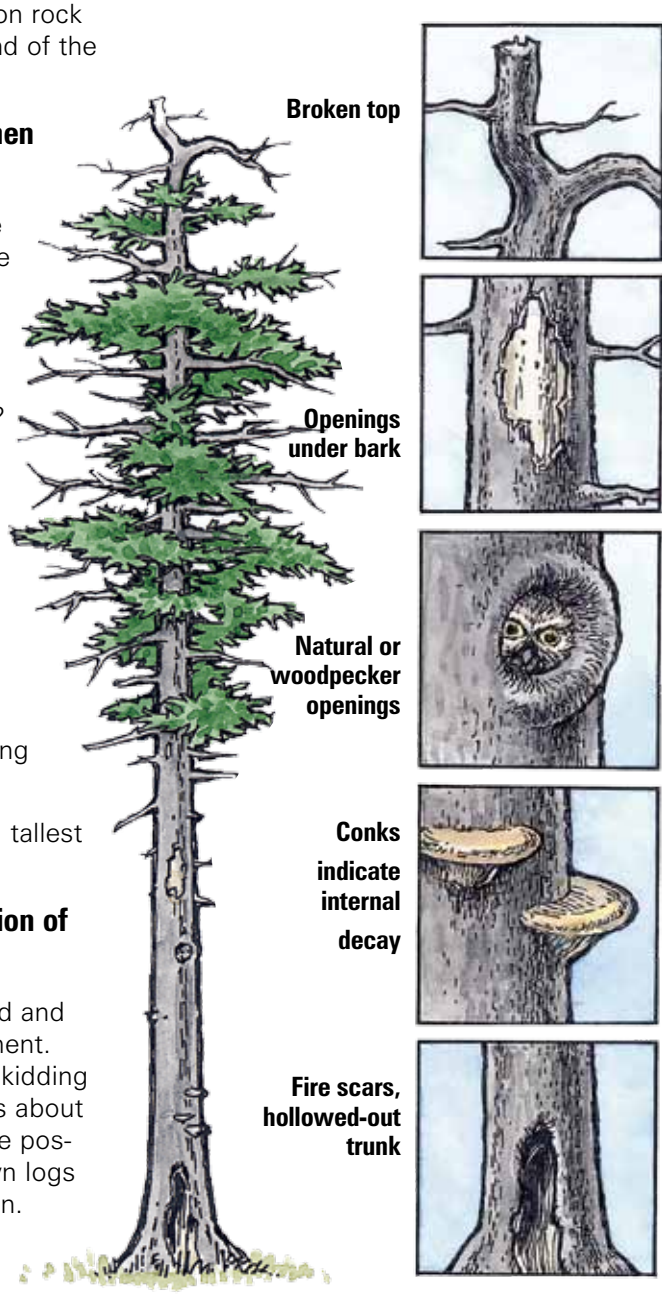
How do I ensure protection of existing down logs?

Down logs can be crushed and broken by logging equipment. Never allow yarding and skidding without informing workers about down log needs. It may be possible to save existing down logs by identifying their location.

Is there opportunity for alternative plans?

Yes. The location and species of wildlife trees and down logs may be modified following review by ODF. For example, you may be able to substitute hardwood species for conifer species when managing for hardwoods, or additional materials in one unit for those required in another.

For other information sources, see the Appendix, pages 183-184.



How do you protect sensitive wildlife sites when you harvest?

What are sensitive wildlife sites?

- habitat sites of fish and wildlife species identified as threatened and endangered (T&E) or on other lists adopted, by rule, by the Oregon State Fish and Wildlife Commission or federally listed under the Endangered Species Act (ESA)
- sensitive bird nesting, roosting and watering sites
- biological sites that are ecologically and scientifically significant
- significant wetlands.
- critical wildlife or aquatic habitat sites that are listed in the "Cooperative Agreement between the Board of Forestry and the Fish and Wildlife Commission (1984)" or sites designated by ODF

What wildlife species are associated with these sensitive sites?

- northern spotted owl (page 39)
- bald eagle (pages 40-42)
- great blue heron (page 43)
- osprey (pages 44-45)
- golden eagle
- goshawk
- marbled murrelet
- band-tailed pigeon
- Oregon silver spot butterfly
- Oregon chub

Oregon Silverspot Butterfly was listed as a threatened species with critical habitat in October 1980. USGS Pacific Region. USFWS photo.

Where are sensitive sites located, and what is your responsibility to find sensitive sites?

Your local ODF office has responsibility for maintaining inventories of sensitive resource sites. When you submit your Notification of Operation form, it is ODF's responsibility to identify any sensitive resource sites that may conflict with your operation. Landowners do not have a responsibility under the Forest Practices Act to search for and inventory unknown sites. However, if a landowner or operator knows of or discovers a non-inventoried site during planning or while conducting an operation, the operation must be stopped and ODF informed.

When and how are sensitive resource sites protected?

When operations conflict with sensitive resource sites, protection is required. For some sites, such as significant wetlands and sites used by northern spotted owls, bald eagles, great blue herons and ospreys, the conflicts have been identified and levels of protections are established (pages 39 to 45). For other sites, such as those used by golden eagles, band-tailed pigeons, marbled murrelets or other threatened or endangered species, ODF determines if a conflict exists and develops site-specific protections with the landowner and a representative of ODFW. The following questions must be answered:

1. **Is the site active?**

   Active means that the site has been used in the recent past by one of the species listed on page 37. For example, a bald eagle may be using another nest site, but the nest site on your property may still require protection. Another example is an old osprey nest that might have been used by the bird six years ago. This site would be considered "inactive." No protection is required for abandoned resource sites. Multi-year surveys are usually needed to show that a site is inactive and these surveys are subject to ODF review.

2. **What, if any, are the possible conflicts?**

   A conflict exists if an operation may lead to sensitive resource site destruction, abandonment or reduced productivity. The proposed operation is reviewed and the site inspected with the landowner, operator and representative of ODFW to identify conflicts. If there are no conflicts, no special protection measures are required.

3. **How are conflicts resolved?**

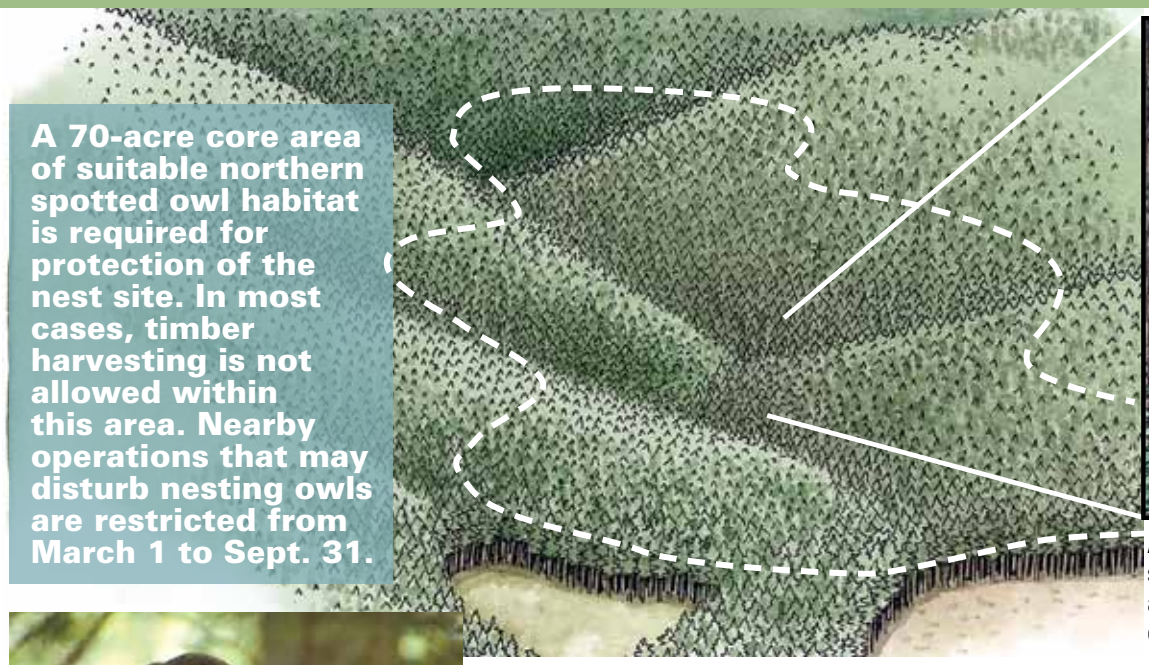
   A written plan must describe reasonable measures sufficient to resolve the conflict in favor of the resource site. Reasonable measures may include, but are not limited to, preparing and implementing a habitat management plan, limiting the timing of forest practices, redesigning the proposed practices in favor of site protection, and excluding the forest activities outright.

What else must a landowner or operator consider when working near sites used by species listed under the ESA?

- Compliance with the Oregon Forest Practices Act requirements does not ensure compliance with the federal ESA. It is the responsibility of the landowner and operator to know and incorporate federal ESA requirements in their actions.
- Landowners with approved "incidental take permits" under the federal ESA may be allowed some exceptions to compliance with the forest practice requirements.
- Additional information about the federal ESA can be obtained from the Oregon offices of the National Marine Fisheries Service (for listed anadromous fish) or the U.S. Fish and Wildlife Service (wildlife and non-anadromous fish).

NOAA
National Marine Fisheries Service
Oregon State Habitat Office
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232
503-231-2202

U.S. Fish and Wildlife Service
Oregon State Office
2600 SE 98th Ave., Suite 100
Portland, OR 97266
503-231-6179



A northern spotted owl nest site can be an actual tree or an activity center of a pair of adult owls.

What about the northern spotted owl?

The northern spotted owl is a threatened species. A threatened species is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Northern spotted owls nest in unique forest habitats that require protection when in use.

What is a northern spotted owl resource site?

It is a 70-acre "core area" encompassing a northern spotted owl nesting site, which can be an actual tree or an activity center of a pair of adult spotted owls. These nesting sites require protection until there is reliable evidence that the site is no longer occupied by a pair of owls. The shape of the core area can vary depending on characteristics of the forest. The boundary is designed to make a contiguous habitat.

How are northern spotted owl resource sites protected?

When a landowner submits a Notification of Operation within one-half mile of a northern spotted owl resource site, ODF will inform the landowner that the owl resource site exists. ODF maintains an inventory of owl sites. If the proposed operation conflicts with the spotted owl resource site, the landowner must submit a written plan for review prior to beginning the operation.

A 70-acre core area of suitable spotted owl habitat is determined by the landowner (sometimes multiple landowners) and ODF. Fledgling owls need this area before they leave the nest site. Mortality of juvenile owls is very high, with predation from other owls and starvation. Suitable habitat is important for their survival before they disperse from the nest.

Suitable spotted owl habitat for the 70-acre core area means:

- a stand of trees with moderate to high canopy closure (60-80 percent)
- a multi-layered, multi-species canopy dominated by large overstory trees (greater than 30 inches DBH)
- a high incidence of large trees with deformities (large cavities, broken tops, and other evidence of decadence)
- numerous large snags; large accumulations of fallen trees and other woody debris on the ground
- sufficient open space below the canopy for owls to fly

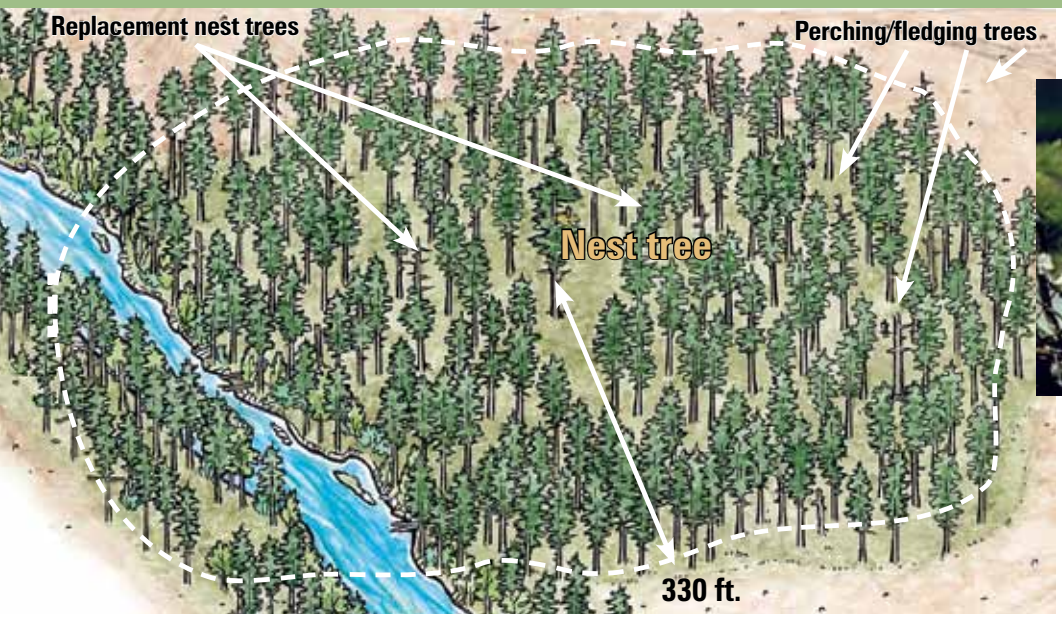
The core area must consist of forest stands that come closest to approximating the conditions desired by spotted owls.

Forest practices that do not maintain the cores area's habitat suitability for owls are not allowed. In most cases, timber harvesting within the core area will not be allowed.

The period between March 1 and Sept. 30 is when nesting owls can least tolerate disturbance. Forest operations within one-quarter mile of a nest site are not allowed during this time.

Are there exceptions?

Yes. Exceptions to the protection requirements may be granted by ODF if the operator has obtained an incidental take permit from federal authorities under the federal ESA.



The protected area around a bald eagle nest tree is no less than 330 feet. Size and shape depend on use of the area by bald eagles. The resource site includes the active nest tree and all identified key components – perching/fledging trees, replacement nest trees and a forested area around the nest tree. Do not disturb within one-quarter mile, or one-half mile if within line of sight. For nesting sites, operations are restricted from Jan. 1 to Aug. 31.

Facts about bald eagle nests:

- **Nests are 5 to 8 feet in diameter and 2 to 3 feet deep.**
- **They are located within the top 20 feet of the tree, covered by a live branch.**
- **They are found in large trees, in prominent locations, giving a clear view of the water.**
- **In contrast, osprey nests are smaller, more rounded and at the top of the nest trees (see Pages 44-45).**

What about the bald eagle?

The bald eagle is a legally protected species and forests with suitable nest, roost and perch trees are needed for its maintenance. Bald eagle nesting sites, roosting sites and foraging perches are all sensitive to forest practices and require protection.

What is a bald eagle nesting resource site?

- An active nest tree is one in which a bald eagle has nested in the past and is determined to be structurally capable of successful future use, whether or not the tree still contains a nest. As long as the nest tree remains standing it and the surrounding designated area require protection.
- Bald eagles often construct more than one nest and vary their use between them from year to year. All bald eagle nests within a given territory require protection, although a nest may not be currently occupied or may not have been used for raising young for many years.
- An active nest tree may fall or no longer be capable of supporting a bald eagle nest site. When this happens, the nest resource site continues to be considered active and is protected for an additional five years only if the site contains other suitable nesting sites. If a nesting resource site is not used during this five-year period, the site is considered abandoned and protections no longer apply. Unoccupied status must be substantiated.
- Replacement nest trees ensure the maintenance of a site in the future. Bald eagles show a strong attachment to a chosen territory. If a nest tree is lost, the pair will use a nearby replacement nest tree.
- Perch trees are often adjacent to the nest tree. In addition to perching, they are used as nest access points by adults, or pilot trees that young use when learning to fly. They are often snags or live trees with exposed, strong, lateral branches high in the crown.
- Around the nest tree, perching, fledging and replacement trees compose a forested area that provides additional protection and acts as a visual screen.

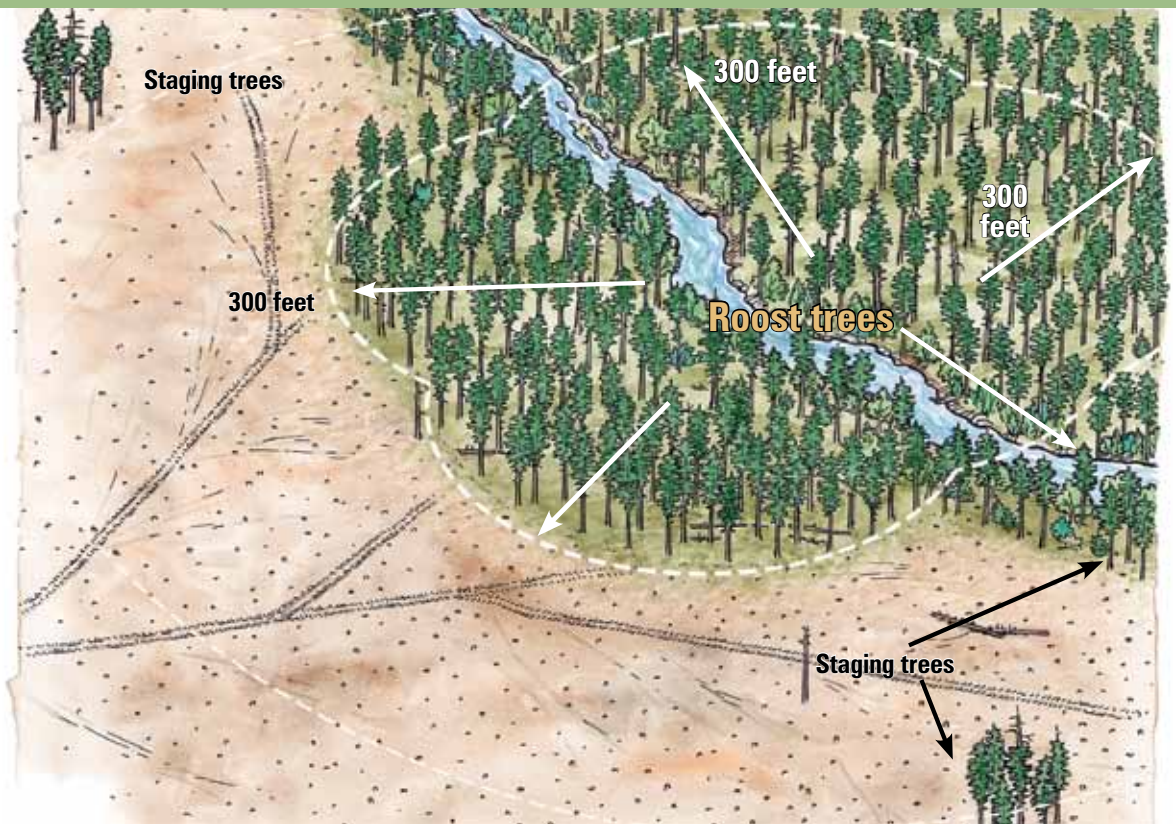
How are bald eagle nesting sites protected?

When a landowner proposes an operation within one-half mile of a bald eagle nesting site, a review is started. The landowner is responsible for designing and submitting to ODF a written plan describing how the site will be protected.

Any forest operations around the site must be designed to protect the trees from damage and windthrow. Experts must agree on the vegetation that must be left. Trees are left to perform a job, either to provide a visual screen for the site or to protect the site from windthrow. This area should not be less than 330 feet from the nest. Its size and shape depend on actual use of the area by bald eagles. General guidelines for nesting areas call for maintaining the existing integrity of the stand.

Bald eagle roosting resource sites include the active roost trees, probable roost trees as identified by ODF, and other key components, including staging trees and a forested area around the roost trees. An active roosting site is one that has been used within the past five years.

For roosting sites, do not disturb within one-quarter mile, or one-half mile within line of sight, from Nov. 15 to March 15, (Oct. 31 to March 31 Klamath Basin only).



From Jan. 1 to Aug. 31, when nest construction, mating and rearing of young occurs, forest operations are not permitted within one-quarter mile of a nest or perch tree or one-half mile if the eagles have a line-of-sight vision from the trees to the disturbance. ODF may modify this period of time and the distances when an operation will not cause the birds to flush from these trees.

What is a bald eagle roosting resource site?

- During the winter, bald eagles use communal roosting sites where they gather for the night. Experts believe these sites are selected because they are near food and their location provides protection from winter cold and wind. Many roosting sites are used year after year.
- Typically, bald eagles leave roosting sites for feeding grounds shortly before sunrise and return near sunset. When returning to the roost, they sometimes engage in circling and aerial displays. These locations, called staging areas, serve to gather the birds before they enter the roost.

How are bald eagle roosting sites protected?

The goal is to avoid destruction, abandonment or reduced use of the site by roosting bald eagles. During and after forest operations, the roosting resource site must be left and protected from damage. The operation must be designed to protect the trees from windthrow.

During the critical period of use, operations must be conducted so they do not disturb bald eagles using the roosting site. Operations are not allowed within one-quarter mile of active roost trees. If the eagles have line-of-site vision from these trees to the operation, the distance is one-half mile.

The critical period of use in the Klamath Basin is Oct. 31 to March 31.

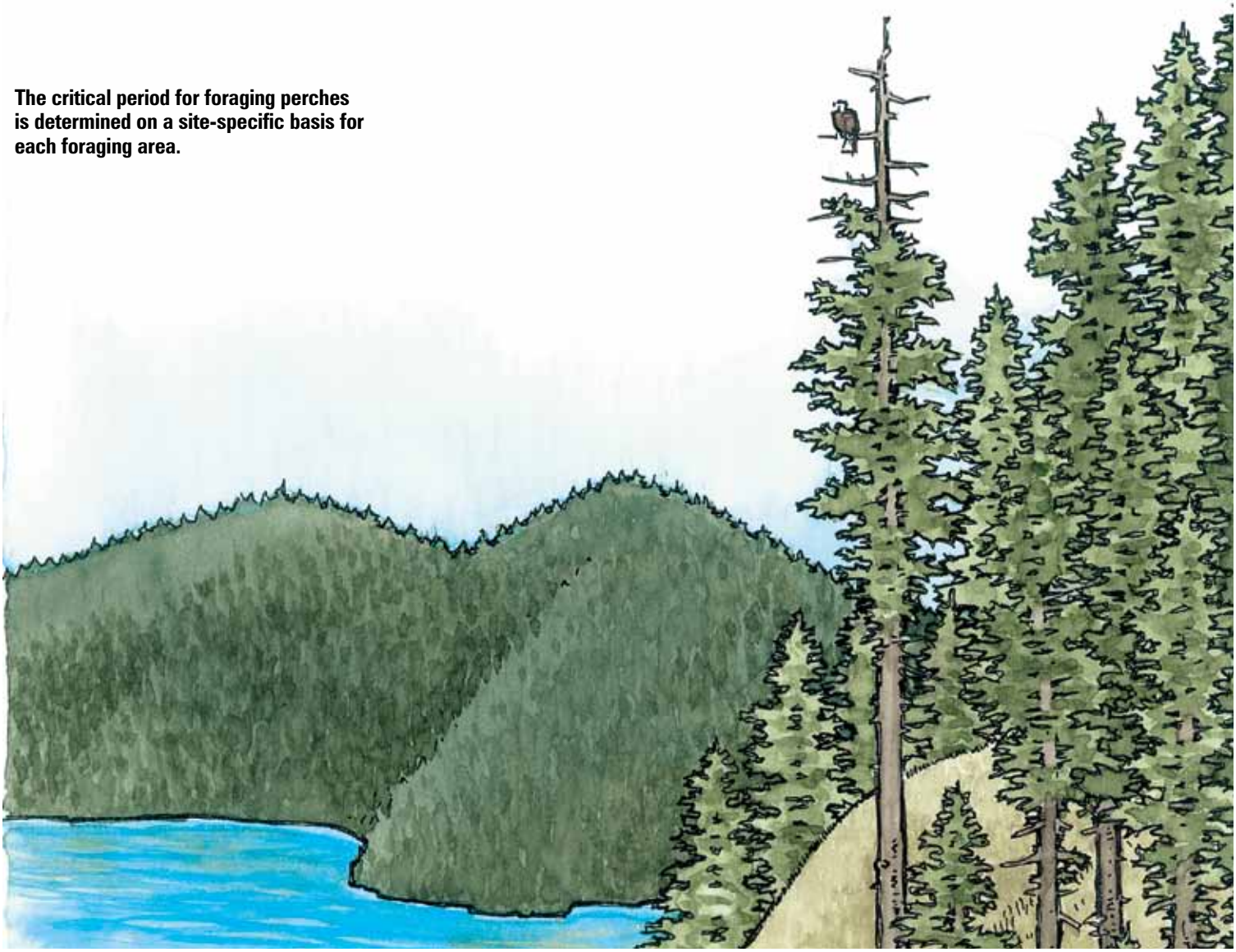
For the rest of the state, the critical use period is Nov. 15 to March 15.

Identify active roost trees, probable roost trees and staging trees, and choose a forested area around the roost trees. Roost sites frequently occur in mature forests. Roost trees are often significantly larger than the rest of the stand. Staging trees are often large, dead-top or dominant trees where one or more eagles can perch and have direct access to the roosting site. The surrounding forested area must be adequate to maintain a suitable microclimate around the roost trees. Microclimate, disturbance and windthrow must be considered when designing a forested area around a roosting site. A minimum 300-foot forested area around the outermost roost trees is needed.

Activities that disturb roosting eagles include: timber harvesting, road construction, heavy equipment operation and low flying aircraft.

Are there exceptions?

Yes. Exceptions to the protection requirements may be granted by ODF if the operator has obtained an incidental take permit from federal authorities under the federal ESA.



The critical period for foraging perches is determined on a site-specific basis for each foraging area.

What is a bald eagle foraging perch?

When hunting, bald eagles use a sit-and-wait strategy. Large trees that provide vantage points overlooking the hunting area are important. Bald eagles concentrate their activity around one or more of these large trees. In the case of a foraging perch, the resource site is the active foraging perch. Active means that eagles routinely use the perch as a vantage point while hunting.

How are bald eagle foraging perches protected?

The goal is to avoid perch tree destruction, abandonment or reduced use. It is done by maintaining site integrity and by avoiding disturbance when bald eagles are likely to use the perch tree for hunting. During and after forest operations, the perch tree must be left and protected from damage. Timber should be felled away from the perch tree. In areas of high wind, design of the harvest may require that adjacent trees be left to protect the perch from windthrow.

During the critical period of use, operations must be conducted so they do not disturb bald eagles using the foraging area. The critical period is determined on a site-specific basis for each foraging area, depending on whether it is used by nesting, wintering or migratory eagles.

First identify the active foraging perches. Bald eagles usually perch in the tallest trees on the edge of stands. They select strong branches high in the crown. Snags and dead-top trees are often used. These perches allow views of water, such as lakes, rivers, reservoirs, estuaries and the ocean.

Are there exceptions?

Yes. A bald eagle foraging perch may be harvested if ODF determines that disturbance at a single foraging perch will not cause a conflict to eagles using the entire foraging area, or that adequate replacement foraging perches will remain in the vicinity after completion of the forest operation. Check with ODF.


Great blue heron resource sites require protection.

What about the great blue heron?

Great blue heron are colonial nesters, which means there are many nests together in what's called a rookery. Clusters of large nests located near the tops of trees identify a rookery. The rookery is near water and is used year after year.

What is a great blue heron resource site?

It includes the active nest tree and any identified key components. An active nest tree is one that has been used by great blues within the past three nesting seasons. Key components include a forested area around the nest trees that has perching, fledging and replacement trees.

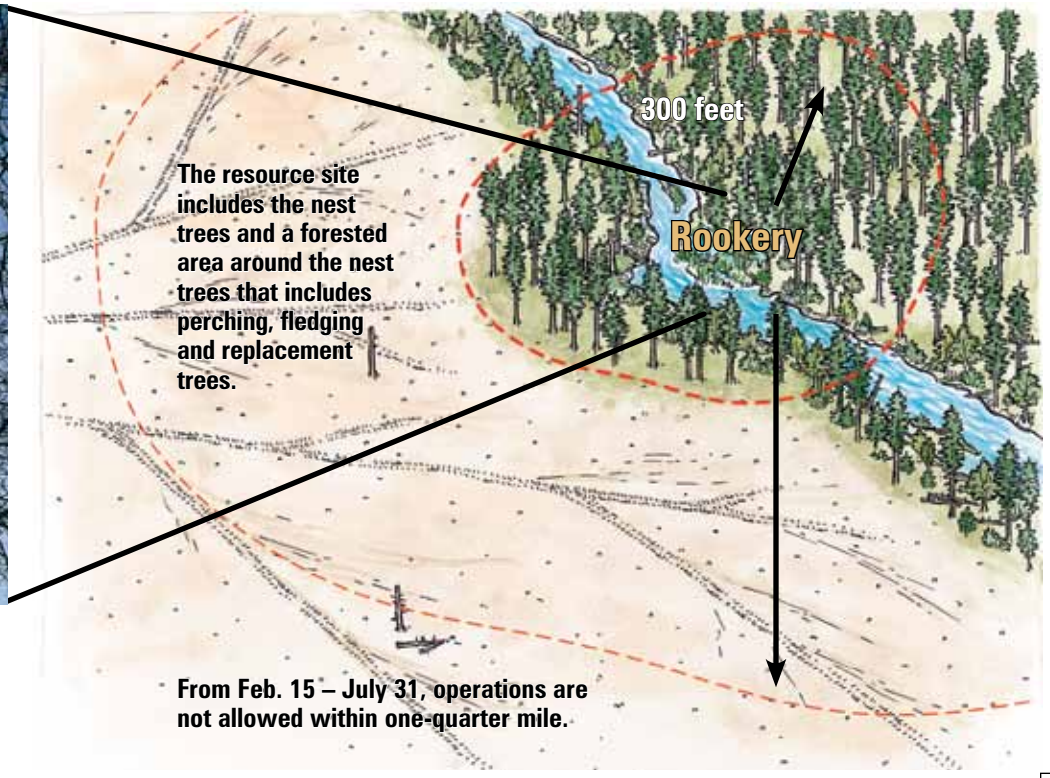
How are great blue heron resource sites protected?

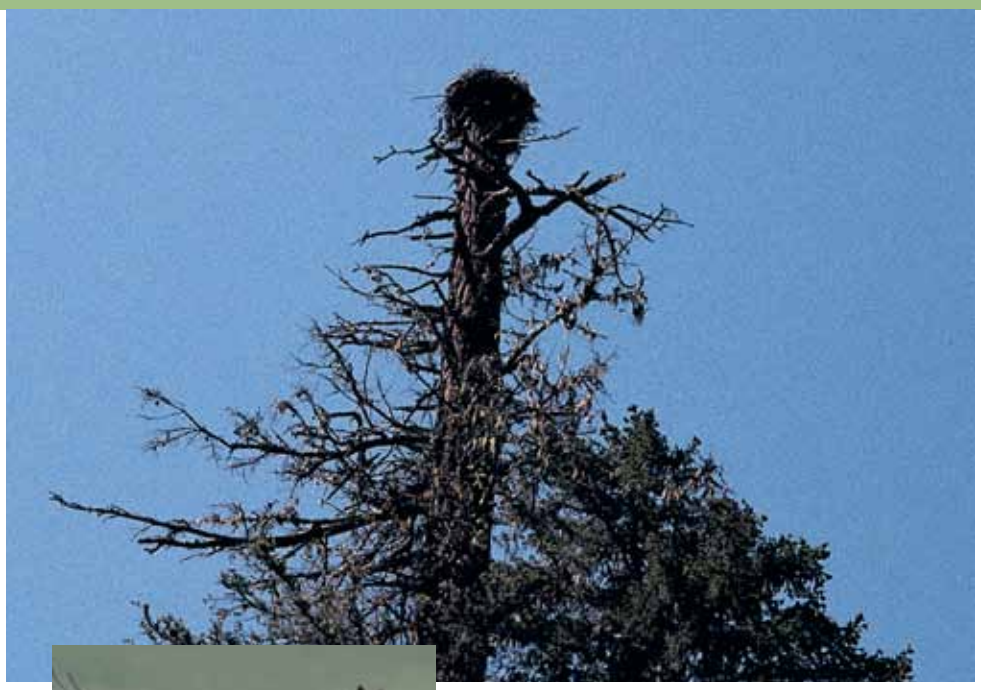
- The goal is to avoid resource site abandonment or reduced use. It is accomplished by maintaining site integrity and by avoiding disturbance during the critical period of use when nest construction, mating and rearing of young occur.
- During forest operations, the active nest tree, perching, fledging and replacement trees must be left and protected from damage. The operation must be designed to protect the trees from windthrow.
- During the critical period of use, the active nest tree and any key components must be protected from disturbance. Forest operations are not allowed within one-quarter mile of the active nest trees Feb. 15 to July 31.
- First identify the active nest trees. Then choose a vegetative area around the nest trees. Trees used as nest sites should be tall, with plenty of space for these large birds to fly in and out. Older trees with open branching are ideal. A 300-foot area around the outermost nest trees is needed to give a visual screen around the rookery and protect nest, perch, fledging and replacement trees from windthrow.
- Some trees may be harvested within the vegetative area surrounding the active nest trees. When conducting harvest activities within this area, operators must consider great blue heron resource protection as the highest priority.
- Activities likely to cause the birds to flush from the nest include: timber harvesting, log hauling, road construction and low-flying aircraft.

Are there exceptions?

There are exceptions to protecting a great blue heron resource site if ODF determines that the loss of the site will not adversely affect the local population and there are no economically feasible alternatives. Check with ODF.

These great blue heron nests have plenty of space for these large birds to fly in and out. Older trees with open branching are chosen.





© Jim Cruce Photo

Osprey nest trees on forestland are usually large snags and broken-top trees, up to 60 inches DBH and 100-150 feet tall. Often they are above the surrounding forest and large enough to support a nest 4 to 6 feet in diameter and 1 to 2 feet deep. In other locations, osprey are often seen nesting on man-made telephone pole platforms.

What about the osprey?

Osprey resource sites require protection because they provide for successful reproduction of this important species. The birds often nest in large, prominent snags or trees with broken tops. These trees have a limited life span and are vulnerable to damage from forest practices. When using the nesting sites, the birds are also sensitive to human disturbance.

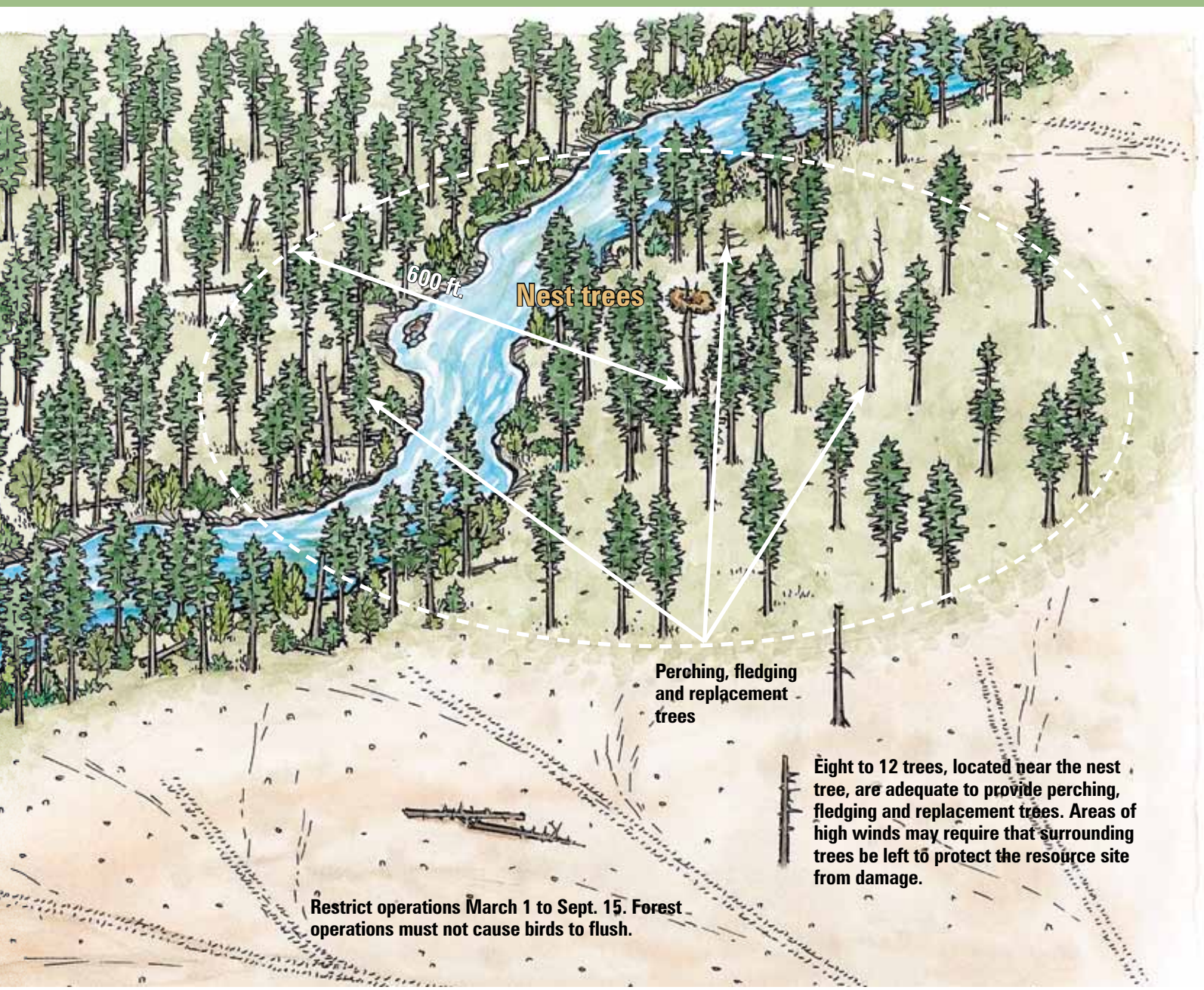
What is an osprey resource site?

It includes the active nest tree and any identified key components. An active nest tree is one that has been used by osprey within the past five nesting seasons. Key components include perching, fledging and replacement trees.

Osprey are fish-eating raptors. After foraging, an adult osprey eats part of a fish in a tree near the nest, and delivers the remainder to the nest. These same trees are also used as perches by fledglings when learning to fly. Perching and fledging trees tend to be taller and larger in diameter than nest trees and have broken or dead tops, forks or lateral branches high in the crown. They allow easy access and views of the surroundings.

How are osprey resource sites protected?

- The goal is to avoid resource site abandonment or reduced use of the site. It is accomplished by maintaining site integrity and avoiding disturbance during the critical period of use when nest construction, mating and rearing of young occur.
- During forest operations, the active nest tree, perching, fledging and replacement trees must be left and protected from damage. The operation must be designed to protect the trees from windthrow.



- During the critical period of use, the active nest tree and any identified perch trees must be protected from disturbance. Forest operations are not allowed within 600 feet of the active nest tree or perch trees March 1 to Sept. 15.
- First identify the active nest tree. Then choose suitable perching, fledging and replacement trees that are likely to be used by osprey. The trees should be taller than the surrounding forest, with platforms large enough to support nests.
- Resting perches are used by adults when not fishing or tending the nest, and by fledglings when learning to fly. These are large, tall snags or trees that have broken or dead tops, forks or lateral branches high in the crown.
- Eight to 12 trees are adequate for perching, fledging and replacement trees, and should be located near the active nest tree.
- Activities that cause disturbance include timber harvesting, log hauling, road construction and low-flying aircraft.

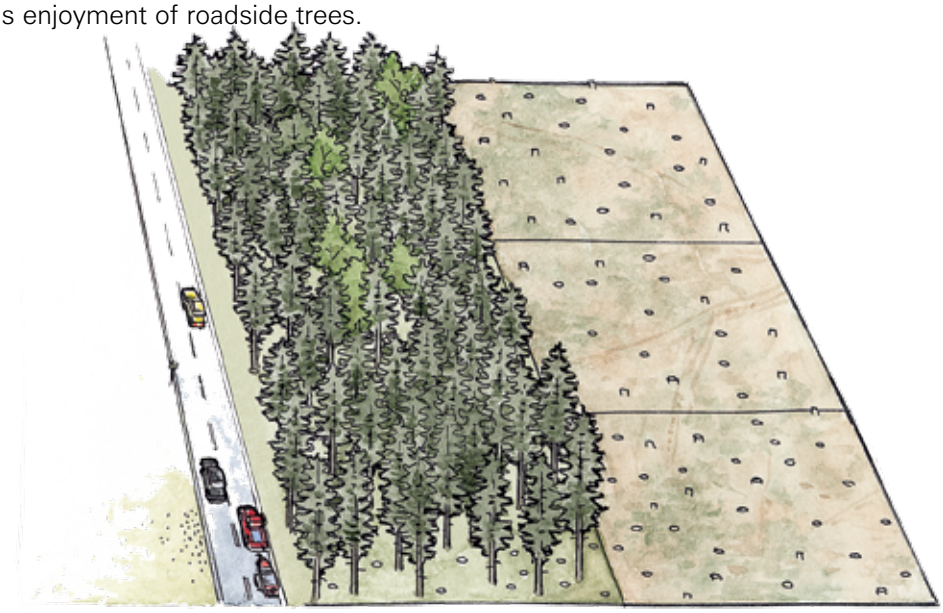
Are there exceptions?

Yes. There are exceptions to protecting osprey resource sites if ODF determines that the loss of the site will not adversely affect the local population and there are no economically feasible alternatives. Check with ODF.

For other information sources, see the Appendix, pages 183-184.

What are the requirements for harvesting near scenic highways?

Oregon's popular scenic highways are often bordered by forestlands. When located along certain designated scenic highways, these lands have unique timber harvest requirements to help maintain the public's enjoyment of roadside trees.



Designated scenic highways

These include interstate freeways 5, 84, 205 and 405, plus Oregon state highways 6, 7, 20, 18, 22, 26, 27, 30, 31, 34, 35, 36, 38, 42, 58, 62, 66, 82, 97, 101, 126, 138, 140, 199, 230, 234 and 395.

Are there any exceptions?

Three scenarios are exempt from the scenic highway requirements: timber harvests along highways within urban growth boundaries, harvests on lands zoned as rural residential, or harvests on single ownerships less than 5 acres in size.

What area is affected by the requirements?

The scenic highway requirements apply to the "visually sensitive corridor" that extends 150 feet from the edge of the highway (Area 1 in the illustration). This distance is measured on the slope, along both sides of a scenic highway. The "edge of the highway" means the fence for interstate highways and the outermost edge of the pavement for state highways.

What are the requirements?

The following must be left temporarily on each acre of the 150- foot corridor: (Note: 1 acre = 290 feet of scenic corridor; 150 x 290 = approximately 1 acre.)

Leave at least 50 healthy trees on each acre, at least 11 inches DBH (species are landowner's choice),

Or

Leave at least 50 healthy trees on each acre that are 40 square feet of basal area.

Note: 50 trees/acre = 17 trees per 100 feet of corridor length.

When can the temporary trees be harvested?

The trees may be removed when the new trees in the corridor understory reach an average height of at least 10 feet

And

there is at least the minimum number of trees per acre of free-to-grow seedlings or saplings required for reforestation. (See "Will you need to reforest after harvest?" on page 71).

THERE IS AN ALTERNATIVE:

When the area extending from 150 to 300 feet from the edge of the highway (Area 2) has at least 40 square feet of basal area

Or

There are at least the minimum number of trees per acre of free-to-grow seedlings or saplings required for reforestation in Area 2 averaging 10 feet tall

Then

No trees are required to be left in the visually sensitive corridor, or trees initially left may be removed. (See illustration on page 47).

However, if this alternative is used, Area 2 stocking cannot be reduced below 40 square feet of basal area

Or

Below the minimum number of trees per acre of free-to-grow seedlings or saplings required for reforestation

Until

Area 1 has been reforested as required and the stand is at least 10 feet tall and has the minimum number of stems per acre.

QUESTION:

What if the stocking in the scenic corridor (Area 1) is already below 50 healthy trees on each acre?

Then Area 2 cannot be harvested until Area 1 has been reforested and the stand has attained an average height of 10 feet

And

There are at least the minimum of trees per acre of free-to-grow seedlings and saplings required for reforestation.

How is slash managed in visually sensitive corridors?

fpa *Harvests in visually sensitive corridors shall be cleared of major harvest debris within 30 days of harvest completion*

Or

fpa *Within 60 days of stopping active harvest activity on the site, regardless of whether the harvest is complete.*

What are the reforestation requirements in visually sensitive corridors?

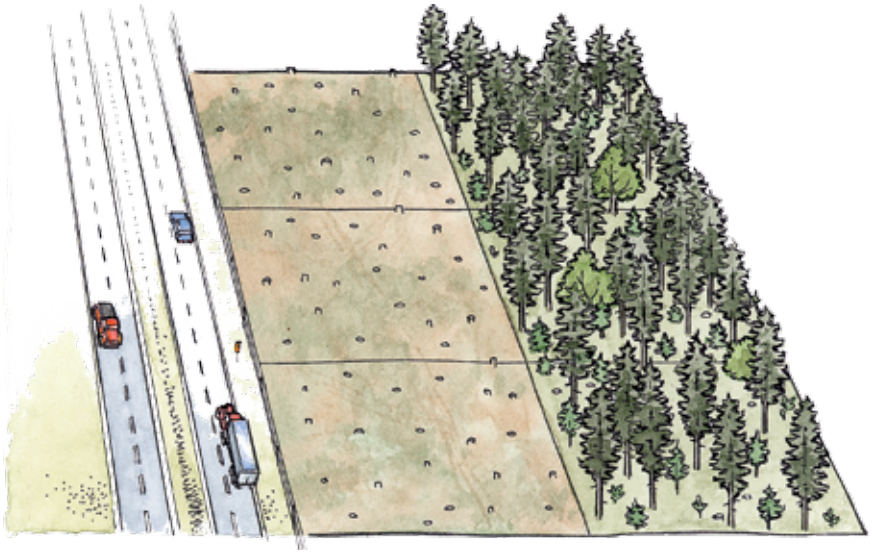
fpa *When the harvest in a visually sensitive corridor results in a Type 1 or Type 3 harvest, reforestation shall be completed by the end of the first planting season after the completion of the harvest (see harvest types, page 17).*

Is there liability for injury or damage from trees left in corridors?

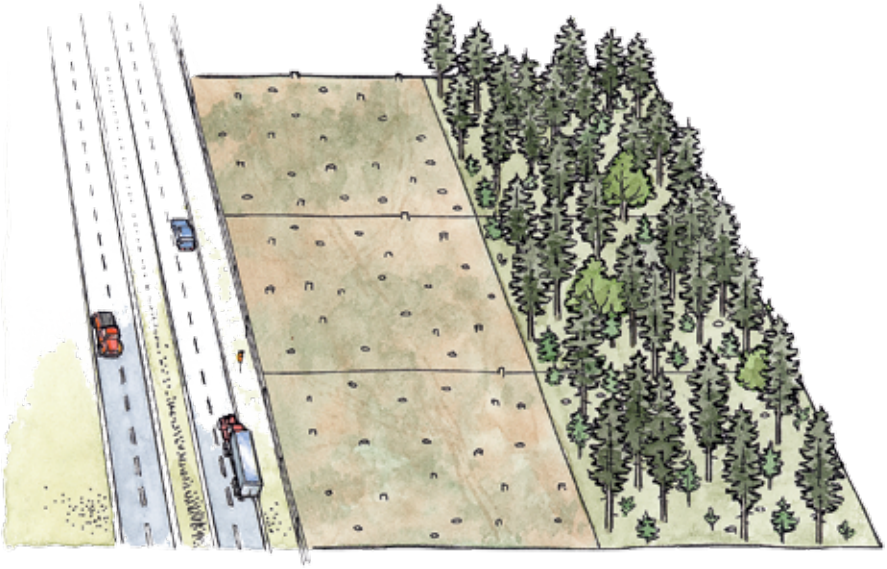
Landowners and operators are not liable for injury or damage caused by the trees left in the visually sensitive corridor to comply with the requirements above. Where public safety is a serious concern, the Oregon Department of Transportation may encourage or prescribe removal of specific trees.

What tree species must be left in the corridor?

The landowner can choose the 50 trees that are left. Hardwoods make good visual screens, so conifers do not have to be left if there are enough hardwoods. The 50 trees on each acre (not an average) must be distributed throughout the visual corridor.



AREA 1 AREA 2



AREA 1 AREA 2

Are modifications or waivers granted?

Yes, ODF may do so when the following circumstances exist:

- to maintain motorist safety
- to protect improvements such as dwellings or bridges
- to protect forest health
- to provide the motoring public with exposure to distant scenic vistas
- when trees that are required to be left are not visible to motorists
- when a land use change is inconsistent with a visually sensitive corridor
- when the requirements will result in severe economic hardship for the owner because nearly all of the owner's property is within the corridor

For other information sources, see the Appendix, pages 183-184.

What are the requirements where rapidly moving landslides may occur?

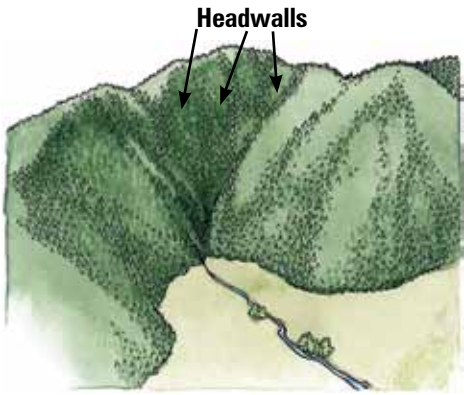
What is the problem on very steep slopes in western Oregon?

Very steep slopes can be prone to rapidly moving landslides, and timber harvesting and road construction can affect their occurrence. In addition to their potential soil and water effects, they can pose significant threats to public safety. This section describes rapidly moving landslides, where they can occur and requirements for forest practices near such areas. These measures are only one part of the shared responsibility needed among homeowners, road users, and state and local governments for effective protection of the public in areas prone to these landslides.

What is a rapidly moving landslide?

Rapidly moving landslides begin as small landslides on very steep slopes, averaging about 3 feet deep, 30 feet wide and 40 feet long. When these landslides move down steep slopes and into stream channels they are called debris flows or debris torrents. They can affect fish habitat both positively and negatively. They carry logs and boulders, which provide nutrients and contribute hiding cover for fish, but the fine sediment can suffocate fish eggs and emerging fry. If people, homes or buildings are anywhere in their path, serious harm can occur. Other landslides, such as deep-seated earthflows, move more slowly and are not considered rapidly moving landslides.

Scars left by rapidly moving landslides.



Very steep slopes and steep headwalls or draws are prone to landslides.

Where are the high landslide hazard locations?

"High landslide hazard location" (sometimes abbreviated HLHL) refers to a steep area that is likely to be the starting point of a rapidly moving landslide. These locations are:

A. any slope in western Oregon steeper than 80 percent, except in the Tyee core area, where it is any slope steeper than 75 percent (see illustration),

Or

B. headwalls or draws in western Oregon steeper than 70 percent, except in the Tyee core area, where it is any headwall or draw slope steeper than 65 percent (see illustration),

Or

C. a steep slope in any part of the state determined in the field by a geotechnical specialist and confirmed by ODF to have conditions with a landslide hazard equivalent to A or B.

What if your timber harvest or road construction project is located near a high landslide hazard location?

Landowners and operators are responsible for identifying high landslide hazard locations in the activity area, identifying roads, homes and other structures below the activity area, and evaluating the

The Tyee core area includes parts of Coos, western Lane and western Douglas counties. It stretches from the Siuslaw watershed south to and including the Coquille watershed. It also includes that portion of the Umpqua watershed north of Highway 42 and west of Interstate 5.

What is the Tyee core area?

The Tyee core area is a portion of Oregon where the geology consists of thick sandstone beds beneath the soil surface. These sandstone beds decompose rapidly and have very few underground cracks where soil water can enter. As a result, their shallow soils can become waterlogged and slip off the steep slopes, creating rapidly moving landslide hazards. There are exceptions, however, and geotechnical specialists find slopes that do not have these susceptible characteristics and are not subject to the Tyee slope restrictions.

Table 2-18 Operations in High Landslide Hazard Locations

Downslope Public Safety Risk Level	Requirements	Restrictions
High	Written plan and geo-technical report to ODF	Harvesting or new road construction is not allowed in certain locations
Intermediate	Written plan to ODF; site-specific measures	Limit on how much area can be harvested
Low	Identify downslope structures and public roads in notification to ODF	No ground-based equipment, skid roads or serious ground disturbance Avoid roads in these locations; direct drainage water away from them

Table 2-18 describes major restrictions and requirements for the different levels of downslope public safety risk. You may need a written plan and, in some cases, assistance from a geotechnical specialist to assess and plan the operation. See page 50 for examples of some important factors that can determine local risks.

level of risk to public safety. You may need a geotechnical specialist to assist with some or all of these tasks. ODF will review and verify the information you provide and make the final determination of the level of risk to public safety. Table 2-18 describes the restrictions and requirements depending on the level of risk. See below for more details about risk levels.

Determining public safety risk is complex and sensitive work. It is extremely important to work closely with ODF, starting in the planning stages for a harvest or road construction project, if public safety related to landslides may be a concern.

How can streams in high landslide hazard locations affect risk?

Streams that drain high landslide hazard locations can be prone to debris torrents – such streams are often found squeezed into narrow channels with steep sideslopes. When large quantities of debris from a landslide reaches such a channel, the torrent can become even more damaging as it scours additional material from the channel and moves rapidly toward the lower watershed.

If there's a potential public safety risk around these channels, you may be required to leave large trees along streams in locations where they might slow debris torrent movement. Where public safety is not a concern, leaving trees around these channels can provide an important source of large wood that provides good fish habitat.

What locations are most risky for people?

How much time people spend in the locations, especially during wet-season storms, is a key risk factor. People in homes or buildings that are in the path of rapidly moving landslides are at highest risk. People traveling on busy roads with this hazard have less risk. Most other circumstances have a low risk.

What about small Type N streams subject to rapidly moving landslides?

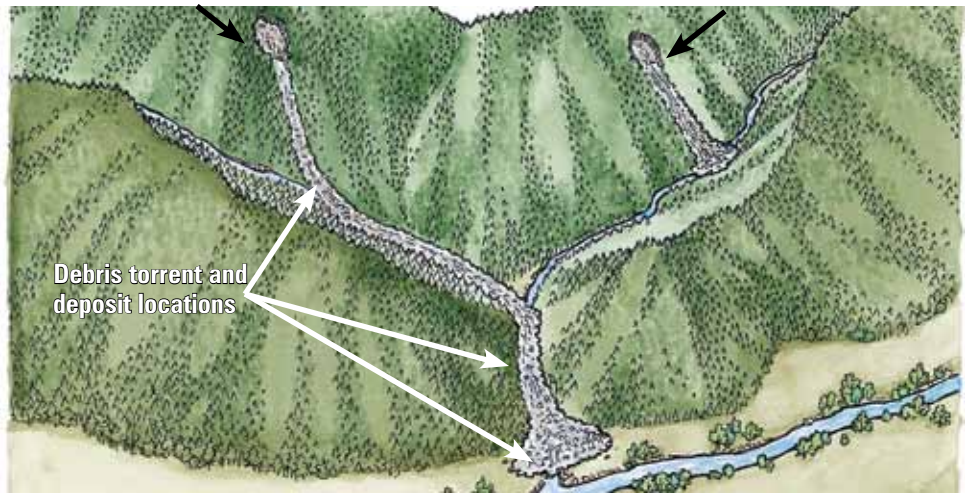
Landslide deposits in stream channels that contain large woody debris can benefit fish by improving spawning and rearing habitat and other local conditions. For small Type N streams subject to rapidly moving landslides, some or all of the green trees and snags required for Type 2 or Type 3 harvests larger than 25 acres must be left within 50 feet of these channels for the first 500 feet that drains into a Type F stream. Downslope public safety requirements can supersede this directive, and operators may propose alternate practices (e.g., placing wood in the Type F stream) to meet the same objective. Contact ODF for further details and assistance.

For other information sources, see the Appendix, pages 183-184.

The home at the right is on a debris fan at the base of a debris torrent-prone stream that is susceptible to landslides originating in the canyon behind it. Thus, it has a higher risk than the home at left that is below a single, uniform steep slope.

This landslide had no sharp channel junctions and moved and grew rapidly, causing considerable damage.

This slide stopped when it hit a sharp right angle. This limited damage and, over time, local fish habitat may be improved.



This illustration shows the action of two landslides. Landowners who conduct operations on slopes need to evaluate the potential for landslides. Many locations prone to rapidly moving landslides contain no obvious evidence of prior landslides.

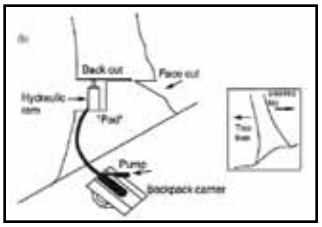
Doing a timber harvest

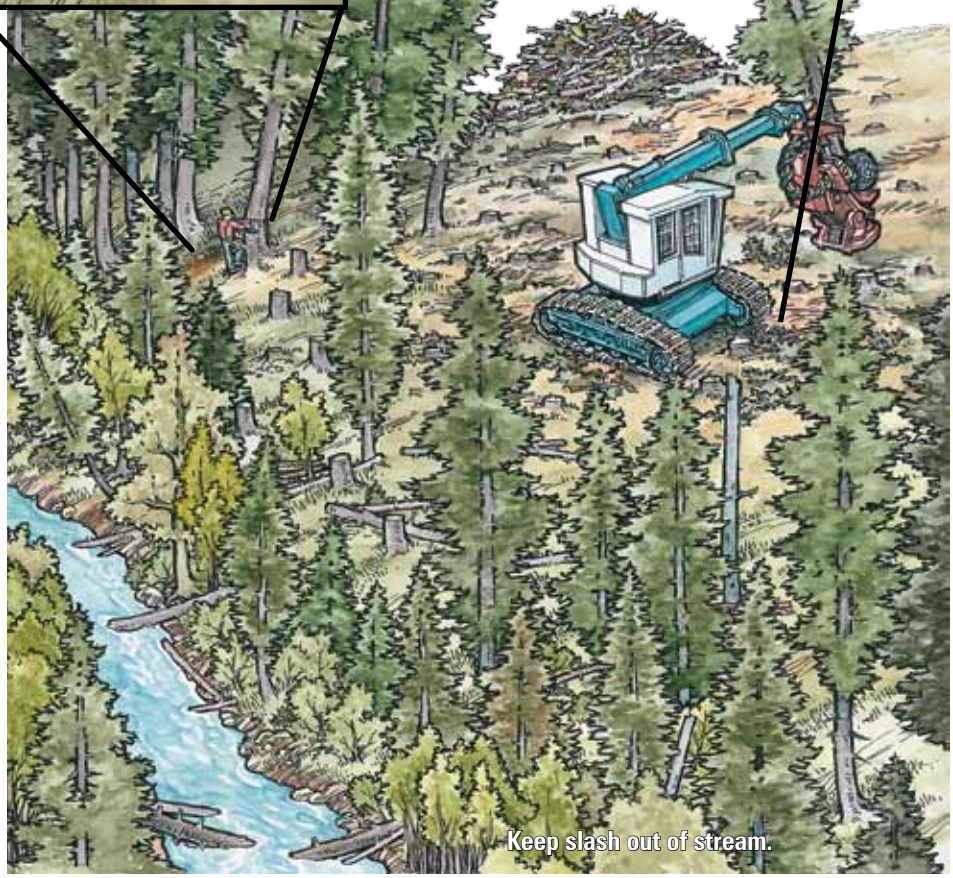
What should you know when felling, bucking and limbing trees near water?

What are these requirements intended to protect?

- stream channels and banks,
- water quality, by keeping slash out of streams,
- soils in RMAs, and vegetation that is left in the RMA

Hydraulic jacks help prevent RMA damage and reduce log breakage.





How can tree felling, bucking and limbing cause damage?

These harvesting activities can:

- gouge or break down stream banks
- damage or bury remaining vegetation
- leave slash in the channel or within the high water level
- cause trees to roll, crushing and breaking remaining vegetation
- disturb soil and damage vegetation with mechanical felling equipment

What are the felling, bucking and limbing requirements?

Fell, buck and limb trees to minimize disturbance to channels, soils and retained vegetation in RMAs, streams, lakes and all wetlands greater than one-quarter acre.

When possible, fell trees away from RMAs, streams, lakes and significant wetlands, except trees felled for stream improvement projects that have been planned and reviewed. Note: Because hardwoods often lean toward streams, are shorter and have broader crowns, safety and feasibility concerns may not allow for directional felling.

Buck and yard hardwood trees to minimize damage to beds, banks and retained vegetation. When it can consistently protect bed and banks, yard hardwoods away from water before limbing.

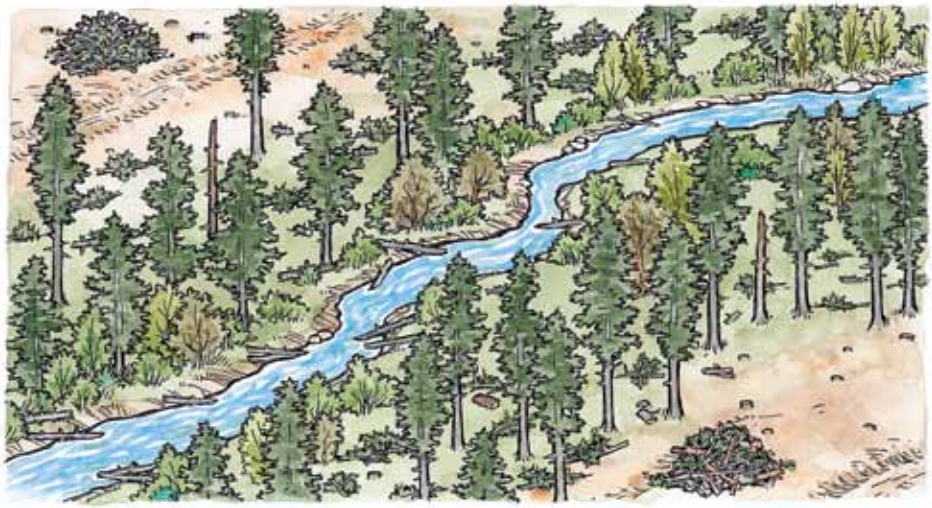
On steep slopes use jacking, line pulling, high stumps, whole-tree yarding or stage-cutting to prevent damage to vegetation retained in RMAs, soils, streams, lakes and significant wetlands.

Minimize slash accumulations in channels, significant wetlands and lakes, including during felling, bucking, limbing or yarding.

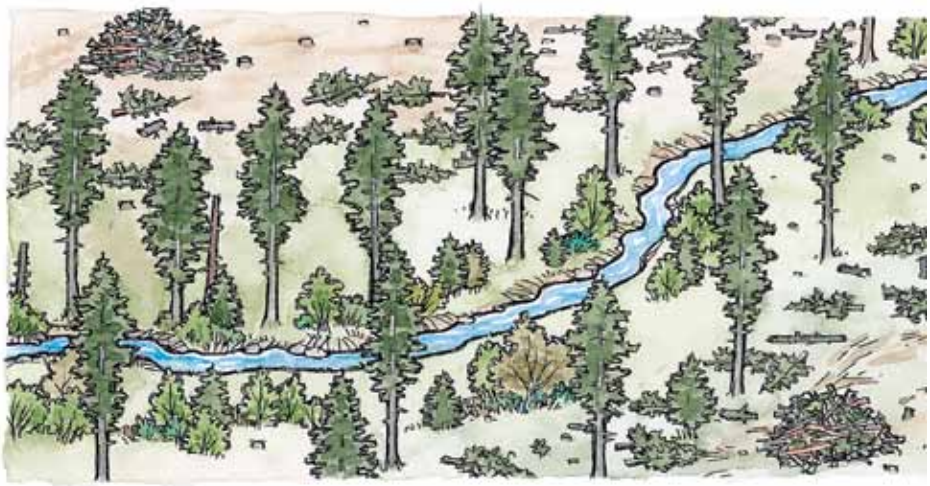
Remove slash within 24 hours from Type F and Type D streams, lakes and significant wetlands. Don't allow slash to accumulate in Type N streams, lakes or wetlands in quantities that threaten water quality or increase potential for mass debris movement.

Place slash removed from streams, lakes or wetlands above high-water levels and away from streambanks, wetlands and side channels.

How much and what size slash should be removed?



Type F streams: Leave slash too big for hand removal. It becomes large woody debris. This requires a written plan approved by ODF. Plans need to show a benefit of slash, or that removing it would create greater damage.



Type D streams: All slash should be removed from below the high-water level.

Type N streams: Banks and streambed should be generally free of slash.

What should you know when ground yarding near water and using temporary crossings?

After trees are cut, limbed and bucked into logs, they are moved (yarded) by skidders, tractors or shovels on a skid trail to a landing, where they are loaded onto trucks. Both skid-trail construction and temporary stream crossings may be needed to yard logs cut in the RMA or to yard logs to a landing across the stream. These activities have the potential to disturb RMA soils and vegetation, reducing their ability to limit sedimentation and protect water quality.

What yarding activities can disturb RMAs, wetlands and lakes?

- construction, use and removal of temporary stream crossings
- skid trails that generate muddy runoff that can move into waters of the state

Both of these activities are subject to requirements described in this section.

What are these requirements intended to protect?

- channels and banks
- vegetation left in the RMA
- RMA soils that control runoff and keep sediment out of waters

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Maintain RMA vegetation and minimize disturbance to beds and banks of streams, lakes and all wetlands of more than one-quarter acre.

What should be avoided when planning temporary stream crossings?

When improperly built, temporary stream crossings are a threat to streams, lakes and wetlands.

Why?

- High water can erode fill materials and wash out crossing structures, creating sediment.
- Crossings must be planned to affect as little of the channel, banks and riparian area as possible.

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Minimize the number of temporary stream crossings.

What this means:

- Install crossings only where necessary to access across streams.
- Crossings are not allowed simply to straighten skid roads.
- Use existing, permanent roads as much as possible.
- Locate skid trails outside the RMA are used as much as possible.
- A maximum of one crossing per harvest unit is desirable.

Additional temporary crossings can be used when:

- the alternative involves crossing a landslide
- the alternative is skid trails on slopes greater than 60 percent
- the alternative is to cross a property line and the adjoining landowner is unwilling to have skid trails on that property
- the only alternative is a skid trail parallel to and within 100 feet of the stream
- the only alternative is a permanent crossing

When is a temporary crossing structure needed?

- when there is streamflow at the time of harvest
- if streamflow will occur during harvest
- if streambanks are wet or fragile

Is logging equipment allowed in stream channels?

Tractors, skidders, feller-bunchers and any other equipment being used for logging is subject to the following restriction:

Do not operate ground equipment within any stream channel, except as required for temporary stream crossings.

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What this means:

The only time logging equipment is allowed in a stream is for construction of a temporary stream crossing structure, or when crossing a dry stream with a stable bed and banks.

Is anything else not allowed?

Straightening or shortening any stream channel is not permitted.

What are acceptable temporary crossing structures?

The choice of temporary crossing structure depends on stream size, time of year, whether fish are present and the volume of timber moved via the crossing.

The illustrations show several temporary stream crossings. The improved mat ford and natural bottom ford are for log truck use only. Yarding across these two temporary crossings would result in sediment or wood debris entering the stream.

The other three temporary crossings are for both yarding and truck use.

Always remove temporary crossings at the completion of yarding (see page 56).

Examples of temporary crossings

IMPROVED MAT FORD

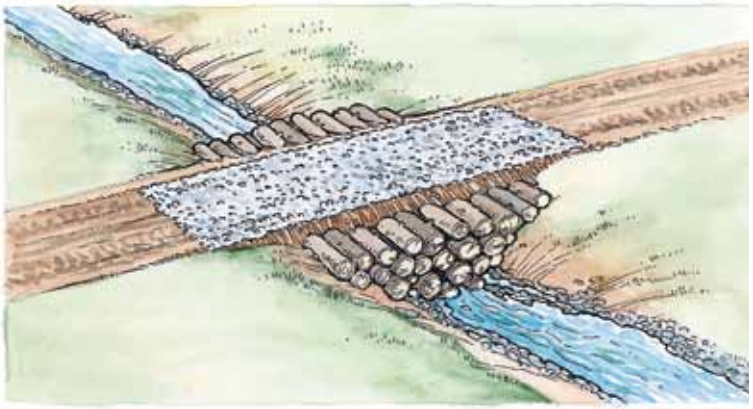
This is for log truck use only and constructed with concrete or wood planks fastened together.

NATURAL BOTTOM FORDS

This is for log truck use only. Use this only where bed and banks are gravel, cobbles or bedrock. Approaches must be gravel, cobbles or bedrock. Any bare soil in the approach must be rocked.

LOG CROSSING

Fill over logs should be rock. Keep fill back from ends of logs. Use only for Type N streams with very low flows.



CULVERT AND ROCK FILL

Temporary stream crossing with culvert and rock fill. Maximum fill is 8 feet. Larger fill requires a written plan (see Page 55). Culvert size must accommodate stream flow during period of use.

BRIDGE

Temporary short bridges provide the greatest stream protection. Use portion of rail car or reinforced concrete. Constructed abutments may not be needed. Wood timbers on the ground some distance back from the bank may suffice.

How do you know if the temporary structure will handle the stream flow?

Use temporary stream crossing structures like a log crossing, culvert or ford capable of passing stream flows likely to occur during use.

Be sure your temporary stream crossing:

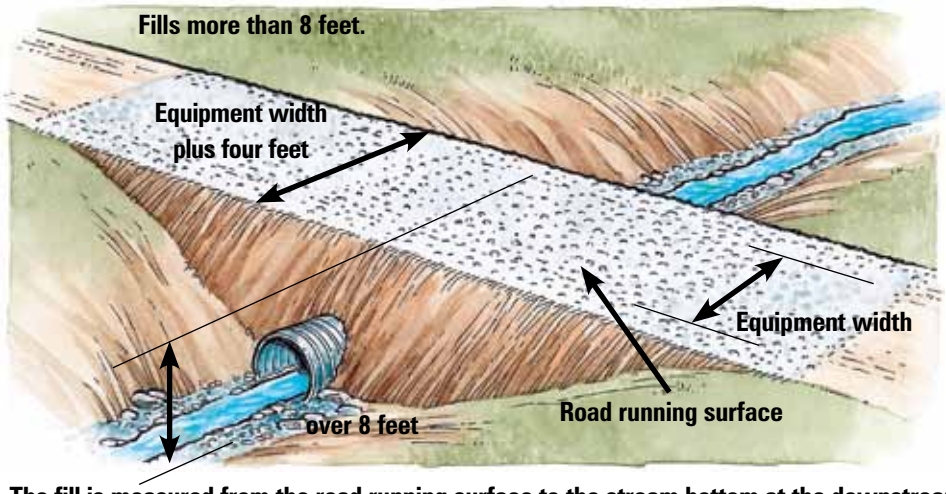
- is able to pass the highest flow reasonably expected during the life of the structure – this is a storm flow that is higher than normal seasonal flow
- is able to pass flows without ponding water behind the fill or saturating the fill soil

Where should temporary crossings be located?

- Choose a single channel that is narrow and not deeply incised.
- Avoid multiple, braided or side channels.
- Avoid eroded areas or streambanks with exposed soils.
- Banks should be less than 5 feet high. Bridges are better where banks are higher.
- Look for rock, cobble or gravel rather than clays, decomposed granite soils or sand.
- Avoid very wet or weak soils.
- Avoid slide areas, gullies or active erosion areas.
- Approach the crossing at right angles and get up, out and away from the stream as quickly as possible.

Choose temporary locations that minimize cuts, fills or other bank disturbance. Provide cross-drainage on nearby roads and skid trails to prevent runoff and sediment delivery to the stream.

This temporary stream crossing culvert is too small. The stream is ponding behind the culvert and seeping through the fill. The culvert could fail, sending fill soil downstream.



The fill is measured from the road running surface to the stream bottom at the downstream side. Fills more than 8 feet must be designed in accordance with road construction-stream crossing fill rules, except that passage of a 50-year flow is not required for temporary crossings.

When is a written plan required for temporary stream crossings?

Minimize the size of temporary stream crossing fills. Fills more than 8 feet deep can be a downstream risk if they fail. Any temporary fill more than 8 feet deep requires a written plan that is reviewed by ODF.

What is necessary when constructing temporary structures in live streams?

- Keep equipment out of the water.
- Temporary water diversions are OK if done during low flows and if fish are not affected. This means you can either pump stream water around the construction site or use a temporary trench. Be sure to minimize sediment entering water.
- It is recommended that temporary crossing fill be rock rather than soil. This makes it easier to remove after the operation is complete.
- Protect streambed and banks from damage.

Temporary structures must withstand erosion by the stream and minimize sedimentation.

When and how should temporary crossing structures be removed?

Remove temporary stream crossing structures after completion of the operation or prior to seasonal runoff, whichever comes first. Place fill material where it cannot enter the water.

Soil and slash left below the high water level may be carried into the stream if not placed in a stable location.

Rule of thumb: Any material that might make its way into the stream should be removed.

What is necessary when constructing temporary crossings in dry streams?

When the channel is dry and will remain dry during the operation, crossing structures may not be necessary.

Locate crossings where bed and banks are clean gravel, cobbles or bedrock. If wetlands or any other wet soils are present, use temporary structures.

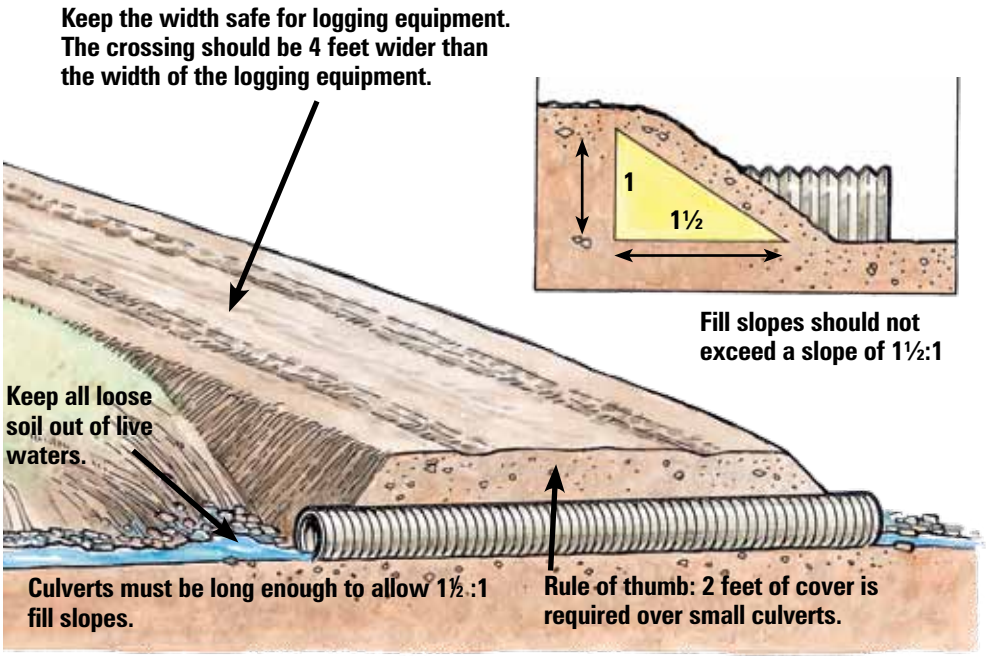
No temporary crossing is required as long as disturbance is no greater than what would occur if structures were constructed.

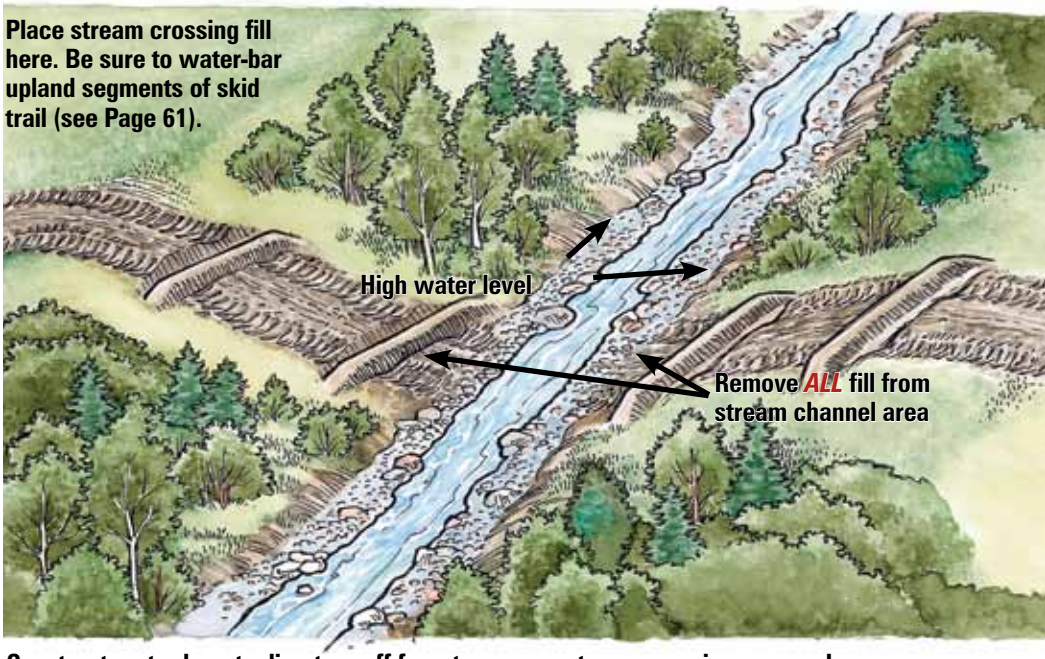
Be sure to maintain fish passage on Type F streams.

How do you decommission a temporary crossing in a dry stream?

Remove soil that enters the stream during yarding after the operation or before stream flow, whichever comes first. Place material where it will not enter water.

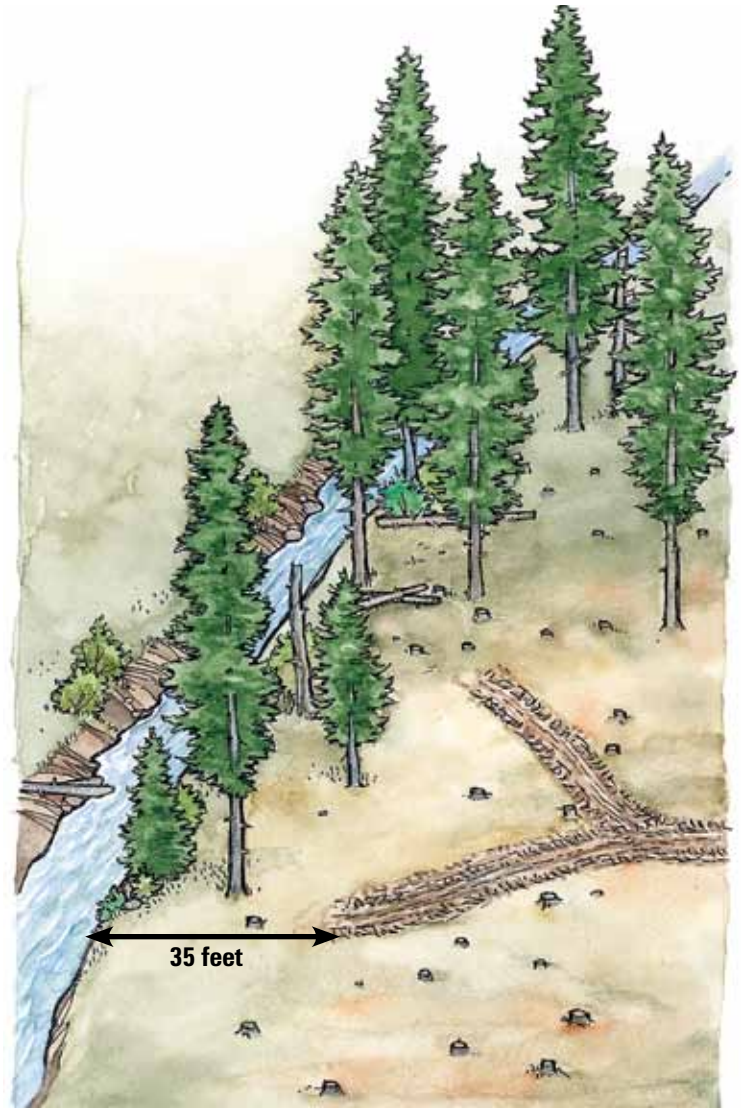
Construct water bars, dips or other water diversions on stream crossing approaches after the operation or prior to rainy-season runoff, whichever comes first.





Construct water bars to divert runoff from temporary stream crossing approaches. Construct as soon as crossing use has ended and before rainy or runoff season.

A minimum of 35 feet of horizontal distance is required between skid trails and the high water level of Type F and D streams. Only stream crossings are allowed closer to streams. Approaches to stream crossings must be designed to get skid trails out of this 35-foot portion of the RMA as quickly as possible.



What about skid trails in RMAs?

Skid trails are routes used by vehicles to transport felled trees to collection sites (landings). For the purpose of the forest practice requirements skid trails are also defined as:

- any area where equipment constructs a trail by excavating and filling
- any area used by equipment where visible ruts are formed

Machine activity within 100 feet of streams, lakes and other wetlands greater than one-quarter acre must minimize the risk of sediment entering waters and prevent stream channel changes.

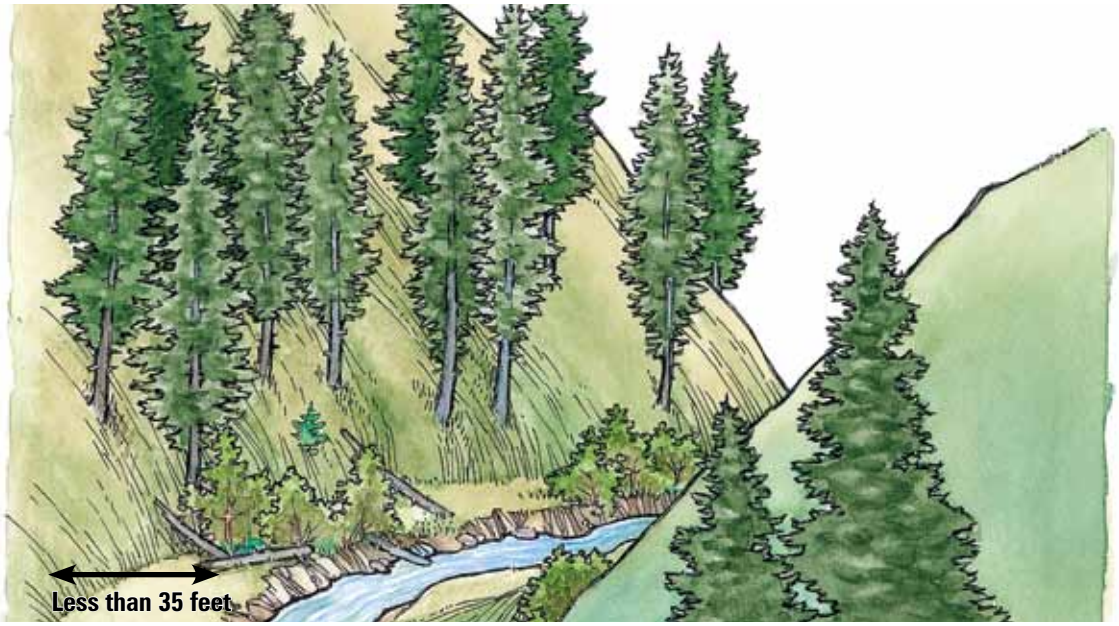
Locate, construct and maintain skid trails in RMAs acording to harvesting rules.

What is not allowed?

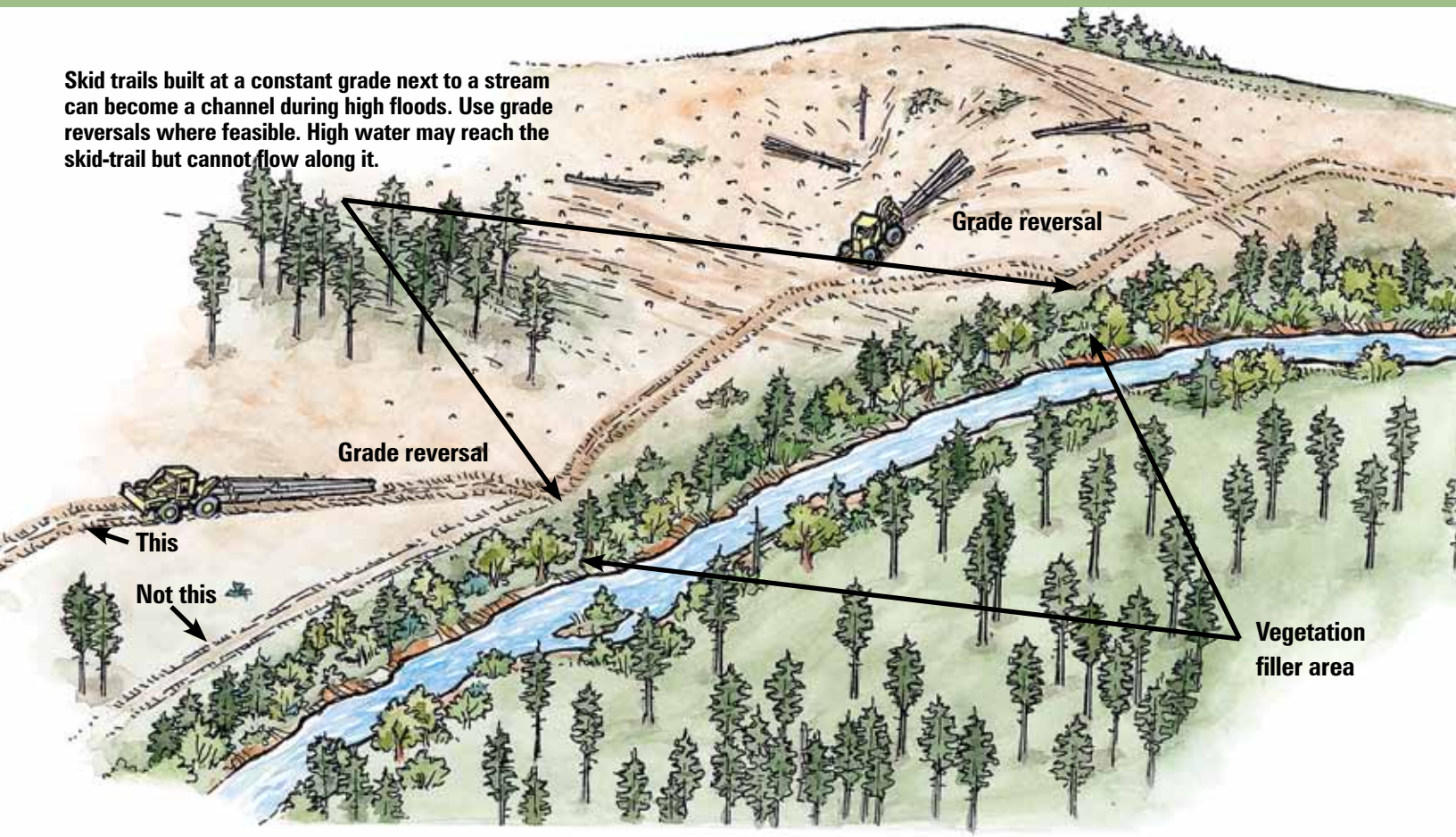
Using a stream channel for a skid trail or driving up and down stream channels is not permitted.

How far must skid trails be kept from Type F or D streams?

Minimize exposed soil from skid trails in RMAs. Except for stream crossings, do not locate skid trails within 35 feet of Type F or Type D streams. Be sure an adequate vegetation filter exists between skid trails and water so sediment can be filtered from skid trail runoff water.



For Type F and D streams in steep, narrow canyons, the distance from the high water level to the steep canyon slope is generally less than 35 feet. This means an alternative logging system (cable or helicopter) must be used.



How far must skid trails be kept from Type N streams and wetlands?

Table 3-1 gives guidelines for minimum adequate setback distances for all Type N streams and wetlands. Distances are measured from the closest area of disturbed soil to the high water level.

How do you construct skid trails to avoid stream diversion during high flows?

Locate and construct skid trails so that when high flows occur water from the stream will not flow onto the skid trail.

Skid trails constructed in a floodplain run the risk of diverting waters from the stream. These skid trails can become temporary streams that cause serious erosion.

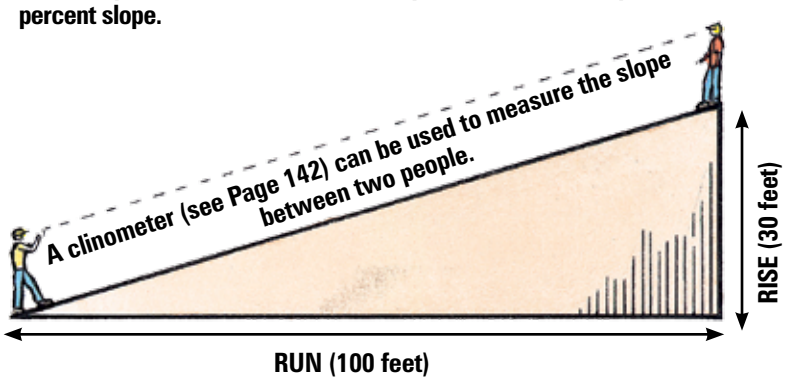
Avoid the possibility of a channel diversion by trying to keep skid trails well above the stream high water level.

Skid trails below the high water level must have frequent grade reversals or large rolling dips. Grade reversals are essential when skid trails are parallel to channels (see illustration).

Table 3-1 Minimum Skid Trail Setback Distances for Type N Streams and Wetlands

Soil	Slope in Percent		
	0 to 35%	35 to 50%	50 to 65%
Normal	20 feet	35 feet	100 feet
Erodible	35 feet	100 feet	Likely rule Violation

How to measure slope in percent: RISE divided by RUN = percent SLOPE. For example: a rise of 30 feet divided by a run of 100 feet equals a 30 percent slope.



What should you know when ground yarding outside RMAs?

- Generally, skid trails should follow slope contours rather than go up and down the slope.
- The potential for erosion increases with the steepness of the slope for ground yarding.
- Skid trail construction on steep slopes often requires cutting and sidecasting.
- Sidecasting removes productive soils, replacing them with less productive subsoils.

Deep compaction from pressure and vibration from heavy equipment can decrease tree growth, and increase runoff and erosion on slopes.

Avoid ground skidding on unstable, wet or easily compacted soils and on steep slopes unless it can be done without damaging soil productivity through soil disturbance, compaction or erosion.

Locate skid trails where sidecasting is kept to a minimum.

What this means:

If more than 20 percent of the harvest unit has major soil displacement, deep compaction or extensive erosion, the operation is considered damaging and not in compliance.

Major soil displacement is the lateral movement of soil, often producing ruts that can change natural drainage and increase erosion.

What this means:

There is a risk of sidecast material sliding and causing problems well below the skid trail. Minimize soil disturbance by fitting skid trails to the topography, and avoid buildup of sidecast.

Skid trail sidecast should not cover productive soil for a significant percentage of the unit. It is likely to cause landslides and remove soil from the slope. Any combination of slope covered by sidecast, slides from sidecast and excavated skid trails should not exceed more than 20 percent of the ground in any 5-acre portion of the unit.

Operators should plan to pull back sidecast and place it in the skid trail after the harvest and before the rainy season.

Rule of thumb: A sidecast depth of 3 feet or more is considered excessive on slopes of 50 to 65 percent. Two feet or more is excessive on slopes greater than 65 percent. Note: Know your soil type – some are more prone to failure when placed on steep slopes.

Both the logs and the yarding vehicle can cause excessive soil disturbance, especially on slopes.

What locations are not stable for skid trails?

- actively moving landslides
- high landslide hazard locations (see page 49)
- all slopes steeper than 70 percent
- slopes on non-cohesive soils (sands, decomposed granite soils, and ash), greater than 60 percent
- areas impacted by intense wildfire (reduce these slope guidelines by 10 percent)

Avoid excavating skid trails on slumps or slides. Locate skid trails on stable areas. Minimize the risk of material entering waters of the state.

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Slumps and slides are evidence of less stable soils. Constructing skid trails on these features or other potentially unstable locations can change drainage and steepen or load the slope. These can increase the chance of soil movement and resource damage from erosion and sedimentation.

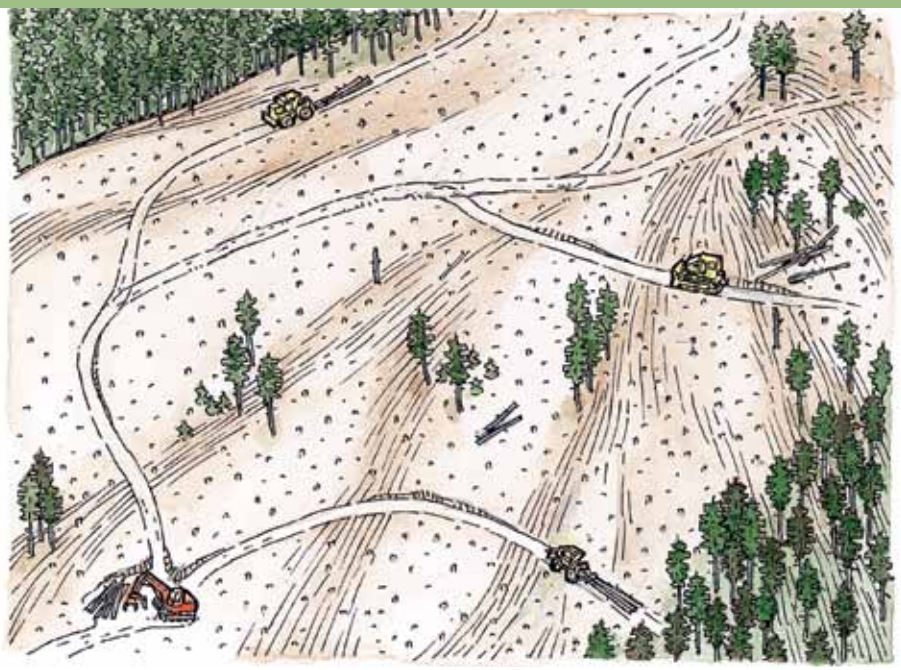
What this means:

Landowners and operators need to recognize both stable and unstable locations for skid trails. Also, carefully consider drainage and potential impacts to nearby streams and other waters, whether or not a soil failure might occur.

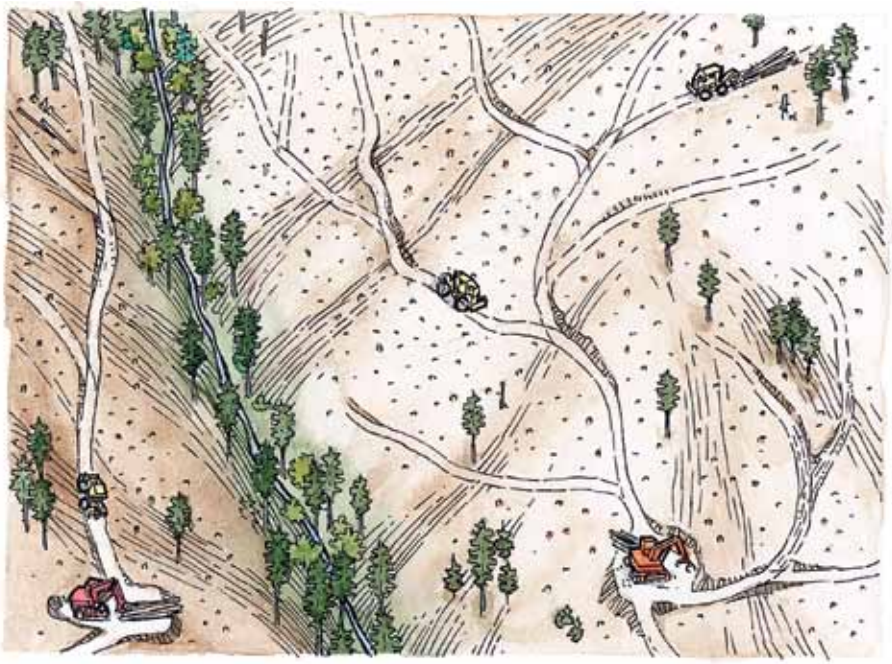
Are there any tips on skid trail layout?

Advance planning can minimize the impact of skid trails on soil and the amount of ground occupied by skid trails. Preplanned skid trails can become permanent parts of your logging unit. They can be used for other management activities and future harvests.

There are two common patterns for preplanned skid trails: branching and parallel (see illustrations).



On gentle slopes, the branching skid trail pattern has one or more main trails from which other trails branch off to provide access to the area.



On steeper slopes, the parallel skid trail pattern attempts to parallel the natural contours of the land.

Shovel logging is a unique yarding method in which a tracked vehicle travels and accumulates logs throughout the cutover area, using few or no constructed skid trails. Similarly, **logging with feller-bunchers or grapple skidders** requires traffic throughout the harvest unit. See pages 147-149 for further information about these systems.

With such harvest systems, care must still be taken to limit soil disturbance and compaction, and to control drainage (see next section) where there is any excavation, filling or rutting in traffic areas.

How is drainage from skid trails controlled?

Construct dips, grade reversals or other effective water diversions in skid trails as necessary to minimize soil displacement and to ensure runoff water is filtered before it enters water.

- For drainage dips, see page 109.
- For grade reversals, see page 58.

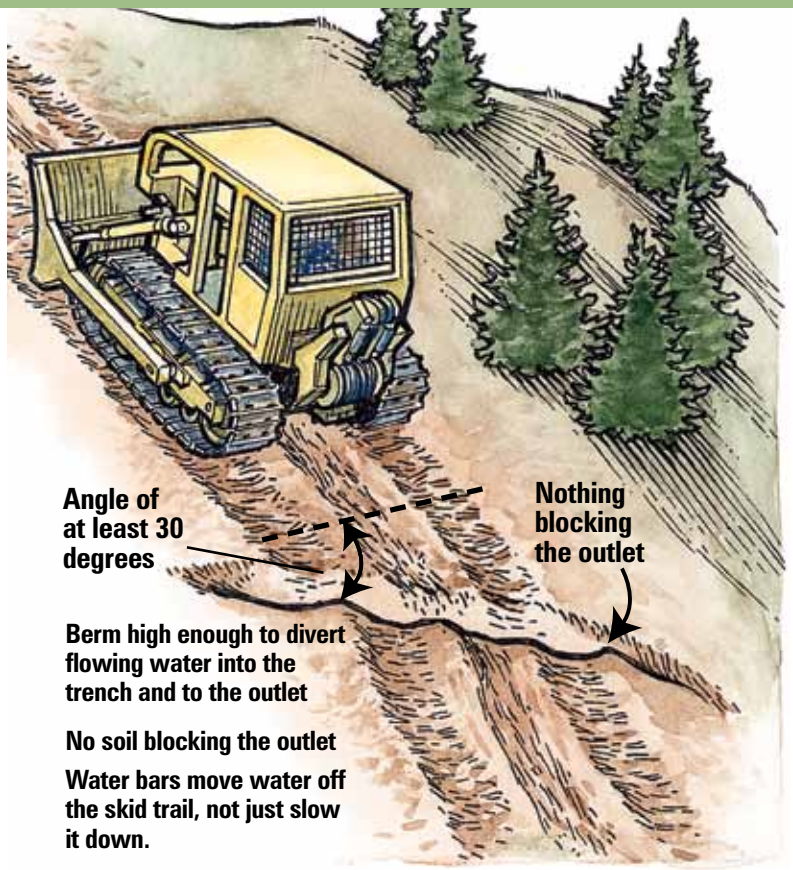
Drain skid trails by water barring or other effective means immediately following completion of the operation and at all times during the operation when runoff is likely.

Skid trails with too few grade changes can concentrate water and erode the slope.

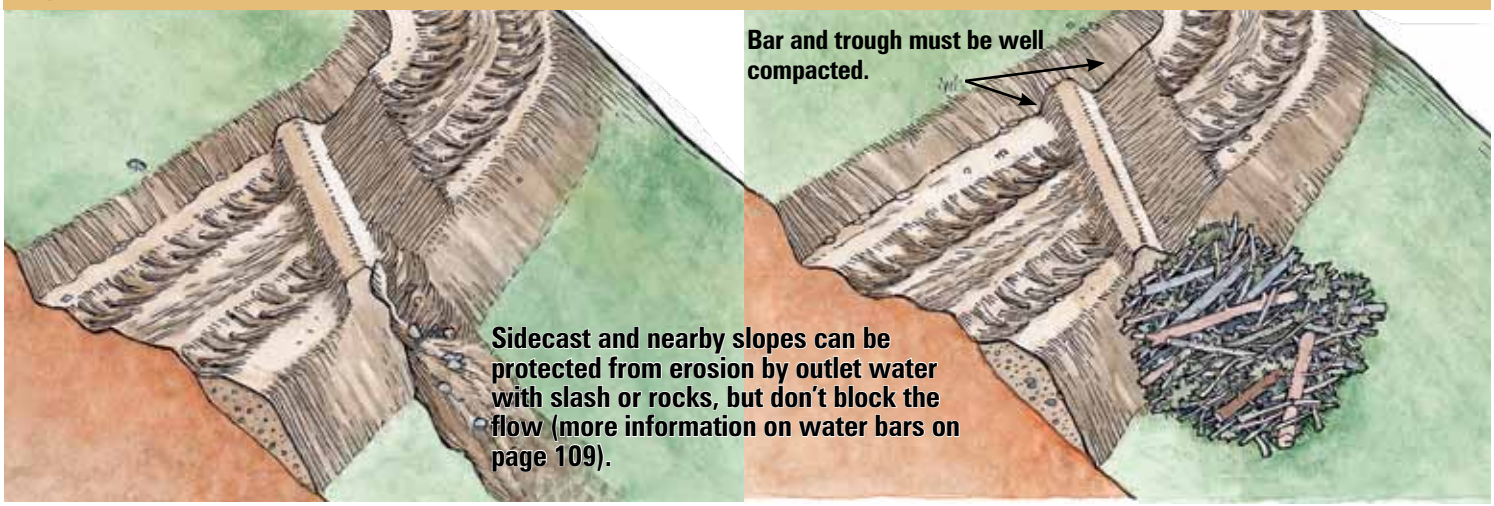
Operators are required to keep material eroded from skid trails from entering waters of the state.

Stabilization must be permanent. Water bars must be able to handle or prevent erosion from all potential uses and storm events. This effort must take into account unauthorized recreational traffic.

Sidecast and nearby slopes can be protected from erosion by outlet water with slash or rocks, but don't block the flow (more details on water bars on page 109).



Tips on skid trail water bars



How do you determine water bar spacing?

Table 3-2 is a guide to minimum water bar spacing on skid trails. Narrower spacing, especially on steep slopes, can significantly reduce the erosive power of runoff and provide extra protection.

Table 3-2 Minimum Water Bar Spacing On Skid Trails

Slope of Skid Road	Soil Description	
Percent (see Appendix)	Sensitive soils (silts, granitics)	Normal forest soil (loam, gravel, cobble)
5 to 15	150 feet	300 feet
15 to 35	100 feet	200 feet
35 to 50	50 feet	100 feet
Over 50	25 feet	50 feet

What other concerns are there for ground skidding on steep slopes or those likely to erode?

Ground skidding on these locations can cause sediment to enter streams, so there are some unique requirements to protect streams during skidding activities on such slopes.

What slopes or soils have these requirements?

Slopes of more than 60 percent have unique requirements for ground skidding. Note that ground skidding is never allowed in high landslide hazard locations, which typically have more than 70 to 80 percent slopes (see page 49).

The requirements also apply to slopes of more than 40 percent with decomposed granite soils, which are more likely to erode even when less than 60 percent. These soils are most common in areas of southwest Oregon. They have been identified and mapped on county soil surveys.

What are the requirements for steep-slope skidding?

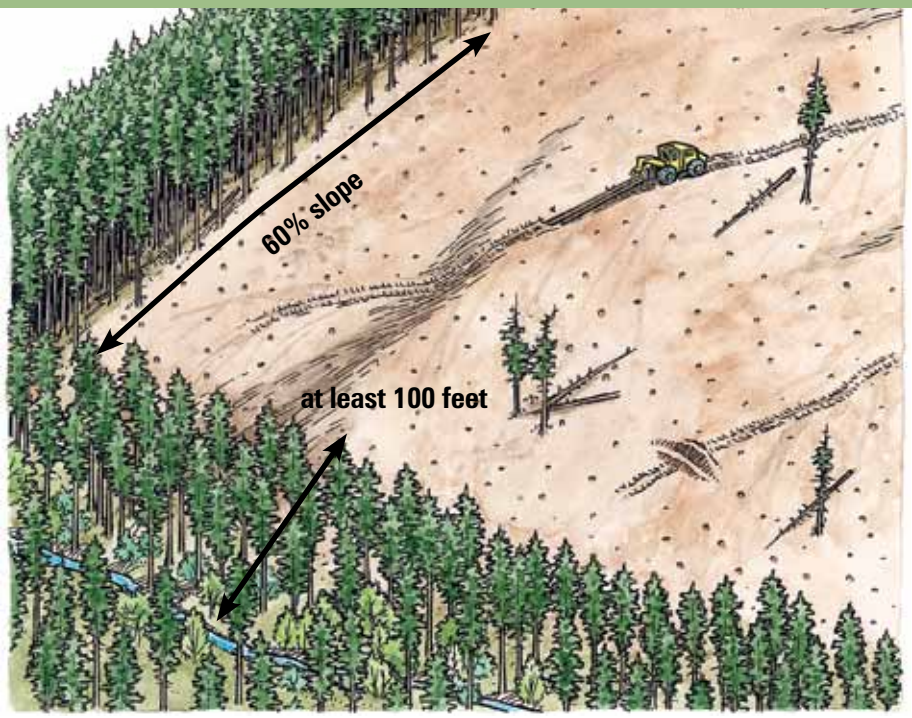
Since ground skidding on steep or slopes likely to erode has a high potential for delivering sediment to streams, it must be done carefully. Here are the requirements:

- Do not construct skid trails straight up and down the slope, because water can flow back onto the skid trail even if water bars are installed.
- Skid at an angle to the slope (see illustration above right).
- Keep skid trails at least 100 feet from stream channels.
- Plan spacing and location of trails carefully – no more than 10 percent of the steep slope area should be disturbed.

How do you build steep-slope skid trail cross ditches?

While similar to water bars, steep slope skid trail cross ditches should be deeper (see photo sequence at right).

For other information sources, see the Appendix, pages 183-184.



Steep slope skidding is allowed. However, skid trails must be at an angle to the slope. Never use skid trails up and down steep slopes.

Begin construction of the skid trail cross ditch at the far edge of the skid trail.

Cut an extra-deep cross ditch at an angle greater than perpendicular to the skid trail, and be sure the ditch is open so water can drain out.

The finished skid trail cross ditch should be deep. This is more than a water bar.

What should you know when cable logging near water?

Cable yarding across streams, wetlands or lakes is a good harvesting choice if it results in less road construction and if the logs can be suspended above the RMA and through narrow, widely spaced corridors. Written plans that are reviewed by ODF are needed for cable yarding across Type F or Type D streams, any large or medium Type N streams, and lakes or significant wetlands.

What this means:

The written plan should describe cable corridor spacing, corridor width and how vegetation will be protected when operations move from one corridor to another.

Minimize the yarding of logs across streams, lakes, significant wetlands and other wetlands greater than one-quarter acre when harvesting can be done using existing roads or other practical alternatives.

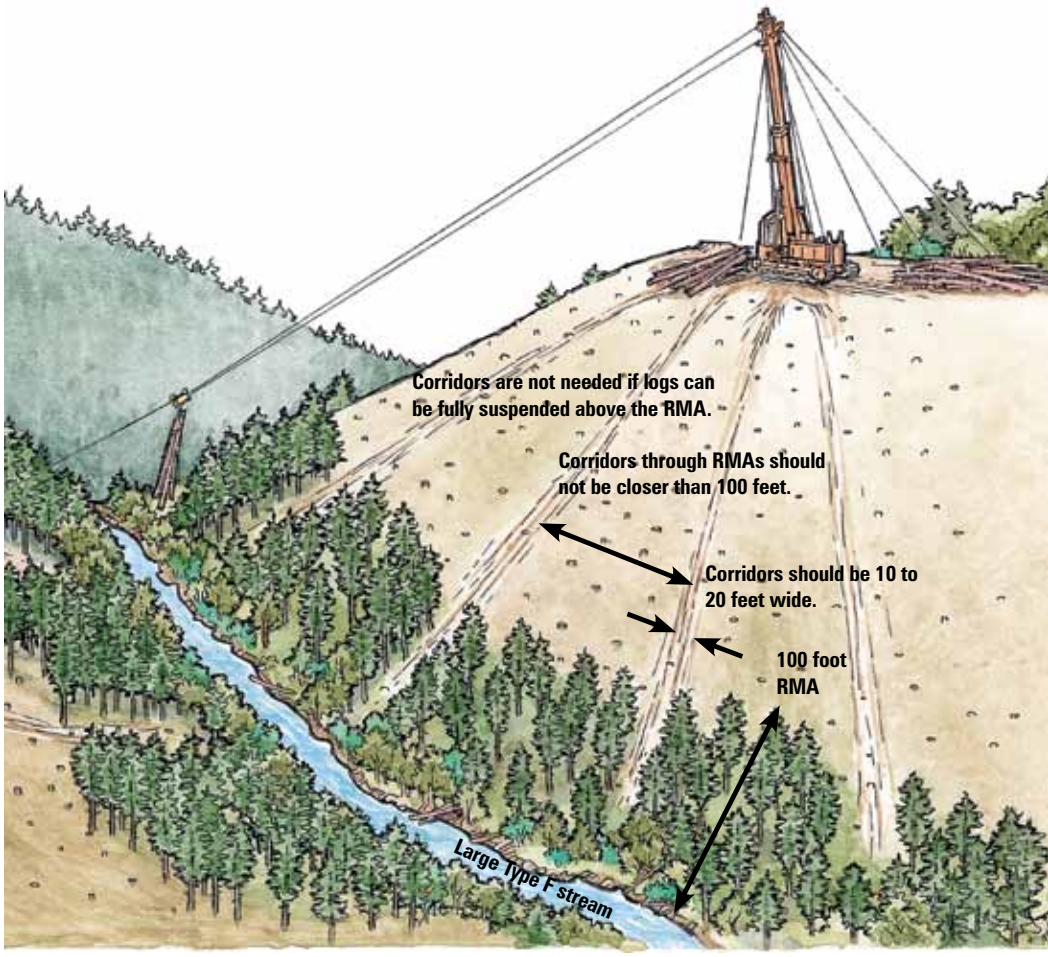
Maintain RMA vegetation and minimize disturbance to beds and banks of streams, lakes, all wetlands more than one-quarter acre and retained vegetation.

What cable logging activities can disturb RMAs, wetlands and lakes?

- cutting trees for cable corridors that are too wide and too close together
- swaying cables in the corridors that damage adjacent trees – minimize cable sway during yarding and when raising and lowering lines
- swinging logs that damage trees adjacent to the corridors
- swinging lines to the next corridor, rather than pulling them out and re-stringing

What are these requirements intended to protect?

- stream channels and banks
- water in the channel
- vegetation left in the RMA
- soils in the RMA



Use yarding corridors through retained streamside trees as long as the number and widths are minimized. Trees outside the corridor must be left with adequate crowns to provide original canopy cover.

How much suspension is needed?

When yarding is necessary across Type F or Type D streams, any large or medium Type N streams, lakes or significant wetlands, swing the yarded material free of the ground in the aquatic areas and riparian areas.

When yarding across small Type N streams or other wetlands greater than one-quarter acre, minimize disturbance to stream channel or wetland and retained streamside vegetation. At least the leading end of logs must be raised off the ground.

Avoid dragging logs with the lead edge on the ground, and never drag logs:

- down a stream channel
- across a channel
- through wetlands

What are the requirements for log landings?

Logs are yarded from where trees are felled in the harvest unit to openings located near roads in the forest called "landings." There the logs are stored and eventually loaded onto trucks for delivery to a mill or other location. Because landings are built on cleared ground that is often compacted, they are potential sources of runoff and erosion. Sometimes they have a tendency to expand in size (explained below). Keeping them small, drained and well located is what these requirements are all about.

Minimize the size of landings to that necessary for safe operation.

fpa

What is the problem with oversize landings?

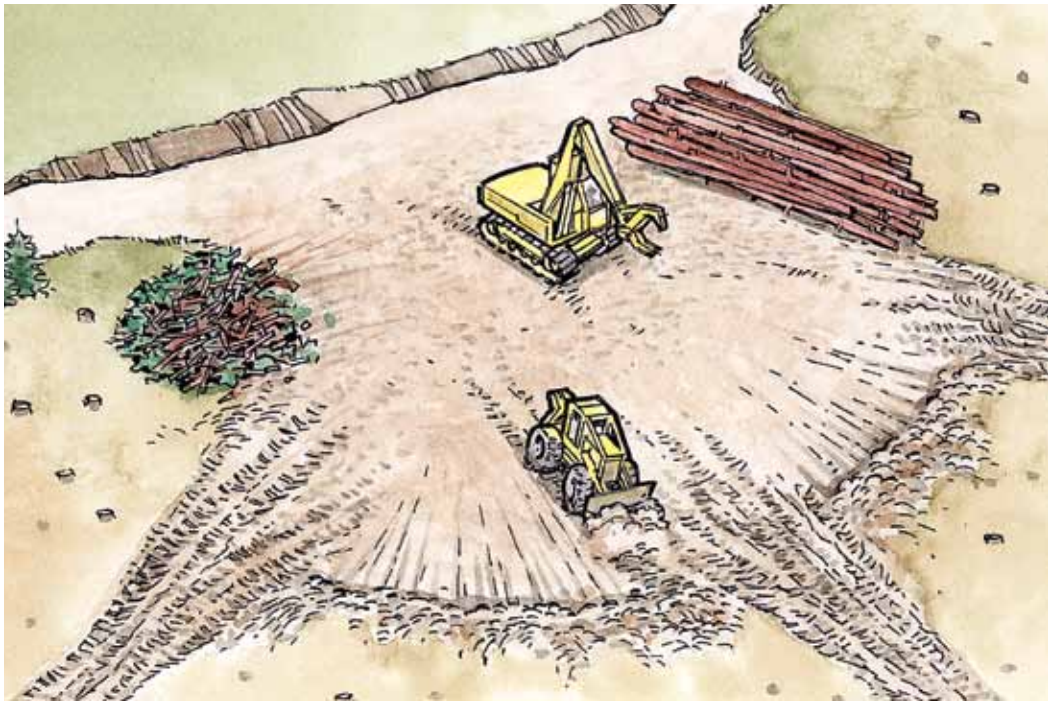
- They are bare, compacted surfaces where runoff can accumulate and erode soil.
- Sediment from landings can move to waters of the state.
- Oversize landings take forestland out of production.

Generally, landings more than one-quarter acre (about 100 feet by 100 feet) are larger than necessary. In many situations, smaller landings will meet safety and operational needs, but sizes and shapes will vary with the logging system and other needs.

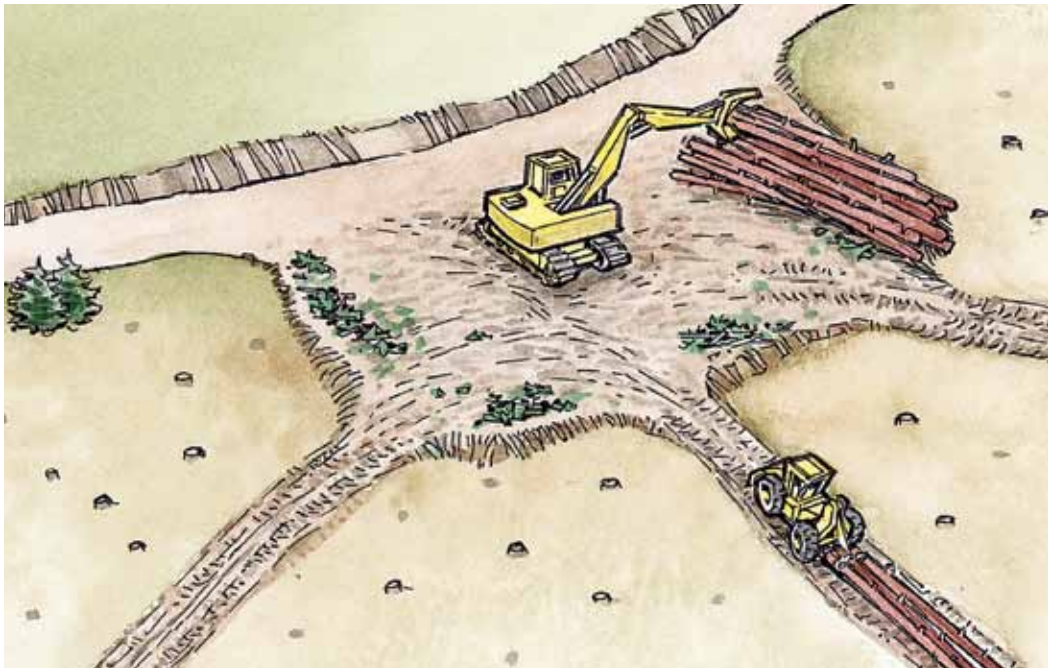
Landings must provide enough space for the skidding, yarding, loading and trucking equipment, as well as the logs that are expected to accumulate prior to loading and hauling. Different systems and equipment, along with the slope of the land and density of trees in the area, influence the number and size of landings needed.

Whole-tree harvest systems, whether ground-based or cable, require larger landings. This is due to the different equipment and space needed to remove and pile tops and limbs and to cut and load logs for transport.

Helicopters require large landings, but usually fewer are needed. Mobile cable yarding machines can operate on narrow sections of road, with little more than a turnout required if truck loading is frequent. Tower yarders may require that a separate "yarder pad" be constructed on a spur road above the main road where logs are landed and then loaded onto trucks.



Tractor yarding requires moderate-size landings that sometimes grow larger than needed. When several skid trails enter a landing and equipment, logs and debris converge, there is a tendency is to "cut the corners" of trails or actively expand the landing. Instead, have trails converge before they reach the landing, and also pile debris where it does not impede traffic yet can be burned, chipped or otherwise utilized later.



Locate landings on stable areas that minimize the risk of material entering water.

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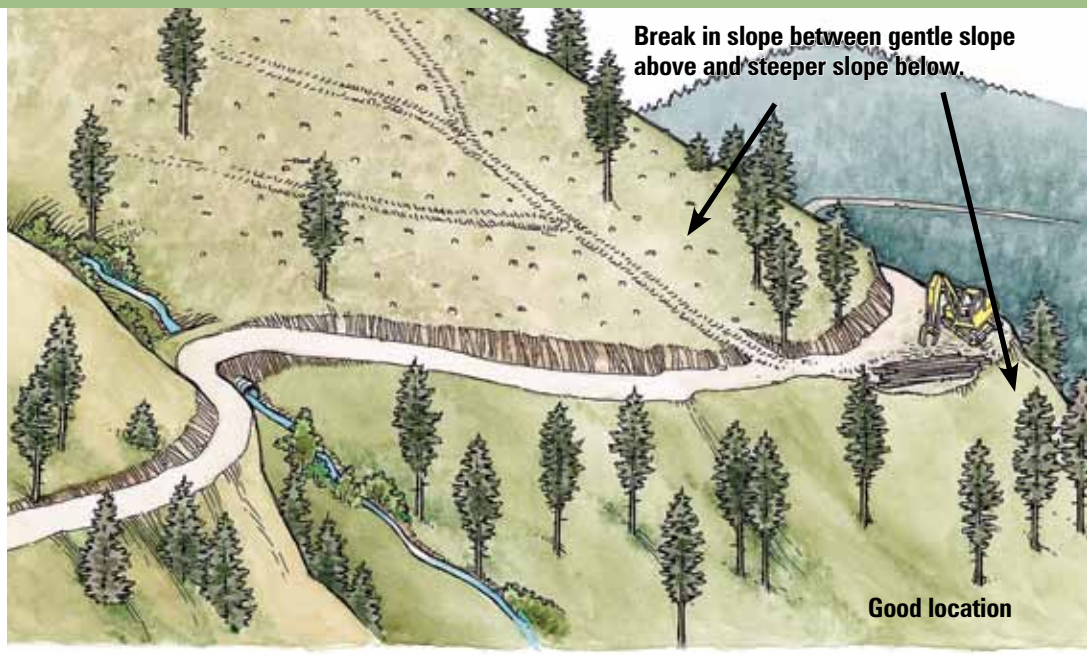
What this means:

If any part of a landing is on a slope steep enough to pose a risk of fill or sidecast entering waters of the state, it is a violation.

Similarly, It is a violation when landing fill or excavation occurs in such a way that an old landslide (often appearing as a slump) may be reactivated. Landing fill also must not be placed in a high landslide hazard location.



Ridge noses above the break in slope (often formed on steep slopes) can be a good location for landings.

Avoid landings in RMAs. If there is no alternative, you must submit a written plan for review by ODF.

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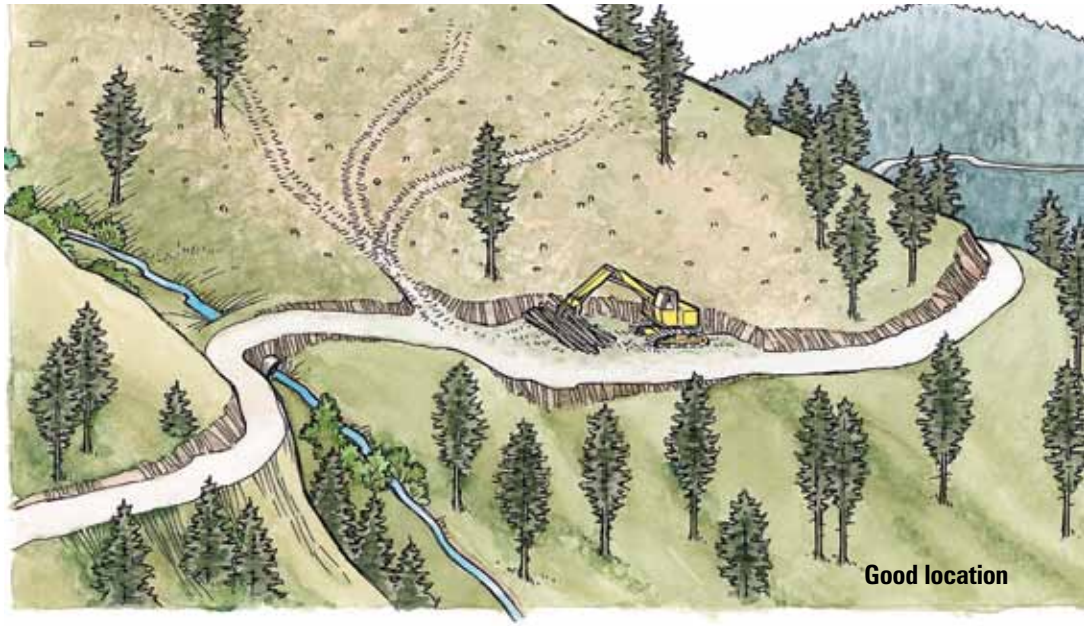
What this means:

This requirement is intended to keep landings out of RMAs. It applies even when a portion of a landing may be located in a RMA. And even if the landing is outside the RMA, a nearby location may be a poor choice because of the chance of sediment entering waters of the state.



Do not incorporate slash, logs or other large quantities of organic material into landing fills.

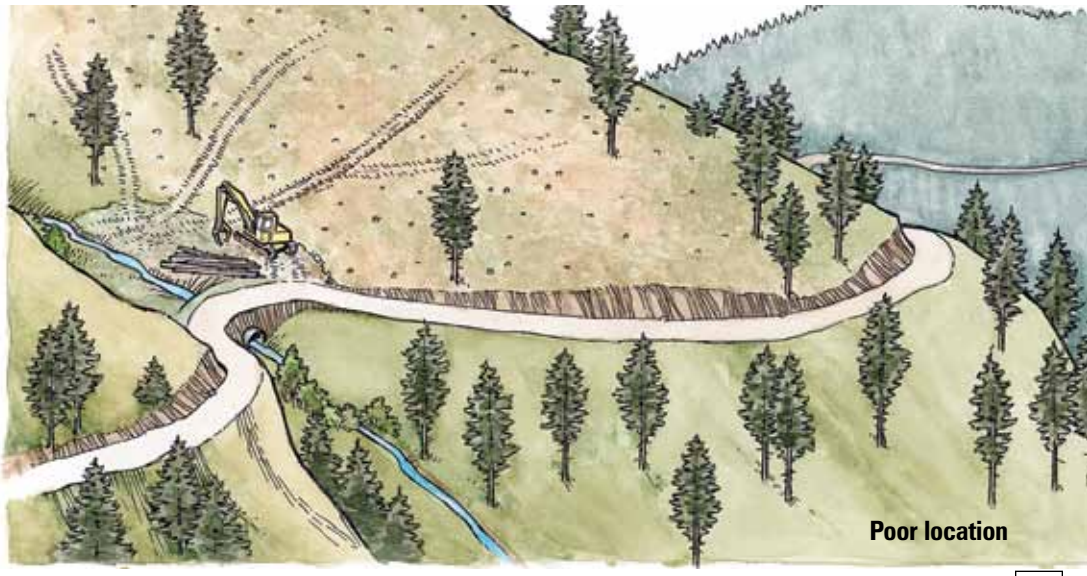
What this means:

This is intended to prevent a landing fill failure from entering water. When this material decomposes, landing fills can slide downslope. Buried slash may also become a fire hazard.

Organic material in landing fills should generally be avoided, but is most serious on slopes of more than 50 percent and when landings are within 100 feet of a water body.

If a landing is constructed such that material can enter waters of the state, it may be in violation.

Put excess material from landing construction in stable locations well above the high water level. End-hauling to a stable location may be necessary.



What this means:

This is intended to prevent damage to water quality and aquatic habitat from material used in landing construction.

Excess soil, rock and debris must be placed in stable locations, and never below major-storm flow levels.

This requirement may make it necessary to end-haul this material.

Not allowed:

- building a log landing in a stream channel
- skidding logs into a stream channel,
- dropping logs into a stream channel while cable harvesting

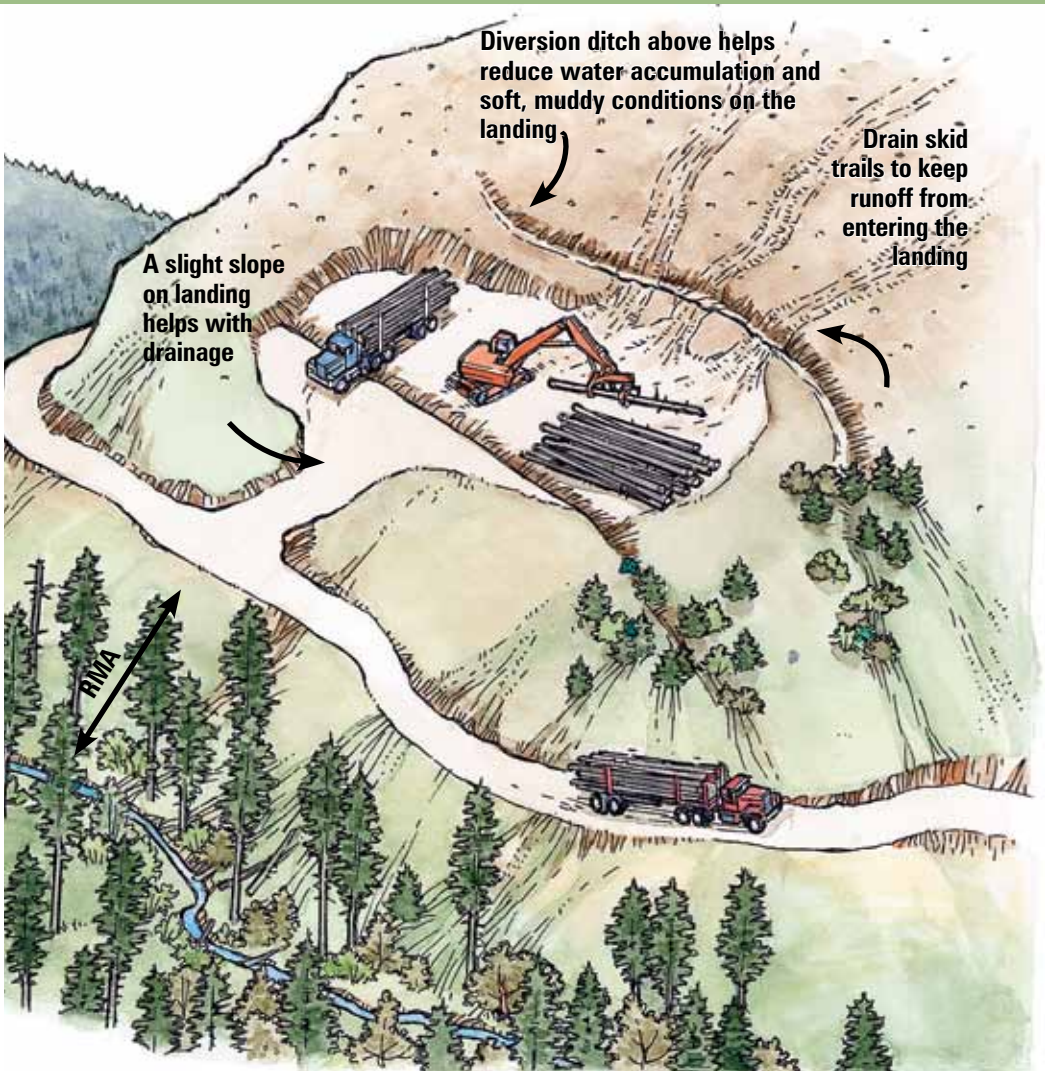
Establish effective drainage on landings during and after use.

What this means:

This requirement is intended to minimize sediment entering water.

It is especially important to control drainage from landings constructed above high-hazard sites.

A landing not sloped for effective drainage may be in violation.



Landing drainage structures include culverts, ditches and water bars.

Remove excess material from landings and place it in stable locations.

What should you know about slash treatment and site preparation?

What are slash, slash treatment and site preparation?

When a harvest is finished, some tree tops, limbs and defective wood often are left on the site. This material is called slash, and some of it may require treatment to make the site ready for successful reforestation (site preparation), to reduce wildfire hazards, or both. Piling, burning and chipping are examples of slash treatments. Sometimes slash treatment and site preparation are done together, or it may be a two-step process.

Some questions you need to answer:

- Will the slash create an additional wildfire hazard?

  It's important to anticipate the slash your harvest is likely to generate, and how it will affect the wildfire hazard that currently exists with dead and dying trees, needles and branches on the forest floor, etc. If the harvest is not expected to raise wildfire hazard above your forest's natural wildfire hazard, then slash treatment is less of a concern. ODF can help you determine whether or not the harvest will raise the natural wildfire hazard.

- Will the slash interfere with reforestation?

  If you're planning a Type 1 or Type 3 harvest, reforestation will be required. Your harvest site will likely need some slash treatment, because those harvest types leave enough slash to make it difficult to find suitable planting spots. Also, if natural regeneration is your plan, there may not be enough bare soil to provide a natural seedbed without some slash treatment.

- Are there concerns about burning due to proximity to communities or major highways?

  Increased air quality standards and visibility considerations can limit the days that burning is allowed, especially near larger communities. Plans for slash treatment and any related site preparation should consider the possibility of significant restrictions on burning.

Slash, after harvest and before treatment.

- Are there opportunities to use or treat slash that avoid burning?

  Onsite burning is the traditional treatment to reduce or eliminate slash, but newer equipment and technologies have provided some alternatives and opportunities. Among these is chipping slash to provide material used for biomass energy production. Proximity to biomass energy facilities and road access for chip vans are important considerations.

Why are slash treatment and site preparation important?

- Wildfire hazard can be reduced.
- It can expose planting spots and make reaching those spots easier.
- It may reduce damage to planted seedlings by rodents that hide in slash.
- It can be used to remove vegetation that will compete with newly planted seedlings.

What can slash do if it is not treated?

- make wildfire control more difficult
- result in insect and disease problems in the surrounding forest
- result in reforestation gaps
- fall into planting holes and interfere with seedling survival,
- get into waters of the state

Are there ways to reduce slash during the harvest?

Yes. Whole-tree harvesting and cut-to-length harvesting are two methods that can reduce slash on the harvest unit (see the Appendix, Pages 148-149). Because whole-tree harvesting generates a lot of slash at the landing as yarded trees are topped and delimbed, there may be an opportunity to chip this material and sell it as fuel for biomass energy. This may avoid a need for further slash treatment.

In cut-to-length harvesting, a mobile processor cuts the tree and then tops and delimbs it in the same area. The machine operator can drop the slash in its travel path, and often crush it enough to reduce the wildfire hazard while leaving openings for later tree planting.

What are other ways to reduce slash accumulation?

- Careful tree felling and bucking can minimize breakage, leaving less slash.
- Broader harvest planning and marketing may allow slash piles or their chips to be sold for biomass energy generation.
- Lop and scatter (on-the-ground chainsaw work), combined with machine crushing, may reduce accumulations of slash.
- It may be possible on some sites to chip slash.

How do you treat slash and prepare the site for planting?

Typically slash is treated either by machine, by burning or by a combination of both.

This crawler tractor, equipped with a grapple, picks up whole trees and moves them to a landing or roadside.

After limbs and tops are removed at the landing, the material is piled and either chipped or burned. Whole-tree harvesting brings slash to a central location and efficiently disposes of it, leaving a forest floor ready for replanting.

To reduce wildfire hazard, slash can be crushed, cut or lopped so it lies close to the ground for rapid decay. This is effective for light harvests, but usually is not adequate slash treatment for heavily harvested areas.

Crawler tractors with toothed brush blades are used to pile slash. Never use straight blades; they scrape the soil surface and carry soil into the slash pile. Piles free of soil burn cleaner, reduce soil erosion and protect productive topsoil.

Two commonly used machines are excavators or bulldozers equipped with brush blades. Excavators have the advantage of making cleaner piles for burning. Of course, ground-based machines should be confined to gentle terrain. While they are effective, both machines can cause excess soil disturbance and water quality problems if not used carefully.

What problems can occur with slash treatment and site preparation?

- Soils can be exposed to erosion, especially on slopes of greater than 35 percent.
- Soils can be compacted and/or rutted.
- Aggressive slash treatment or whole-tree harvesting may be undesirable on less productive sites where organic matter provides a key source of nutrients and other benefits.

How are slash piles prepared for burning?

- Plan ahead! Oregon's Smoke Management Plan has been highly successful in meeting both air quality and landowner objectives, but it does require understanding and patience by all parties. Landowners must register, notify and pay fees to ODF prior to burning, with fees depending on the burn type (landing pile vs. broadcast) and acreage. Local ODF district staff issue approvals for ignition, with assistance from state meteorologists.
- Cover a portion of the pile with a waterproof barrier. (Note: There are restrictions on the type, area and disposal of coverings – contact ODF for details). This allows for burning during wet periods and reduces the risk of escape. The drier material also burns more completely with less smoke.
- Small, scattered piles can be left for wildlife unless mountain beaver (boomers) or other rodents are a problem.

See page 89 for additional tips.

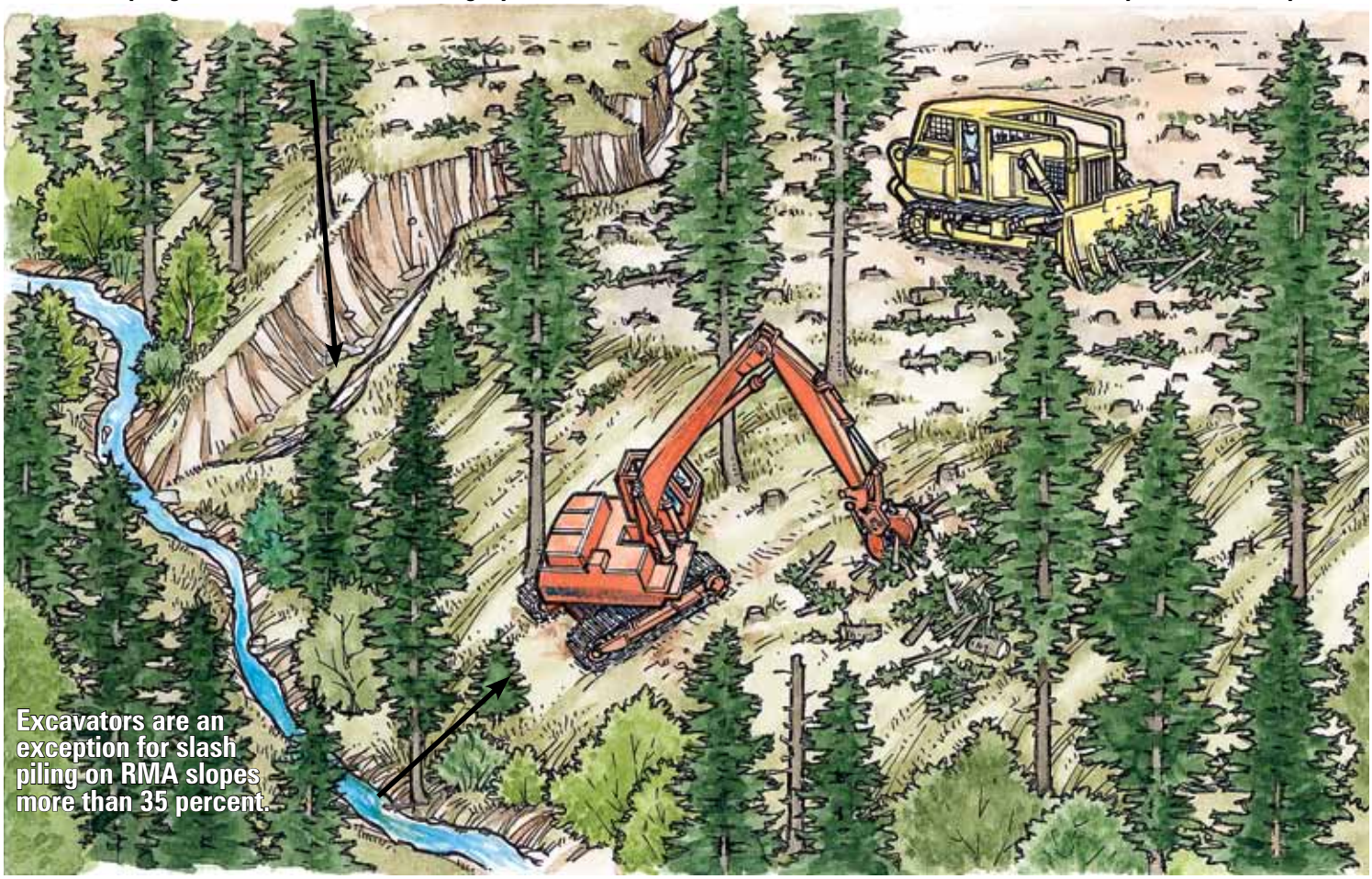
An excavator has the advantage of picking up slash rather than pushing it. It can make taller, more compact piles that burn efficiently, with little soil disturbance.

When treating slash, stay clear of wet areas.

The same machine that brings whole trees to the landing may carry slash back and scatter it on the forest floor. This returns nutrients and organic matter to the soil for the next forest. It also protects soil from erosion, especially in skid trails. The fire hazard is minimal because the slash is crushed and close to the ground.

No machine piling is allowed around an eroded gully.

In RMAs, machines on slopes less than 35 percent.



Be sure to have a vegetation filter between machine piling activities and RMAs or waters of the state. This keeps sediment from reaching the stream.

Keep slash out of waters of the state. Slash can deplete oxygen levels as it rots, and in steep reaches it can be a debris torrent hazard.

Are there requirements if mechanical site preparation is done near water?

During mechanical site preparation, operators shall not place debris or soil in waters of the state or where it may enter waters of the state.

When mechanical site preparation is necessary in RMAs or near water, conduct operations in a way that sediment or debris does not enter waters of the state.

When using mechanical site preparation, operators shall provide adequate distance between disturbed soils and waters of the state to filter sediment from runoff water.

Machine piling (see illustration above) is not allowed:

- in RMAs with slopes greater than 35 percent
- on sites with surface or gully erosion
- where subsoil may be exposed or subsoil compaction is likely to occur

An exception: Excavator slash piling in RMAs is allowed on slopes of more than 35 percent, but only during dry periods.

Reforestation after harvest

You will be harvesting some timber. Do you need to plan to reforest the area?

The purpose of the reforestation rules is to establish standards to ensure the timely replacement and maintenance of free-to-grow forest tree cover following forest operations.

Each year, millions of new seedlings are planted in Oregon to replace harvested trees. Harvest areas that require reforestation must be replanted within two years. Within six years, those seedlings must be free-to-grow and "well-distributed" (see page 76). The law is clear: It is the responsibility of the landowner to establish the next generation of trees after a harvest.

Planning for reforestation goes hand in hand with timber harvest planning. The harvest activity often triggers both the need and the time limits for reforestation. Harvest machines and activities can be used in ways that promote successful reforestation. Some income from the harvest usually is budgeted for seedlings and other reforestation needs.

When is reforestation required?

Timely reforestation of forestland following operations that reduce tree stocking below established standards is essential to ensure continuous growth and harvesting of forest trees species.

Reforestation is required any time tree stocking after harvest is below the minimum standards. This applies regardless of what the tree stocking was before the harvest.

Who is responsible for reforestation?

The landowner is responsible for reforestation, regardless of who cuts the trees. When the land is sold, if the reforestation requirements are not completed, that obligation transfers to the buyer. By law, the seller must inform the buyer, in writing, of any remaining requirement. Know your legal obligations whether you are a land buyer or seller.

Which forestlands require reforestation?

Any forestland, Site Class VI or better, is subject to the requirements of the reforestation rules.

There are six major forestland site classes in Oregon (page 141).

- I, II and III are high-site-class forestland
- IV and V are medium site class
- VI is low site class

Be sure to read the section: "You want to harvest timber on your property. How do you plan for it?" (page 13). It describes how to determine your harvest unit site class, its basal area and your harvest type (1, 2, 3 or Unclassified). Type 1 and Type 3 harvests require reforestation.

Where is reforestation not required?

Reforestation is not required on those portions of the harvest area:

- where adequate free-to-grow tree stocking remains after completion (Type 2 and Unclassified harvests meet this standard)
- that are not disturbed by operation activities
- on sites lower than Site Class VI.

How many trees per acre are required?

Use Table 4-1 to determine the minimum stocking requirements for high, medium or low site class harvest units. You can meet the requirements by either planting seedlings (Column 2), leaving adequate saplings or poles (Column 3), leaving adequate basal area in trees 11 inches and larger (Column 4) or a combination of the three. Combinations are determined by using the "equivalent calculation" explained on the next page. All of these choices can and should be made when you plan your timber harvest.

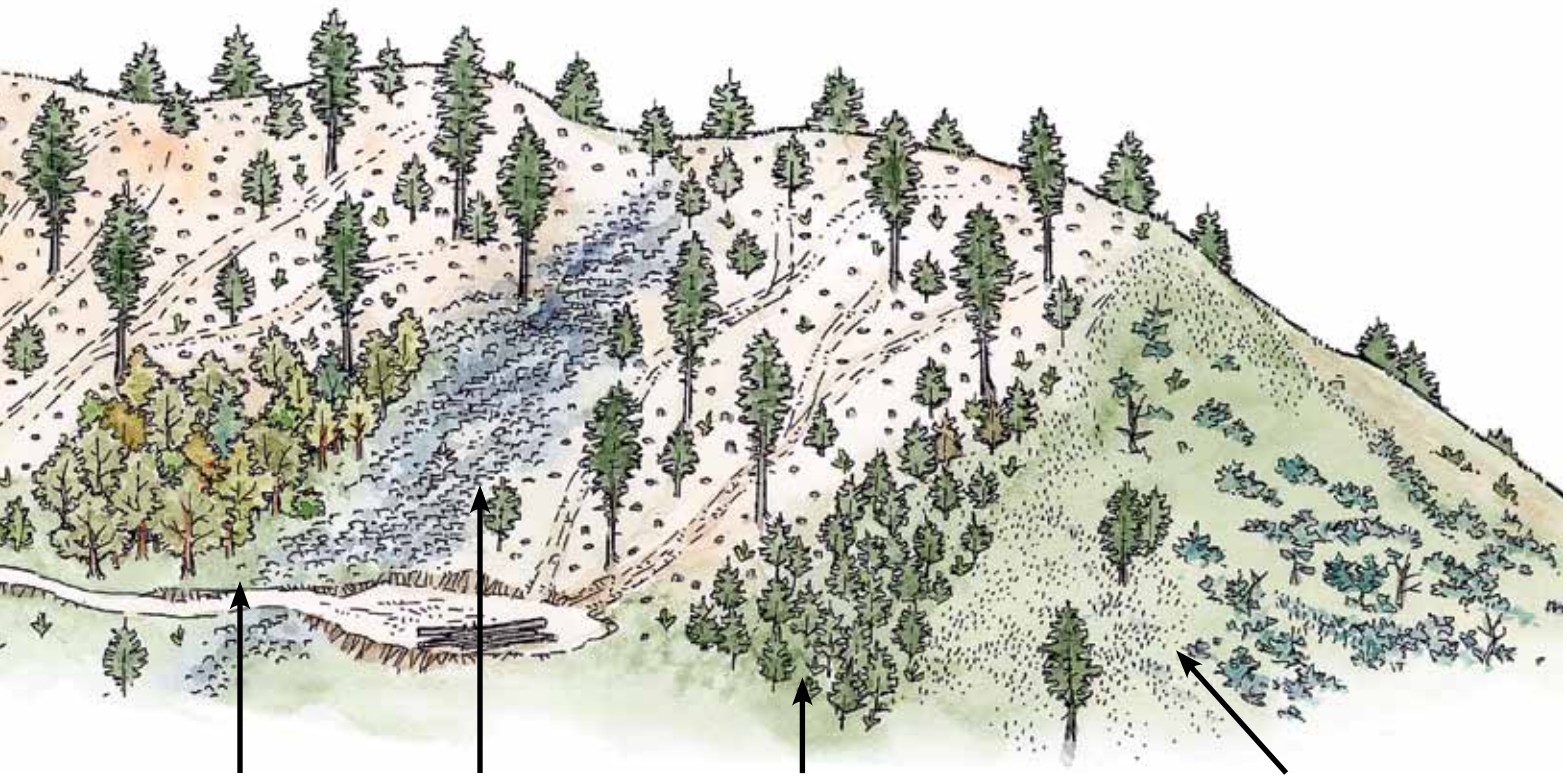
Note that these are the minimum numbers of free-to-grow trees required. As reforestation plans are developed, it's important to consider local conditions and whether all planted and residual trees can be expected to grow and thrive. In addition, the minimum stocking levels may not meet your management objectives.

What are seedlings?

They are live trees of acceptable species of good form and vigor less than 1 inch in DBH.

What are saplings and poles?

They are live trees of acceptable species of good form and vigor, with a DBH of 1 to 10 inches.



This harvest unit includes portions that don't require reforestation. For example, you are not required to plant areas that were not disturbed where young conifer reproduction and hardwoods are growing; areas with very shallow soils that don't support trees; and areas that are lower than Site Class VI.

Table 4-1 Reforestation Requirements for High, Medium and Low Site Classes			
Site Class	Seedlings (less than 1 inch DBH) or →	Saplings & Poles (1-10 inches DBH) or →	Trees 11 inches and larger
High (Site Classes I, II and III)	200 per acre, or	120 trees per acre, or	80 square feet of basal area per acre
Medium (Site Classes IV and V)	125 per acre, or	75 trees per acre, or	50 square feet of basal area per acre
Low (Site Class VI)	100 per acre, or	60 trees per acre, or	40 square feet of basal area per acre

Table 4-2 converts the number of trees per acre to average spacing. For example, if the average spacing between remaining saplings and poles on your Site Class IV harvest unit is approximately 19 feet, you have more than the required 75 (saplings or poles, not seedlings) trees per acre.

Between 300 and 435 trees per acre are included in Table 4-2 because higher planting densities are often used on better sites as well as to account for such factors as animal damage, brush competition and mortality. The first few years after harvest are critical for seedling survival and growth. Prompt planting of suitable stock, brush control and other measures can help ensure reforestation success. Seek out technical assistance and local experience if needed.

Table 4-2 Tree Number and Equivalent Tree Spacing	
Trees per acre	Average spacing (feet)
435	10
300	12
200	15
125	19
120	19
100	21
75	24
60	27

What are the equivalent calculations used for partial cuts?

The equivalent calculation is useful if you're planning a timber harvest in which some areas of seedlings, saplings and poles, and healthy larger trees will be left. Such a harvest could reduce the need for hand-planting new seedlings, but how do you determine their equivalent value? Use the calculation described here.

Note: Regardless of the site class, the following are equal to one another:

100 seedlings = 60 saplings and poles

= 40 square feet of basal area of 11 inch DBH and larger trees.

Use this formula to make the equivalent calculation:

New trees = rule standard – [# seedlings + (# saplings and poles/0.6) + (basal area/0.4)]

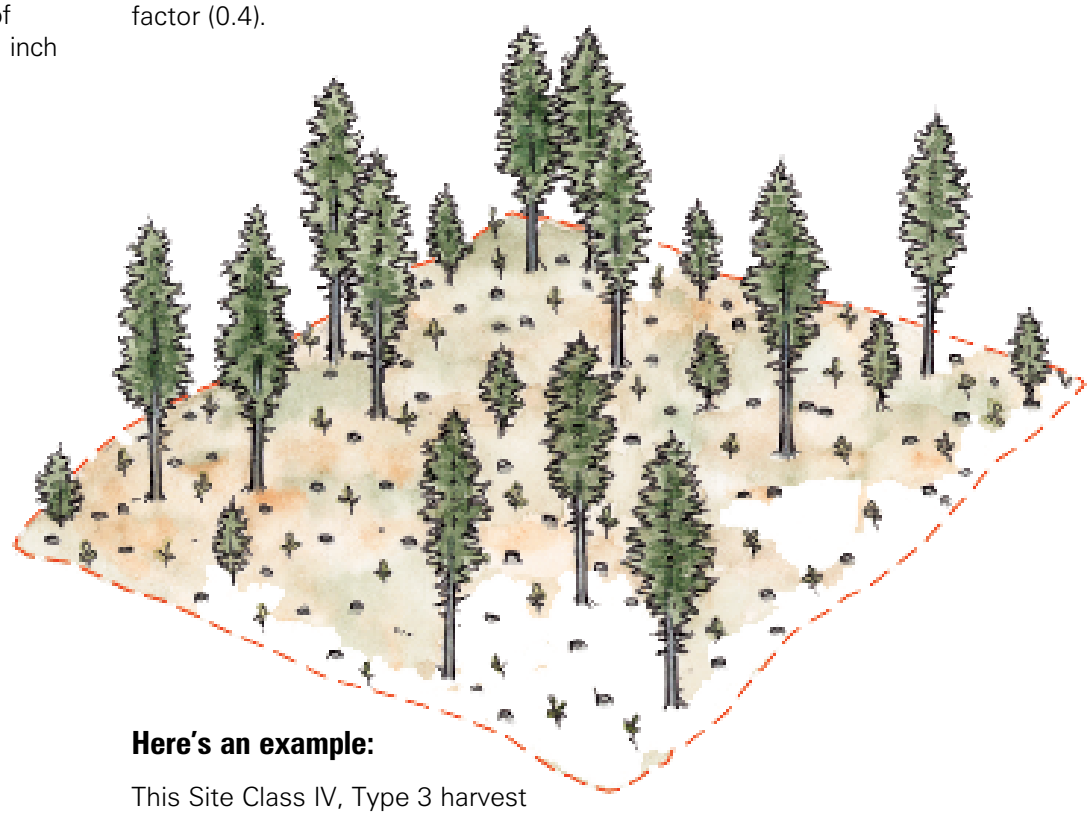
New trees are the minimum number of additional free-to-grow seedlings that must be established per acre to meet the Table 4-1 standard.

Rule standard is the site class seedling standard listed in Table 4-1 (200, 125 or 100 seedlings per acre, depending on site class).

 # seedlings means the number of free-to-grow seedlings per acre that were left after harvest.

 # saplings and poles means the number of free-to-grow saplings and poles per acre that were left after harvest. This is divided by the equivalent factor (0.6). This includes wildlife trees and trees left in patches.

Basal area means basal area per acre of free-to-grow trees greater than or equal to 11 inches DBH that were left after harvest. This is divided by the equivalent factor (0.4).



Here's an example:

This Site Class IV, Type 3 harvest has the following trees remaining after the harvest.

Average seedlings per acre = 35
Average number of saplings and poles per acre = 8
Average BA/acre of trees greater than 11 inches DBH = 15

Use the equivalent calculation formula to determine seedling equivalents:

$$\frac{\text{8 saplings and poles per acre}}{0.6} = \text{13 seedling equivalents}$$

$$\frac{\text{15 square feet of basal area per acre}}{0.4} = \text{38 seedling equivalents}$$

$$35 + 13 + 38 = \text{86 seedling equivalents}$$

Site Class IV reforestation requirements (Table 4-1) call for a minimum of 125 seedlings per acre, or equivalent larger trees. The equivalent calculation shows that stocking is not adequate. An additional 39 seedlings per acre must be planted, as shown in the calculation below.

From the equivalent calculation formula:

125 tree standard – (35 + 13 + 38) = 39 new seedlings to be planted per acre.

Will larger trees left on the unit meet the reforestation standards?

When planning a harvest in which trees 11 inches or larger will be left, the basal area (Appendix, page 152) of these trees determines whether the reforestation standards (Table 4-1) will be met. Table 4-3 shows the basal area (Column 2) for individual trees with diameters ranging from 11 to 32 inches. For a given average tree diameter, the other columns show the number of trees per acre that equal the reforestation standards of 80, 50 or 40 square feet of basal area, and the average spacing between those trees. This helps in assessing and planning for reforestation needs.

For example:

Let's say you are planning to harvest on Site Class III. You know from Table 4-1 that at least 80 square feet of basal area per acre of 11 inch or greater DBH trees must be left to meet the reforestation standards.

According to Table 4-3, 80 square feet of basal area could be 122 11-inch trees with average spacing of 19 feet, or it could be 15 32-inch trees with average spacing of 54 feet, or some other combination of average diameter and spacing for the trees you must leave.

Note the importance of site quality: Another harvest is planned on a Site Class VI area, which has a reforestation requirement of 40 square feet of basal area per acre. You would need to leave 61 11-inch trees with average spacing of 26 feet, or seven 32-inch trees with average spacing of 78 feet.

Table 4-3 Equivalent Reforestation Standards for Trees of Varying Diameters

Avg. DBH of trees 11" or greater	Basal area (ft^2) per tree	# Trees equal to 80 ft^2 BA per acre	Avg. space between Trees (feet)	# Trees equal to 50 ft^2 BA per acre	Avg. space between trees (feet)	# Trees equal to 40 ft^2 BA per acre	Avg. space between trees (feet)
11	0.66	122	19	76	23	61	26
12	0.79	102	21	64	26	51	29
14	1.07	75	24	47	31	37	34
16	1.40	58	27	36	35	29	39
18	1.77	46	31	28	39	22	44
20	2.20	37	34	23	44	18	49
22	2.60	31	37	19	48	15	54
24	3.14	26	41	16	52	13	58
26	3.69	22	44	14	56	11	63
28	4.28	19	48	12	60	10	68
30	4.90	17	51	11	63	8	73
32	5.58	15	54	9	69	7	78

In either case, if the minimum basal area can't be maintained with the expected harvest removals, you need to plan for tree planting to meet the reforestation requirements.

Do the required wildlife trees count toward reforestation standards?

Yes, if they are alive and large enough. Live conifer trees 11 inches DBH and larger left standing in harvested areas to meet the wildlife tree and snag requirements will be counted toward reforestation stocking standards if the trees are free-to-grow.

To meet both reforestation and wildlife tree requirements, trees must be conifers at least 11 inches DBH, 30 feet tall and free-to-grow. The law allows these conifers to be double-counted. This is an incentive for landowners to retain free-to-grow conifers, rather than hardwoods, as wildlife trees. Why? In general, conifers live and last longer and are used by more wildlife species.

Do the required RMA trees count?

No. For the purpose of determining compliance with the tree stocking requirements of the reforestation rules, tree stocking in RMAs within an operation area will be considered separately from stocking in the rest of the operation area.

Since the purpose of an RMA is water protection, it is important that RMAs are planted after harvest. You are not allowed to leave understocked openings in the RMA where harvesting has occurred. Landowners are expected to do site preparation and planting inside RMAs, and make good-faith efforts to reforest streamside areas. ODF determines if a reasonable effort has been made. However, a slightly lower level of stocking in an RMA is preferable to repeated entries with chemical or mechanical methods to achieve full stocking.

Free-to-grow trees left in the undisturbed parts of the RMA may not be counted toward the required stocking of the disturbed area. Similarly, reforestation is not required in understocked parts of the RMA if they were not disturbed by the operation.

Above: These ponderosa pine are free-to-grow. Right: This Douglas-fir is not free-to-grow.

What does free-to-grow specifically mean?

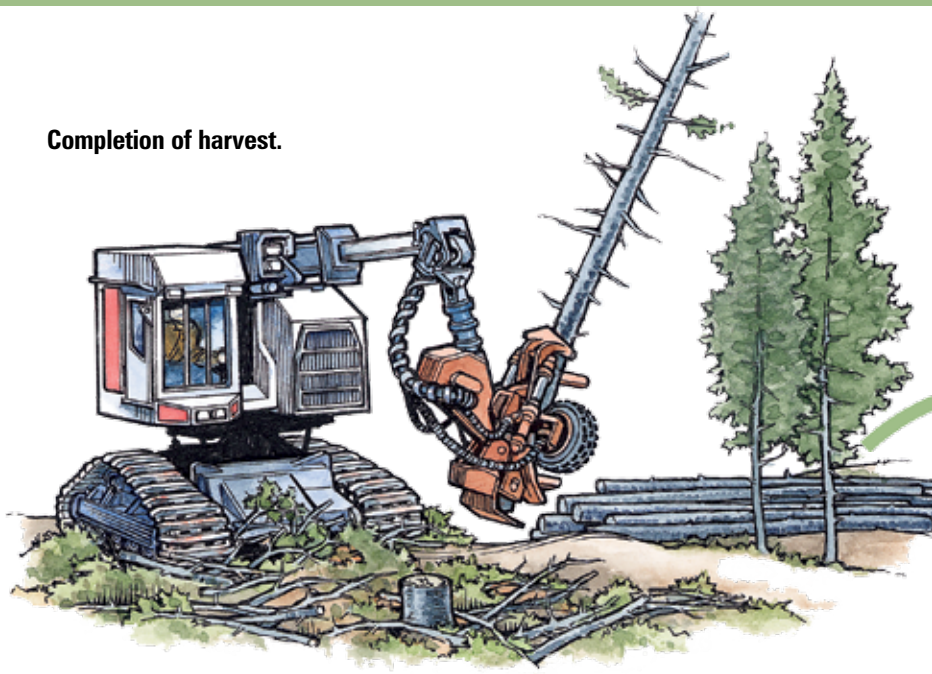
Reforestation involves more than just planting seedlings or saving seedlings, saplings or poles on the harvest unit. To meet the requirements at the end of six years, the harvest unit must be a stand of freely growing, well-distributed trees, of acceptable species and form, with a good chance of becoming healthy and taller than neighboring grass and brush competition. (Keep reading for more about the six-year requirement below.)

What does well-distributed mean?

An effort must be made to reforest the entire harvest unit. However, the unit will be considered adequately stocked and the trees well-distributed if at least 80 percent or more of the harvest unit has at least the minimum per-acre required tree stocking. Not more than 10 percent may contain less than one-half of the minimum per-acre tree stocking required for the site class.

These allowances are not loopholes in the reforestation standards, but rather reflect the variable results that may occur even when initial plantings are well-distributed. It's usually a good idea to plant extra trees to account for those that may die or not be free-to-grow after six years.

Completion of harvest.



How much time is allowed for reforestation?

The time period for compliance with the reforestation rules begins at the completion of the operation or 12 months after tree stocking has been reduced, whichever comes first.

Completion of the operation means that the harvest has been completed and the harvest unit will not be disturbed again. Usually, when the yarding process ends, the harvest is considered to be completed. To prevent delays in reforestation, the compliance schedule begins no later than 12 months after stocking is reduced, meaning 12 months after felling begins.

If the harvesting activity extends long enough, reforestation may be required to begin on a portion of a harvest unit even though other parts are not completed.

The landowner shall begin reforestation, including any necessary site preparation, within 12 months of when reforestation is required.

What this means:

Whether you intend to depend on natural reforestation (described on page 77 or to hand plant seedlings or plant seed, once the clock starts from the date noted above, you have 12 months to start reforestation activities such as site preparation and ordering tree seedlings. For example, if yarding ends on May 1, you should begin site preparation and order seedlings in the next 12 months. Planting could occur during the coming winter/spring if site prep is completed and seedlings are available. Site preparation is often tied with slash treatment. See pages 67-70 for slash treatment requirements.

The landowner shall complete planting or seeding within 24 months unless ODF has approved a written plan for natural reforestation.

What this means:

If you intend to hand-plant seedlings or plant seed, it must be completed within 24 months unless a written plan for natural

First year – reforestation begins; second year – planting completed.

reforestation has been approved. Remember, reforestation timing is critical if your harvest is completed in the fall. For example, if the harvest ends on Oct. 1, site preparation activities, such as burning or spraying, may not be possible due to weather. The first planting season (December to April) could be lost. In this case, site preparation would have to be completed before the second planting season so planting could be done during the second planting season.

Control brush and grass competition. Chemical herbicides are one method.

By the end of the sixth full year, the landowner shall have established a free-to-grow stand of trees, which meets or exceeds the minimum stocking level required.

What this means:

An adequately stocked, free-to-grow stand must be established by Dec. 31 of the sixth year after the compliance period has started. For example, all operations completed in 2011 that depend on hand-planting seedlings or planting seed must have a free-to-grow stand established before the end of 2017. Six full calendar years are allowed to establish the next generation of trees.

Can natural reforestation be used to meet the requirements?

Natural reforestation relies on natural processes to reforest a harvest unit. It is acceptable with a written plan approved by ODF. On Site Class VI or other harvest units with poor soils or harsh climates, natural reforestation may be the best way to reforest. In the case of wetlands with high water tables, competing vegetation and limited accessibility, natural reforestation may have greater success than hand planting.

Within six years – free-to-grow stand is established.

Landowners may submit plans for alternate practices such as natural reforestation that do not conform to the reforestation stocking standards. A plan for alternate practices may be approved if ODF determines that there is a high probability that the purpose of the reforestation rules will be achieved.

What this means:

Landowners must submit a written plan to ODF for an alternate practice for reforestation within 12 months of tree stocking reduction. The plan should describe how reforestation will be accomplished and should describe the following:

- seed sources to be used
- site preparation methods
- vegetation competition control methods
- time estimate to obtain a free-to grow stand
- how progress will be evaluated
- what will be done if reforestation does not progress as planned

Time limits for natural reforestation may differ.

When natural reforestation is planned, the time limits for evidence of successful germination and for establishing a free-to-grow stand of trees, which meets or exceeds the minimum stocking level required for the site, shall be established in the approved written plan required for such methods.

What this means:

A natural reforestation plan must provide specific time limits for site preparation, evidence of reforestation success, and establishment of a free-to-grow stand. The deadlines should not be shorter than six years and rarely longer than 10 years.

What if reforestation cannot be accomplished?

Extensions are granted when reforestation cannot be accomplished within six years due to circumstances beyond the landowner's control. Those circumstances are determined by ODF and may include:

- tree nursery failure
- inadequate availability of seedlings after salvage harvesting
- extreme drought
- insect infestations
- smoke management restrictions on slash burning
- wildfire or disease damage
- severe wildlife damage that could not be reasonably anticipated or controlled

You must submit a written request for an extension to ODF as soon as you realize your reforestation effort may not meet the deadline. Extensions are granted based on evidence documenting reasonable attempts to comply. You will be required to achieve stocking within a prescribed time using recognized methods.

What are unacceptable reasons for reforestation failure?

- failure of hand-planting success when inappropriate seedlings or seed sources are used
- natural reforestation failures due to poor natural seed crops in the years immediately following a harvest
- failures on harsh sites due to harvest unit design or competing vegetation
- wildlife damage, such as by mountain beaver, that could be reasonably expected and controlled

Using natural reforestation can be less costly than hand-planting, but its reliability varies. A written plan is required for natural reforestation.

How are the tree species acceptable for reforestation determined?

ODF determines the tree species acceptable for artificial reforestation, natural reforestation, and as residual seedling, sapling and pole, or larger tree stocking based on all of the following criteria:

- *Species must be ecologically suited to the planting site.*
- *Species must be capable of producing logs, fiber or other wood products for lumber, sheeting, pulp or other commercial forest products.*
- *Species must be marketable in the foreseeable future.*

What this means:

In nearly all cases, native species are considered acceptable and are preferred for reforestation. One exception could be white fir that has moved into a ponderosa pine/ Douglas-fir site due to fire exclusion. On Site Classes IV, V and VI, landowners are encouraged to favor ponderosa pine and Douglas-fir to white fir.

A conifer or hardwood species that has any commercial value (even commercial firewood) will meet the requirement of B above. A hardwood or mixed hardwood/ conifer stand is as much a forest as a stand of pure conifers.

Tree species that are not currently marketable -- or marketable in the foreseeable future -- cannot be used for tree stocking. Generally, juniper is not considered acceptable, but it often grows on poor sites (lower than Site Class VI) where reforestation is not required anyway.

Hardwood trees remaining after a harvest can meet up to 20 percent of the required stocking levels if they meet the criteria in A, B and C above. With a plan approved by ODF, hardwoods may supply all the required stocking.

When appropriate, reforest with a mixture of acceptable tree species to reduce the risk of insect and disease losses and to promote stand diversity.

Hand planted seedlings or seed should be genetically adapted to the site.

Do non-native tree species meet reforestation standards?

Landowners wishing to use non-native tree species must submit written plans that must be approved by ODF. The plans are required within 12 months of tree stocking reduction, and must include:

- tree species to be used
- evidence that the species is ecologically suited
- evidence that the species is capable of producing commercial forest products
- research or field tests that show success in similar sites

Are reforestation standards ever waived?

Reforestation requirements may be waived or modified following a stand-improvement operation (e.g., pre-commercial thinning, commercial thinning, overstory removal or other partial-cut harvest) if ODF determines that the after-harvest stand will result in enhanced long-term tree growth and there is a high probability that the purpose of the reforestation rules will be achieved.

fpa

What this means:

Stand improvement harvests, like those noted, are intended to increase long-term tree growth and value if done correctly. Additional reforestation may not be required. In some cases, stand improvement harvests result in stocking slightly below the stocking standard rules. If that happens, ODF must decide if, in the long term, free-to-grow tree stocking will occupy the site. If so, reforestation will not be necessary.

What's needed if there is an exemption from reforestation requirements?

- Landowners may request a suspension of the reforestation rules when salvaging or converting low-value forest stands in order to establish forest stands that are adequately stocked and free-to-grow. There must be evidence that the landowner qualifies for incentive funding and that the harvest costs will exceed revenues.
- Where reforestation is not required, landowners must protect soil productivity and stabilization within 12 months of the operation with suitable trees, shrubs, grasses or forbs.

What if you want to change to a different land use?

Timber harvesting sometimes is done in preparation for a land use different from forestry. For example, trees often are removed when an area is developed for home sites. Such harvesting is still a forest operation subject to ODF oversight, but requirements by other state and local agencies also will require attention:

- An operations notification to ODF is required, and the form includes a place to note a land-use change.
- If you need or want to remove trees that otherwise would be required to stay or be replaced, you must submit a written plan for approval by ODF. The plan must show that local land-use agencies (city and county, usually) have approved the land-use change and will issue the needed permits, and the change will be in compliance with regulations of other state agencies (e.g., Oregon Department of Environmental Quality, Oregon Department of Agriculture).

What are the penalties for inadequate reforestation?

Landowners will be ordered to comply with reforestation requirements and may be fined up to $5,000.

For other information sources, see the Appendix, pages 183-184.

Fire and chemicals

Fire prevention during forest operations

Preventing unwanted fire is required during all forest operations in Oregon, and it's important to understand the many ways this is achieved. This section will help you comply with the requirements during the fire season – further details about these and other fire prevention measures are available from ODF.

Only a small percentage of wildfires are caused by forest operations, but fire prevention measures help reduce the risk of major resource damage and economic losses.

Oregon's Cooperative Fire Protection Program

Oregon's Cooperative Fire protection Program is composed of strong, combined efforts among forest landowners, contract operators, ODF, local forest protection districts and fire patrol associations, and an effective set of fire prevention requirements that are supported by all cooperators.

The landowner's fire protection responsibility is met by following fire prevention requirements, as well as paying a forest patrol tax assessment to the local forest protection district (included in annual property taxes). A forest landowner/operator also has the duty to control a wildfire that starts on an operation. If the landowner/operator has insufficient personnel or equipment to handle a fire, then ODF or a forest protective association will conduct needed firefighting. Also, as an incentive for fire prevention and to keep the tax as low as possible, the law specifies that the party responsible for certain types of fires will pay some ("limited liability") of the firefighting cost.

Why is so much attention given to fire prevention with forest operations?

Forest operations pose a variety of risks for starting wildfires, so Oregon's Cooperative Fire Protection Program (see box on page 81) includes a comprehensive set of fire prevention rules. Enforced during the fire season, these operation rules help keep wildfire losses to a minimum in our forests. Although industrial operations start a small share of all human-caused fires on state-protected forests (about 10 percent), the potential firefighting cost is much higher on such wildfires — due to accumulated slash, fuel conditions and timber values to protect.

Who is responsible for fire prevention measures?

Preventing wildfires is the responsibility of forest landowners and everyone else involved with forest operations during the fire season. Reducing resource loss, costly firefighting, environmental damage and financial liability — through effective fire prevention measures — is the goal of Oregon's protection program.

Is there any liability if the requirements are met?

If a landowner or operator has done everything correct in readiness and response to a fire in an operation, his or her liability for suppression cost is limited to the first $300,000. If there are any "willful, malicious or negligent" actions or lack of preparedness determined in a subsequent investigation, there is an unlimited liability for suppression cost. More details are given below.

Are any permits needed?

You must obtain a "Permit to Use Fire or Power-driven Machinery" (also called a PDM permit) from ODF prior to starting any operation that uses motorized equipment or tools.

Does this include personal chainsaw use?

Using a chainsaw for personal or recreational purposes does not require a permit. However, it does require the fire prevention practices described under "Chainsaw special requirements" on page 86.

What equipment and resources are required for an operation?

Firefighting equipment required on an active operation can vary with size of operation and time of year – check with ODF for specific details. Basic requirements include:

- a water source, pump, hose and nozzle with a minimum of 300 gallons for a self-propelled vehicle (fire truck) or 500 gallons for a non-self-propelled trailer
- minimum hose lengths, which can vary from 500 feet to "can reach every corner of the unit"
- specific hand tools (Table 5-1)
- an on-site fire-watch person who is ready to take action to suppress any fire

Are there exceptions to the fire prevention requirements?

ODF districts or forest protective associations may waive any fire prevention requirement or permit when in their judgment, the operation or proposed alternate preparedness measures would provide sufficient fire prevention without adding greater fire hazard. For example, ODF may issue a written waiver of the PDM permit requirement when an operation is not a fire hazard. Waiver of the permit does not relieve the operator of compliance with other applicable fire requirements. Written waivers also may be granted for alternate methods or equipment proposed by the operator, when those methods provide equal or better fire prevention. All waivers must be requested by the landowner as the ultimate responsible party. A waiver may require additional prevention resources (e.g., water, hose).

What should you be prepared to do if a fire starts?

Under Oregon law, unlike other states, forest landowners are responsible to control and extinguish wildfires that occur on their land. You must be prepared with equipment and personnel to control and extinguish:

- any fire that starts in an operation area while the operation is active
- any fire that results from an operation activity
- any fire that spreads from burning activities

These responsibilities are required by law, and are termed as providing "every reasonable effort." The specific level of landowner or operator effort is based on the amount and type of resources available. ODF or the local fire protection association will respond to every fire, but firefighting resources must be available and used at the operation site. Without this effort additional liability falls on the landowner and operator.

What can happen if a fire is left uncontrolled?

If a fire on Oregon forestland burns uncontrolled and threatens life, forest resources or property, and proper action is not taken to prevent its spread, the fire is considered an illegal public nuisance. This "uncontrolled fire declared nuisance" designation can dramatically increase landowner/operator liability.

How serious can the liability be for a landowner or operator?

Depending on the circumstances of an uncontrolled fire, a landowner/operator can be subject to either limited liability or total liability for firefighting costs:

Limited Liability: When a forest operation causes a fire and an investigation finds that all applicable regulations were fully followed, the landowner/operator may be required to reimburse up to $300,000 of state-provided fire suppression costs. This liability limit for suppression costs only applies if all required prevention measures are met, and no willful, malicious or negligent actions are found to have caused the fire. The landowner/operator may have no liability if the official investigation identifies a fire cause unrelated to the operation.

Total Liability: If there is any "willful, malicious or negligent" action or lack of preparedness found in an investigation, there can be an unlimited liability for paying all firefighting costs. If an investigation reveals that the rules were not followed — such as not meeting fire watch requirements, or failing to file for a PDM permit — the landowner/operator may be billed for the total state-provided costs to put out the fire. This liability for large wildfires can be millions of dollars. Additional fire liability information is available from ODF or forest protective association offices.

Some important definitions in the fire prevention rules:

FIRE SEASON means the legally declared period of time each summer, determined by the State Forester, when Oregon forest operations are subject to forest fire prevention restrictions and Industrial Fire Precaution Levels (IFPL). The state is divided into local areas where fire season and fire restrictions can be tailored to match local fire hazard conditions on a daily basis by ODF.

FORESTLAND means any woodland, timberland, grazing land or clearing that contains enough forest growth or slash to constitute a forest fire hazard, regardless of how the land is zoned or taxed.

LANDOWNER means the legal holder(s) of a forest property title. Oregon law considers the forest landowner and the operator as one entity, and it refers to either or both as landowner/operator.

OPERATION means any industrial or commercial activity on forestland inside or within one-eighth mile of a forest protection district, including but not limited to timber harvest, land clearing, use of power-driven machinery, and prescribed burning as a management tool (excludes agricultural crop activities). Examples include forest thinning, road construction or repair, herbicide spraying and prescribed burning of logging slash.

OPERATOR means any person who, either personally or through employees, agents, representatives or contractors, conducts any operation, as defined above. Oregon law considers the forest landowner and the operator as one entity, and it refers to either or both as landowner/operator.

PRESCRIBED BURN means the deliberate burning of wildland forest fuels under carefully managed conditions of weather, fuel moisture, wildfire hazard, proximity to designated populated areas and time of day. Purposes for burning may include fire-hazard reduction, reforestation success, habitat improvement, invasive or unwanted vegetation control, and aesthetic enhancement.

How do fire danger levels affect forest operations?

During legally declared fire season, forest operations are subject to different levels of fire prevention restrictions, which can change daily depending on the local wildfire potential within each regulated use area. Landowners and operators engaged in active forest projects must daily check the local closedown level — known as "fire danger" or "IFPL level" — to be sure the proper fire prevention restrictions are followed each day.

Western Oregon: Four closedown levels, called Industrial Fire Precaution Levels (IFPL), are used during the fire season for private and other lands under ODF fire protection in western Oregon. IFPL closedown levels are based on the fire danger in each local "regulated use area." Check with your local ODF office for specific equipment closedown times, locations and requirements.

Eastern Oregon: The IFPL system does not apply on ODF-protected forestlands east of the summit of the Cascade Mountains. However, additional fire prevention measures may be required — landowners/operators should always check with ODF for current requirements in their local district. During legally declared fire season, industrial fire restrictions in eastern Oregon are similar to the IFPL Level 1 (described below) for western Oregon. Operators on federal lands in eastern Oregon should be aware that the IFPL system is used by the U.S. Forest Service and BLM in that region.

Level I. Closed Season

This initial level of fire hazard is announced by ODF and puts basic precaution requirements (water, tools and other equipment) in effect. A fire/security watch is required at this and all higher levels unless waived by ODF.

- For up to three hours after power-driven machinery has been shut down for the day, a fire watcher must conduct a continual visual observation of the operation area on which the machinery was used.
- If the fire watcher detects any fire in the operation area, he or she must safely try to control and extinguish the fire and summon all necessary assistance. The fire watcher must have adequate transportation and communications to summon assistance.

Level II. Partial Hootowl

In addition to the Level I requirements, the following activities are allowed only between the hours of 8 p.m. and 1 p.m. (local time) the next day:

- Power saws, except at loading sites
- Cable yarding
- Blasting
- Welding or cutting of metal

Level III. Partial Shutdown

In addition to the Level I requirements, the following are prohibited except as indicated:

- Cable yarding — except that gravity-operated logging systems using non-motorized carriages may operate between 8 p.m. and 1 p.m. the next day when all blocks and moving lines are suspended 10 feet above the ground except the line between the carriage and the chokers.
- Power saws — except that power saws may be used at loading sites and on tractor/skidder operations between the hours of 8 p.m. and 1 p.m. local time.

In addition, the following are permitted to operate between the hours of 8 p.m. and 1 p.m. local time:

- Tractor, skidder, feller-buncher, forwarder or shovel logging operations where tractors, skidders or other equipment with a blade capable of constructing a fireline are immediately available to quickly reach and effectively attack a fire start
- Mechanized loading or hauling of any product or material
- Blasting
- Welding or cutting of metal
- Any other spark-emitting operation not specifically mentioned

Level IV. General Shutdown

All operations are prohibited.

What about hauling through more than one shutdown/regulated use area?

The precaution level at the woods loading site shall govern the level of haul restriction, unless otherwise prohibited by other than the IFPL system.

Summary of key requirements during the fire season

During legally declared fire season, in addition to restrictions under the daily local fire danger level (described above), landowners and operators are required by law to follow the basic fire prevention measures summarized here. ODF can provide more detailed information and guidance.

Permit for power machinery/tools: A "**Permit to Use Fire or Power-Driven Machinery" (PDM)** must be obtained from the local ODF office before starting any operation that uses motorized equipment or tools.

Fire watch after daily operations: For up to three hours after power-driven machinery (including saws) has been shut down for the day, a fire-watch person must continually observe the operation area where the motorized equipment was operated. If a fire is detected, the fire watch must immediately summon firefighting assistance from ODF *and* must also safely try to control the fire. The fire watch must have adequate communication and/or transportation to promptly report the fire.

Water supply and pump on-site: For most motorized operations (see chainsaw exception below) lasting more than two days, a water tank, delivery pump, hose and nozzle must be maintained and ready for immediate firefighting use. The water supply tank must have at least 300 gallons of water for a self-propelled fire truck, or at least 500 gallons of water for a non-propelled tank/trailer. The pump must be capable of at least 20 gallons/minute discharge, when pumping through 50 feet of hose and a ¼ inch diameter nozzle. Additionally, the required water supply must include at least 500 feet of ¾ inch diameter or larger hose, of which at least 250 feet of the hose must be ready for immediate use — fitted with a nozzle, connected to the pump and water supply.

Firefighting hand tools on-site: Every operation must have firefighting hand tools kept ready for immediate use only for firefighting, and stored in a clearly identified toolbox. The number of tools required depends on the number of workers on the operation (see Table 5-1 on page 86).

Fire extinguishers on motorized equipment: All equipment powered by an internal combustion engine (other than chainsaws) must be equipped with a 5-pound chemical fire extinguisher with a minimum rating of 1A, 10BC or equivalent protection. The extinguisher must be approved by a nationally recognized testing laboratory, ready for immediate use, fully charged, and maintained annually.

Fire tools and extinguishers on trucks: Each truck, including crew vehicles, used on an operation must be equipped with a 5-pound fire extinguisher, as described above for motorized equipment. Each truck also must have a round-pointed shovel with an 8 inch face and a handle more than 26 inches long, and a Pulaski or axe with a handle longer than 26 inches. All must be ready for immediate use.

Engine exhaust spark arrester: All engines must be equipped with a spark arrester. Exceptions are allowed for fully turbocharged engines, for engines under 51-cubic-inch displacement, and for trucks and pumps used exclusively to fight fire. Those excepted engines must be equipped with a muffler and exhaust in good operating condition.

Chainsaw requirements: Each power saw must be equipped with an exhaust screen that retains at least 90 percent of carbon particles and meets exhaust temperature standards. Saws meeting these requirements are listed in a "Spark Arrester Guide" publication available at ODF offices. Additionally, the following must be immediately available to the power saw operator: an 8-ounce or larger fire suppressant and a round-pointed shovel with an 8 inches face and a handle more than 26 inches long. Power saws must be stopped during fueling and moved away at least 20 feet from the fuel supply before restarting. A water supply is not required for operations using only a chainsaw.

Cable logging precautions: Operations using cable systems must conduct additional fire precautions, including clearing flammable debris from near blocks; having water supply and shovel stationed at each block, and preventing cables from rubbing on rock or woody material.

Flammable debris removal: Power-driven machinery must be kept free of excess flammable material — such as needles, bark or slash — that may create a fire risk.

Falling hazard snags: ODF may issue a written order that certain snags, which are a fire hazard, be felled either before or concurrent with the operation.

Waiver for alternate methods: The ODF district may provide a written waiver for alternate methods or equipment proposed by the operator, when those methods provide equal or better fire prevention as other requirements.

No smoking: Smoking is not allowed while working in an operation.

Immediate control of any unwanted fire: The landowner and operator must immediately act to control and extinguish any fire started in an operation while the operation is active, any fire that results from operation activity, and any prescribed burn that has escaped control.

Questions: If you have questions about operation requirements during fire season, contact ODF or your local forest protective association.

Can you do anything more to prevent a wildfire?

Yes. There are several voluntary practices that have proved effective in minimizing accidental fire starts and the spread of an unwanted fire. Landowners and operators are encouraged to consider these added fire preparedness and prevention measures that go beyond those required by law.

Voluntary measures during critically dry or hazardous fire periods include: early shutdown when low relative humidity is measured, early shutdown when high winds occur, minimizing tracked vehicle operation in rocky areas (sparks!), providing additional water volume and hose length to reach all operation areas, extra precautions tailored to site and job conditions, and conducting "fire drills" to assure crew preparedness.

For other information sources, see the Appendix, pages 183-184.

Table 5-1 Required Number of Firefighting Tools for Various Numbers of Operation Workers

People in Operation	1-4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Tool Box	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Axes or Pulaskis	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3
Shovels	2	2	2	3	3	3	3	4	4	5	5	6	7	7	7	7	7
Hazel hoes/ Pulaskis	1	2	3	3	4	5	5	5	6	6	7	7	7	8	8	9	10

Using fire: Prescribed burning for forest management objectives

Controlled burning can be a valuable management tool, but forest landowners and operators must follow some important steps to control smoke and the risk of fire escape.

Why burn?

A prescribed burn is a controlled fire that consumes tree harvest slash, unwanted vegetation or other wildland fuels. It can be an efficient and effective forest management tool when used under carefully monitored conditions of local wildfire hazard, weather, fuel moisture, proximity to populated areas and time of day. Burning is prescribed for specific purposes, and should be conducted by skilled professionals experienced in lighting, controlling and extinguishing such fires.

Purposes for burning may include fire-hazard reduction, invasive species or unwanted vegetation control, and improvement of reforestation, habitat, forest health and/or aesthetics. Prescribed burns are often scheduled after timber harvest, and the risk of wildfire can be reduced by burning the slash and other excess flammable material. Burning removes fuels that otherwise could make a future wildfire far more destructive when they have accumulated to hazardous levels. Prescribed burning also can prepare sites for reforestation, by adding nutrients and removing thick logging slash and competing vegetation.

Burning is commonly integrated with mechanical thinning or tree harvest operations that redistribute and reduce excess woody fuel loading — keeping prescribed burning feasible and safe. Burning cannot be done safely without careful attention to forest fuel loads and location, and removal of a portion of the fuels through harvest is a common part of an integrated management strategy.

Options for treating excess fuels and unwanted vegetation by burning include:

- piles at the roadside or log landing
- "jackpot" or windrow piles in the harvest unit
- broadcast burning of slash in the harvest unit
- spot-burning of un-piled slash concentrations
- under-burning below a well-spaced tree canopy

Controlled burns versus wildfire

Although prescribed burning generates smoke and carries some risk of escape, the catastrophic wildfires they help avoid by reducing fuels can cause much greater problems. Wildfires are destructive, polluting, unpredictable, dangerous and costly to control. Prescribed burning uses small, controlled fires during non-summer months when smoke can be reduced and kept away from communities. Burning is allowed only when weather conditions favor good fire control and smoke dispersal to maintain air quality. In areas such as central and eastern Oregon, carefully prescribed forest thinning and prescribed burning can mimic the natural, low-intensity wildfires that historically "managed" many forests.

How are smoke problems avoided?

ODF regulates burning on forest lands throughout the state under Oregon's Smoke Management Plan (see box at right), drawing from decades of experience. The agency monitors weather conditions and provides daily forecasts, and it issues burning instructions to landowners who have registered to conduct burning projects. During the non-summer months, ODF coordinates thousands of burning requests from private and public forest owners and managers statewide. ODF's strict oversight and regulation of forest burning projects help minimize air quality impacts and smoke intrusions into populated areas.

Oregon's Smoke Management Plan is widely regarded as the most successful forest burning program in the Western U.S. This success is defined as meeting both air quality objectives *and* landowner management objectives. Accomplishing these dual needs requires diligent understanding and cooperation by all parties involved in forest prescribed burning.

Oregon's Smoke Management Plan goals:

- Protect public health and reduce long-term air pollution from wildfires
- Minimize burn smoke intrusions into designated cities and wilderness areas
- Maximize burning opportunities while minimizing smoke emissions
- Help accomplish forestry fuel reduction and reforestation objectives
- Actively monitor and report accomplishments for continuous improvement
- Self-funding the program with burning registration fees

The ODF administers the Plan, including handling burn permits and fees, burn conditions monitoring and approvals, and annual reporting. A "Smoke Management Reference Manual" is available from ODF offices.

What should you know about requirements for burning on forest lands?

Plan ahead, and carefully! A prescribed burn must be well-planned and conducted under strict environmental and meteorological conditions, meant to keep the fire fully confined. Prescribed burning involves some risk, and burn managers must prevent the burn from escaping uncontrolled. Precautions are necessary, as are skilled burn crews. Fire trails must be installed, and equipment and personnel must be available to ensure containment.

Be aware that the potential liability for suppression costs and damage to adjoining property may deter some landowners from burning projects, as the same liability from fires from other forest operations also applies to prescribed burning. In addition, allowable burning days and other restrictions can be more stringent for forestlands near population centers and locations where smoke disperses more slowly, such as the Willamette Valley and the Medford area.

Burning projects on forest lands must address the following:

- Any burning activity must be registered with ODF at least seven days before the planned ignition; a written burn plan is required in some situations.
- Fees are due with registration, calculated on a per-acre basis that varies with site location, burn acreage and burn type (i.e., landing, piles, broadcast).
- Burn plans and implementation must consider protection of air, water quality, and fish and wildlife habitat.
- Burning must protect trees left after harvest, riparian buffers and soil productivity.
- Burning must maintain vegetation required under the forest practice rules, including RMAs for streams, lakes and wetlands (see below).
- Burn area and intensity should be limited to only what are needed for reforestation or fuel hazard reduction.
- At least one day before igniting the burn, the landowner/operator must call the local ODF office for clearance to burn, subject to favorable conditions.
- Those requesting ignition approval should be prepared to provide specific information about the burn, including fuel load amounts and the planned ignition time.
- Ignition activity must not start, or if begun must be discontinued, if weather or other conditions change and are no longer within ODF-approved limits.
- Burn accomplishment must be reported to ODF within a week for all prescribed burning.

What about burning near streams, lakes and wetlands?

Burning near streams, lakes and wetlands involves some additional resource risks. Thus, a written plan is required when burning is expected within:

- 100 feet of Type F and D streams
- 100 feet of large lakes
- 300 feet of significant wetlands

The written plan should describe, as needed, how detrimental effects will be minimized:

- in RMAs
- on highly erodible soils
- for any required wildlife trees, snags, down logs and understory vegetation

What about using water to help control the slash burn?

If you need to draw water from a stream, lake or other water body as part of the burn operation, you must notify both the Oregon Water Resources Dept. and the Oregon Fish and Wildlife Dept. This notification must be submitted to the local offices of these agencies at least 15 days before the water is drawn. Copies of the original ODF Notifications of Operation forms are used, but specific information about the water use must be included.

Tips for burning slash piles

Use pile covers: During the dry season, cover a portion of the pile with a waterproof barrier. Such covers have been shown to reduce pollutants by allowing rapid ignition and more complete combustion when burning is allowed. Covered piles allow for safer burning during more desirable wet periods. Drier woody material within the pile favors more rapid and complete combustion, which has fewer pollutants and improves smoke dispersal.

On steep slopes, prescribed burning can be an effective way to limit soil disturbance while controlling fuels and enhancing reforestation.

Burn only approved covers: The only inorganic cover that may be legally burned with a pile is a **plastic sheet (polyethylene)**, which may not exceed 100 square feet and a thickness of 4 mil. Other covers may be used to keep piles dry, but they must be removed prior to burning.

Well-built piles burn better: Properly constructed burn piles (or windrows) burn more completely with less smoke and air pollution. Piles that burn best are compact, tall and relatively clean of dirt. They can be constructed by a log loader, excavator, dozer with a brush blade or by hand.

Burn under proper fuel weather conditions: Conduct burning and light piles only during weather periods approved by ODF for safe burning and good smoke management. Burning during wet weather can achieve project objectives while reducing (but not eliminating) the need for fire control measures, because of less risk of escape.

Sometimes, not every pile or downed log needs burning: Small, scattered piles can be left unburned for use as wildlife habitat, unless mountain beaver (boomer) or other pests are a problem. Also, Oregon forest law requires larger clearcut harvests to retain two pieces/acre of down wood — this wood must not be piled or burned.

It is possible to practice prescribed burning and save down logs.

Are there ways to avoid burning slash and other forest fuels?

Yes. There are a number of alternatives to burning that may be used to reduce, consume or otherwise eliminate harvest slash and other forest fuels. They may be attractive when considering burning costs, unpredictable timing (smoke management) and the risk of fire escape. However, the alternatives can involve their own costs and other concerns, which should be carefully weighed against the advantages of a well-planned burn project.

Non-burning alternatives to treat excess forest fuels include, but are not limited to:

- Do nothing: leave woody fuels onsite
- Cut-to-length or whole-tree harvesting (see the Appendix, pages 148-149)
- Pre-commercial thinning of smaller/ excess trees
- Skidding/yarding of unmerchantable wood/tops to the landing
- Lopping and scattering of slash on the forest floor
- Chipping or grinding on-site or at the log landing
- Debarking and/or chipping of pulp fiber at the landing
- Mechanical crushing of slash
- Cutting/digging tree planting spots prior to reforestation
- Herbicide treatment to kill unwanted and competing vegetation
- Pile/windrow/concentrate slash, without burning

Biomass harvest operation.

Biomass utilization

Biomass utilization is a forest operation where slash — and other excess woody debris —is removed from forest land and chipped/ground into fuel for renewable energy generation. Although interest and activity in biomass utilization has been growing, tonnage prices paid to landowners may not cover the costs of biomass collection, processing and transport. As such, plans for biomass utilization should be integrated with other timber harvest and management objectives. With new biomass energy facilities that reduce transport costs and other related efficiencies and market incentives, biomass utilization can become a more attractive option for landowners.

For other information sources, see the Appendix, pages 183-184.

What are the pros and cons of burning harvest slash?

PROs

- Burning can reduce fuel loads and related fire hazards.
- Burning can be used on steep slopes where vehicles cannot work.
- Burning can reduce habitat for mountain beaver, rabbit and mice that may damage new tree seedlings.
- Burning can control brush that may compete with new tree seedlings.
- Burning is a way to provide adequate tree planting spots.
- Burning can release some nutrients and improve soil fertility.

CONs

- Burning can be risky – the landowner has liability if the fire escapes.
- Burning in winter or spring reduces risk but requires planning and flexible scheduling.
- Burning and the smoke it creates can be unpopular with neighbors and communities.
- Piles burn best, but extra work and accepted coverings are required to burn during the wet season.
- Burning requires initial notification, fees and a permit to light fires.

Prescribed burning with a helitorch has become less common as whole-tree cable harvesting and other approaches have reduced the need.

Parts of these machine piles will be covered with acceptable waterproof barriers and be ready for burning during the winter months.

Fire protection for homes on forestlands

Taking steps to reduce fire hazards around homes on forest ands is not only smart, it's often required by Oregon law **– even when forest operations are not involved**.

What should you know about fire protection for homes on forestlands?

Oregon law (see box on page 93) requires property owners in designated forestland-urban interface areas to reduce excess vegetation, trees and woody material — around structures and along driveways where they could fuel a wildfire. It also may be necessary to create fuel-free openings along property lines or roadsides.

Required fuel-reduction actions may include:

- Primary/secondary fuel breaks
- Driveway/road/lot fuel breaks
- Ladder fuel (smaller trees and shrubs) thinning/removal
- Brush removal and green spaces
- Tree pruning
- Tree thinning
- Clearance around roofs and chimneys
- Removal of flammable material from roofs and decks
- Firewood re-location
- Water supply development/access

This firewood shed is located well away from the home.

Oregon's Forestland-Urban Interface Fire Protection Act

The Oregon Forestland-Urban Interface Fire Protection Act (also called the Interface Protection Law) enlists the help of property owners in making fire-vulnerable forest-dwelling interface areas less hazardous and helping firefighters more safely and effectively defend homes from wildfires. The Interface Protection Law seeks to reduce the loss of residences from forest fires, as well as to reduce firefighting costs when wildfires approach residential areas in or bordering the forest.

Under the Act, forestland-urban interface areas within each county are identified by a local classification committee, with a focus on:

- lands within the county and inside an ODF protection district
- lands meeting the state's definition of "forestland"
- lands defined as "suburban," "urban" or "rural" when logical boundaries are needed
- developed lots that are 10 acres or smaller, which are grouped with other lots and have a minimum density of four structures per 40 acres

As forestland-urban interface areas are identified, they are then classified in terms of fire risk. The classifications range from "low" to "extreme," with the category determining the size of the fuel break around a structure that needs to be established by the landowner. After the local committee drafts the area maps and risk classification, public input is sought for potential revisions and final adoption. The forestland-urban interface classifications are reviewed every five years.

Requirements under the Act are being implemented gradually, with three counties initially included in 2003 and other counties being added over a planned 15-year rollout period. Further details about the requirements are found in Oregon Revised Statutes 477.015 to 061, and Oregon Administrative Rules 629-044-1000 to 1110.

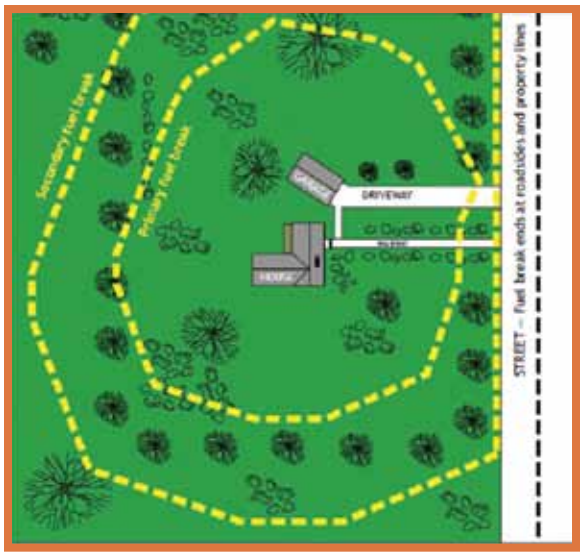
How do you know if your property is in a designated interface area?

The Interface Protection Law is administered on a county-by-county basis (see box at left). Within the next decade it will apply to all counties with significant forestlands – meanwhile, you should check with ODF to determine whether your property is in a designated interface area. If your property is in such an area you may have received information about the requirements for reducing fire hazards. If your property isn't currently included but is in or borders forestland, consider using the requirements to reduce the risks to your property as well as for the protection of other people and resources.

How do you evaluate your property and meet the requirements?

In counties that have completed the classification process, ODF notifies landowners within the designated forestland-urban interface areas about the requirements, usually with a mailing. Landowners have two years after receiving the notification to comply with the fuel-reduction standards. ODF provides information to forestland-urban interface landowners about the fuel-reduction standards, along with property evaluation forms. The evaluation forms are designed to help the landowner assess fuel reduction needs and make the property fire-safe. You should use the evaluation form that matches the classification for the area where your property is located, i.e., moderate, high, extreme, or high-density extreme (no fuel reduction is required in locations classified as "low").

Property owners also receive a "certification card" that should be signed and returned to ODF after all the fuel-reduction standards have been met by the landowner. Contact your local ODF office for copies of the evaluation form and certification card.



Is there a penalty if your property does not meet the requirements?

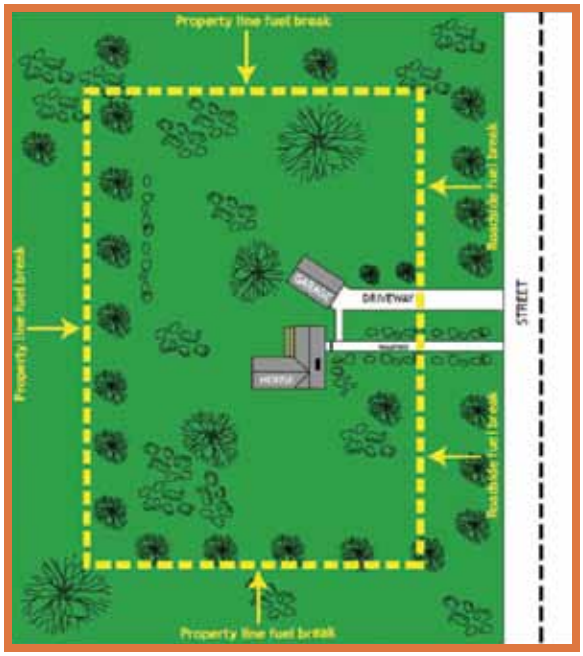
There is no fine for not meeting the requirements. However, the state is empowered to collect up to $100,000 in suppression costs if:

- a landowner does not certify his or her property
- a wildland fire originates on the property
- the fire spreads within the protection zone around a structure and driveway that does not meet the standards **AND**
- ODF has extraordinary costs for suppression

The cost collection may exceed $100,000 if a landowner is found to be willful, negligent or malicious in the origin of the fire.

Returning the certification card to ODF provides an important record that you have met your responsibilities as a property owner in a designated interface area, thereby relieving you of the $100,000 firefighting cost-recovery liability. Note that certification cards become void whenever a property is sold, a structure is added or a county classification committee has reclassified forestland-urban interface lands.

For other information sources, see the Appendix, pages 183-184.



Primary fuel breaks around residences:
At least 30 feet wide in this zone:

- Ground cover should be mostly non-flammable; examples include asphalt, bare soil, concrete, rock/gravel, mulches, green grass, succulent ground cover or wildflowers.
- Cut dry grass to a height of less than four inches
- Grass, leaves, twigs and similar cuttings and debris should be broken up to avoid a continuous fuel bed.
- Maintain shrubs and trees in a green condition, mostly free of dead plant material, and without potential "ladder fuels" removed.
- Arrange trees and shrubs so that fire cannot jump from plant to plant; thinning may be necessary to accomplish this.

Using engine fuels, oils and other petroleum products

Forest operations often involve machinery and vehicles that require petroleum products. Careful handling and use of these products can reduce the risk of spills and help protect the environment.

If a spill occurs when using petroleum products or chemicals for vegetation and pest control (see next section), landowners and operators must follow specific rules for handling the spill. ODF oversees most of these handling, use and spill regulations for forest operations.

What types of "petroleum products" are subject to forest practice requirements?

"Petroleum products" often present on forest operations and subject to the forest practice rules include engine fuels, gasoline, hydraulic oil, lubricating oils and greases. The rules distinguish between "other petroleum products" and "chemicals." Refer to next section, "Using chemicals," for more information about proper use of forest chemicals such as herbicides or pesticides.

What are some sources of potential petroleum product leaks and discharges?

Heavy equipment, service trucks, crew vehicles, saws, fuel tanks, fuel supply trucks, fuel transfer, fuel or lubricant containers, waste oil storage, improper equipment repair methods, equipment malfunctions, vehicle accidents and vandalism.

What actions must be taken to prevent and deal with leaks and spills?

Adequate precautions are required to prevent leaks, minor discharges, or "reportable spills" from entering and causing a visible sheen on state waters (streams, rivers, lakes, or wetlands). Operations should be planned to keep petroleum products and chemicals from entering such waters. Be aware that uncontrolled ditch water can be a source of such contamination.

Petroleum and other chemical containers and handling equipment must be maintained in a leak-proof condition. This includes machinery used for transportation, on-site storage or application of chemicals. If there is evidence of leakage, the equipment must not be used further until it is repaired (see "Using chemicals" section). If an accidental leak or spill occurs, immediate action is needed to stop and contain it, and it must be promptly reported (see box).

If a spill occurs: Oregon requirements for petroleum products and other chemicals

Operators must take immediate and appropriate action to stop and contain leaks, minor releases or "reportable spills."

Any "reportable spill" of petroleum product — exceeding 42 gallons onto land, or any amount delivered to state waters — must be reported within 24 hours to the Oregon Emergency Response System (OERS).

Any "reportable spill" of pesticide — exceeding 25 gallons (or 200 lbs.) onto land, or any amount delivered to state waters — must be reported within 24 hours to the OERS.

Smaller quantities discharged onto soil, less than the gallon amounts stated above, should be stopped, contained and prevented from future delivery into state waters.

If a spill enters state waters, operators must also immediately report it to the nearest ODF office. This reporting does not exempt the operator from requirements to notify other agencies.

First response to a "reportable spill" incident is through 9-1-1. Once notified, local public safety agencies should call OERS at 800-452-0311.

For more information, contact ODF, Oregon Dept. of Environmental Quality, the Oregon Dept. of Agriculture, or see the OERS Web page: www.oregon.gov/OMD/OEM/tech_resp/oers.shtml

What are some "best practices" for preventing spills and unwanted discharges?

- "Good job site housekeeping"– Remove and dispose of used containers and other waste; regularly inspect the job site for risky materials and situations; store fluids in rigid, properly labeled containers.
- Proper handling and storage – Securely store fuel and other chemicals; refuel equipment and transfer petroleum/chemicals in locations where spills/discharges cannot enter water.
- Preventative maintenance – Inspect heavy equipment for leaks; secure equipment to avoid damage and leakage; perform needed maintenance to prevent leaks/discharges; drain engine oil changes into a container; remove used fluids from the forest for proper disposal or recycling.

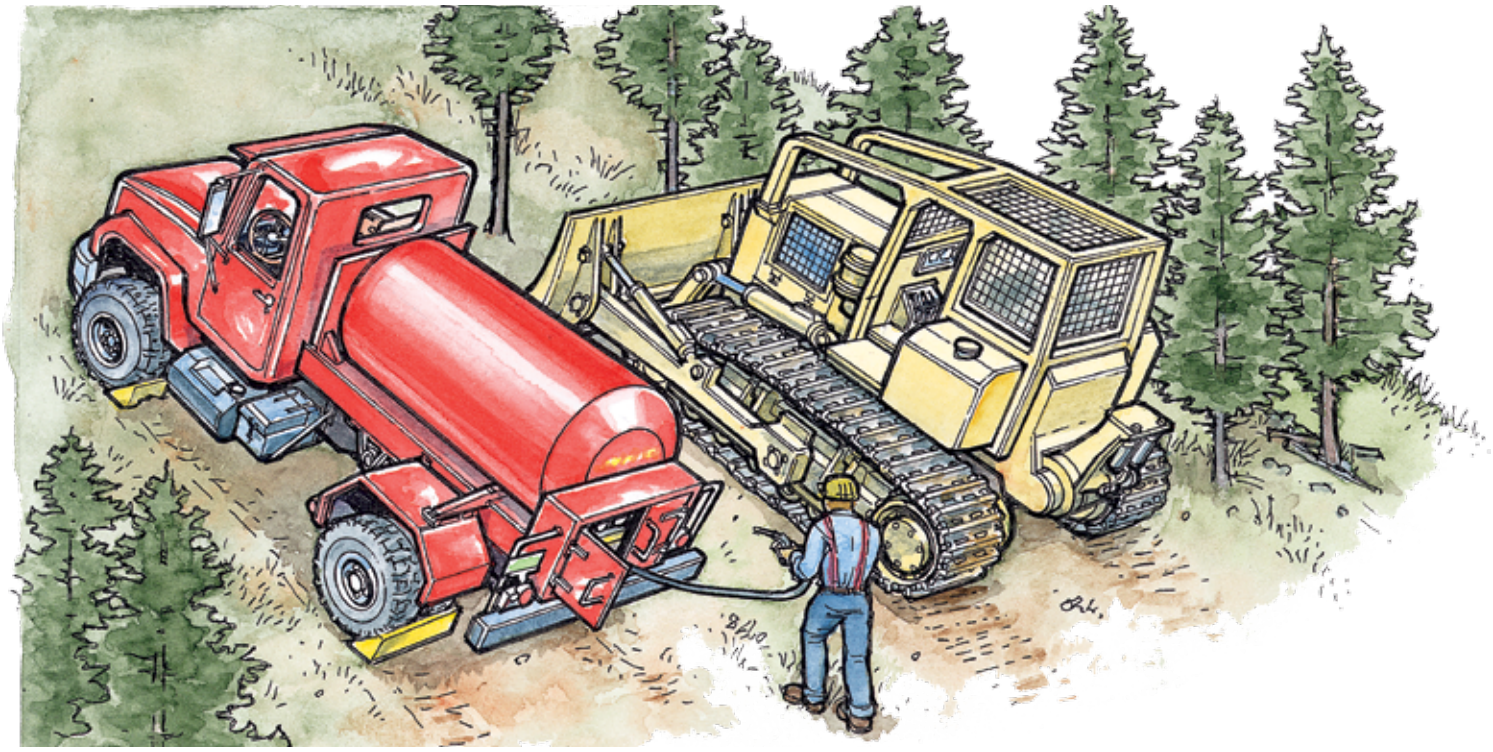
What are some ways to be ready to handle a spill or unwanted discharge?

- Planning – Plan how to deal with a discharge or spill, including the responsible person(s) and how to evaluate the discharge, deploy containment measures, respond to the discharge volume/type, and handle communications and recordkeeping.
- Spill kits – Provide spill response kits on the job-site; kits contain absorbent supplies (pads, socks, booms) to be used for immediate spill containment, cleanup and communication.
- Employee training – Provide for supervisor and key employee training and information for proper spill prevention, planning and responses.

What about disposal of wastes from petroleum and other chemical products?

- Remove from the forest all petroleum product waste, including crankcase oil, filters, used hydraulic oil, grease and oil containers.
- Absorbent supplies (rags, pads, socks, booms) that were used to clean up petroleum leaks should be placed in plastic bags and removed from the forest to an approved waste disposal site.
- Properly dispose of all other mechanical debris — such as machine parts, old wire rope and used tractor tracks — so it doesn't enter state waters.

For other information sources, see the Appendix, pages 183-184.



To avoid fuel truck leaks, chock the wheels. Transfer fuel where a leak cannot deliver into a stream or wetland. Be sure brake and transmission service is current. Fuel truck drivers need a commercial driver's license and a hazardous materials transport license.

Never dispose of used motor oil or containers in a pit or near water.

Know all the requirements and who to contact

In addition to the forest practice rules and related ODF administration, landowners and operators who use petroleum products and other chemicals need to know that other requirements and agency oversight may apply. Forest operations involving such products may also be subject to:

- pesticide control laws administered by the Oregon Dept. of Agriculture [see the next section, "Using chemicals"]
- hazardous waste laws administered by the Oregon Dept. of Environmental Quality
- hazard communication rules administered by the Oregon Occupational Safety and Health Division
- water use laws administered by the Oregon Water Resources Dept.

  For example, using water from streams or other surface waters to mix pesticides requires prior notice to both the Oregon Water Resources Dept. and the Oregon Dept. of Fish and Wildlife. Notifying ODF of the operation does not satisfy this requirement, but you can send copies of the original ODF operations notification to the other agencies. These must be sent to the other agencies' local offices at least 15 days before the operation begins.

What "other petroleum products" are included in the requirements?

Other petroleum products include fuel, motor oil and hydraulic fluid.

Take precautions to prevent leaks or spills of other petroleum products from entering waters of the state.

Common sources of other petroleum product contamination include:

- vehicle fuel tanks
- fuel supply trucks
- waste oil storage containers
- service lubricant supplies
- diesel used for pesticide mixtures

What are the waste disposal requirements?

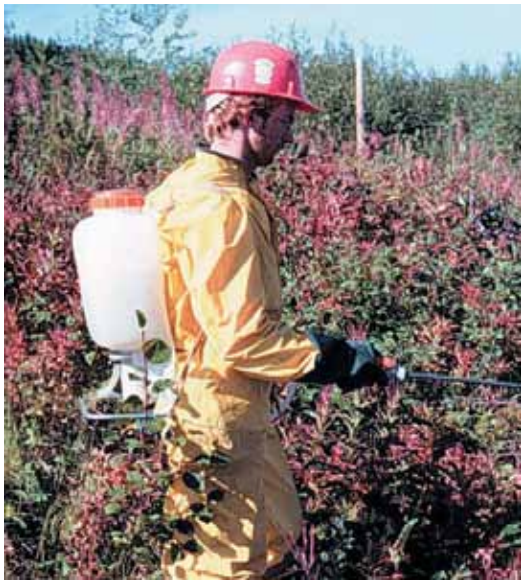
Remove from the forest all petroleum product waste including crankcase oil, filters, grease and oil containers.

Dispose of all other debris (e.g., machine parts, old wire rope, used tractor tracks) so it doesn't enter waters of the state.

For other information sources, see the Appendix, pages 183-184.

Using chemicals to control vegetation and pests

Various chemicals, including pesticides and fertilizers, are used to protect and grow healthy and productive forests. If not handled and used properly, including following directions on the product label, these materials can be a health hazard for people and aquatic life. This section describes the requirements for using these products.



Hand-operated backpack sprayers and mechanized ground equipment are widely used.

What are pest control chemicals?

Pest control chemicals are called pesticides, of which there are several broad classes. All are used in the forest, some more than others.

- Herbicides are chemicals used to control plants.
- Insecticides are chemicals used to control insects.
- Rodenticides are chemicals used to control rodents.
- Fungicides are chemicals used to control fungi.

Petroleum products were discussed in the previous section – note that some also are used with pest control chemicals.

- Oils are sometimes mixed with and used as carriers for pesticides.
- "Adjuvants" are mixed with pesticides to control drift and help chemicals adhere to foliage.

Operators are encouraged to use integrated pest management (IPM) strategies. In this approach to pest and vegetation control, chemicals are just one of a variety of pest control methods.

Why are herbicides used on forest lands?

Herbicides are among the most common chemicals used in forestry, although normally they are used only during a few years in the life of a forest. Herbicides control the growth of weeds and other unwanted plants while a new forest is being planted and established. These plants compete with tree seedlings for water, sunlight, space and nutrients. Both biologically and economically, herbicides are often the most effective means of controlling competing vegetation.

What are requirements meant to do?

Pest control requirements ensure that:

- these products are not found in soil, air or water in quantities that could damage water quality, animals or aquatic life
- plants in RMAs and sensitive resource sites are protected

On larger forest ownerships, helicopters are a cost-effective method for applying herbicides.

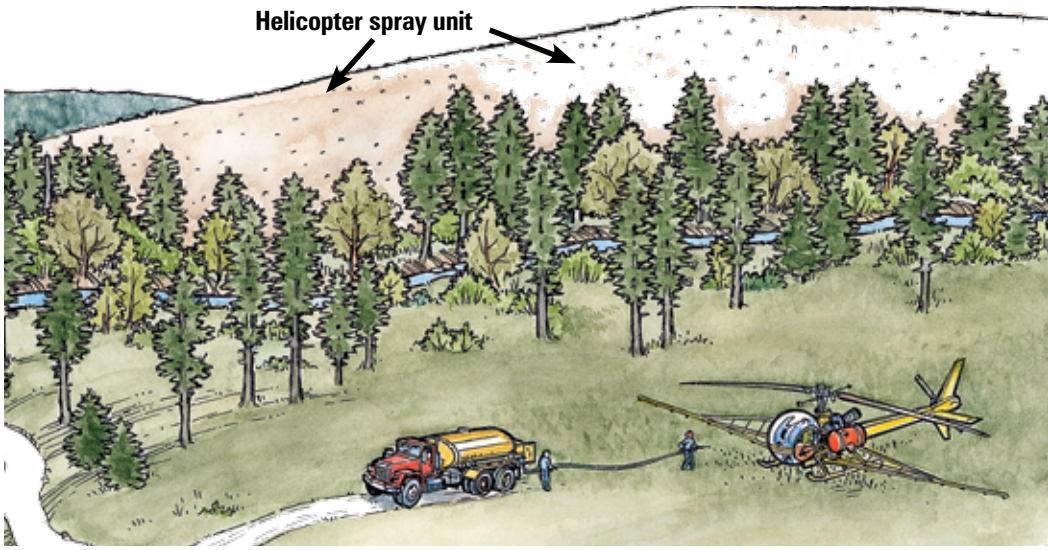
What about the requirements of other government agencies?

It is not enough to follow forest practices requirements. Chemicals and other petroleum products used on forestlands are also subject to:

- Oregon Dept. of Agriculture pesticide control laws:
  - Commercial operators must be trained and licensed.
  - Operators must understand and follow product label requirements.
  - Operators must not apply pesticides in a faulty or negligent fashion. This means pesticides must not drift from the target area and must not harm people, their property or the environment.

The Pesticide Use Reporting System has been developed to report pesticide use locations, chemicals, amounts and purposes. Contact ODA or see its website for current requirements.

- Oregon Dept. of Environmental Quality hazardous waste laws:
  - Operators must dispose of containers and other chemical waste properly and report and clean up spills.
- Oregon Occupational Safety and Health Division hazard communication rules.
  - Operators must know and follow chemical handling requirements.
- Water Resources Dept. water use laws:
  - Operators must notify WRD and the Oregon Department of Fish and Wildlife before mixing chemicals with water taken from streams and lakes.



Care must be taken when mixing chemicals, transferring chemicals from containers to equipment, fueling aircraft or heavy equipment, cleaning tanks or equipment, or locating landing/staging areas for aircraft or equipment.

Notify local WRD and ODFW offices by sending copies of the original Notifications of Operation forms when those are turned in to ODF.

Any agency website can be found through www.oregon.gov.

Is planning ahead important?

Yes. That's because:

- No waivers are granted for the 15-day waiting period for aerial chemical application operations.
- Written plans are required for any chemical application within 100 feet of a Type F or D stream or within 300 feet of a specified resource site (wetlands, special bird nesting sites, etc.).
- Operators must notify community water-system managers at least 15 days before applying chemicals near Type F or D streams used by such water systems (details below).

How should areas for chemical mixing, transfer and helicopter staging be located?

- Locate these activities only where a spill would not enter waters of the state.

Spill kits are used to contain hazardous materials.

- Do not locate mixing, transfer and aerial staging areas within 100 feet of Type F or D streams.
- Protect waters of the state and other forest resources by following chemical product labels.
- Maintain the vegetation left in compliance with the water protection requirements.

How are leaks handled?

- Maintain all equipment in a leak-proof condition during transport, on-site storage and application.
- If leaks occur, stop using equipment until corrected.
- Take immediate action to stop and contain leaks or spills.

- Take precautions to prevent leaks or spills from entering waters of the state.
- Report to ODF immediately any spill that enters or may enter waters of the state.
- Any spill of more than 42 gallons of petroleum or 25 gallons (or about 200 pounds of a liquid or solid) of pesticide should be reported to the Oregon Emergency Response Center at 800-452-0311. Also report to the Center spills of any amount that reach streams or other waters.

What are the required practices and safe distances when mixing and applying chemicals near water?

When using water from a stream or water impoundment for mixing chemicals, prevent chemicals from entering waters of the state by:

- providing an air gap or reservoir between the water source and mixing tank
- using pumps, suction hoses, feed hoses and check valves that are used only for water

Notes for Table 5-2

- All distances are measured horizontally, not as slope distances.
- Direct application of chemicals is not allowed within the distances listed.
- Always comply with label requirements. If product labels require greater distances, comply with them.
- Always comply with any forest practices water protection rule that is more stringent than the label and other requirements. Written plans are required for any chemical application within 100 feet of a Type F or D stream or within 300 feet of a specified resource site (e.g., wetlands, sensitive bird nesting sites).
- ODF may approve alternate plans for applying fungicides or non-biological insecticides.
- What is considered fertilizer? Fertilizer is plant food added to soil to increase growth, and contains 5 percent or more of nitrogen, phosphorous or potassium. Hay, straw, peat, leaf mold and animal manure are not considered fertilizer.

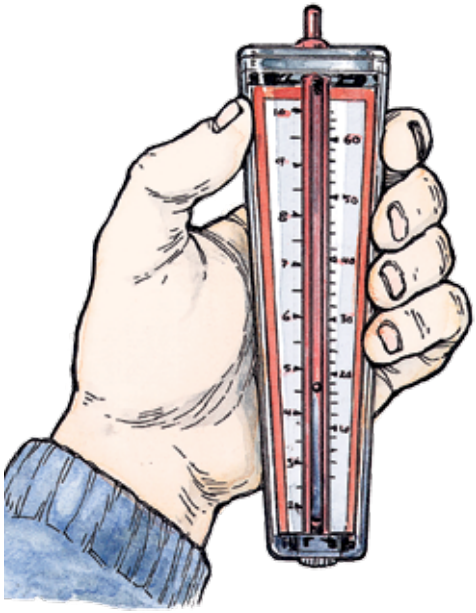
Table 5-2 describes the distances from water bodies (buffers) that must be maintained when chemicals are used on forestland.

Table 5-2 Distances from Water Bodies when Using Chemicals

Chemical Application Buffers Required for Waters of the State by the Chemical and Other Petroleum Products Rule	Herbicides, Rodenticides, insecticides and all other Chemicals except the next two columns		Fungicides and non-biological Insecticides		Fertilizers (See Table 5-2 Notes at left)	
Application (see table notes)	Aerial	Ground	Aerial	Ground	Aerial	Ground
Aquatic areas of fish-bearing streams with no domestic use (most Type F streams)	60 feet	10 feet	300 feet	10 feet	No direct application	No direct application
Aquatic areas of domestic-use streams with fish (all Type D and some Type F streams)	60 feet	10 feet	300 feet	10 feet	100 feet	100 feet
Aquatic areas of other streams (Type N streams)	No buffers specified, but protect vegetation noted in Table 2-14	No buffers specified, but protect vegetation noted in Table 2-14	60 feet if flowing at time of application	No buffer specified	No direct application to large and medium streams	No direct application to large and medium streams
Significant wetlands	60 feet	10 feet	300 feet	10 feet	No direct application	No direct application
Aquatic areas of lakes larger than 8 acres	60 feet	10 feet	300 feet	10 feet	No direct application	No direct application
Aquatic areas of other lakes with fish	60 feet	10 feet	300 feet	10 feet	No direct application	No direct application
Other standing water larger than ¼ acre at time of application	60 feet	10 feet	300 feet	10 feet	No direct application	No direct application
All other waters	no buffer specified	no buffer specified	no buffer specified	no buffer specified	no buffer specified	no buffer specified

What about disposal of chemical containers?

Follow DEQ requirements. The flushing solution used to clean chemical containers may be applied to the operation area.



Monitoring devices like this wind gauge, along with a wet bulb/dry bulb sling psychrometer to measure relative humidity, are handy for use in the field.

What about weather conditions?

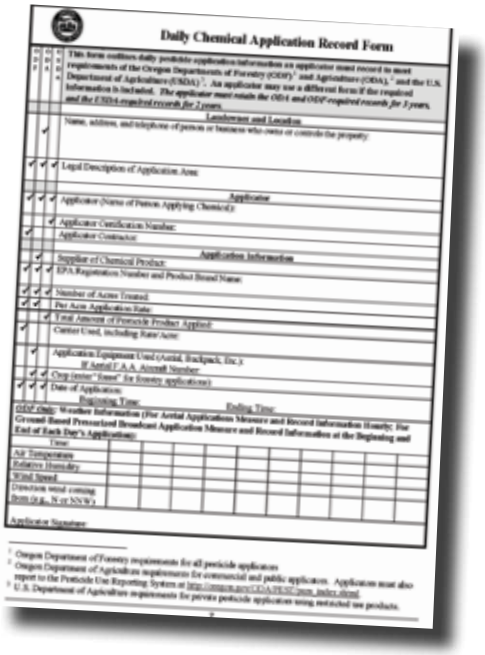
Temperature, relative humidity, wind speed, wind direction, temperature inversions and rainfall may affect the deposition and drift of pesticides during aerial and pressurized, ground-based applications. Landowners must apply chemicals only when weather conditions protect non-target forest resources, and comply with product labels.

What about keeping application records?

Daily records must be kept for broadcast chemical application (applied in a sweeping manner rather than directed at a specific target point), either by aircraft or pressurized ground equipment (backpack sprayer or motorized tank sprayer). Information required for each application day includes:

- legal description of the area treated
- acreage of the area treated
- brand name or EPA registration number of the chemical used, carrier used and application rate
- date and time of application
- air temperature, relative humidity and wind velocity and direction, measured within the operation area and recorded hourly for aerial applications, and at the beginning and end of the day for ground applications
- name of the person making the application
- name of contractor and pilot for aerial applications
- name of contractor and employee for ground-based applications

Daily records also are required for pesticide applications (e.g., hack and squirt) other than those by aircraft or pressurized ground equipment.



Daily Chemical Application Record Form

This form outlines daily pesticide application information an applicator must record to meet requirements of the Oregon Departments of Forestry (ODF)[1] and Agriculture (ODA),[2] and the U.S. Department of Agriculture (USDA)[3]. An applicator may use a different form if the required information is included. *The applicator must retain the ODA and ODF-required records for 3 years, and the USDA-required records for 2 years.*

ODF	ODA	USDA	
		✓	**Landowner and Location**
			Name, address, and telephone of person or business who owns or controls the property
✓	✓	✓	Legal Description of Application Area
			Applicator
✓	✓	✓	Applicator (Name of Person Applying Chemical)
		✓	Applicator Certification Number
✓			Applicator Contractor
			Application Information
		✓	Supplier of Chemical Product
✓	✓	✓	EPA Registration Number and Product Brand Name
✓	✓	✓	Number of Acres Treated
✓	✓	✓	Per Acre Application Rate
		✓	Total Amount of Pesticide Product Applied
✓			Carrier Used, including Rate/Acre
		✓	Application Equipment Used (Aerial, Backpack, Etc.)
			If Aerial: F.A.A. Aircraft Number
	✓	✓	Crop (enter "Forest" for Forestry applications)
✓	✓	✓	Date of Application
			Beginning Time: Ending Time:

ODF Only: Weather Information (For Aerial Applications Measure and Record Information Hourly; For Ground-Based Pressurized Broadcast Application Measure and Record Information at the Beginning and End of Each Day's Application):

Time										
Air Temperature										
Relative Humidity										
Wind Speed										
Direction wind coming from (e.g., N or NNW)										

Application Signature

[1] Oregon Department of Forestry requirements for all pesticide applications
[2] Oregon Department of Agriculture requirements for commercial and public applicators. Applicators must also report to the Pesticide Use Reporting System at http://oregonpsep.CEANSW.com/psep_index.html
[3] U.S. Department of Agriculture requirements for private pesticide applicators using restricted use products.

Information needed for each application day includes:

- legal description of the area treated
- acreage of the area treated
- brand name or EPA registration number of the chemical used, carrier used and application rate
- date and time of the application
- name of person making the application

Fertilizer applications require the following records:

- legal description of area treated
- acreage of area treated,
- date and time of the application
- name of person making the application

All these records shall be maintained by the operator for three years from the date of application, and available at the request of ODF.

This form (pictured at left) may be used for your records and is available from ODF.

What about notification of community water system managers?

Chemical applicators shall notify water system managers of planned chemical operations at least 15 days before operations begin when:

- chemicals will be aerially applied within 100 feet or ground-applied within 50 feet of domestic portions of Type F or D streams
- the community water system watershed area is not larger than 100 square miles

The water system manager may request additional information.

ODF maintains a list of community water systems for which notification is required.

For other information sources, see the Appendix, pages 183-184.

Roads and stream crossings

The roads on your property need some maintenance. What do you need to know?

Maintenance of roads on forestlands is a key forest practice. Because dirt or rocked roads exist on most forest ownerships, maintenance work is a common need. Some older or heavily used roads also can benefit from improvements, including better drainage or surfacing.

Maintain active and inactive roads in a manner sufficient to both provide a stable surface and keep the drainage system operating as necessary to protect water quality.

What this means:

- Road maintenance is the landowner's responsibility.
- Landowners are required to do the maintenance necessary to protect water quality, not drivability.
- Roads should be inspected to maintain water quality protection.
- Landowners have the ability to control access on their roads through the use of gates and by vacating roads (see page 114).
- Notification of ODF is not required for routine road maintenance activities.

Definitions for forest roads:

- *Active roads* are currently being used for timber hauling.
- *Inactive roads* have been used at some time since 1972. Roads used for any forest management purpose other than timber hauling are considered inactive. Inactive roads may no longer be drivable due to brush, fill washouts, etc.
- *Vacated roads* have been barricaded. They are self-maintaining and erosion is very unlikely (see page 114).
- *Abandoned roads* constructed prior to 1972 and not used for forest management since that time are not subject to regulatory authority.
- *A stable surface* is one that remains smooth so that water will not erode the surface and traffic will not lead to water running down ruts. Surfacing material does not break down under traffic, and pumping of mud up through the rock surface does not occur during use (see also durable surfacing and geotextiles later in this chapter).

Facts about roads

Fact #1

Roads are an essential part of forest management.

Fact #2

Of all the ownership features and management activities monitored on forestlands, the largest source of sediment has been roads. Road sediment can be significantly reduced with good road maintenance, improvement and construction practices.

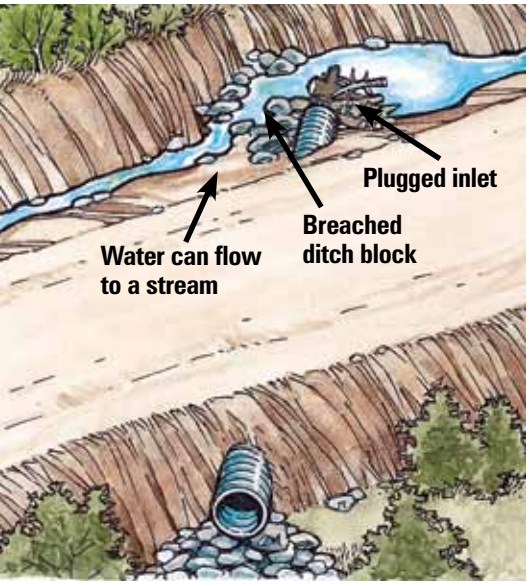
Fact #3

When properly located, designed, built and maintained, roads have a low potential for contributing sediment.

Fact #4

If not well-planned, constructed and maintained, roads located next to streams, on steep slopes or on unstable topography have the potential to produce sediment for a long time.

Not a major sediment problem yet, but when roads become channels for drainage, major sediment pollution can result



This undersized ditch relief culvert resulted in a breached ditch block and sediment flowing directly into the stream. Recommended: 18 inch culverts.

Watch for damaged culverts that need replacement. Repair work should be completed during dry weather.

- *An operating drainage system* means:
  - Water is moved across or under the road before causing erosion.
  - Locations where ditches may be blocked by slides or ravel are identified in advance.
  - Additional ditch relief culverts are added or the road surface changed (inslope, outslope, crown, see page 107) to carry water around the problem.
  - Unanticipated problems are treated as quickly as possible.
  - A functional system, such as undisturbed vegetation, is in place to filter muddy runoff so only minimal sediment enters waters of the state.

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.

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What this means:

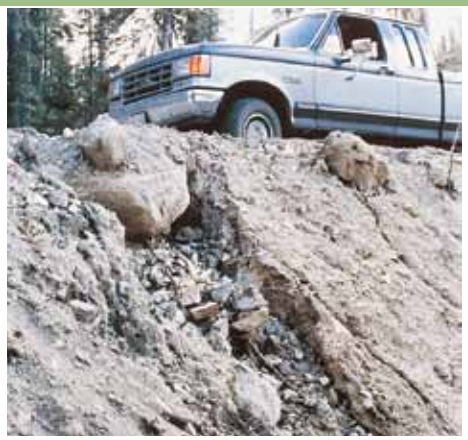
Someone must be responsible for cleaning all drainage obstructions, including damaged portions of culverts. In-stream large woody debris and beaver dams that do not pose danger to a culvert should not be removed.

Provide effective road surface drainage, such as water bars, surface crowning, constructing sediment barriers, or outsloping, prior to the rainy and runoff seasons.

fpa

What this means:

Take action to prevent surface runoff from traveling down the road surface. For roads without ditches this means outsloping, removal of unnecessary berms and water barring. For roads with ditches this means crowning and removal of berms.



Soil sloughing off a road cut.

Poor road surface drainage caused this fill slope erosion.

The only berms that should be on the outside of roads are those essential for fill protection. They should seldom exceed 100 feet in length.

What about cut-and-fill slopes?

- In steep terrain, cutslope ravel and slides are common if soils are thick or the rock is fractured.
- Sidecast fill on steep slopes can begin to fail years after initial construction. Tell-tale signs are arc-shaped cracks along the outside edge of the road. An excavator can be used for sidecast pullback, especially if it could move into a creek.
- Debris collects in ditches, and dense vegetation may block water flow. However, light vegetation can stabilize ditches.
- Ditch inspection should be done during storm events when problems are most obvious. Watch for blockage, overflow problems and ditch downcutting.

- Don't delay in cleaning up. Move soil and debris to a location where they will not create additional erosion problems.
- Be aware that these problems may be symptoms, indicating a need for larger ditches or more culverts.
- Reduce erosion by seeding and mulching bare cut-and-fill slopes.
- Ditchline erosion may indicate a need for more or larger culverts or armoring with rock (see ditch gradients, page 108).

Haul all excess material removed by maintenance operations to safe disposal sites and stabilize these sites to prevent erosion. Avoid sidecasting in locations that might become unstable or where erosion will carry materials into a stream.

Roads receive heavy use during logging. Be aware of early signs of damage. Serious damage to road surfaces starts with excess water. Standing water is a sure sign of road-drainage problems. Ruts indicate that road strength is deteriorating.

What about road grading?

- The purpose is to maintain road surfaces – either crown, inslope or outslope (see page 107).
- Grading maintains road surface cross-drain structures.
- Grading corrects road surface damage resulting from vehicle traffic and freeze-thaw cycles that reduce drainage effectiveness.
- Timely road grading and road use restrictions during wet periods can protect drainage on unimproved roads.
- Grade road surfaces only as often as necessary to maintain a stable running surface and adequate surface drainage.

Grader damage to inside ditch toe slopes exposes an easily erodible surface and is a source of sediment.

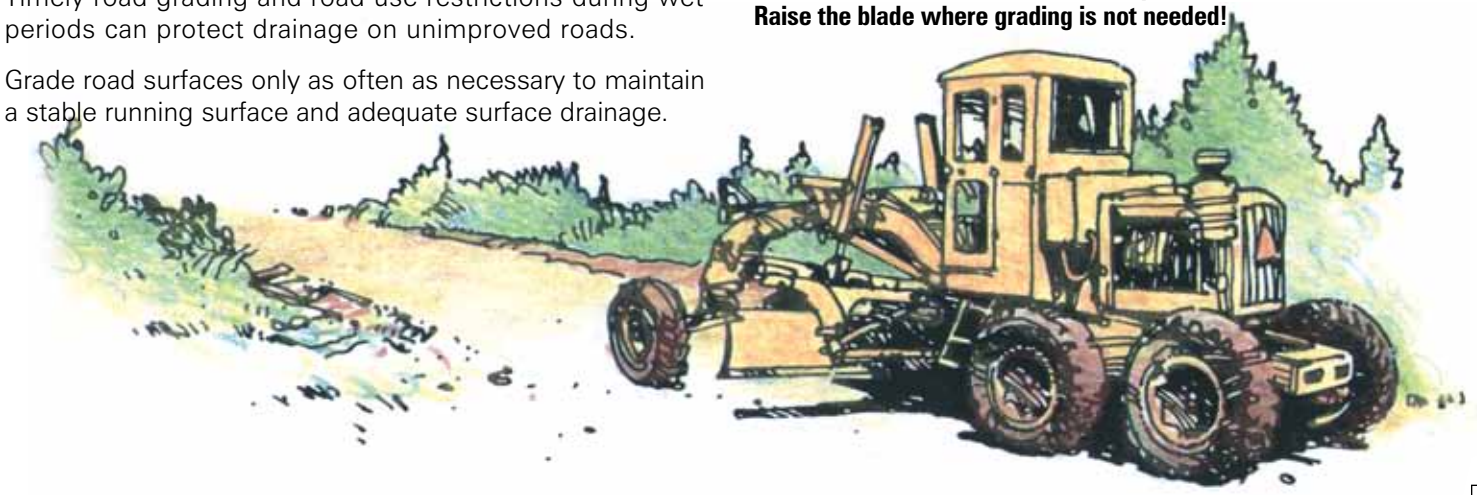
Slow, controlled grader operation is key to reducing culvert inlet and outlet damage. Reduce damage by keeping graders on the road running surface. Never sidecast gravel toward culvert inlets or outlets.

What are precautions for road grading?

- Grading should be done when roads are neither dusty nor muddy. Moist roads are more easily shaped and compacted by grading machinery.
- Watch for steep sections or curves where added wear and rutting takes place.
- Avoid cutting the toe of cut slopes when grading roads, pulling ditches or plowing snow.

When applying road oil or other surface stabilizing materials, plan and conduct the operation in a manner that prevents these materials from entering waters of the state.

Avoid grading sections of road where it isn't needed. Doing so disturbs stable surfaces and creates potential sediment sources. Raise the blade where grading is not needed!



What this means:

Waste oil is prohibited on forest roads. Other materials need to be applied so they do not enter or wash into streams, lakes and wetlands.

In the northwest and southwest Oregon regions, 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.

What this means:

Landowners are required to take whatever reasonable action is necessary to prevent material from entering waters of the state. Road repair includes replacing or adding culverts, sidecast pullback and removing of debris in the road.

Place material removed from ditches in a stable location.

What this means:

Soils and debris removed from ditches during grading and/or cleaning should be placed in a location that does not cause slope instability or where it will wash back into the ditch.

Remove berms on the edges of roads or provide effective drainage through berms, except for those berms intentionally designed to protect road fills.

What do you need to know about road drainage?

Whether old or new, forest roads need effective drainage to remain functional and avoid erosion and sedimentation problems. In addition to better maintenance, road drainage improvements may be needed on roads that show such problems.

Provide a drainage system using grade reversals, surface sloping, ditches, culverts and/or water bars as necessary to control and disperse surface water to minimize erosion of the road.

What this means:

Roadway surfaces are normally crowned or sloped to remove surface water. Other key features include road grade changes, adequate ditches and ditch relief culverts that control drainage and ensure water quality.

Most landowners, at least in western Oregon, prefer to use crowned roads with ditches and cross-drain culverts.

Outsloping is most suitable for low-service roads with a gentle grade (less than 7 percent) and where rutting is prevented by more frequent smoothing (grading) of the surface.

Provide effective cross drainage on all roads, including temporary roads.

What this means:

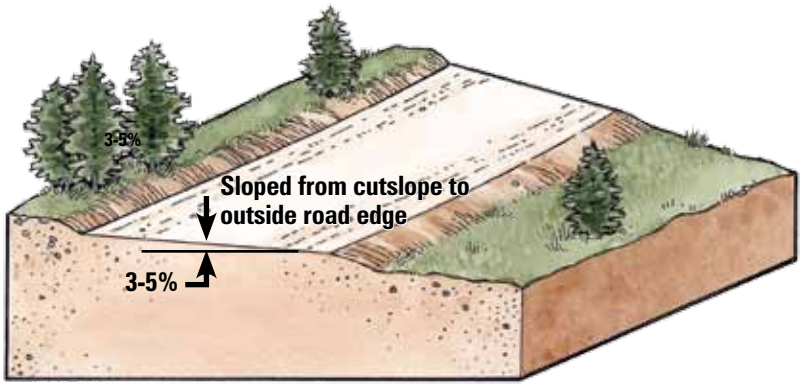
Even for temporary or inactive roads, drainage must be provided that gives the same level of water quality protection as required of active roads.

Drain uncompleted roads, which are subject to erosion.

What this means:

When work is stopped on road improvements or new construction and there is an erosion potential, cross drainage with culverts, water bars, dips or other means is required (see following pages for details).

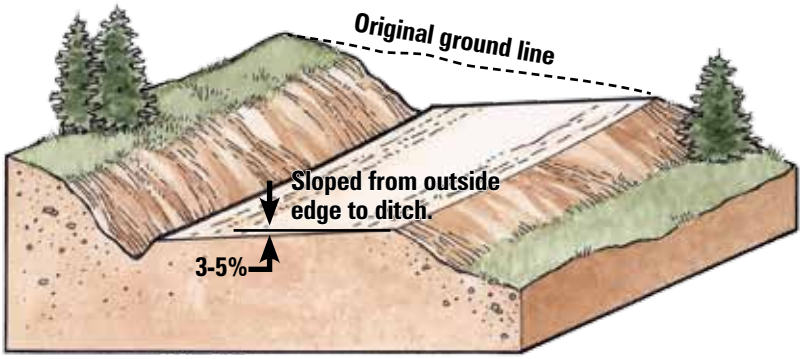
Outslope Road



OUTSLOPE ROAD IS USED WHEN:

- the road grade is gentle or flat (≤ 7 percent)
- the ditch or cutslope is unstable
- the surface can be kept smooth
- a road is vacated
- rutting can be controlled
- road use is seasonal and traffic is light

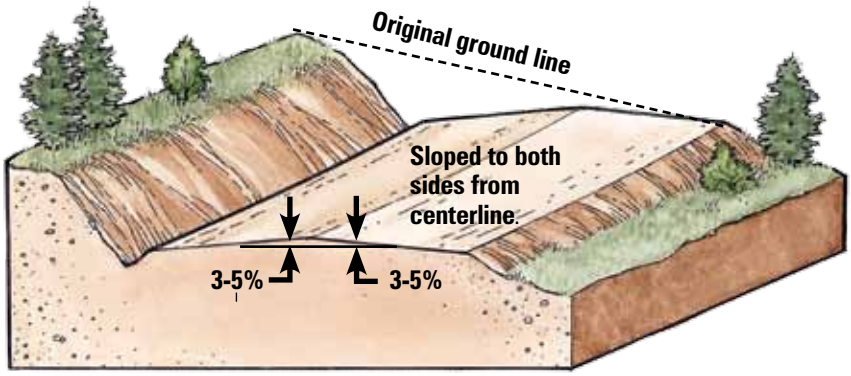
Inslope Road



INSLOPE ROAD IS USED WHEN:

- the road grade is steep (>7 percent)
- surface drainage is carried to a ditch or surface drain
- an outslope causes fill erosion
- an outslope is ineffective due to ruts
- slippery or icy road conditions are prevalent

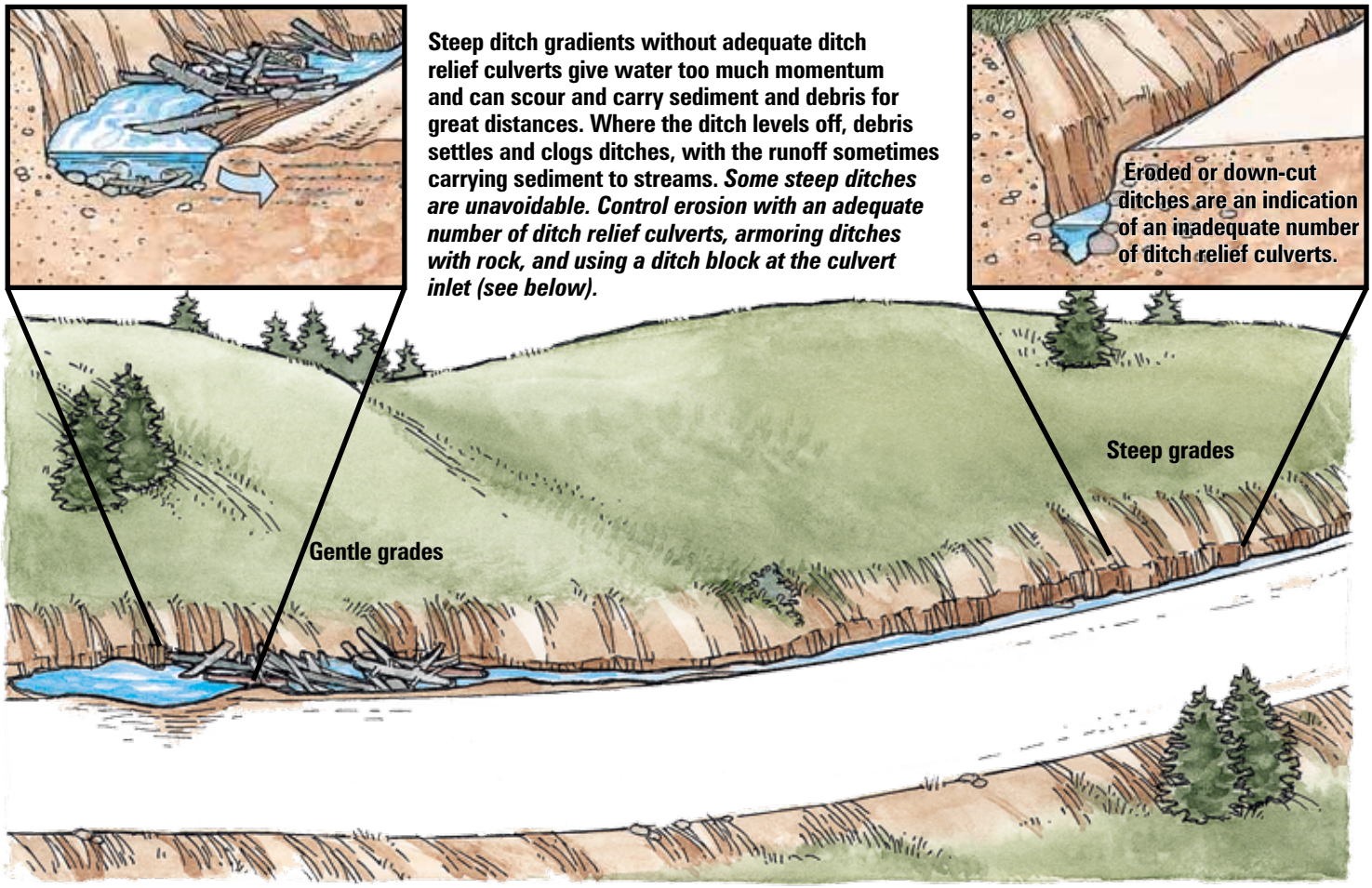
Crown Road

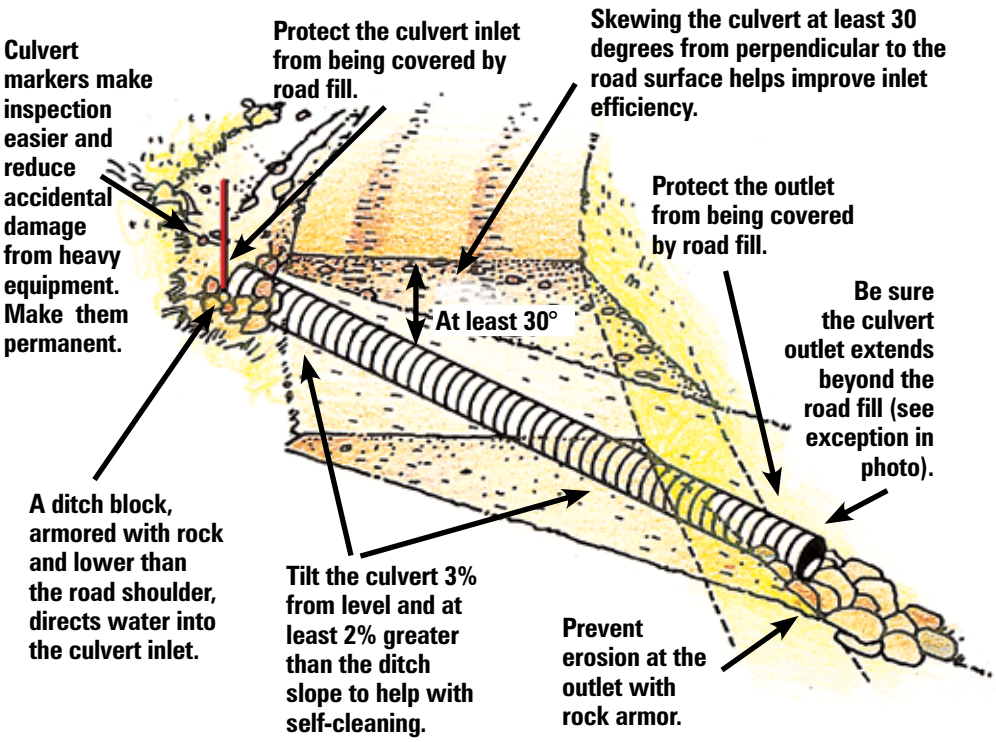


CROWN ROAD IS USED WHEN:

- two traffic lanes are needed
- there is a single lane on steep grade
- regular maintenance of ditches, crown and cross drains is possible
- slippery or icy road conditions are prevalent
- the road grade is flat (crown fill)

What you need to know about ditch grades: too steep or not steep enough?



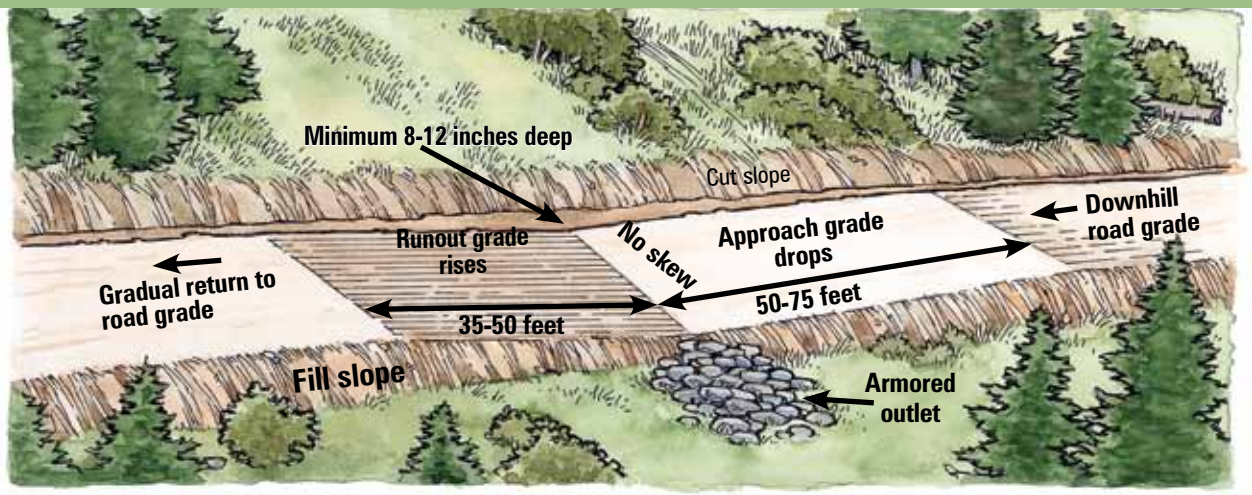


What are ditch relief culverts?

- They move water from the ditch on the uphill side of the road under the road, releasing it onto a stable area on the downhill side.
- They prevent water from crossing the road surface and softening the roadbed.

Eighteen-inch-diameter culverts are recommended where soil and debris plugging is a concern.

It may not always be possible to have the culvert extend beyond the fill. For steep fills, a half-round or flume should carry water beyond the fill.

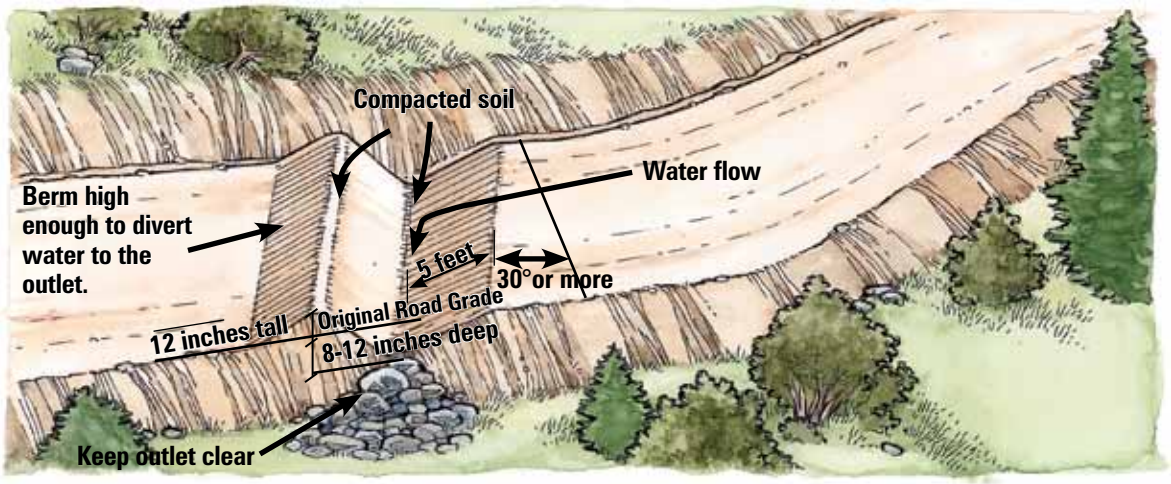


The drain dip bottom is sloped to carry water from the inside to the outside of the road surface, onto natural ground.

What are drain dips?

Gentle rolls in the road surface that are sloped to carry water to the outside, onto natural ground.

- Their approach, depth and runout features provide drainage without being a driving hazard.
- They can be used on ditched or unditched roads.
- They are effective on roads with gentle grades.
- They may be difficult to construct on steeper grades, where ditch relief culverts are preferred.
- Some dimensions and locations may be difficult for log trucks to negotiate.



What are water bars?

Small earth dams or humps built into the road surface, which divert road surface water to where it will not cause erosion.

- They are used on inactive roads and skidtrails.
- They are best constructed with mechanical equipment (better excavation and compaction), but can be built with a shovel.
- Basic spacing guidelines use soil type and slope (see Table 6-1), but other local factors such as road dimensions, aspect (compass direction the hillside faces) and climate also should be considered.

Table 6-1
Water Bar Spacing (feet) Guidelines

Slope	Erodible Soil (sand, ash, etc.)	More Stable Soil
2-5%	400	600
6-12%	200	300
13-18%	100	200
Over 19%	50	150

You are responsible for road drainage near streams.

Locate dips, water bars or cross drainage culverts above and away from stream crossings so that road drainage water is filtered before entering water.

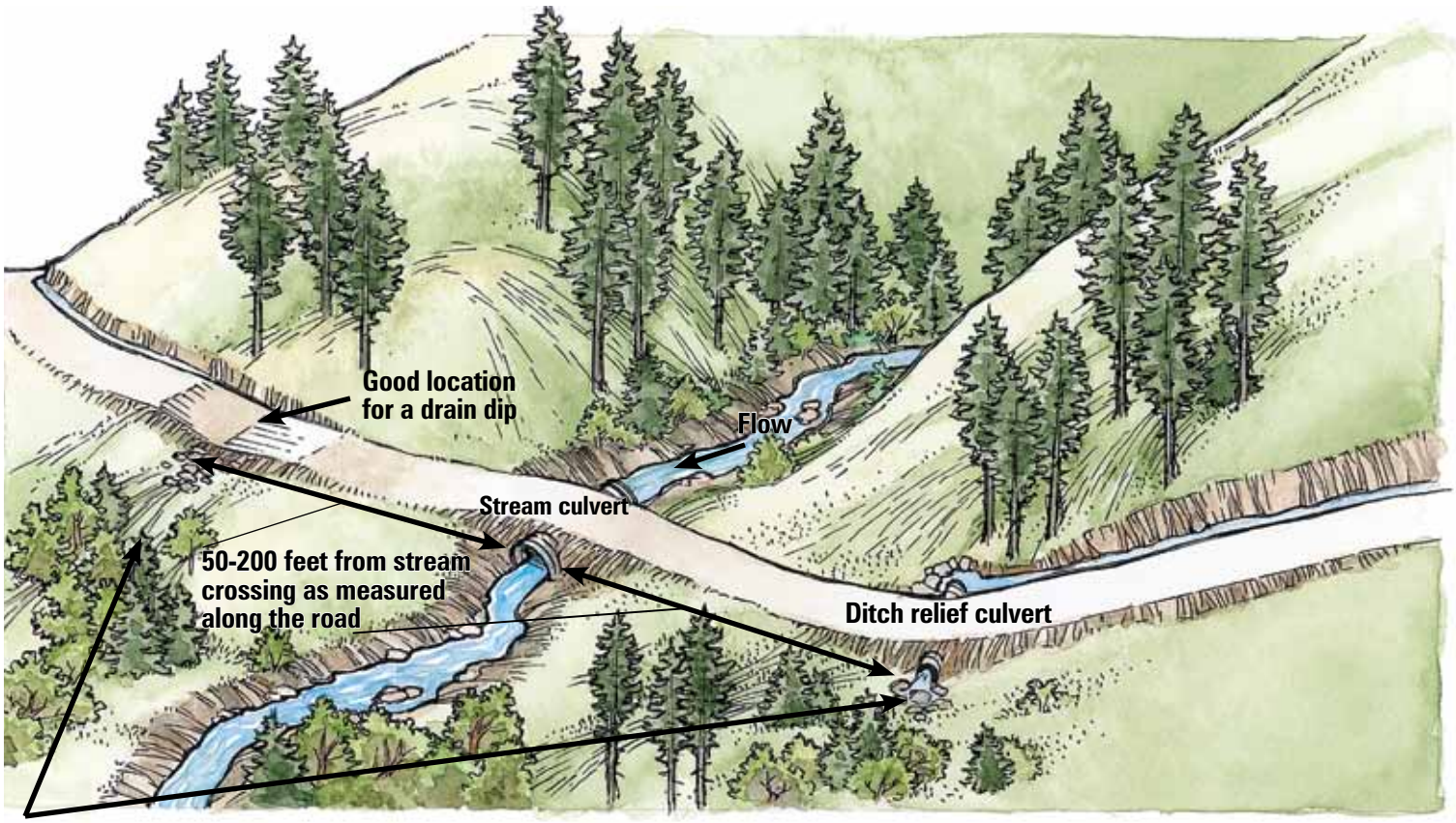
fpa

What this means:

Install dips, water bars or cross-drain culverts above and away from stream crossings so road drainage water may be filtered through ground vegetation before entering the stream.

Drainage water should be directed onto undisturbed, vegetated soil.

Route ditch drainage through a filter of vegetation and undisturbed soil so sediment can be removed before water reaches the stream.



Ditch drainage should be directed into vegetation and undisturbed soil filter, and not allowed to continue flowing down the ditch and into the stream.

Cross streams at right angles to the main channel. Road grades that drop into the stream can increase sediment in the stream. Grades that dip very gently or not at all toward the stream deliver less sediment. Never allow road ditches or ditch relief culvert drainage to flow into a stream. Culvert drainage and road ditches should always be directed through a vegetation filter before reaching the stream. Be aware of the risk of causing slope failure on steep slopes if water is concentrated into very steep areas or old landslides where water hasn't been flowing.

Hay bales or small slash windrows can reduce stream sedimentation. They slow surface water and trap sediment.

Road surfacing can double the cost of a road. However, gravel roads can provide all-weather access, reduce road maintenance costs and protect water quality by covering the soil with a weather-resistant surface.

What about springs or seeps near roads?

Provide drainage when roads cross or expose springs, seeps or wet areas.

What this means:

- This applies to all hillslope wet areas, regardless of whether they were known before construction.
- Road fill should not be placed on top of springs. In areas with high groundwater, it may be necessary to use French drains in the ditch area, or use a free-draining fill.
- Where cut slopes or road surfaces expose flowing water, roads must be graded and cross-drained to remove this water before ditch cutting occurs.

Clear channels and ditches of slash and other construction debris that can interfere with effective roadway drainage.

What this means:

Road work and use can generate debris that can impact both natural and constructed drainages. All floatable material should be removed from ditches for a minimum of at least 25 feet above ditch relief culvert inlets.

What's needed when a road is used during wet weather?

Traffic on forest roads during wet weather can generate fine sediment that, with surface runoff, may reach and pollute streams. Durable surfacing or other effective measures are needed to avoid these problems on roads used for log hauling during wet weather. In some situations, if such pollution occurs, operators are required to cease active road use.

What this means:

Wet weather is any period when rain or snowmelt normally occurs. In western Oregon this period typically extends from October through April. In eastern Oregon, this includes wet periods from both snowmelt and individual rainstorms.

Wet-weather road use can be a source of water turbidity and fine sediment to streams from muddy runoff water. Turbidity refers to the very small, dissolved materials that remain suspended in water and prevent light from penetrating. High turbidity levels can cause stress in fish, affect fish feeding rates, impair their homing instincts and reduce growth rates. Sediment can smother fish eggs (redds) and affect aquatic insect life.

A durable surface such as rock is needed for wet weather use of road segments that drain to streams. Not just any rock will do – avoid round or weak rock. Instead, use hard, fractured rock with sharp corners, a mix of sizes and some fines (small pieces). Fractured rock packs, better and the fines help seal the surface from water, which make it resistant under heavy traffic. Sometimes adequate rock, called pit run, can be dug directly from quarries. In other cases, rock should be crushed, sized and mixed to provide the needed quality. Rock surfacing depth should be thick enough to prevent serious rutting.

It is best to use quality rock near stream crossings, because rock quality can affect water quality. Use of quality aggregate can reduce sediment and water turbidity during wet weather road use (see box on previous page).

Durable rock surface on a log hauling road during heavy rain. Notice that the water in the ditch is clean.

What is durable surfacing?

Durable material resists deep rutting or the development of a layer of mud on the road surface.

It may be quarry aggregate or pit run rock (see page 111). It does not include crushed sandstone, decomposed granite or similar material. Durable rock has a small percentage of fines (very small pieces). Too many fines can wash into streams (see sidebar on Page 111).

- Rock is best applied in layers. A base layer of hard, 3-to-12 inch angular rock with no fines provides for good drainage. A surface layer of hard, 3/4" and less angular rock with some fines to provide cohesion and stability. Rock must be thick enough to prevent pumping of

Where Snow and Freezing Weather Occur

Snow berm breaks allow for drainage during snowmelt without damaging the road surface. They also serve as escape corridors for wildlife.

During snowmelt periods, water is directed through the snow berm break.

What's the goal?

Ensuring that the road surface is well-frozen or otherwise stable during use, and that it will drain properly during thaw periods. This helps protect both the road and water quality.

Reasons for snow plowing:

- It enhances deep-freezing of the road surface.
- It keeps water off the road during melt periods.

When plowing snow, take care with snow berms:

- Provide breaks in snow berms to allow for road drainage.
- Locate breaks above a vegetated filter area and away from streams.
- Locate breaks away from steep fills, headwalls or landslide areas.
- Near streams, plow a snow berm along the road edge to keep runoff from flowing directly the into stream.

Be prepared to suspend road use:

- when thawing occurs and traffic damages the road surface
- at the sign of surface rutting
- when there is potential for road runoff to reach streams

mud up through the rock. Geotextiles can minimize pumping and reduce the need for a thick rock layer (see below).

- Even durable surfacing may develop ruts that channel runoff and sediment, requiring grading or resurfacing.

Under what conditions must road use cease?

Operators must cease active road use where runoff from a deeply rutted or muddy surface causes a visible increase in turbidity of a Type F or D stream. There is also cause for concern when such an increase in turbidity is seen in a Type N stream, as this could reflect inadequate road maintenance or eventually result in sediment reaching a Type F or D stream.

Geotextiles are used to reinforce subgrades by spreading the load across a larger area. This reduces the chance of settling and failure. It also allows road construction across wet areas, reducing the need to remove unsuitable roadbed material.

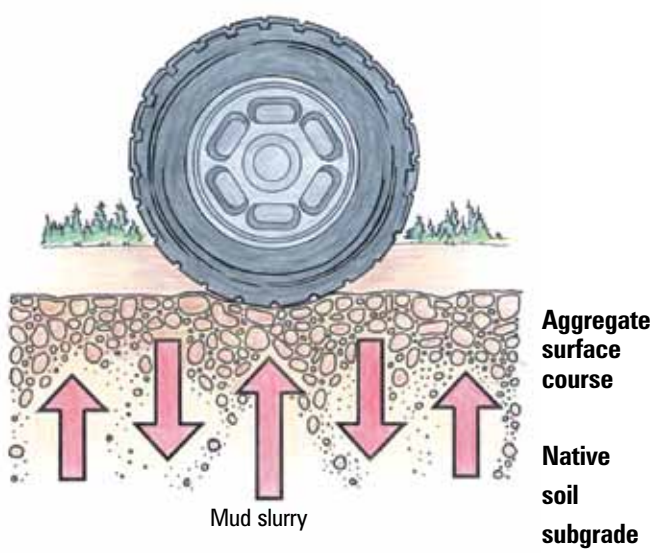
What are geotextiles and what are their uses?

Geotextiles are synthetic, permeable fabrics used to reduce rutting, stabilize the ground and increase the load-carrying capacity of both paved and unpaved roads.

They are used to separate rock surfacing materials from subgrade soils while allowing for water passage.

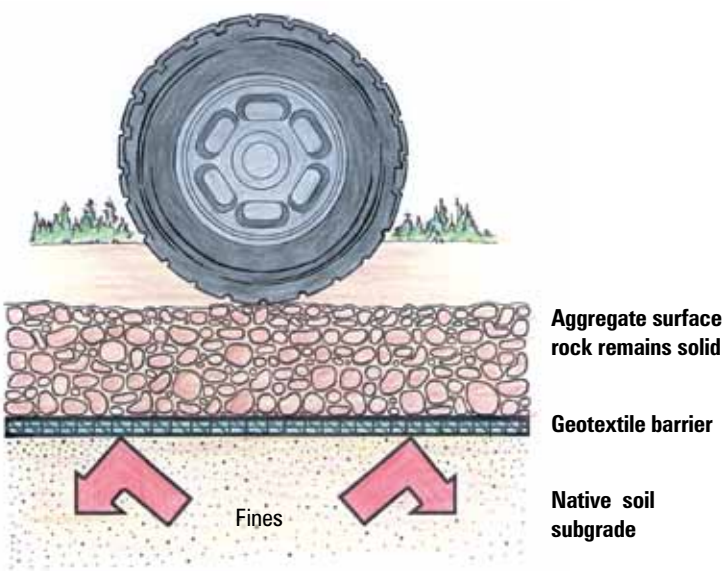
Geotextiles can reduce the amount of rock surfacing needed and reduce overall road costs.

Geotextiles can keep weak or wet subgrade soils from moving into the road base rock layer, reducing its weight-carrying effectiveness.



ROADWAY WITHOUT GEOTEXTILE

Mud slurry mixes with surface aggregate. Mud may pump up through the rock surface.



ROADWAY WITH GEOTEXTILE

Fines are stopped by geotextile.

What about road closures?

Forest roads remain part of the landscape long after harvest, site preparation and reforestation are completed. If access is not needed after successful reforestation, roads may be closed temporarily or permanently, or vacated. A plan for road closure should always consider local wildlife suppression concerns.

Temporary road closure is easiest. Permanent closure, or vacating a road, involves specific actions described below.

Consider gates, barricades or signs to limit use of roads during wet periods. Such barriers also can be effective for reducing the chance of human-caused fires, vandalism and other illegal activities. Develop a plan for allowing timely access to emergency responders (e.g., ODF, sheriff).

How are temporary road closures used?

During wet periods, if road use is likely to damage the road drainage structures. Temporary closures also are useful when roads are not needed for extended periods.

Upon completion of an operation, ensure that drainage structures are fully functional. The road surface should be crowned, outsloped, insloped or water-barred. Remove berms from the outside edge where runoff is channeled.

How do you vacate a road?

Road vacating is the unbuilding or dismantling of a road to provide a stable, revegetated condition. Vacating a road is more than just blocking the road from traffic. It can solve costly road maintenance requirements, but it requires the most preparation.

Vacated roads must provide adequate drainage and stability without further maintenance, which requires measures such as traffic barriers, frequent cross ditches, and scarification and/or seeding of exposed soils.

Traffic control is an effective way to reduce road maintenance costs and provide protection of other forest resources. Traffic control can include full road closure, temporary or seasonal closure, or road restricted to only light use. Whichever traffic control option is selected, all require regular maintenance inspections.

Alternatives to gates include large berms or trenches, logs, stumps or large boulders. Never use a suspended cable to block a road, as it can be difficult to see and may seriously injure an unsuspecting visitor. Liability in such cases lies with the landowner, even if signs are displayed.

A tank trap must be deep enough and in a location where vehicles cannot go around. Warning signs for the trap should be displayed well in advance, preferably at a turnaround area.

It may be necessary to physically block road access. Gates provide temporary closure along with quick access if needed. To prevent vandalism, gates and other barriers must be well anchored.

When vacating a road, removal of all stream crossing culverts and associated fill material is required. Non-drivable water bars (cross-ditches) should be installed to drain the road surface. Space water bars more closely, because with time they may fill with sediment.

Remove all steep sidecast fill. Place removed fill and debris away from streams and off steep slopes or old slide areas.

Restore all stream crossings to a stable, self-maintaining condition. This includes reseeding both the road surface and cut-and-fill slopes.

When should vacating a road be considered?

Long-term needs for access should be carefully considered before vacating a road, because the costs of reconstruction can be substantial. However, it may be desirable to vacate a road:

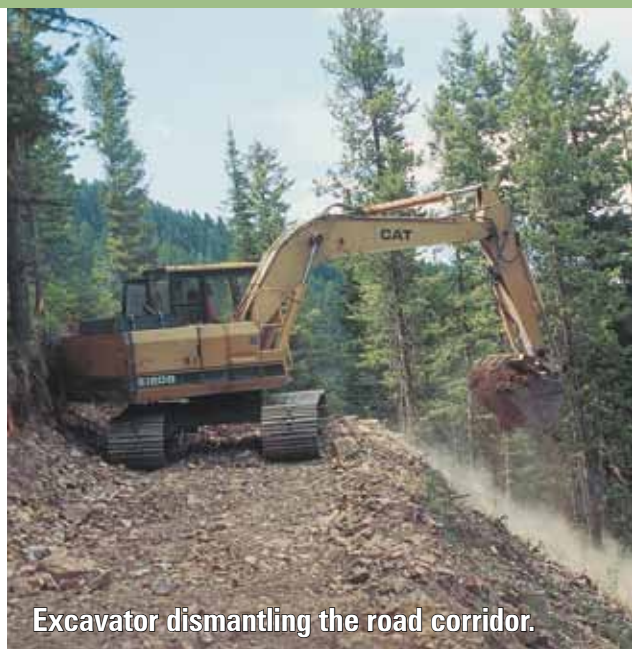
- when the road no longer serves a useful purpose
- when there's a need to eliminate or discourage access
- when you need to reduce erosion and sedimentation from a poorly located road
- when you need to correct unstable road cuts and fills

Where is road vacating used?

It may be necessary to vacate only some road segments, such as recontouring a road junction and its initial stretch of road. Other segments may be stable and can be revegetated as is.

To vacate a forest road, landowners shall effectively block the road to prevent continued use by vehicle 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.

Road segment before vacating.



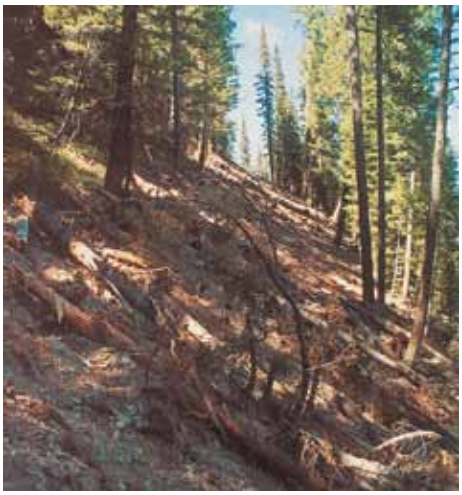
Excavator dismantling the road corridor.

What this means:

In addition to preventing traffic, culverts that might carry flow (including all stream crossing culverts) should be removed and unstable sidecast should be pulled back.

Reasonable actions to vacate a forest road may include:

- removal of stream crossing fills
- pullback of fills on steep slopes
- frequent cross ditching
- vegetative stabilization



Vacated road segment with large wood in place before reseeding the surface with grass.

What about rock pits and quarries?

Development, use and abandonment of rock pits or quarries located on forestland and used for forest management shall be conducted using practices which maintain stable slopes and protect water quality. Rock pits for non-forest management uses are regulated by the Department of Geology and Mineral Industries.

Don't locate quarry sites in channels.

When using rock pits or quarries, prevent overburden, solid wastes, or petroleum products from entering waters of the state.

Stabilize banks, headwalls, and other surfaces of quarries and rock pits to prevent surface erosion or landslides.

When a quarry or rock pit is inactive or vacated, stabilize banks, headwalls, and other surfaces and remove from the forest all petroleum-related waste material associated with the operation and dispose of all other debris so that those materials do not enter waters of the state.

For other information sources, see the Appendix, pages 183-184.

Do you need help?
A consulting forester, road engineer or geotechnical specialist could help with a difficult or complex situation. Getting such help could avoid not only a violation, but also damage to your property and road investments.

You want to build or reconstruct a forest road. What do you need to know?

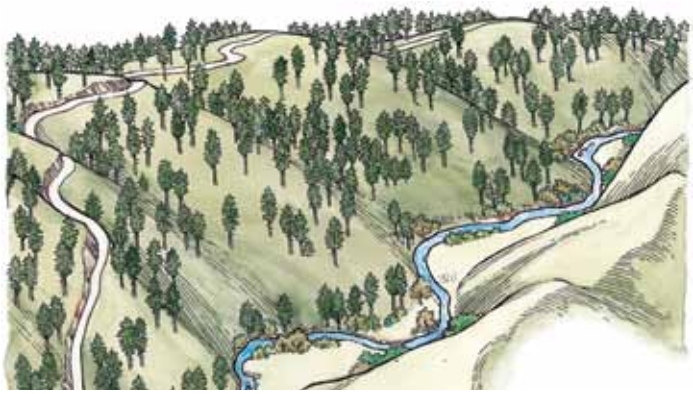
When do you need a written plan before starting road construction?

A written plan is needed for road construction that involves:

- a risk of material entering water from direct placement, rolling, falling, blasting, landslide or debris flows
- machine activity in Type F or D streams, lakes or significant wetlands
- operations in an RMA
- a stream crossing with a fill more than 15 feet deep
- placement of logs or boulders in a channel for stream enhancement
- a high landslide hazard location (see page 48).

UNACCEPTABLE OPTION. Roads built or reconstructed next to a stream channel with multiple crossings are not allowed. Note: Many older roads and highways are in such locations.

ACCEPTABLE OPTION, if no other alternative. Road built up on the 45 percent sideslopes. This option might be more difficult to build, but it is better.



BEST OPTION. Build road on ridge top and plan for cable harvesting.

What else do you need to know about road location?

Locate roads where you can minimize the risk of materials entering water and where you can minimize disturbance to channels, lakes, wetlands and floodplains.

Avoid locating roads on steep slopes, slide areas or high landslide hazard locations (page 48) and in wetlands, RMAs, channels or floodplains if alternatives exist. Minimize the number of stream crossings.

Reduce the duplication of roads by making use of existing roads where practical. Investigate agreements to use or tie into roads on adjacent ownerships before constructing new roads.

What this means:

Your road location is very important. Roads should be avoided in certain locations. Reduce the amount of road in the following locations to the maximum extent possible:

- RMAs
- parallel and next to a stream of any size
- on high landslide hazard location, especially when rock is fractured
- on steep, granitic slopes or other high gully hazard areas
- across the toe of old landslide deposits

In a few locations roads cannot be constructed without causing significant impacts to streams and water quality. One example is a road constructed in the bottom of a very

narrow canyon. This cannot be done without filling in part of the stream channel. Another example is some slopes that are too unstable for safe road construction. Road construction in these and other critical locations is not allowed.

What about road construction on steep slopes?

Rapidly moving landslides can be triggered when road fill or sidecast material is pushed or placed onto steep slopes below the road. Movement may occur with the next major storm or it may not occur for decades. For this reason, always end-haul excavated material if there is a risk of a landslide reaching a stream, a home or a paved public road (see illustrations, page 50).

Design and construct roads to limit the alteration of natural slopes and drainage patterns to those that will safely accommodate the anticipated use of the road and will protect waters of the state.

What this means:

If the road you want to build is on gentle terrain and away from streams, the design and reconnaissance is less detailed. But if the road you want to build is on steep slopes or crosses Type F streams, the design is more complicated. You've got to know:

- how to minimize disturbing erodible slopes next to stream channels
- how to avoid damage to side channels
- how to allow for large flood flows without crossing structures washing out
- how to pass juvenile trout and salmon upstream and downstream at crossings
- how to allow fish access to side channels
- how steep grades (more than 20 percent) can create drainage, traction and safety problems; assist vehicles may be needed.

Do not concentrate road drainage water into headwalls or high landslide hazard locations.

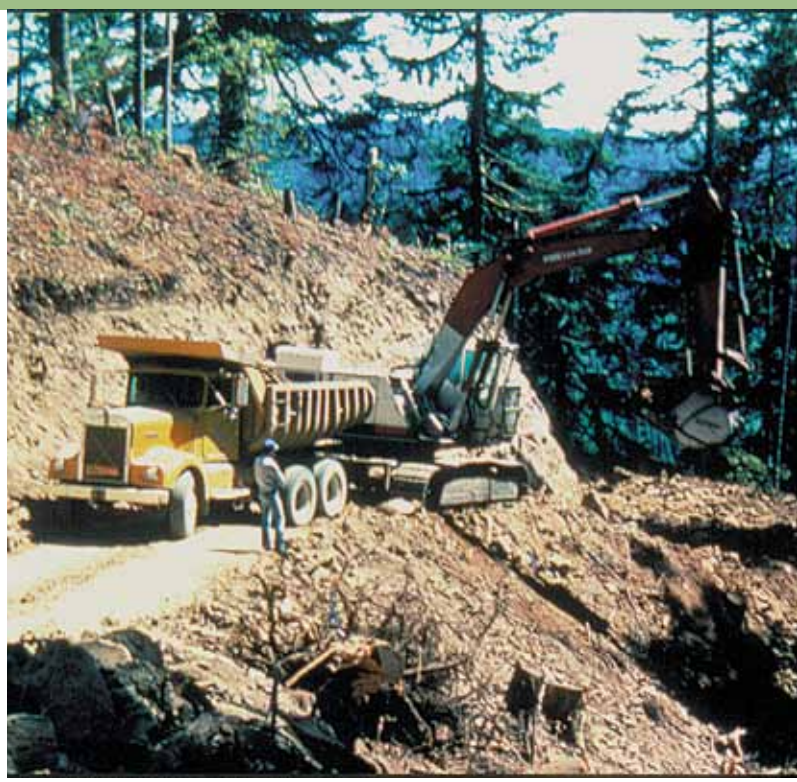
What this means:

If possible, place cross drain culverts away from high landslide hazard locations. If this is not possible, use numerous cross drain culverts to handle runoff.

Design roads no wider than necessary to accommodate anticipated use.

What this means

Narrow road widths reduce erosion, protect water quality and can reduce costs. Use the preferred width in Table 6-2 when possible. To allow for two-way traffic, turnouts are required in narrow roads in strategic and stable locations.



When constructing a full-bench road, the entire road surface is excavated in the hill. The excavated material is end-hauled, meaning the material is removed by truck to an area needing fill or to a stable disposal area.

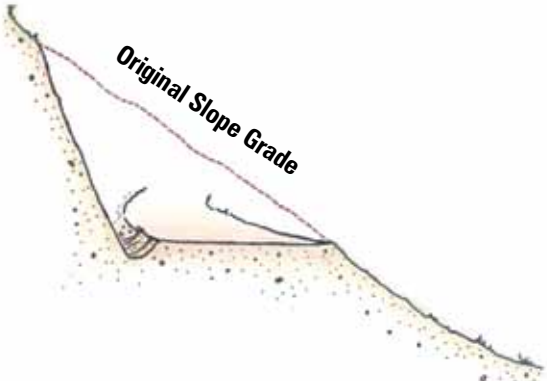


Table 6-2 General Guidelines for Road Widths

Road Use	Maximum Width	Preferred Width
Minor spur & temporary	18 feet	12 feet
Collector road	22 feet	16 feet
Mainline haul road	30 feet	24 feet

When constructing a full-bench road, the entire road surface is excavated into the hill. The excavated material is end-hauled, meaning the material is removed by truck to an area needing fill or to a stable disposal area.

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

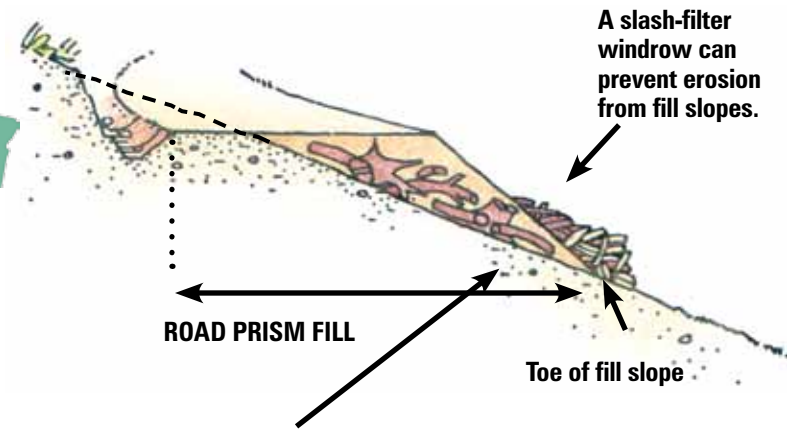
End-haul excess material from steep slopes or high landslide hazard locations.

What this means:

Roads built with sidecast construction across steep slopes can trigger landslides. If there is a risk of a landslide reaching a stream, home or paved public road, the road must be full-bench constructed and excavated material must be end-hauled.

Cut-and-fill construction is common for gentle terrain. Soil is taken from cuts and pushed or "drifted" to where fill is needed to build up flat areas or cover culverts. Never let sidecast or waste material enter streams, and never place it on unstable areas where it might erode or slide.

Slash-filter windrows are compacted logging slash, installed along the base of fill slopes during road construction. Built by excavators, these 3-by-3 foot barriers are very effective at slowing surface runoff and keeping sediment from entering streams.



Always avoid mixing stumps and other vegetative debris into the road fill. Over time, it can lead to road slumping and failure.

Design cut-and-fill slopes to minimize the risk of landslides.

What this means:

Select slope angles that are unlikely to result in landslides. Consult a geotechnical specialist for roads needed in high landslide hazard locations.

Stabilize road fills as needed to prevent fill failure and later damage to waters of the state-using compaction, buttressing, subsurface drainage, rock facing or other means.

How do you dispose of road waste materials?

During road construction, don't put debris, sidecast, waste and other excess materials in locations where they may enter waters of the state during or after construction.

What this means:

Never place end-haul material, clearing and grubbing debris, or other soil or rock where it could cause slope instability or be eroded by a flood.

Select stable areas for disposal of end-haul materials. Prevent overloading areas, which may become unstable from additional material loading.

What this means:

You must submit a written plan for waste disposal areas, which have a risk of slope failure and also a risk of material from that failure entering water.

The weight of waste fill can trigger landslides, even when placed on a gentle sloping bench. Before placing waste on a midslope bench, or a slope steeper than 50 percent, consult a geotechnical specialist. Be cautious using midslope areas that already contain waste. Additional waste can lead to a landslide.

Stabilize exposed material that may be unstable or erodible by seeding, mulching, riprapping, leaving light slashing, pull-back or other means.

You want to build or improve a stream crossing. What do you need to know?

Forest roads that cross or come close to water can affect:

- water quality
- aquatic habitats
- fish migration
- stream and wetland characteristics
- riparian habitats

Stream crossing structures include culverts (both closed and bottomless arch), bridges and fords. Each is designed to allow water to pass the structure without causing erosion and provide a safe vehicle crossing.

Some crossings require a written plan for review by ODF. On Type F streams, structure designs must allow juvenile and adult fish to migrate upstream and downstream.

What does the choice of stream crossing depend on?

Stream size: Bridges are best for streams more than 10 feet wide and those with high gradients.

Whether it's a Type F stream: Bottomless arch culverts and bridges protect the natural streambed with less impact on fish.

Construction and maintenance costs: Structures ranked in order of increasing cost are:

- ford
- round culvert
- squash culvert
- bottomless arch culvert
- bridge

Future years of use: Culverts provide year-round access with a rock surface. However, a ford used once in the length of a forest rotation has less impact than a permanent stream crossing.

Soil foundation conditions: Bedrock crossings may require bottomless arch culverts, bridges or fords.

Available equipment and materials: Culvert installation can include the use of a dozer, backhoe or excavator, portable compactor, bedding gravel, armoring material, culvert outlet downspout and sediment filter.

Bridges sometimes require cranes, concrete truck access for abutments, piledrivers, and high-service-level roads for steel or pre-stressed concrete delivery.

Fords require armoring of approaches and stream bottom, and possibly geotextile and excavation equipment.

Other requirements: Some crossings, especially bridges, require qualified engineers. Hydrologic and fisheries needs may require additional consultation. Written plans and review by ODF may be needed.

Are written plans needed for road building projects across a stream or wetland, or near a lake?

Yes. Written plans must be submitted to ODF before:

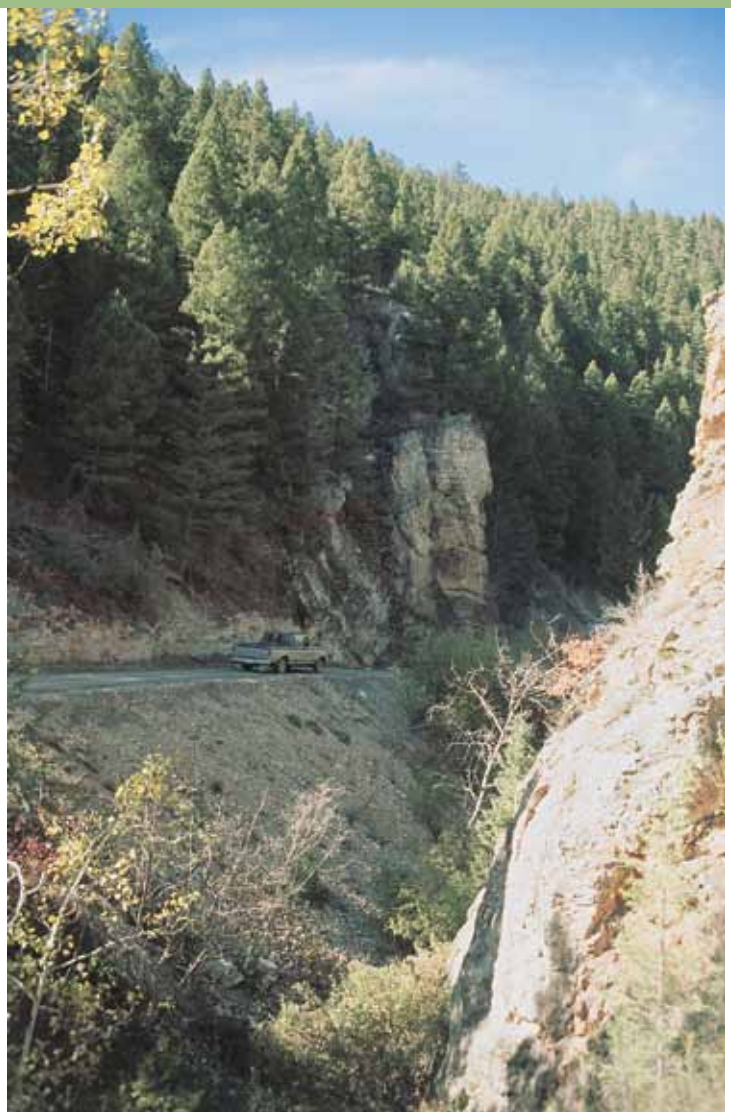
- any road construction where there is a risk of material entering a stream, lake or wetland
- road construction or reconstruction in any RMA
- conducting machine activity in Type F or D streams, lakes or significant wetlands
- installing a stream crossing with a fill more than 15 feet deep
- placing logs or boulders in stream channels for stream enhancement

What do you need to know about stream crossings?

- The channel, any side channels and the floodplain must be protected.
- There are restrictions on the sizes of stream crossing fills.
- They must be designed to handle 50-year peak flows.
- Crossing structures (e.g., culverts) must be passable by adult and juvenile fish.
- Fish must be able to access side channels.
- Crossing structures must be maintained for fish passage.

What is involved when locating a road near waters of the state?

- Minimize the total area disturbed by road fill.
- Minimize the excavation of stream-adjacent side slopes.
- Minimize the risk of materials entering water.
- Minimize disturbance to channels, lakes, wetlands and floodplains.
- Avoid locating roads in wetlands, RMAs or floodplains if alternatives exist.
- Minimize the number of stream crossings.



Avoid locating stream crossings in steep narrow canyons. If there is no alternative, a written plan must be submitted to ODF. Roads in these locations normally are not allowed unless there is no other way to manage the land.

Install drainage structures on flowing streams as soon as feasible.

fpa

What this means:

Install structures quickly and keep equipment out of the stream, except the minimum necessary to build the road.

Basic stream culvert installation from start to finish.

Construction of culvert stream crossings has the greatest potential to cause immediate sediment pollution. Installing culverts is more than just placing a pipe in a stream. Complete the work promptly, at a time when the least damage will occur. A portable pump can be used to carry stream water around the construction site. The channel foundation and trench walls must be free of logs, stumps, limbs or rocks that could damage the pipe.

The culvert bed must conform with the natural streambed. The bed should be either rock-free soil or gravel. Bedding should provide even distribution of the load across the length of the pipe. All stream crossings on Type F streams must be designed to provide fish passage. (See Page 127).

Secure each end of the culvert with backfill. Pour backfill material on top of the pipe. This allows finer soil particles to flow around and under the culvert sides. Larger particles roll to the outside. Fine soil particles, close to the culvert, compact more easily. Once the ends are secured by backfill, the center of the culvert is covered.

Tamping fill material throughout the entire backfill process is important. The base and sidewall material should be compacted first. This reduces any chance of water seepage into the fill.

5

Armor the culvert inlet and outlet. Rocks, logs or grass seeding can be used to protect these locations against erosion. Check the area upstream and downstream from the culvert. Clear the upstream area of woody debris that might plug the culvert.

6

The road approach to the new culvert is the next phase of construction. Be sure that the culvert fill above the top of the pipe is at least 18 to 24 inches, to protect the pipe from damage by traffic.

7

Layers of fill are pushed into place and carefully compacted to build up and maintain a consistent road grade. The crossing should be rocked to minimize the risk of sediment washing off the road and into the stream.

What are other best management practices for stream culvert installation?

- Install during low flows.
- Excavate the culvert bed as quickly as possible.
- Use a temporary dam, or pump stream water around installation, if the culvert bed is silt or clay material.
- Use clean gravel for the culvert bed when needed.
- Backfill around the culvert with native soil or gravel.
- Compact the backfill.
- Cover the fill with a gravel surface.
- Seed and mulch the area.

What are the different kinds of culverts, and how are they used?

Three styles of pipes, described below, are among the most common stream crossing culverts.

The style of pipe used is based on what will provide fish passage and handle peak flow.

1. ROUND CULVERTS

Round culverts are available in metal, plastic and concrete (metal and plastic are most common). They are used for small streams.

- Galvanized metal culverts, sometimes called CMPs (corrugated metal pipes), are most common.
- Plastic culverts, sometimes called CPPs (corrugated polyethylene pipes), are a popular alternative.

Advantages of CMPs

- more crush-resistant
- fire-resistant
- more easily backfilled with a variety of backfill materials
- available in different lengths and shapes
- easily transported, one inside the other

Disadvantages of CMPs

- heavy, larger sizes require mechanical placement
- difficult to cut without cutting torch or power saw

Round, galvanized corrugated metal pipe sunk into the streambed to allow for fish passage.

Advantages of CPPs

- light weight, easier to transport and install
- can be cut and joined with hand saw or chainsaw
- flexibility favors its use as downspouts (see photo at right)

Disadvantages of CPPs

- susceptible to melting in a forest fire
- prone to failure if not properly backfilled and compacted
- prone to puncture if coarse material is used for backfill

Arch culvert on a low clearance road, sunk into the streambed to allow for fish passage.

2. ARCH (SQUASH) CULVERTS

- Arch culverts are used for stream crossings with low road clearance.
- Their larger bottom offers fish passage advantages.
- They require less road fill.
- They are more costly than round culverts.

3. BOTTOMLESS ARCH CULVERTS (pictured on page 127)

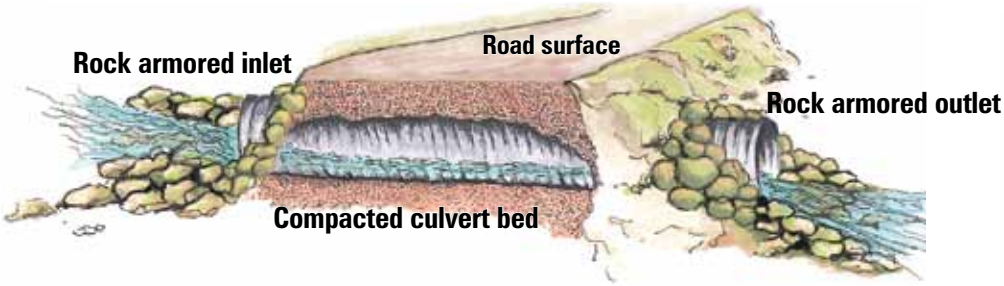
- They are the most expensive culvert installation.
- They require a concrete or rock foundation for support.
- They leave the stream bottom undisturbed.

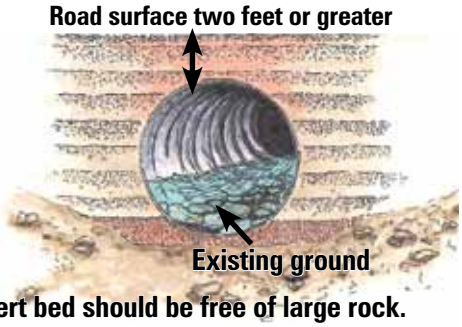
The flexibility of a plastic pipe makes it a popular alternative to a metal culvert.

Minimize fill material by restricting the width and height of the fill to only that needed for safe vehicle use and provide adequate cover above culverts and other drainage structures

Stream culvert installation details

To provide for fish passage on Type F streams, one option is for culverts to be sunk into the streambed and embedded with streambed materials. This option is most appropriate for streams with up to an 8 percent gradient with deep valley fill. For streams with a gradient less than 2.5 percent, another option is a bare culvert placed at a zero grade (less than 0.5 percent) and sunk into the streambed a minimum of 6 inches.



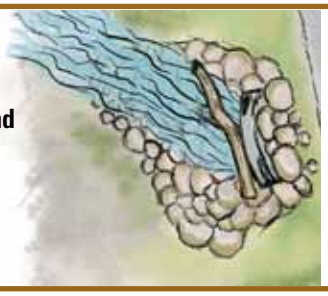


For an arch pipe, the culvert should be countersunk the greater of 20 percent or 18 inches. A round culvert should be countersunk the greater of 40 percent or 24 inches. This partial burial of the culvert into the streambed reduces water velocity in the culvert and allows gravel to deposit in the bottom. The effective width of the culvert should be equal to or exceed the width of the stream.

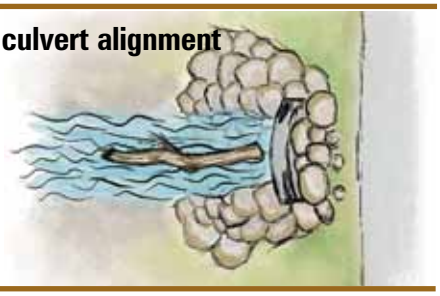
Tamp backfill material at regular intervals. Base and sidewall fill material should be compacted from finer soil particles. Fill height should extend at least 18 to 24 inches above the top of the culvert to protect the pipe from damage by traffic.

Incorrect culvert alignment

Incorrect alignment of culvert with stream results in accumulation of floating debris and eventual inlet plugging (overhead views).



Correct culvert alignment



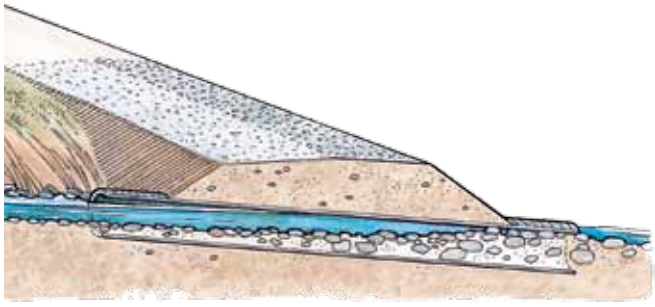
Common culvert installation problems

Culvert alignment is critical for proper culvert function. Culverts set at an angle to the channel can cause bank erosion. Skewed culverts can develop debris problems. Culvert alignment must fit the natural stream channel.

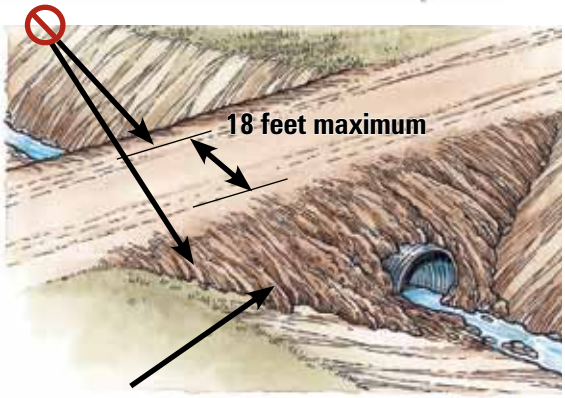
Inlet is too narrow, allowing water to erode the fill.

Outlet is too narrow and set too high, causing water to undercut the road fill and streambed.

Culverts installed at greater than stream grade result in the outlet becoming buried, and flow is restricted.



Never use a stream crossing to dispose of excess material. This road surface is wider than necessary and there's the risk of excess material entering the stream.



The slope of the fill slopes should be a maximum of 1½ :1. Soils unstable at such an angle (e.g., clays) should not be used.

How should you excavate side slopes near stream crossings?

Minimize excavation of side slopes near the channel.

What this means:
(See illustration at right)

Use the minimum possible curve radius; about 50 feet for log trucks. This may make it difficult for any future lowboy traffic, which might require more gradual curves. Instead, plan that future logging equipment may have to drive to the site and not be delivered by lowboy.

What are the requirements for fills more than 15 feet deep?

Deep fills present risks if they fail and fill material is carried downstream. Written plans are required by ODF for fills more than 15 feet deep. The design of these fills must minimize surface erosion, embankment failure and downstream movement of fill material.

How do you prevent erosion of stream crossing fills?

Prevent erosion of the fill and channel.

When stream crossing fills erode, it's likely the eroded material will enter the stream.

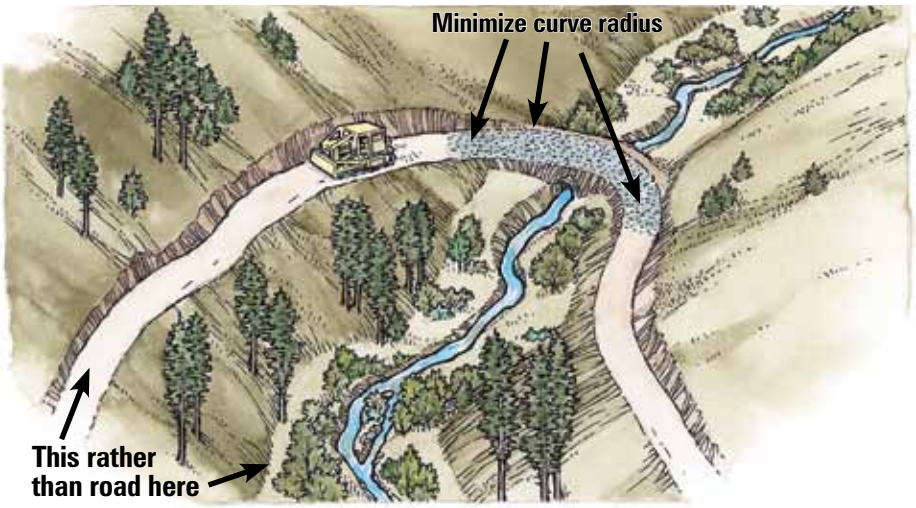
Seed and mulch fill slopes with appropriate species if germination will be successful prior to the wet season.

If not, use a non-erodible cover material such as clean gravel or riprap.

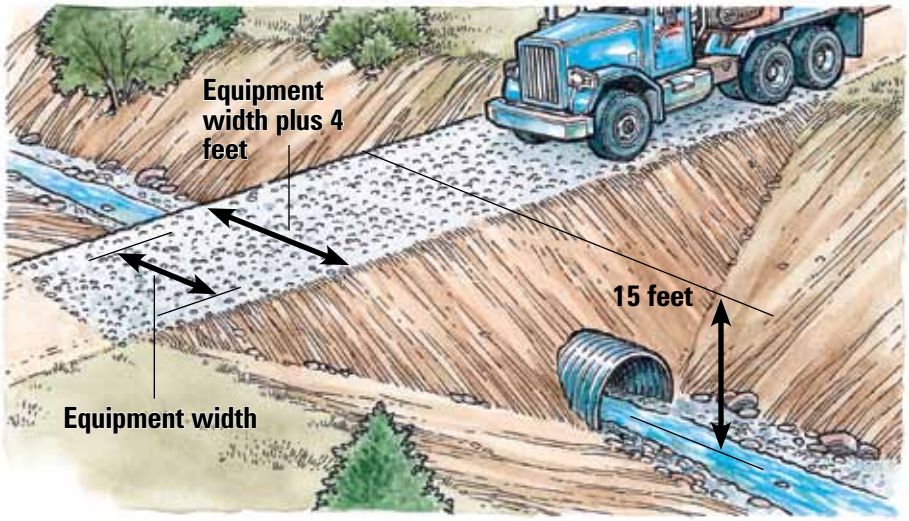
How do you avoid erosion of the stream channel below the culvert?

Install culverts that are equal to or greater than the width of the stream. This will prevent water from increasing in speed as it moves through the culvert and protect the channel below the culvert from erosion.

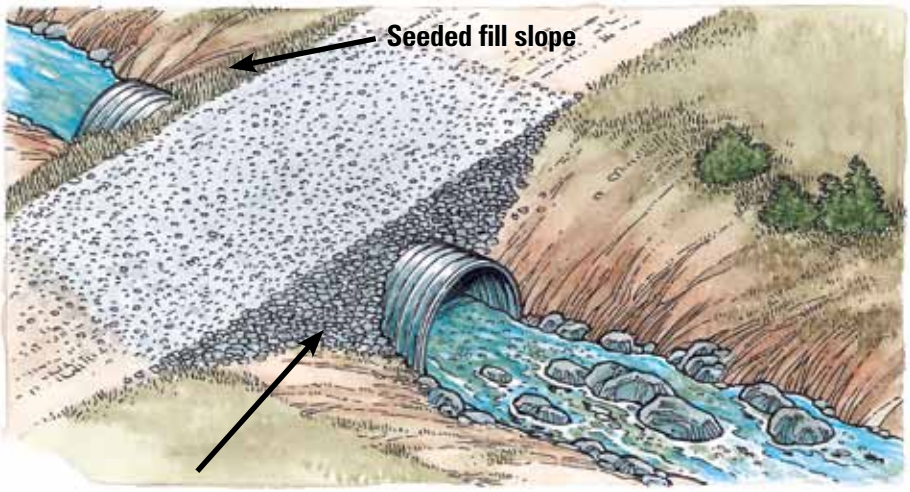
When crossing streams at right angles and where it is not necessary to place a curve in the road, the width of the fill at the top should not exceed 18 feet.



If possible, locate the road on side slopes of up to 50 percent rather than near the channel.



Where is fill depth measured? From the road running surface to the stream bottom at the downstream side.



Use gravel cover on fill slope if seeding may not be effective.

What about equipment restrictions?

Prior approval of ODF is required for machine activity in Type F or D streams, lakes and significant wetlands.

Keep streambed machine activity to an absolute minimum.

Acceptable machine activity includes crossing the stream as necessary to construct the crossing. This activity is restricted to low flow levels.

Clear water and stable flows are indicators of low flow levels.

Do not divert water from channels except when necessary to construct stream crossings.

What this means:

Minimize stream channel disturbance and impact on aquatic life. However, sometimes it's helpful to temporarily divert stream water while constructing a stream crossing. Prior approval is needed.

What about flow requirements for stream crossings?

Stream crossings must handle heavy storm flows and also allow for fish passage. Design and construct culverts, bridges and fords to:

- pass a peak flow of at least a 50-year return interval; select a size adequate to preclude ponding of water higher than the top of the culvert
- allow migration for adult and juvenile fish upstream and downstream during conditions when fish movement in that stream normally occurs

What this means:

Design all stream crossing structures to pass the 50-year peak flow without washing out (see the Appendix, page 179).

For Type F streams, design all stream crossing structures to pass juvenile and adult fish upstream and downstream.

Planning for a stream crossing must include flood calculations. When overlooked, the potential for water-quality damage is enormous. The costs of this plugged culvert road washout repair will far exceed the costs of a properly planned installation.

These requirements are for:

- all new road construction and reconstruction
- reconstruction of any partial or complete stream crossing washout
- replacement of any crossing structure

An exception to the 50-year peak flow requirement is allowed to reduce the height of fills where roads cross wide flood plains. The exception is allowed if all of these apply:

- The stream crossing includes a wide flood plain.
- The stream crossing structure matches the size of the active channel and is covered by the minimum fill necessary to protect the structure.
- Except for culvert cover, soil fill is not placed in the flood plain.
- 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.

What this means:

The intent is to reduce filling in channels and flood plains where there is a risk of major washouts.

Use this design when the flood plain at the crossing is many times the width of the active channel.

Here's an example.

If a road is located in a wide flood plain, a very deep and wide fill may be needed for a new or replacement culvert that can handle a 50-year flow. To avoid the risks of such large fills, there is an option to use a smaller (or the existing) pipe with construction of an armored depression that can handle storm flows (see illustration below).

This vented ford is a cross between a ford and a culvert crossing. Water passes through the culvert during normal flows, but the structure can accommodate peak flows across a ford section during large storms.

What about culverts and fish?

Fish move both upstream and downstream during different seasons to spawn, search for favorable water temperatures and find refuge or food during aquatic insect hatches. On Type F streams, new stream crossings or any that are reconstructed or replaced must provide for upstream and downstream passage of both adult and juvenile fish.

If a culvert is used on a Type F stream, you may be challenged to provide for adequate fish passage, especially upstream against fast-flowing waters. How the local stream features interact with pipe design, and placement must be carefully considered.

How can you make it easier for fish?

- Don't force fish to jump to enter a culvert.
- Keep culvert openings free of debris.
- Minimize culvert lengths.
- Locate culverts on a straight part of the stream.
- Set culverts below stream grade so streambed gravels can naturally accumulate in the culvert (note: A larger pipe size may be needed to accommodate a 50-year flow).

What's best for fish passage?

Each situation is unique but this is a general ranking of methods:

- re-route road (avoid/remove stream crossing)
- channel-spanning structure (long and short-span bridges; bottomless arches)
- fords (note: These are only suitable for low-traffic roads)
- streambed simulation (sunk and embedded culverts)
- bare culvert placed at a zero grade (culvert at < 0.5 percent gradient and sunk for backwatering)
- hydraulic design (weir and baffle culvert designs)

Fish may not be able to swim fast enough to overcome culvert water velocity that develops in narrow culverts that are less than the width of the stream. Rule of thumb: water moving through a bare culvert that is turbulent (uneven water surface or whitewater) is probably a fish passage barrier.

Water may be too shallow for fish to swim. This can be a problem created by bare pipes. Shallow water leaves fish only partially submerged and unable to get maximum thrust from tail and body movements.

Ensure fish movement is not impeded.

There's no pool below the inlet for fish to rest in or jump from.

Hanging culverts can be too high to jump.

Bottomless arches leave the streambed intact, making it easier for fish to pass. Natural streambed roughness creates pockets of low water velocity where fish can move more easily. Footing should be secured to bedrock to prevent the structure from failing.

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 the main channel.

What this means:

All road projects involving construction or reconstruction work should address local needs for water flow and fish passage. Such projects include:

- minor road relocation
- replacement of stream crossing structures
- any road widening
- clearing of a road closed by trees growing on the surface
- opening of any old road

What about crossing structures on side channels?

Young fish find protection in wetlands and side channels during high flows. Culverts or bridges, added to old roads, can reconnect these fish habitats.

In some cases relocating the road can be a more effective way to reconnect these fish habitats (see illustration at right). This can reduce the number of stream crossings needed to maintain road access.

What about fords?

A ford is a stream crossing option for low-service-level roads that are private, gated and have infrequent use. Access control is important to avoid damage to the ford approaches when they are vulnerable to damage and erosion. Fords seldom have year-round access.

Unimproved fords, except those on solid rock, are generally inadequate for truck traffic. Traffic breaks down stream gravels and mud is brought into the channel from vehicle tires.

Requirements depend on how much use the ford receives.

Where should a ford be located?

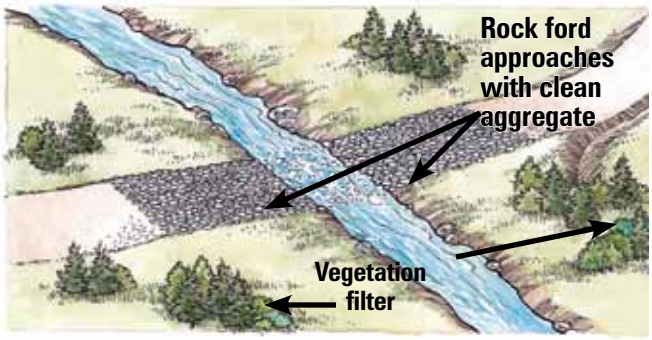
A bedrock stream bottom is ideal for a ford location. Otherwise, the bottom should be armored with suitable rock.

The size and shape of existing in-stream rock can guide the minimum size of armor rock required to resist downstream movement. It should be bigger than the common size in the stream bottom. Angular rock is preferred, because it resists movement by interlocking. Do not restrict fish passage.

Gently sloping, stable streambank approaches are preferred. Approaches should be rocked to minimize erosion when driving in and out of the ford. Where practical, approaches should be at right angles to the stream. Approaches should dip into and out of the stream, creating a concave shape that ensures the stream cannot be diverted out of its natural channel and down the road.

Early road construction techniques often filled side channels, contributing to the failure of main channel culverts during high water.

In this example, a minor relocation of the road prism resulted in only one culvert reinstalled for road access. This reduces maintenance and allows the side channel below the new crossing to be restored to a more natural condition.



Where there is light road use, fords with rocked approaches can be good alternatives to culverts. Well-designed and located fords can greatly reduce the amount of material at risk of erosion and delivery to streams during high flows.

What about bridges and bottomless arches?

These structures are the stream crossing of choice. They require carefully constructed abutments to avoid erosion and stream damage during high flows.

Avoid mid-span piers if possible. Not only are they costly, they often cause channel scour and are difficult to stabilize.

Use riprap to protect abutment fills from erosion.

Bridges are best for large streams and those plagued with floatable debris problems. Bridges and bottomless arch culverts have the least impact on fish when installed properly.

Keep road drainage under control. Even with grass cover, runoff and sediment have flowed around this abutment and drained directly into the stream.

Are there tips for new permanent bridges?

- Bridges should be sized to accommodate stream channel width and flood risk.
- Bridges and bridge approaches should be constructed to minimize soil or other material from reaching the stream.
- Whenever possible, existing vegetation and organic material should be retained around stream crossings to control erosion. Exposed soil should be covered with slash or other protective material.
- Abutments and wingwalls should prevent material from spilling into the stream.

Consider simple bridges for small Type F streams. They can be similar or lower in cost compared to large, complex culvert installations.

What are the advantages of temporary portable bridges?

- handy for stream crossings on temporary low-standard roads
- useful when short-term access to forestland is cut off by a stream
- quick, economical and can be installed with minimal impact
- can be re-used in different locations as needed
- can restore crossings to their original condition

For other information sources, see the Appendix, pages 183-184.

A portable bridge provides access across streams less than 10 feet wide with minimal disturbance to streambanks or bed. Select locations with firm soil banks, level grade and minimal vegetation clearing.

Along with its portability, this bridge is strong enough for all harvesting activities.

This 20-foot portable bridge was hauled into place on a flatbed truck, and set into place in one day. The bridge cribbing is 10-foot timbers laid on the ground four feet from the bank.

A small tractor built the road approaches to the bridge. Over a three-week period, the bridge carried approximately 25 truckloads of logs.

When harvest was completed, the temporary bridge was removed.

Other considerations

Additional requirements may affect some forest operations

This manual was designed to be relatively comprehensive, but operations on forestlands can involve such a wide range of activities that some situations can have other legal requirements and responsible agencies. Here are three examples:

Pond Construction

Unless one already exists, landowners often are interested in developing a pond on their forest property for both practical uses and amenity values. On forest land, a pond can attract unique aquatic and wildlife species, and it can provide a valuable water source if a wildfire occurs.

Constructing a pond requires a permit application and approval from the Oregon Water Resources Dept. (WRD). There is a base permit application fee and an additional fee that varies with the planned size of the pond. Be aware that construction of large ponds (i.e., those with dams over 10 feet high and storage levels over 9.2 acre-feet) require approval of a more detailed and costly application that includes a design by a licensed engineer.

Pond development also requires good planning and coordination between the application process and construction work, due to the many details and time involved. Key steps and timing for the application and permitting process include:

- landowner submits application and pays base plus pond-size fees
- WRD posts a public notice of the application within 60 days
- after this posting, there is a 60-day public comment period
- WRD issues permit decision within 180 days

Ponds are an attractive and often useful feature on forest land. Their construction requires an application and permit from the Oregon Water Resources Dept.

Removal-Fill Permits

Some projects involve the removal or filling of large amounts of soil or rock in or near a water body, activities that fall outside the scope of Oregon's Forest Practices Act and Rules (FPA). In such cases where the amounts involved are much greater than normally moved during forest road and stream crossing construction, the operation requires a removal-fill permit from the Oregon Dept. of State Lands (DSL).

More specifically, a removal-fill permit typically is needed for projects involving 50 cubic yards or more of alteration of streambed, streambanks or wetlands. Moving such large quantities could be part of a major reservoir or irrigation project, or a unique construction situation (see photo below). Beyond forestland, projects located in key salmon habitat waterways or state scenic waterways require a DSL removal-fill permit for any level of alteration.

In reviewing a removal-fill permit application, DSL determines if the project is consistent with the protection, conservation and best uses of the water resources of the state. DSL also assesses whether or not the project would unreasonably interfere with navigation, fishing and public recreation. The following steps are part of this process:

- landowner submits application and pays related fee
- application processing and review can extend up to 120 days
- if acceptable, DSL issues approval of individual permit

Projects that move a lot of material in or near a stream channel or wetland, such as this stream crossing upgrade, may require a removal-fill permit from the Oregon Dept. of State Lands.

Rock Pits and Quarries

Local development, use and abandonment of quarries or rock pits/storage areas for forestland management normally follow requirements under the Forest Practices Act and Rules. However, where quarry operations on forestlands involve large quantities of commercial products sold for non-forest uses off-property, Oregon's mining regulations apply – these are administered by the Oregon Dept. of Geology and Mineral Industries (DOGAMI).

For normal forest management-related rock projects, forest practice rule requirements focus on maintaining stable slopes and protecting water quality. Operators shall not locate quarry sites in streams; they shall prevent overburden or waste from entering waters; and they shall stabilize banks and other quarry surfaces to prevent surface erosion/landslides. Quarries or rock pits that may impact resource sites that require special protection (e.g., sensitive bird nesting, roosting and watering sites) also are subject to all related forest practice rules.

Large, commercial rock quarry operations are subject to mining regulations and DOGAMI oversight. Such operations require a fee-based permit for mining activities that exceed one acre and/or 5,000 cubic yards of new disturbance in any 12-month period, unless the excavated material stays on the property. Under these fee-based permits issued by DOGAMI, reclamation also is required and a related security deposit must be made.

For other information sources, see the Appendix, pages 183-184.

Opportunities to enhance resources through voluntary measures

Oregon offers landowners a variety of voluntary opportunities to maintain or enhance the environment as forest operations are planned and conducted. The following review describes some of the available opportunities for landowners to protect or improve forest resources — encouraging unique and better ways for achieving environmental objectives, including going beyond the standards set in law or rule.

Plan for Alternate Practice

Oregon's Forest Practices Act and Rules provide landowners and operators with an option to modify specific requirements in the law and rules, if comparable of better protection of forest resources can be achieved. This approach requires a "Plan for an Alternate Practice," a document prepared by the landowner, operator or timber owner, submitted to ODF and describing the practices that differ from those specified in the applicable law or rule.

Landowners and operators who are considering alternate forest practices or methods should contact ODF early, as not only can staff provide helpful guidance, a written plan and formal approval are required before operations can begin. The written plan must describe in sufficient detail the alternate practice and how it would yield results equal or better than under the standard rule requirements. Once the written plan is approved by ODF, the alternate practice effectively becomes the rule, and all provisions of the written plan must be met.

These are examples of some situations for which approval of alternate practices with protection standards or methods different than those specified in rule or statute may be granted:

- management actions for reasons of forest health, public safety or safety hazards
- specific practices that will improve soil, water quality, fish or wildlife habitat
- to conduct needed management following a disaster, storm, pest or disease epidemic
- when required forest practices would conflict with a resource site
- to exceed the 120 acre clearcut size limit
- to modify the reforestation requirements
- to modify the retention requirements along streams, wetlands or lakes
- to make a land use change
- to conduct activities unique to a bona fide research project
- to modify the requirements for special resource sites (threatened fish and wildlife, sensitive birds, significant wetlands, etc.)
- to conduct any other specific practice that will result in less environmental damage than if the standard requirement were applied

In the 1960s and '70s, many forest streams were cleared of woody debris with the mistaken idea that it was good for fish. The impacts of this practice persist, and carefully planned additions of large wood are desirable in many locations.

Placing large wood and other stream habitat enhancement

Many fish-bearing (Type F) streams in Oregon can be improved with more large wood structure and other key features that enhance spawning and rearing habitat for fish. Landowners are generally encouraged to make such improvements, and the forest practice rules provide further incentive by allowing somewhat greater timber harvest in nearby riparian management areas in exchange for stream enhancement projects that meet certain conditions.

The purpose of placing large wood in streams is to simulate additions from windthrow and other natural processes. The goal is to maintain and restore stream habitat with relatively stable features, although some reconfiguration of the wood is expected with changes in natural stream flow. Wood placement projects often are most efficient when combined with other forest operations, and such projects must meet all applicable forest practice requirements, including preparation of a written plan. Wood placement also must follow standards developed by ODF and the Oregon Dept. of Fish and Wildlife, currently found in the publication "A Guide to Placing Large Wood in Streams."

With an approved wood placement project, landowners may also qualify for basal area "credit" toward the live-tree retention requirements in the stream RMA (see Chapters 1 and 2). This can allow for harvest of more timber from the RMA; i.e., use of the "Active Management Target" for basal area retention. The specific basal area credit amount given depends on both the stream size and the size and number of logs that are placed in the stream.

Other stream enhancement projects also may qualify for basal area credit toward the RMA tree retention requirements. Such projects include creation of backwater alcoves, riparian grazing control measures (e.g., fencing) and placement of other habitat structure (e.g., boulders, rootwads) in stream channels. A written plan is required, and the basal area credit granted is negotiated between the agencies and the landowner/operator.

For both wood placement and other stream enhancement projects, it may be possible to apply the associated basal area credit to an RMA location some distance away from the project or at a later date, as long as resources are adequately protected.

Did you know?

Oregon law gives landowners general protection from liability for injury or property damage that results from trees or large woody debris left to comply with forest practice requirements. This includes approved large wood placement for habitat enhancement, which could move downstream during flood flows.

Stewardship Agreements

Stewardship agreements provide a unique approach for landowners to meet and improve upon the basic regulatory requirements for fish and wildlife habitat and water quality protection. The stewardship agreement program promotes voluntary cooperative partnerships between forest landowners and ODF, with management flexibility, assistance and other incentives for participation. The program also provides a way to more efficiently implement the FPA, as an alternative to traditional forest operations enforcement.

A stewardship agreement is based on a written plan for resource conservation, which describes how the landowner will manage the property with particular attention to specific concerns for fish and wildlife habitat and soil and water resources. Unlike forest practices notifications or related written plans for individual operations, the plan developed for a stewardship agreement takes a long-term and property-wide perspective. Landowner efforts such as participation in a forest certification program (e.g., American Tree Farm, Sustainable Forestry Initiative) or a habitat conservation plan can help qualify a landowner for a stewardship agreement.

In response to the landowner's added commitment to resource protection, traditional requirements for planning, review, inspection and enforcement under the Oregon Forest Practices Act can be reduced. This benefit requires that the agreement include sufficient detail to address the general needs for operations notifications, written plans, 15-day waiting periods (except aerial chemical applications) and notices for water withdrawals or public subscriptions. Another benefit to the landowner is agency commitment to provide specific help or incentives, such as conservation program information, technical assistance and coordination with other agencies to resolve issues.

Participation in a forest certification program can help a landowner qualify for a stewardship agreement.

Before a stewardship agreement is approved, the process includes a public notice and 21-day period for comment on the proposed agreement. However, there also are provisions for protecting confidential information in the management plan. In addition, ODF access to the property is limited to reviews and audits that the landowner commits to in the agreement.

Afforestation Incentive

There are afforestation incentive rules, administered by ODF, that encourage landowners to convert parcels of idle, non-forested land suitable for forest cover to commercial forest use. The incentive is a one-time exemption from most tree retention requirements under the Oregon Forest Practices Act, which applies to the entire first rotation following afforestation of a parcel. This single, specially exempted rotation can be of any length, determined by the landowner's choice of when to harvest.

The trees exempted from most retention rules include those that are planted and also those naturally regenerated within 10 years (before or after) of when the area is certified by ODF as afforested. Harvest of these trees otherwise must follow all applicable forest practice requirements, and all trees within 20 feet of most streams also must be retained.

To qualify for the incentive, tracts must be at least 5 contiguous acres and determined by ODF to have been idle or exclusively in non-forest uses, or in an understocked condition, since July 1, 1972. Other understocked forestland also may qualify for the incentive, if the stocking was reduced or limited by causes other than a forest operation after July 1972. However, the afforestation incentive cannot be applied to any acre with 25 square feet or more of basal area.

The Oregon Plan for Salmon and Watersheds

Oregon Plan for Salmon and Watersheds

The Oregon Plan for Salmon and Watersheds seeks to restore salmon runs, improve water quality and achieve healthy watersheds and strong communities throughout the state. Adopted in 1997 by the governor's office with the support of the Legislature and broad-based interests, the plan focuses on voluntary contributions and cooperation among private landowners, government agencies and other groups and individuals. These efforts span the state and involve the forest, agriculture and business sectors in rural, suburban and urban communities.

On forest lands, habitat and watershed improvement projects fall into four general categories: improving road drainage and stream crossings; placing large wood in streams; restoring wetlands; and improving riparian vegetation. More specifically, forest landowners have cooperated in planning and implementing many types of projects, including:

- assessing forest road condition to plan for improved drainage and fish passage
- replacing old culverts with fish-passable pipes or bridges
- placing logs in streams to create pools and hiding places for young fish
- improving forest road drainage and surfacing to reduce muddy runoff
- installing fencing and water sources to keep livestock out of streams and allow riparian vegetation to recover

Landowners can receive both technical and financial assistance for such for projects by participating in the Oregon Plan. Funding for this assistance comes from Oregon Lottery funds, federal funds, and proceeds from the sale of salmon license plates, with grant administration by the Oregon Watershed Enhancement Board (OWEB). Local watershed councils, soil and water conservation districts, OSU Extension offices, ODF and other agencies provide technical assistance and help landowners apply for financial support from OWEB and other sources.

An important aspect of the Oregon Plan is the annual collection and reporting of stream and watershed enhancement accomplishments. These records show that forest landowners have conducted a majority of the stream habitat restoration projects completed since 1997 under the Oregon Plan. Between 1997 and 2010, commercial private-forest landowners contributed more than $84 million in private funds toward watershed enhancement. Hundreds of stream crossing were improved by replacing or repairing culverts where fish passage was blocked or threatened.

Financial Assistance for Family Forest Owners

About 35 percent of the forest land in Oregon is privately owned, and nearly 5 million acres of that land is in individual "family forest" ownerships that are less than 5,000 acres. Because of the valuable natural resources and broad benefits these lands can provide, financial and technical assistance programs exist to encourage and help support family forest owners in managing these resources and maintaining these lands in forestland use. Most programs have a resource conservation or enhancement emphasis, with fish and wildlife habitat or watershed benefits a priority.However, some address concerns such as forest health, noxious weeds and underproductive forestlands.

With approved management plans and projects, landowners can receive payments for desired practices, project cost-sharing up to 50-75 percent, annual land rental payments, tax credits or partial to full land value compensation for easements. Contracts are required for some programs and multiyear commitments may be an option. Following is a list and brief descriptions of the focus of several of the major programs that are available to family forest owners:

Conservation Stewardship Program (CSP)

Maintain existing stewardship and adopt additional conservation on private, non-industrial working forests and agricultural lands.

Conservation Reserve Program (CRP)

Improve natural resources by placing highly erodible and other environmentally sensitive pasture or cropland into conservation practices that reduce erosion, improve water quality and enhance habitat.

Conservation Reserve Enhancement Program (CREP)

Encourage protection of soil, water, fish and wildlife through plant establishment along streams.

Environmental Quality Incentives Program (EQIP)

Encourage management practices to conserve soil, water and related natural resources on working lands.

Forest Stewardship Plan

Assist landowners in stewardship planning and decisions, and recommended resource practices.

Healthy Forests Reserve Program (HFRP)

Restore and enhance ecosystems and habitat for threatened and endangered species while promoting sustainable timber harvests on working forestlands.

Wildlife Habitat Incentive Program (WHIP)

Establish and improve fish and wildlife habitat on private lands.

Wetlands Reserve Program (WRP)

Restore, protect and enhance wetland functions and values on private property.

Bark Beetle Mitigation Funds

Assist landowners in prevention and restoration of areas affected by bark beetles.

Noxious Weed Control Grants

Assist landowners and others in projects to control noxious weeds.

Underproductive Forestland Conversion Tax Credit

Encourage landowners to establish and maintain healthy and productive forests.

Forest Resource Trust – Forest Establishment Program

Encourage reforestation of non-forested land to provide environmental, social and economic benefits.

Landowners can get further information about these assistance programs from ODF, as well as other agencies that administer a number of these programs, including the USDA Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA).

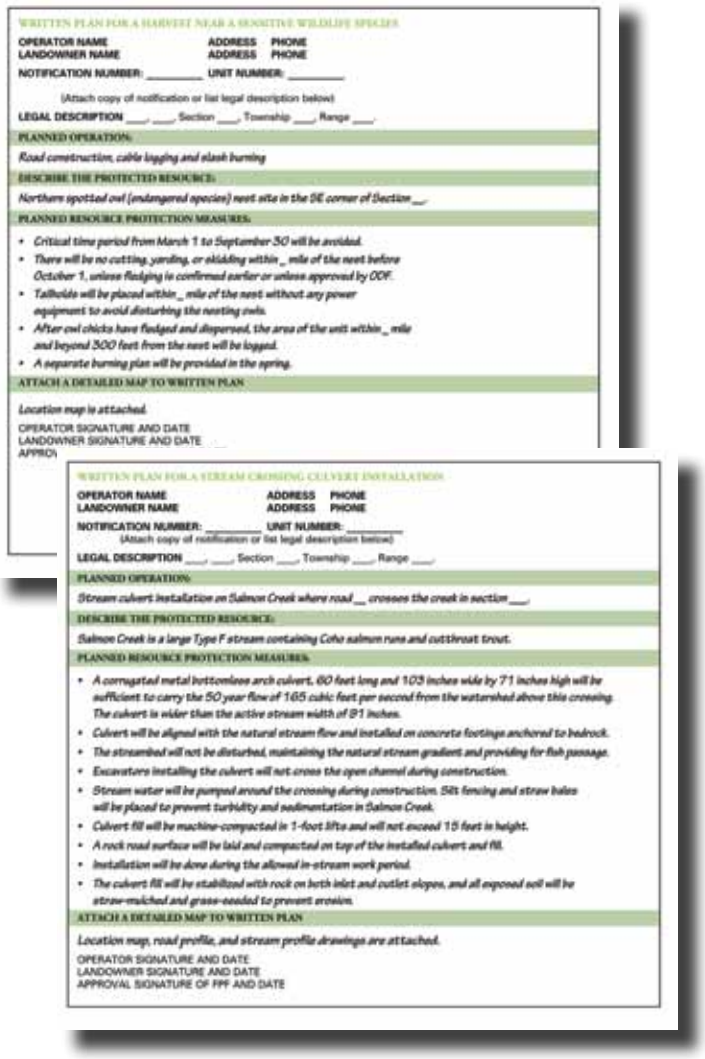
For other information sources, see the Appendix, pages 183-184.

Lands impacted by wildfire may qualify for the afforestation incentive.

Appendix

What you should know about a written plan

It's a document, submitted by a landowner or operator to the Oregon Department of Forestry. It's more than the Notification of Operations – it describes specifically how an operation will meet the requirements of the Oregon Forest Practices Act and Rules. ODF must review it before the operation begins.



WRITTEN PLAN FOR A HARVEST NEAR A SENSITIVE WILDLIFE SPECIES

OPERATOR NAME ADDRESS PHONE
LANDOWNER NAME ADDRESS PHONE
NOTIFICATION NUMBER: _____ UNIT NUMBER: _____
(Attach copy of notification or list legal description below)
LEGAL DESCRIPTION ___, ___, Section ___, Township ___, Range ___.

PLANNED OPERATION:
Road construction, cable logging and slash burning

DESCRIBE THE PROTECTED RESOURCE:
Northern spotted owl (endangered species) nest site in the SE corner of Section __.

PLANNED RESOURCE PROTECTION MEASURES:
- *Critical time period from March 1 to September 30 will be avoided.*
- *There will be no cutting, yarding, or skidding within _ mile of the nest before October 1, unless fledging is confirmed earlier or unless approved by ODF.*
- *Tailholds will be placed within _ mile of the nest without any power equipment to avoid disturbing the nesting owls.*
- *After owl chicks have fledged and dispersed, the area of the unit within _ mile and beyond 300 feet from the nest will be logged.*
- *A separate burning plan will be provided in the spring.*

ATTACH A DETAILED MAP TO WRITTEN PLAN
Location map is attached.
OPERATOR SIGNATURE AND DATE
LANDOWNER SIGNATURE AND DATE
APPRO

WRITTEN PLAN FOR A STREAM CROSSING CULVERT INSTALLATION

OPERATOR NAME ADDRESS PHONE
LANDOWNER NAME ADDRESS PHONE
NOTIFICATION NUMBER: _____ UNIT NUMBER: _____
(Attach copy of notification or list legal description below)
LEGAL DESCRIPTION ___, ___, Section ___, Township ___, Range ___.

PLANNED OPERATION:
Stream culvert installation on Salmon Creek where road __ crosses the creek in section __.

DESCRIBE THE PROTECTED RESOURCE:
Salmon Creek is a large Type F stream containing Coho salmon runs and cutthroat trout.

PLANNED RESOURCE PROTECTION MEASURES:
- *A corrugated metal bottomless arch culvert, 60 feet long and 103 inches wide by 71 inches high will be sufficient to carry the 50 year flow of 165 cubic feet per second from the watershed above this crossing. The culvert is wider than the active stream width of 91 inches.*
- *Culvert will be aligned with the natural stream flow and installed on concrete footings anchored to bedrock.*
- *The streambed will not be disturbed, maintaining the natural stream gradient and providing for fish passage.*
- *Excavators installing the culvert will not cross the open channel during construction.*
- *Stream water will be pumped around the crossing during construction. Silt fencing and straw bales will be placed to prevent turbidity and sedimentation in Salmon Creek.*
- *Culvert fill will be machine-compacted in 1-foot lifts and will not exceed 15 feet in height.*
- *A rock road surface will be laid and compacted on top of the installed culvert and fill.*
- *Installation will be done during the allowed in-stream work period.*
- *The culvert fill will be stabilized with rock on both inlet and outlet slopes, and all exposed soil will be straw-mulched and grass-seeded to prevent erosion.*

ATTACH A DETAILED MAP TO WRITTEN PLAN
Location map, road profile, and stream profile drawings are attached.
OPERATOR SIGNATURE AND DATE
LANDOWNER SIGNATURE AND DATE
APPROVAL SIGNATURE OF FPF AND DATE

Written plans are always required for operations:

- within 100 feet of a Type F or D stream or large lake
- within 300 feet of a significant wetland
- within 300 feet of a sensitive wildlife site used by threatened or endangered species or other sensitive birds; written plans may be required for these places when the operations are farther away than 300 feet if they could conflict with site protection

Written plans **may** be needed for other practices that require ODF review and, in some cases, formal approval. These practices include:

- operations on high landslide hazard locations
- road construction with risk of material entering waters of the state
- burning in a riparian management area
- locating a log landing in an RMA
- road construction in an RMA
- stream crossings with 15 feet or higher fills
- temporary stream crossings with 8 feet or higher fills
- placement of wood in Type F streams
- vegetation retention modification along Type F streams
- vegetation modification along Type D and N streams
- locating a yarding corridor in an RMA
- activities that affect sensitive wildlife habitat
- machine activity in stream channels
- alternate practices
- beaver dam removal
- land use changes

See sample written plans, which include:

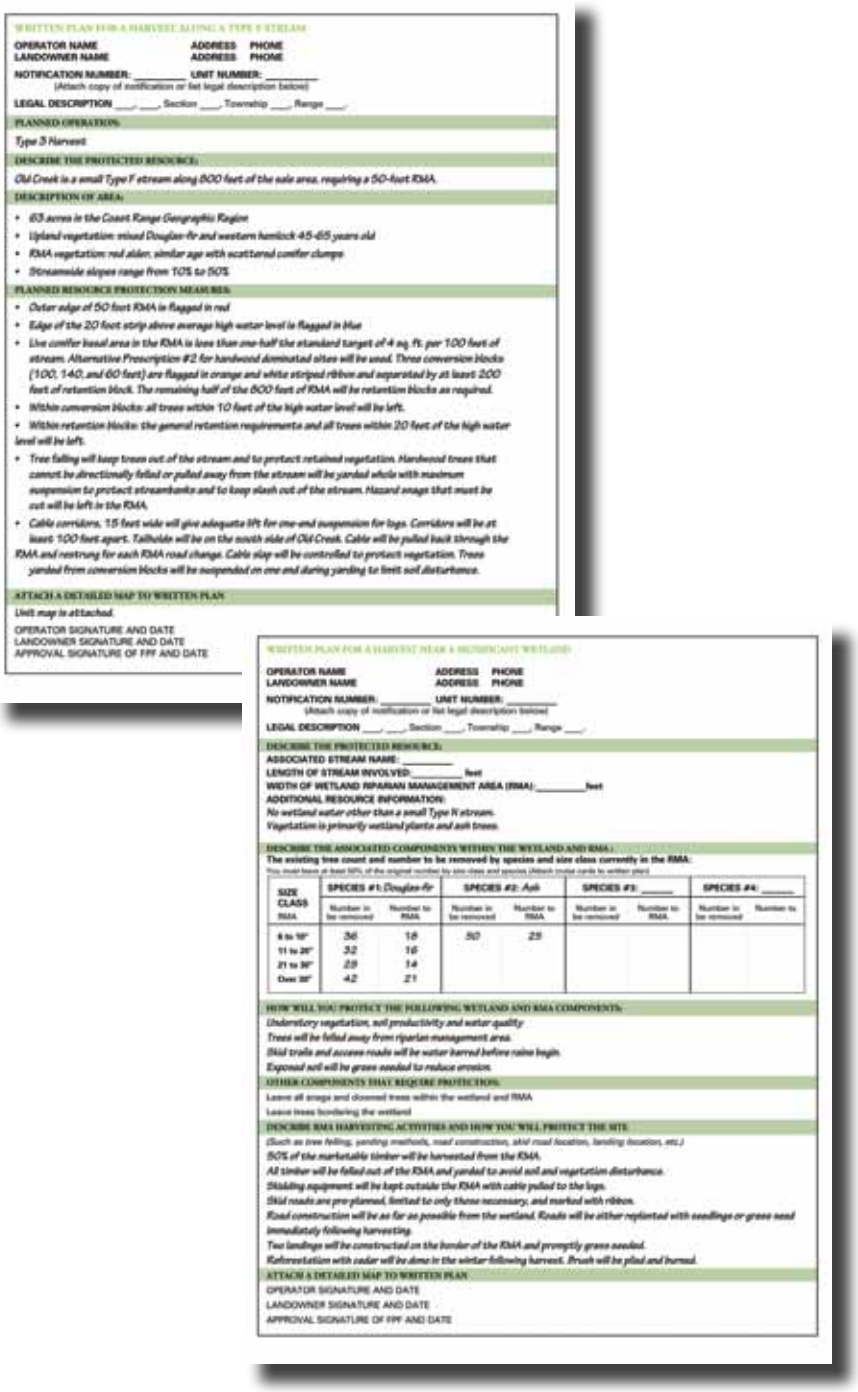
- written plan for a sensitive wildlife site
- written plan for a stream crossing
- written plan for a harvest near a Type F stream
- written plan for a harvest near a significant wetland

Here's a list of items needed in every written plan:

- a legal description or reference to a Notification of Operation and number
- a map showing the operation, the protected resource and section lines, access roads and other important landscape features
- complete description of what's going to be done
- a description of the resource site you are protecting
- a description of how you will do the planned activities to protect the resource site during the operation

Are there fill-in-the-blank forms for written plans?

Yes, they are available from ODF.



WRITTEN PLAN FOR A HARVEST ALONG A TYPE F STREAM

OPERATOR NAME ADDRESS PHONE
LANDOWNER NAME ADDRESS PHONE

NOTIFICATION NUMBER: _____ UNIT NUMBER: _____
(Attach copy of notification or list legal description below)

LEGAL DESCRIPTION ___, ___, Section ___, Township ___, Range ___.

PLANNED OPERATION:

Type 3 Harvest

DESCRIBE THE PROTECTED RESOURCE:

Old Creek is a small Type F stream along 800 feet of the sale area, requiring a 50-foot RMA.

DESCRIPTION OF AREA:

- *65 acres in the Coast Range Geographic Region*
- *Upland vegetation: mixed Douglas-fir and western hemlock 45-65 years old*
- *RMA vegetation: red alder, similar age with scattered conifer clumps*
- *Streamside slopes range from 10% to 50%*

PLANNED RESOURCE PROTECTION MEASURES:

- *Outer edge of 50 foot RMA is flagged in red*
- *Edge of the 20 foot strip above average high water level is flagged in blue*
- *Live conifer basal area in the RMA is less than one-half the standard target of 4 sq. ft. per 100 feet of stream. Alternative Prescription #2 for hardwood dominated sites will be used. Three conversion blocks (100, 140, and 60 feet) are flagged in orange and white striped ribbon and separated by at least 200 feet of retention block. The remaining half of the 800 feet of RMA will be retention blocks as required.*
- *Within conversion blocks: all trees within 10 feet of the high water level will be left.*
- *Within retention blocks: the general retention requirements and all trees within 20 feet of the high water level will be left.*
- *Tree falling will keep trees out of the stream and to protect retained vegetation. Hardwood trees that cannot be directionally felled or pulled away from the stream will be yarded whole with maximum suspension to protect streambanks and to keep slash out of the stream. Hazard snags that must be cut will be left in the RMA.*
- *Cable corridors, 15 feet wide will give adequate lift for one-end suspension for logs. Corridors will be at least 100 feet apart. Tailholds will be on the south side of Old Creek. Cable will be pulled back through the RMA and restrung for each RMA road change. Cable slap will be controlled to protect vegetation. Trees yarded from conversion blocks will be suspended on one end during yarding to limit soil disturbance.*

ATTACH A DETAILED MAP TO WRITTEN PLAN

Unit map is attached.

OPERATOR SIGNATURE AND DATE
LANDOWNER SIGNATURE AND DATE
APPROVAL SIGNATURE OF FPF AND DATE

WRITTEN PLAN FOR A HARVEST NEAR A SIGNIFICANT WETLAND

OPERATOR NAME ADDRESS PHONE
LANDOWNER NAME ADDRESS PHONE

NOTIFICATION NUMBER: _____ UNIT NUMBER: _____
(Attach copy of notification or list legal description below)

LEGAL DESCRIPTION ___, ___, Section ___, Township ___, Range ___.

DESCRIBE THE PROTECTED RESOURCE:

ASSOCIATED STREAM NAME: _____
LENGTH OF STREAM INVOLVED: _____ feet
WIDTH OF WETLAND RIPARIAN MANAGEMENT AREA (RMA): _____ feet
ADDITIONAL RESOURCE INFORMATION:

No wetland water other than a small Type N stream.
Vegetation is primarily wetland plants and ash trees.

DESCRIBE THE ASSOCIATED COMPONENTS WITHIN THE WETLAND AND RMA:

The existing tree count and number to be removed by species and size class currently in the RMA:

You must leave at least 50% of the original number by size class and species (Attach cruise cards to written plan)

SIZE CLASS RMA	SPECIES #1: *Douglas-fir*		SPECIES #2: *Ash*		SPECIES #3: _____		SPECIES #4: _____	
	Number in be removed	Number to RMA	Number in be removed	Number to RMA	Number in be removed	Number to RMA	Number in be removed	Number to
6 to 10"	*36*	*18*	*50*	*25*				
11 to 20"	*32*	*16*						
21 to 30"	*28*	*14*						
Over 30"	*42*	*21*						

HOW WILL YOU PROTECT THE FOLLOWING WETLAND AND RMA COMPONENTS:

Understory vegetation, soil productivity and water quality
Trees will be felled away from riparian management area.
Skid trails and access roads will be water barred before rains begin.
Exposed soil will be grass seeded to reduce erosion.

OTHER COMPONENTS THAT REQUIRE PROTECTION:

Leave all snags and downed trees within the wetland and RMA
Leave trees bordering the wetland

DESCRIBE RMA HARVESTING ACTIVITIES AND HOW YOU WILL PROTECT THE SITE

(Such as tree felling, yarding methods, road construction, skid road location, landing location, etc.)

50% of the marketable timber will be harvested from the RMA.
All timber will be felled out of the RMA and yarded to avoid soil and vegetation disturbance.
Skidding equipment will be kept outside the RMA with cable pulled to the logs.
Skid roads are pre-planned, limited to only those necessary, and marked with ribbon.
Road construction will be as far as possible from the wetland. Roads will be either replanted with seedlings or grass seed immediately following harvesting.
Two landings will be constructed on the border of the RMA and promptly grass seeded.
Reforestation with cedar will be done in the winter following harvest. Brush will be piled and burned.

ATTACH A DETAILED MAP TO WRITTEN PLAN

OPERATOR SIGNATURE AND DATE
LANDOWNER SIGNATURE AND DATE
APPROVAL SIGNATURE OF FPF AND DATE

How to determine the site class for your harvest unit

What is site class?

Site class is a way to classify forests according to how well trees grow. Trees grow faster in locations with fertile soils and plenty of moisture – these areas have higher site classes. Trees grow more slowly in rocky soils and drier climates where the site class is lower. The Oregon Forest Practices Act and Rules use six forest site classes, ranging from I, the highest site class, down to VI, the lowest. Site classes are measures of how many cubic feet of wood an acre of forest can grow each year until it reaches maturity and starts to slow down. Table A-1 shows how site classes are grouped according to their wood production for the purposes of the requirements.

Table A-1 Site Classes for Oregon Forestlands

	I, II, III (High)	IV and V (Medium)	VI (Low)
Annual forest growth (cubic feet of wood volume per acre per year)	120 plus	50-119	20-49

Why do you need to know the site class?

Site class is the basis for many specific requirements. It helps determine harvest type and reforestation stocking standards, and also the requirements for harvest unit leave trees, down wood and harvest size limitations.

How can you find the site class for your harvest unit or reforestation area?

1. Your ODF office can help you determine the site class of your harvest unit or reforestation area.
2. You can hire a consulting forester.
3. You can determine site class on your own. To do that, first determine "site index," which can be converted to site class. Site index is a measure of the height (in feet) that forest trees will grow to at a specific age, usually 50 or 100 years. A higher site index value means that the forest is more productive and the trees will grow faster. Site index varies for different tree species, because each species has its own characteristic growth rate.

Here are two ways to find the site index for your property.

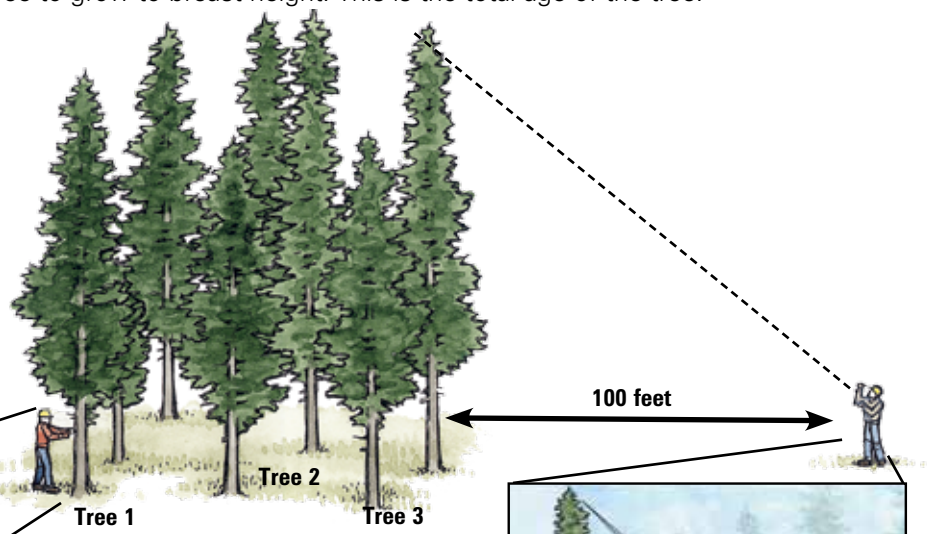
1. Check the soil survey published by the Natural Resources Conservation Service for most Oregon counties. Locate your harvest unit on the soil survey map, find your soil type and note the site index for the primary tree species that grows in your area ***OR***

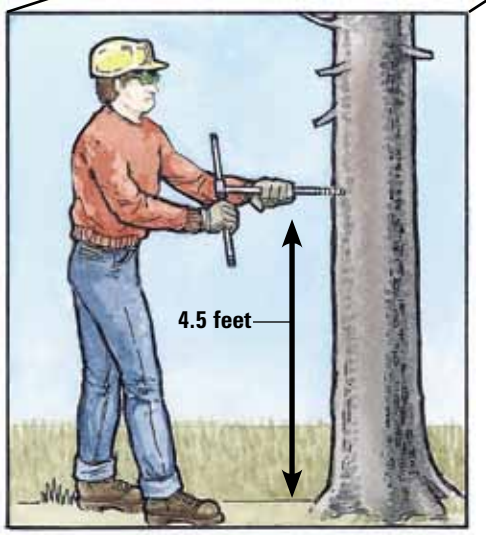
2. Measure site index directly, following this process:

   A. Choose at least three trees, all the same species, that have grown with their crowns in the upper portion of the forest canopy.

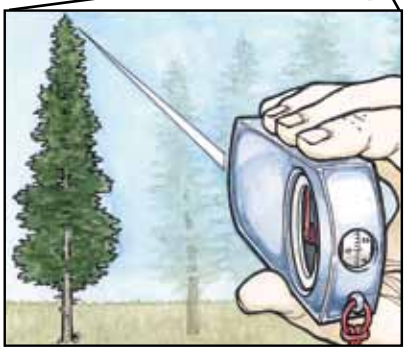
   B. For each tree, measure and record the age and height.

   To determine age, use an increment borer to take a core sample from the tree at 4.5 feet above the ground (breast height) and count the growth rings. Add five to 10 years to the ring count to account for the number of years it took the tree to grow to breast height. This is the total age of the tree.





To determine height, use a clinometer or angle-measuring device. Measuring tree height is not difficult, but it takes instruction and practice to be accurate. See "Other information sources below" for a publication on using an increment borer, clinometer and other forest measurement tools.



Clinometer measuring tree height.

   C. Use the table for your tree species to figure out the site index for each tree you measure. For example, let's say you measured a Douglas-fir from a forest in western Oregon and found the tree was 70 years old and 110 feet tall.

Table A-2 on page 145 shows that the 100-year site index of the tree would be 130. That means that if the tree continues growing to age 100, it is expected to grow to about 130 feet tall. Tables A-2, A-3 and A-4 allow you to find Douglas-fir site indexes (100- or 50-year basis) and ponderosa pine site indexes (100-year basis).

   D. The next step is to take the site index figure from Tables A-2, A-3 or A-4 and plug it into Table A-5 (at left) to find out the corresponding site class. For example, the Douglas-fir tree that had a 100-year site index of 130 is in the high category, which includes site classes I, II and III.

Table A-5 Matching Site Index To Site Class

Site Class	I, II, III (High)	IV and V (Medium)	VI (Low)
Douglas-fir site index (100-year basis, westside)	124 or more	80-123	Contact ODF
Douglas-fir site index (50-year basis, westside)	92 or more	70-91	Contact ODF
Ponderosa pine site index (100-year basis)	109 or more	64-108	40-63

For other information sources, see the Appendix, pages 183-184.

Table A-2 Site Index for Douglas-fir, Western Oregon, 100-year Basis														
Total age (years)	Total height (feet)													
20	21	24	26	29	31	34	37	39	42	44	47	49	52	54
30	37	41	46	50	55	60	64	69	74	78	83	88	92	96
40	48	54	60	66	72	78	84	90	96	102	108	114	120	126
50	56	63	70	77	84	91	98	105	112	119	125	132	139	146
60	63	70	78	86	93	101	109	117	124	132	140	148	156	163
70	68	77	85	94	102	110	119	127	135	144	152	161	170	178
80	73	82	91	100	109	118	127	136	145	154	163	172	181	190
90	77	86	96	105	115	125	134	144	153	163	172	182	192	201
100	80	90	100	110	120	130	140	150	160	170	180	190	200	210
Site index	80	90	100	110	120	130	140	150	160	170	180	190	200	210

Table A-3 Site Index for Douglas-fir, Western Oregon, 50-year Basis										
Age (years, at DBH)	Total height (feet)									
10	16	18	20	22	24	27	29	32	34	37
20	30	35	40	44	49	54	59	63	68	73
30	42	49	56	63	70	76	83	90	97	103
40	53	61	69	78	86	95	103	112	120	129
50	60	70	80	90	100	110	120	130	140	150
Site Class	60	70	80	90	100	110	120	130	140	150
Note: the first column is based on age at DBH (4.5 feet above ground), not total height of tree as in Tables A-2 and A-4. Do not add any years to the DBH age, unlike total age as noted on page 144.										

Table A-4 Site Index for Ponderosa Pine, 100-year Basis													
Total age (years)	Total height (feet)												
20	6	9	12	16	20	25	30	35	40	45	50	55	60
30	11	15	20	26	32	38	44	51	57	64	70	77	84
40	16	22	28	35	42	49	55	63	70	77	85	93	100
50	21	28	35	43	51	58	65	73	80	89	97	105	113
60	26	34	42	50	58	66	73	81	90	99	107	115	124
70	30	39	47	56	64	73	80	89	98	108	116	125	134
80	34	43	52	61	70	79	88	97	106	116	124	133	143
90	37	47	57	66	75	85	94	104	113	123	132	142	152
100	40	50	60	70	80	90	100	110	120	130	140	150	160
Site class	40	50	60	70	80	90	100	110	120	130	140	150	160

Common types of timber harvest systems

Cutting trees, moving logs to a landing and loading logs for transport to a mill are all part of a timber harvest system. It's the way forest owners supply wood products that everyone uses. It also helps them effectively establish new forests. There are different timber harvest systems. Each one has advantages, which are described below. Modifications can make them even more versatile.

What are the harvest systems?

1. conventional chainsaw and tractor/skidder harvest
2. cable logging
3. shovel logging
4. cut-to-length harvesting
5. whole-tree harvesting
6. helicopter logging

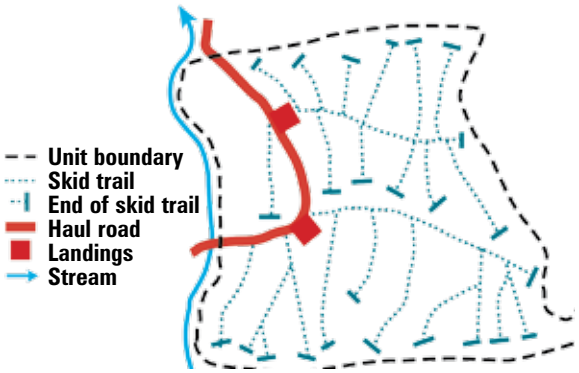
The terrain of your harvest unit will influence your choice of a logging system. On gentle terrain, tree processors and forwarders, excavators, tractors and skidders (explained in the following pages) and even horses can be logical choices. On steep terrain, the choice shifts to cable or helicopter systems.

Conventional chainsaw and tractor/skidder harvest

Hand-operated chainsaws are used to cut, delimb and buck trees into logs at the stumps. Skidders or crawler tractors (dozers) drag the logs to landings, where they are loaded onto trucks.

Tree felling, limbing and bucking are done with chainsaws.

Typical harvest layout. Skid trails should be planned and marked in advance. They often follow parallel branching patterns as shown (see Page 60). By winching logs across greater distances, skid trails can be located farther apart, reducing the area of skid trails and soil impacts from vehicle traffic.



Advantages

- adaptable to smaller harvest locations
- generally less costly equipment

Equipment used

- chainsaw
- log skidder or crawler tractor (dozer)
- log loader or self-loading log truck

Topography considerations

- normally restricted to slopes less than 35 percent
- haul roads usually located at the bottom of the logging unit

Soil considerations

- use of designated skid trails keeps machines on planned routes to help reduce soil disturbance
- on weaker soils, heavy traffic may result in trail ruts that require more water bars after logging
- soil disturbance can be reduced with widely spaced trails and pulling a winch line farther to logs – synthetic lines and other equipment features can make this task easier
- tractors and skidders should lift the front end of logs to reduce soil gouging

Forest stand considerations

- provides much flexibility with a variety of stand management goals

Slash disposal considerations

- lop and scatter possible with light accumulations of slash
- pile and burn is an option but requires additional steps and costs
- chipping and biomass energy utilization may be possible

Reforestation considerations

- yarding traffic or post-logging treatment can scarify ground and create areas for natural regeneration or hand-planting
- some advance regeneration may be lost or damaged by vehicle traffic

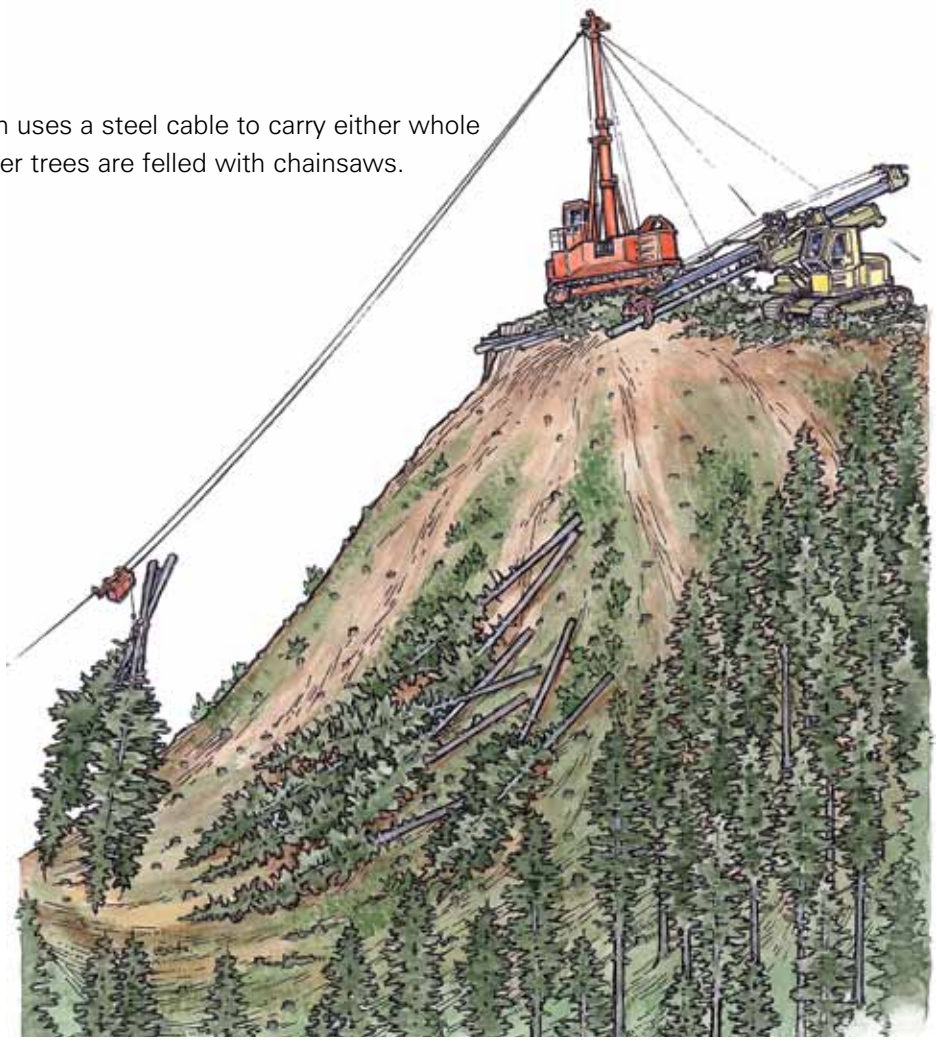
Economic considerations

- often more labor intensive
- generally, more roads are necessary
- least expensive method if road construction is not needed or is budgeted separately

Left: Skidders or dozers drag logs from the forest to the log landing. To reduce soil disturbance, rubber-tired skidders or crawler tractors are kept on skid trails. Winch line and chokers pull logs to the machine. Right: At the landing, a log loader moves logs onto trucks for delivery to the mill.

Cable logging

On steep terrain, this system uses a steel cable to carry either whole trees or logs to a landing after trees are felled with chainsaws.



Cable yarding systems can reach out 2,500 feet or more, especially with intermediate cable supports. This can help limit road construction needs.

Advantages

- allows for harvesting on steep ground and other sensitive terrain
- eliminates the need for skid trails
- can reduce construction and less favorable locations of roads

Equipment used

- chainsaw
- cable yarder
- delimber and log loader

Topography considerations

- well-suited for slopes of 35 percent and greater
- concave slopes allow more cable deflection and greater system efficiency
- intermediate supports allow for log lift in uneven terrain
- haul roads usually located at the top of the logging unit

Soil considerations

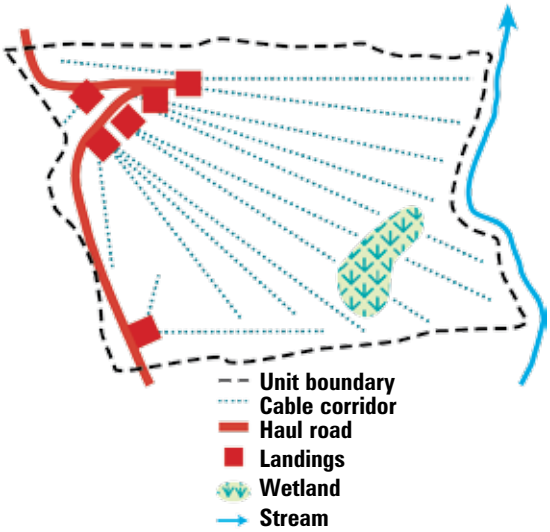
- can significantly reduce soil compaction and disturbance if logs are properly lifted
- heavy equipment is confined to roads and landings

Forest stand considerations

- primarily used with clearcuts and some partial cuts
- a more difficult method for thinning, with potential damage to residual stems

Slash disposal considerations

- if whole trees are brought to the landing, in-unit slash is minimized



Typical cable harvest layout. Generally logs are pulled uphill, but can also be moved downhill. With a strategic layout, logs can be lifted over streams, wetlands and canyons (see page 63).

- heavy slash piles at the landing must be treated or utilized
- if whole tree yarding is not used, prescribed burning of slash may be needed (see pages 69-72)

Reforestation considerations

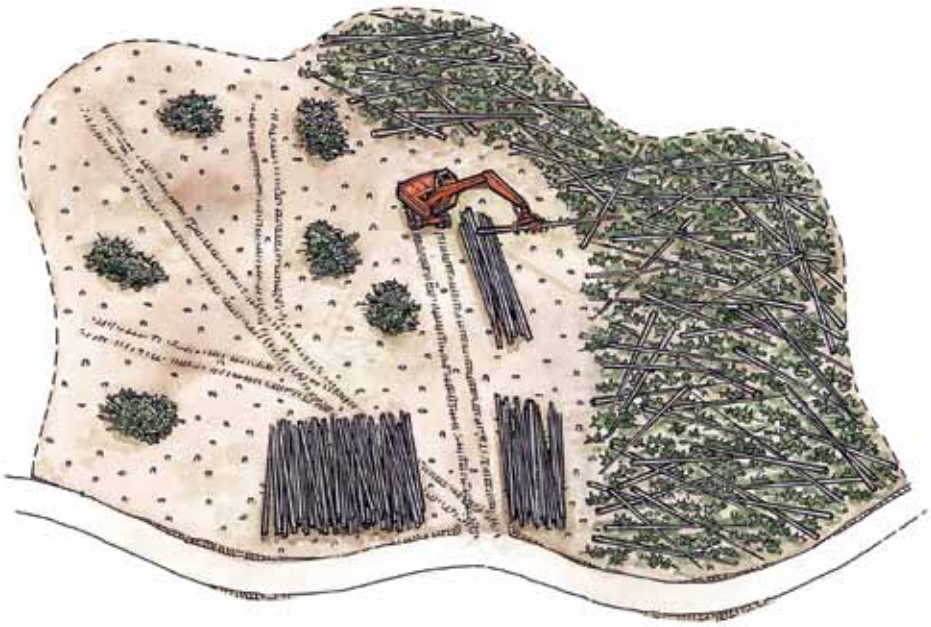
- may expose fewer spots for easier planting or natural seeding
- brush control needs also may be greater when scarification is reduced

Economic considerations

- can be more costly and specialized than ground-based systems
- small-scale systems can be competitive in some situations

Shovel logging

This ground-based harvest system uses a log loader (also called a shovel) to move logs rather than a skidder, tractor or forwarder. The shovel moves logs across the unit to locations near the road where they can be loaded onto log trucks. Logs are often picked up and moved ("swung") several times before reaching the road.



The shovel starts at the nearest access point and moves logs until they are within reach of the road. From there they can be loaded on trucks.

Advantages

- requires few people and machines
- few or no skid trails needed; existing roads may be adequate
- brush can be piled during harvest operations.

Equipment used

- chainsaw
- tracked excavator equipped with a grapple to grip and move logs

Topography considerations

- limited by slope due to machine instability on steep side hills
- may allow for harvest of some sensitive areas, with less disturbance than other systems

Below: Excavators equipped with grapples are common choices for handling logs and doing other useful tasks.

Soil considerations

- less compaction and disturbance if machine passes are limited

Forest stand considerations

- used primarily in clearcuts or partial cuts
- requires clearing of roadsides for log decks

Slash disposal considerations

- while moving logs, the excavator can pile heavy concentrations of slash for burning, chipping or other utilization

Reforestation considerations

- while or after moving logs or slash, the excavator can prepare the site for planting or seeding

Economic considerations

- small crew size
- one machine for multiple tasks can reduce costs
- efficiency improves with shorter yarding distances

Cut-to-length harvesting

This ground-based system uses a mechanized harvester (tree processor) and a forwarder. The harvester severs, de-limbs and cuts each tree into logs and stacks them in the forest. The forwarder follows, picking up the logs and carrying loads to log trucks. It is also called a harvester-forwarder system.

A single grip processor can reach out 30 feet, cut a tree, strip the limbs, cut the stem into pre-programmed lengths and lay the logs on the ground, all in less than a minute. Ideally, they travel over the tree tops and limbs they leave.

A forwarder follows the harvester, picking up logs and delivering them to log trucks. They can travel long distances, reducing the need for log truck roads.

Logs are offloaded from the forwarder directly to log trucks.

Advantages

- leaves slash (tree branches and tops) in the forest
- reduces the need for log landings and access roads

Equipment used

- harvester/processor (tracked or wheeled)
- forwarder (often wheeled)

Topography considerations

- normally limited to slopes less than 35 percent

Soil considerations

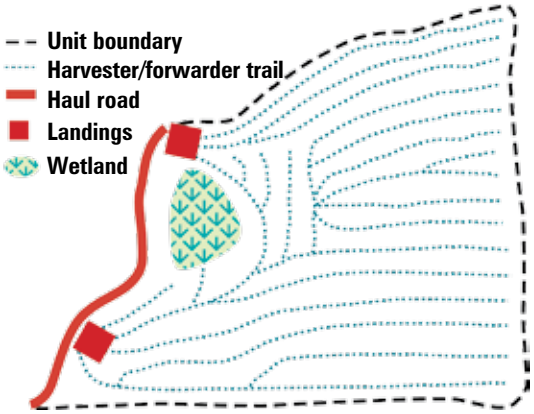
- can reduce compaction and disturbance, especially if the processor moves over duff and slash and if forwarders stay on slash-covered, designated skid trails
- slash left in the harvest unit will recycle nutrients and organic matter

Forest stand considerations

- an efficient method for commercial thinning
- typically used to move short logs out of the forest rather than long logs
- processor efficiency in dense stands is useful for forest health and fuels treatments

Slash disposal considerations

- by traveling over and compacting the slash, the system can reduce wildfire hazards and may meet slash hazard control requirements with no further treatment
- equipment can be used for slash piling for burning, chipping or other utilization



Typical harvest layout. Designated harvester/forwarder trails are about 60 feet apart and often follow parallel patterns across the harvest units.

Reforestation considerations

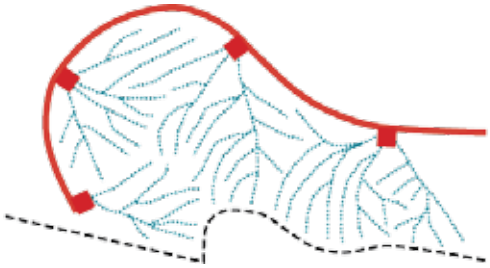
- common for thinnings where residual stocking does not trigger reforestation requirements
- if used for heavier cuts and slash loads, extra steps could create spots for planting or seeding

Economic considerations

- may not require new or improved roads
- relatively expensive and specialized machinery and operators
- may require larger volumes or higher quality timber for efficient use

Whole-tree harvesting

This harvest system brings the entire tree, limbs and tops attached, to the landing or roadside. It can be used for both ground-based and cable applications. When used in ground applications, a feller-buncher often is used to cut and pile bundles of trees in the forest. Then a tractor or skidder drags the tree bundles to the landing or roadside. Finally, a delimber converts the trees to logs.



Typical harvest layout. The feller-buncher and grapple skidder travel over most of the unit. Confining multiple trips to primary skid trails can reduce soil disturbance.

Advantages

- can be relatively efficient, including use of smaller material
- slash is brought to the landing or roadside where it can be burned, chipped or otherwise utilized

Equipment used

- feller-buncher
- crawler tractor or skidder with grapple
- stroke-boom delimber
- log loader

Topography considerations

- normally limited to slopes less than 35 percent
- with ground-based harvest, haul roads are usually at the bottom of the logging area

Soil considerations

- vehicles travel over a larger portion of the area as they cut, stack, gather and drag whole trees
- potential for more soil disturbance and compaction than other ground-based systems
- removal of tops and limbs does not recycle nutrients and organic matter near its source

Forest stand considerations

- efficient harvest and stand conversion when using a clearcut,
- can be used when thinning, but damage to remaining trees can be a problem.

A feller-buncher severs trees and lays them in bunches with limbs and tops attached. Bunches are oriented with tree trunks facing downhill.

Slash disposal considerations

- slash can be piled and later burned, chipped or otherwise utilized
- slash returned to the harvest area can recycle nutrients and organic matter (see pages 67-69)

Reforestation considerations

- widespread traffic and large tree bundles may damage advance regeneration
- dragging tree bundles can expose areas for planting or seeding

Economic considerations

- costs can increase on steeper ground or with longer skid distances
- bunching trees can help reduce the cost of handling small diameter trees.

A crawler tractor or skidder with a grapple picks up bunched trees and drags them to a landing or roadside. Some grapples can swing 180 degrees, making it easier to operate in tight spaces.

The stroke-boom delimber operates at the landing or roadside, removing tree limbs and top, cutting the stem into logs and stacking them.

The loader serves two needs: loading trucks and piling tops, branches and log chunks for later burning, chipping or other utilization.

Helicopter logging

This harvest system was once used exclusively for large, high-value timber. Helicopter harvest remains a higher-cost alternative, but it can be used for smaller logs when timber volumes and quality are adequate.

Advantages

- can harvest visually sensitive, inaccessible or other areas where other systems are unsuitable
- useful option for locations with high recreational use, special wildlife habitat, riparian/wetlands or geologic hazards
- may reduce or avoid new road construction, including hazardous/sensitive locations

Equipment used

- chainsaw
- logging helicopter
- helicopter maintenance and fueling equipment
- log loader

Topography considerations

- can be used on any type of terrain with suitable landing and helicopter service area locations (i.e., adequate size, safety and efficiency)

Soil considerations

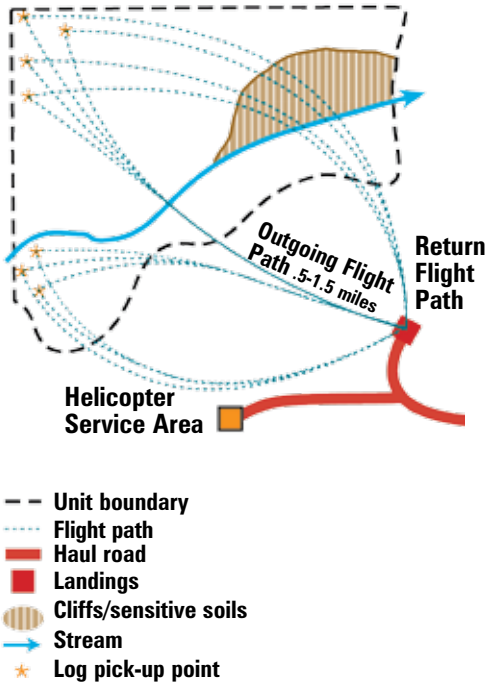
- minimizes in-unit soil disturbance and compaction because logs are fully suspended
- large landings and service areas may require extra drainage or other treatment

Forest stand considerations

- offers efficient, but costly method for commercial thinning
- large landings and service areas can locally impact forest stands.

This helicopter has a payload capacity of 6,000 pounds. Flight distances are kept to one-half to 1.5 miles. Longer distances are more costly. Planning to achieve optimum payloads for each trip helps make the operation economic.

Typical harvest layout



Slash disposal considerations

- lop-and-scatter methods typically are used to reduce fire hazards
- if further treatment is needed, it can be costly where road access is limited

Reforestation considerations

- slash left on-site and limited yarding disturbance result in fewer exposed spots for easy planting or natural seeding

Economic considerations

- typically the most expensive logging system
- equipment and crew needs can result in costs three to four times those of ground-based systems
- reduced road construction needs may help offset high costs
- without adequate volume of higher value logs, harvest costs may exceed timber revenues

Cultural resources

What are cultural resources?

Cultural resources are archaeological sites or objects that are found on public or private lands.

What do they look like?

Typical indications of archeological sites include stone tools, fire-cracked rock, shells, bone fragments and things like house pit depressions, hearths, fire rings, cairns (heaps of stones that signify memorials or landmarks) and similar items. Glassy rock fragments, along with tools and debris from the manufacturing process -- in an area where they are not normally found -- are a good indicator of archaeological sites.

Why are they important?

The number of archaeological sites is limited. They are irreplaceable and nonrenewable. They are also an inherent part of the cultural heritage of the people of Oregon.

How old is old?

Cultural resources include more than prehistoric or Native American artifacts. Even old logging remains, stumps with springboard notches, camp dumps, railroad grades, homestead cabins, historic irrigation ditches, scribed trees and trails are included in the definition of cultural resources. In addition to artifacts, traditional hunting and gathering sites and "religious" sites may also be historical cultural records.

What are the legal protections?

Archaeological-object and -site laws protect these sites.

Counties may also have regulations related to these sites, and landowners who find cultural artifacts should contact the county planning department.

The State Historic Preservation Office maintains a comprehensive, statewide inventory of sites, structures and objects that are potentially significant in Oregon history, prehistory, architecture, archaeology and culture. This office is part of the Oregon Parks and Recreation Department. Game enforcement officers of the Oregon State Police serve as partners in initial investigation and protection of cultural sites, and thus may provide timely help when needed.

Steam Donkey. Photo by Tom Adams, http://www.quercusphotographic.com/

How to know the basal area of your harvest, reforestation or riparian management area

What is basal area?

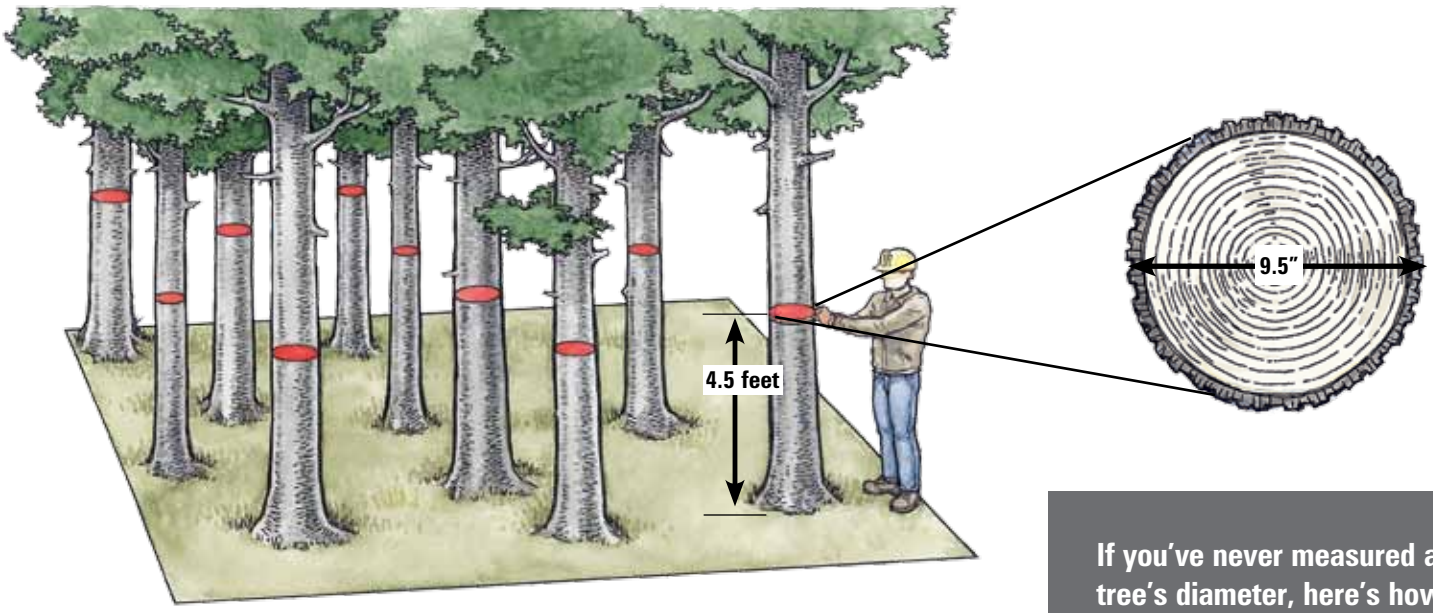
Basal area is the cross-sectional area of a tree stem at 4.5 feet above the ground. The basal area of a tree is calculated by measuring its diameter (see diagram). Tree diameter is measured at 4.5 feet above the ground on the uphill size and is referred to as the DBH (diameter at breast height). Why 4.5 feet? It provides a convenient and consistent point for measuring tree diameter.

To calculate basal area:

Basal area = tree diameter^2 X .005454.

If you know the diameter of a tree, you can calculate its basal area. It's the same formula used to calculate the area of a circle. This tree is 9.5 inches at DBH. Its basal area is 0.5 square feet. Therefore, in our example:

BA = 9.5″ x 9.5″ x .005454 = 0.5 ft^2



Imagine this to be one acre. The cross-section, at DBH, of each tree is indicated.

Why do you need to know about basal area?

Basal area is an important measurement. When combined with the average diameter of the trees, basal area gives people involved with a harvest a mental picture of the forest. If you know basal area you can calculate the number of trees per acre, another part of the picture.

If you're planning to harvest, reforest, leave wildlife trees or evaluate options for an RMA, you'll need to know basal area. The requirements for each of these activities depend on knowing the basal area measurement.

Basal area is usually calculated on a per-acre basis. That's because we're interested in knowing how much surface area (square feet) the tree stems are occupying on each acre. Add the individual basal area of every tree on an acre and you have the basal area per acre.

Basal area is expressed in square feet per acre. Here's a simple example: 250 trees on an acre, all with diameters of 9.5 inches DBH -- 0.5 square feet each -- would total 125 square feet of basal area. (0.5 x 250 = 125).

If you've never measured a tree's diameter, here's how:

Obtain a diameter tape or a normal household tape to measure the DBH.

- A diameter tape is convenient because it measures the tree's circumference but its scale directly converts this amount and shows the diameter in inches.
- A normal tape can be used to measure circumference of a tree. The circumference is converted to diameter by the formula:

$$\text{DBH} = \frac{\text{circumference (inches)}}{3.14}$$

More about basal area

Two separate acres can have the same basal area but a different number of trees. Tree diameters are an important influence on basal area.

For example, these two acres have the same basal area but different numbers of trees. Here's the interesting part. If you know the basal area per acre of a stand of trees, and the average diameter of the trees, you can figure out the number of trees per acre.

If Acre 1 has 24-inch trees and 78.5 square feet of BA, you would need 25 trees to equal 78.5 square feet per acre.

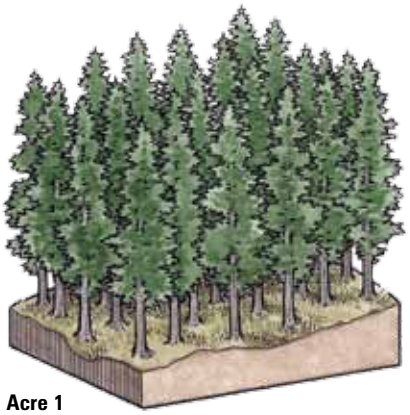
BA = 24" x 24" x .005454 = 3.1

78.5 ft^2 per acre ÷ 3.1 = 25 trees per acre (41-foot spacing)

If Acre 2 has 6-inch trees and a basal area of 78.5, you would need 392 trees to equal 78.5 square feet per acre.

BA = 6" x 6" x .005454 = .2

78.5 ft^2 per acre ÷ .2 = 392 trees per acre (10.5-foot spacing)



Acre 1

This acre has a BA of 78.5.

Acre 2

This acre has a BA of 78.5.

How do you measure the basal area of your harvest unit?

The simplest way to determine the basal area of your harvest unit is to sample the stand with plots. Space plots evenly across the unit along compass lines. On each plot, measure the diameter and calculate the basal area of each tree. Circular, one-fifth-acre plots are commonly used.

To calculate the basal area of each tree on the plot, it's easiest to use Table A-6 at right. Or you may find it to your advantage to use Table A-7, which has the basal areas for tree diameters listed in 2-inch increments. A third option is to calculate the basal area for 1-inch intervals using the basal area formula on the previous page. These added options provide greater accuracy in determining basal area. However, in meeting legal requirements you must be consistent – you can't switch back and forth between the tables and the formula.

As an example, the illustration below shows a 20-acre site with 12 one-fifth-acre plots. First record the basal area of each plot. Then calculate the total basal area for all plots and determine the average basal area per plot by dividing the total basal area by 12. Then expand the average basal area per plot to an entire acre by multiplying by 5. Now you know the average basal area per acre for the 20-acre harvest unit.

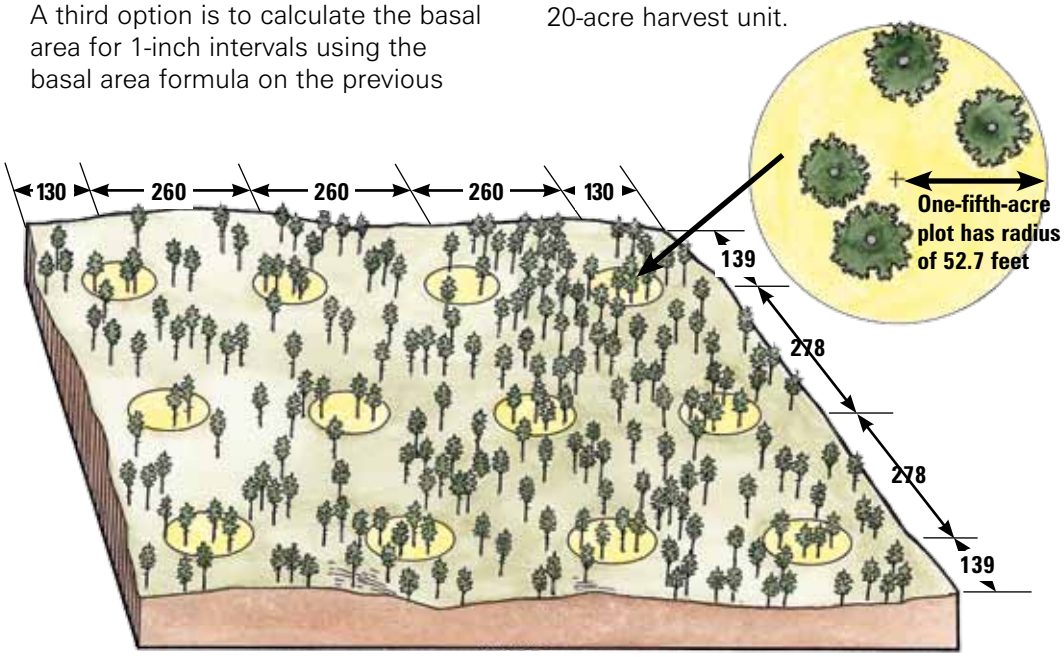
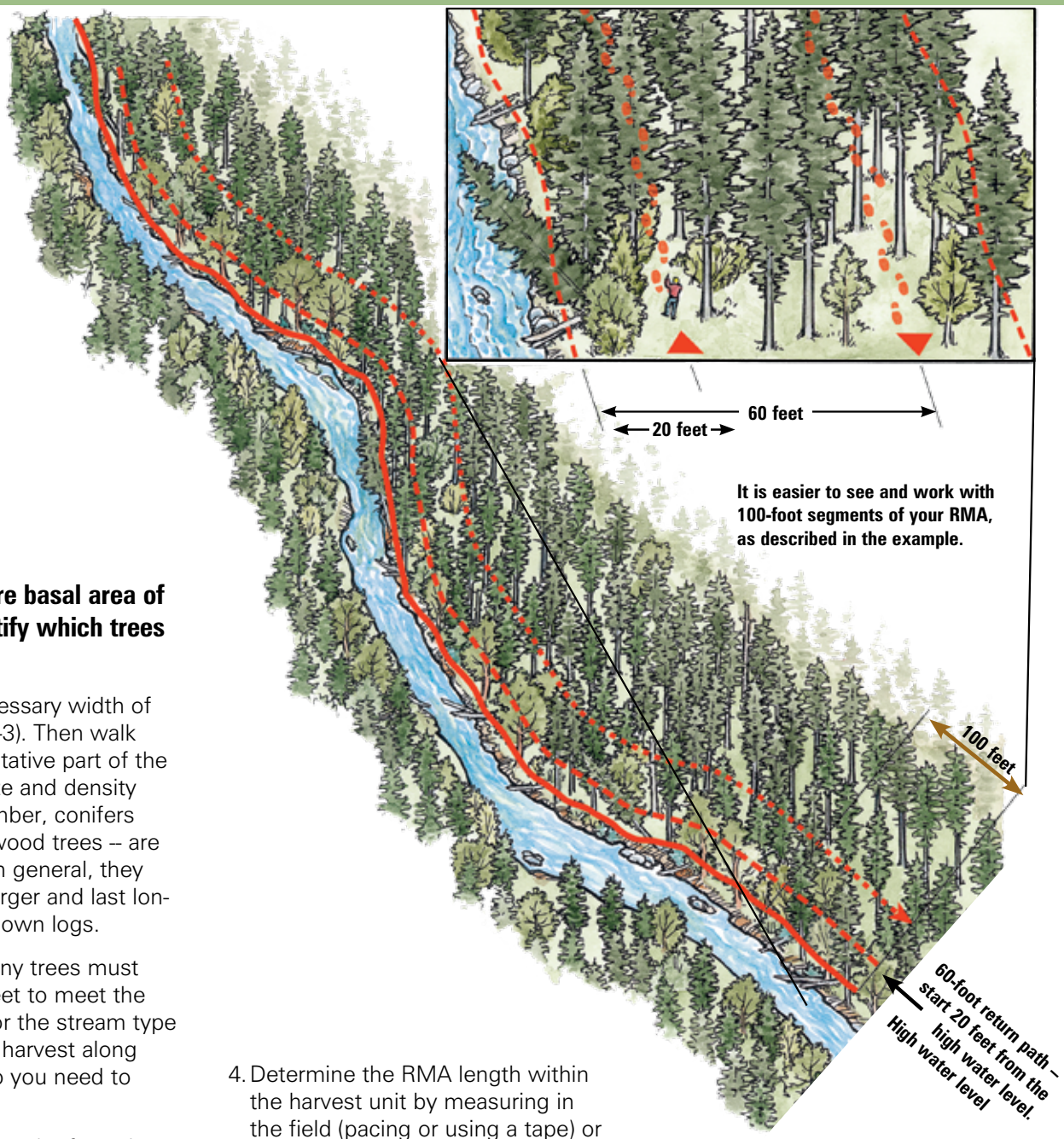


Table A-6	
DBH (inches)	Basal area (square feet)
6 to 10	0.3
11 to 15	0.9
16 to 20	1.8
21 to 25	2.9
26 to 30	4.3
31 to 35	5.9
36 to 40	7.9

Table A-7	
DBH (inches)	Basal area (square feet)
6	0.2
8	0.35
10	0.55
12	0.79
14	1.07
16	1.4
18	1.77
20	2.2
22	2.6
24	3.14
26	3.69
28	4.28
30	4.9
32	5.58
34	6.3
36	7.07

This shows a 100-foot-wide RMA to be inventoried for basal area and tree numbers. The procedure:

- **mark the 20-foot distance from the high-water level and the 100-foot RMA boundary**
- **start at 20 feet from the high-water level and walk parallel with the high-water level**
- **reverse your path and come back at the 60-foot distance**



How do you measure basal area of your RMA and identify which trees to leave?

1. Determine the necessary width of your RMA (Table 2-3). Then walk through a representative part of the RMA to see the size and density of conifers. Remember, conifers -- rather than hardwood trees -- are favored because, in general, they live longer, grow larger and last longer as snags and down logs.

2. Figure out how many trees must be left per 1,000 feet to meet the basal area target for the stream type (see, "You want to harvest along a stream – what do you need to know?" Page 19).

3. Use Table A-6, A-7 or the formula on page 152 to estimate average basal area per tree based on your estimate of the average diameter.

   For example, if the average diameter of conifers in the RMA is about 24 inches then the average basal area per tree is about 3 square feet. If the target for the stream is 170 square feet per 1,000 feet (17 per 100 feet) then you know that you will need to leave about five to six 24-inch conifers per 100 feet of RMA.

   $17 \div 3 = 5.7$

4. Determine the RMA length within the harvest unit by measuring in the field (pacing or using a tape) or scaling off an accurate aerial photo or map. Multiply the basal area target by this length.

   For example, if the RMA length is 1,500 feet and the basal area target is 170 square feet per 1,000 feet, the total for the 1,500 feet in the unit is 255 square feet.

   $170 \times 1{,}500 \div 1{,}000 = 255$

5. Use a tally sheet like the example on page 160 (RMA tree tabulation form) to keep track of acceptable leave trees. Keep in mind you may be asked to submit copies of such field notes to ODF.

Walk along the stream and select acceptable leave trees, starting with those that must be left: trees within 20 feet of the high-water level and trees that lean over the stream. Mark a number on each tree with tree-marking paint and record its diameter, whether conifer or hardwood, and its distance from the stream. Wait to fill in the basal area column until you've walked all of the 20-foot "no touch" portion of the RMA. Reverse direction and come back, marking and recording additional conifers in the outer

RMA, as needed, to get close to the basal area target (recall your estimate of how many trees needed per 100 feet – 5.7, as calculated in the above example).

6. Calculate values for the basal area column (use Table A-6, A-7 or the basal area formula) and sum up the tree numbers and basal area values. Separate snags and large hardwoods from the live conifers.

   Compare the total conifer basal area with the standard target for the georegion and stream type and size (remember, there is usually both a basal area and tree count requirement). If you are above the standard target, you can go through the RMA again and consider harvesting some of the trees found beyond the 20-foot zone. If you are below the target, you'll need to measure and identify enough acceptable leave trees in the outer RMA to reach the target.

Table A-9 RMA Tree Tabulation Form (example)

Tree #	Conifer or hardwood	DBH	Basal area	Distance from stream
1	C	12	.9	<20
2	C	18	1.8	30
3	C	16	1.8	30
4	C	15	.9	40
5	C	14	.9	40
6	C	11	.9	40
7	C	11	.9	<20
8	C	11	.9	<20
9	C	19	1.8	<20
10	C	13	.9	30
11	H	28	4.3	30
12	C	12	.9	30
13	C	18	1.8	30
14	C	16	1.8	<20
15	C	35	5.9	<20
16	C	18	1.8	<20
17	C	21	2.9	30
18	C	14	.9	40
19	C	11	.9	40
20	C	36	7.9	30
Sum conifer	19 trees, 7 <20 ft.		36.5	14 sq. ft. <20 ft.
Sum hardwood	1 tree		4.3	

General prescription requirements for stream RMAs

This section includes the general prescription protection requirements for RMAs for various regions and stream and harvest types. Use these summaries when the live conifer basal area in the RMA is more than the standard target. For a detailed description of stream RMA protection see pages 19-29.

To use the summaries, you need to know the following:

1. the geographic region of your harvest (see page 10)

2. the type and size of the stream in the harvest unit (see page 8)

3. the type of harvest (1, 2, 3 or Unclassified) you will be doing (see page 17)

Check the list below for the page number of the summary that fits your situation. For example, if you are planning an operation in the Siskiyou geographic region, with a Type 3 harvest along a Large, Type F stream, use the summary on page 162.

Type F streams	**Page #**
Westside geographic regions	
Large Type F streams, Type 2 or 3 harvest	157
Medium Type F streams, Type 2 or 3 harvest	158
Small Type F streams, Type 2 or 3 harvest	159
Large Type F streams, Type 1 or unclassified harvest	160
Medium Type F streams, Type 1 or unclassified harvest	161
Small Type F streams, Type 1 or unclassified harvest	162
Eastside geographic regions	
Large Type F streams, Type 2 or 3 harvest	163
Medium Type F streams, Type 2 or 3 harvest	164
Small Type F streams, Type 2 or 3 harvest	165
Large Type F streams, Type 1 or unclassified harvest	166
Medium Type F streams, Type 1 or unclassified harvest	167
Small Type F streams, Type 1 or unclassified harvest	168
Type D and Type N streams,	
Westside geographic regions	
Large Type D or N streams, Type 2 or 3 harvest	169
Medium Type D or N streams, Type 2 or 3 harvest	170
Large Type D or N streams, Type 1 or unclassified harvest	171
Medium Type D or N streams, Type 1 or unclassified harvest	172
Eastside geographic regions	
Large Type D or N streams, Type 2 or 3 harvest	173
Medium Type D or N Streams, Type 2 or 3 harvest	174
Large Type D or N streams, Type 1 or unclassified harvest	175
Medium Type D or N streams, Type 1 or unclassified harvest	176
All geographic regions	
Small Type D streams, all harvest types	177
Small Type N streams, all harvest types	177

Use for

large Type F streams, Type 2 or 3 harvests and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-10 – Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	230	170
Interior & Western Cascades	270	200
Siskiyou	220	170

RMA width – 100 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high water-level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 40 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows, and/or
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. All cottonwood and Oregon ash trees (at least 6 inches DBH) left in the RMA but growing more than 20 feet from the high-water level may count toward the basal area target.

A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are at least 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Can trees left in RMAs help meet other leave tree requirements?

Yes. Conifers left in the RMA in excess of the active management target and hardwoods left beyond 20 feet from the channel may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

medium Type F streams, Type 2 or 3 harvests and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-11 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	120	90
Interior & Western Cascades	140	110
Siskiyou	110	90

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are greater than 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Can trees left in RMAs help meet other leave tree requirements?

Yes. Conifers left in the RMA in excess of the active management target and hardwoods left beyond 20 feet of the channel may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

small Type F streams, Type 2 or 3 harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-12 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	40	20
Interior & Western Cascades	40	20
Siskiyou	40	20

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are at least 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Can trees left in RMAs help meet other leave tree requirements?

Yes. All conifers and hardwoods left in the RMA may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

large Type F streams, Type 1 or unclassified harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-13 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	300	270
Interior & Western Cascades	350	310
Siskiyou	290	260

RMA width – 100 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 40 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. All cottonwood and Oregon ash trees at least 6 inches DBH left in the RMA but growing more than 20 feet from the high water level may count toward the basal area target. This allowance applies only to large Type F streams.

A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are at least 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Use for

medium Type F streams, Type 1 or unclassified harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-14 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	160	140
Interior & Western Cascades	180	160
Siskiyou	140	120

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are at least 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Use for

small Type F streams, Type 1 or unclassified harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-15 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Coast Range & South Coast	50	30
Interior & Western Cascades	50	30
Siskiyou	50	30

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are at least 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches or greater DBH and at least 30 feet high, that are anywhere within the RMA

Use for

large Type F streams, Type 2 or 3 harvest and eastside geographic regions

Table A-16 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	170	130
Blue Mountains	170	130

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 100 feet

Leave the following on each side of stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 40 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. All hardwoods at least 6 inches DBH left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Can trees left in RMAs help meet other leave tree requirements?

Yes. Conifers left in the RMA in excess of the active management target and hardwoods left beyond 20 feet of the channel may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

medium Type F streams, Type 2 or 3 harvest and eastside geographic regions

Table A-17 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	90	70
Blue Mountains	90	70

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work

Can some hardwoods and snags help meet the target?

Yes. All hardwoods (6 inches or greater DBH) left in the RMA may count toward the basal area target.

Sound conifer snags (6 inches or greater DBH and at least 30 feet high) left in the RMA may count toward as much as 10 percent of the basal area target.

Can trees left in RMAs help meet other leave tree requirements?

Yes. Conifers left in the RMA in excess of the active management target and hardwoods left beyond 20 feet of the channel may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

small Type F streams, Type 2 or 3 harvest and eastside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-18 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	50 (40 of live conifer)	50 (30 of live conifer)
Blue Mountains	50 (40 of live conifer)	50 (30 of live conifer)

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. No more than 40 square feet per 1,000 feet of the standard target or 30 square feet per 1,000 feet of active management target is required to be live conifer. The remainder of the target is to be met by the basal area of retained snags, dead or dying trees, or hardwoods if they are available.

All hardwoods at least 6 inches DBH left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Can trees left in RMAs help meet other leave tree requirements?

Yes. All conifers and hardwoods left in the RMA may be counted toward requirements for leave trees within Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

large Type F streams, Type 1 or unclassified harvest and eastside geographic regions

Table A-19 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	220	200
Blue Mountains	220	200

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 100 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 40 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. All hardwoods at least 6 inches DBH left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Use for

medium Type F streams, Type 1 or unclassified harvest and eastside geographic regions

Table A-20 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	120	100
Blue Mountains	120	100

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. All hardwoods at least 6 inches DBH left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Use for

small Type F streams, Type 1 or unclassified harvest and eastside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-21 Basal Area Targets		
Geographic region	Square feet of basal area per 1,000 feet of stream	
	Standard target	Active management target
Eastern Cascades	50 (40 of live conifer)	50 (30 of live conifer)
Blue Mountains	50 (40 of live conifer)	50 (30 of live conifer)

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- enough conifer basal area within the RMA to meet the standard target

[OR]

Leave less conifer basal area, but no less than the active management target, in exchange for stream improvement work. This includes:

- placing logs or trees in stream channels to create pools or hiding cover for fish
- installing fencing or off-channel watering sites to keep livestock away from streams
- constructing small side channels to provide refuge for fish during high flows
- other enhancement work

Check with ODF if you plan to exchange basal area for stream improvement work.

Can some hardwoods and snags help meet the target?

Yes. No more than 40 square feet per 1,000 feet of the standard target or 30 square feet per 1,000 feet of the active management target is required to be live conifer. The remainder of the target is to be met by the basal area of retained snags, dead or dying trees, or hardwoods if they are available.

All hardwoods at 6 inches DBH left in the RMA may count toward the basal area target.

Sound conifer snags at least 6 inches DBH left in the RMA may count toward as much as 10 percent of the basal area target.

Use for

large Type D or N streams, Type 2 or 3 harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-22 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Coast Range & South Coast	90
Interior & Western Cascades	110
Siskiyou	90

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

Can some hardwoods and snags help meet the target?

Yes. All cottonwood and Oregon ash trees, at least 6 inches DBH, left in the RMA but growing more than 20 feet from the high-water level may count toward the basal area target.

A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are greater than 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Can trees left in RMAs help meet other leave tree requirements?

Yes. All conifers and hardwoods left in the RMA may be counted toward requirements for leave trees within Type 2 or Type 3 harvests, as long as they meet the other requirements for leave trees.

Use for

medium Type D or N streams, Type 2 or 3 harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-23 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Coast Range & South Coast	50 (30 may be from hardwoods)
Interior & Western Cascades	50 (30 may be from hardwoods)
Siskiyou	50 (30 may be from hardwoods)

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 10 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target.

Can some hardwoods and snags help meet the target?

Yes. Hardwood trees left in the RMA can contribute up to a maximum of 30 square feet of basal area per 1,000 feet toward meeting the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, can make up as much as 5 percent of the basal area target.

Use for

large Type D or N streams, Type 1 or unclassified harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-24 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Coast Range & South Coast	140
Interior & Western Cascades	160
Siskiyou	120

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RM,
- no fewer than 30 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target.

Can some hardwoods and snags help meet the target?

Yes. All cottonwood and Oregon ash trees, at least 6 inches DBH, left in the RMA but growing more than 20 feet from the high-water level may count toward the basal area target.

A combination of the following can make up to 10 percent of the basal area target:

- the basal area of hardwoods (other than alder) left in the RMA that are greater than 24 inches DBH but growing more than 20 feet from the high-water level
- the basal area of sound snags, at least 6 inches DBH and at least 30 feet high, that are anywhere within the RMA

Use for

medium Type D or N streams, Type 1 or unclassified harvest and westside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-25 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Coast Range & South Coast	60 (30 may be from hardwoods)
Interior & Western Cascades	60 (30 may be from Hardwoods)
Siskiyou	60 (30 may be from hardwoods)

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 10 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

Can some hardwoods and snags help meet the target?

Yes. Hardwood trees left in the RMA can contribute up to a maximum of 30 square feet of basal area per 1,000 feet toward meeting the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, can make up as much as 5 percent of the basal area target.

Use for

large Type D or N streams, Type 2 or 3 harvest and eastside geographic regions

Table A-26 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Eastern Cascades	70
Blue Mountains	70

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 30 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target.

Can some hardwoods and snags help meet the target?

Yes. All hardwoods left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Can trees left in RMAs help meet other leave tree requirements?

Yes. All conifers and hardwoods left in the RMA may be counted toward requirements for leave trees with Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

medium Type D or N streams, Type 2 or 3 harvest and eastside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-27 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Eastern Cascades	50
Blue Mountains	50

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 10 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

Can some hardwoods and snags help meet the target?

Yes. All hardwoods left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, can make up as much as 5 percent of the basal area target.

Can trees left in RMAs help meet other leave tree requirements?

Yes. All conifers and hardwoods left in the RMA may be counted toward requirements for leave trees with Type 2 or 3 harvests, as long as they meet the other requirements for leave trees.

Use for

large Type D or N streams, Type 1 or unclassified harvest and eastside geographic regions

Table A-28 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Eastern Cascades	100
Blue Mountains	100

Use when

the live conifer basal area in the RMA is more than the standard target

RMA width – 70 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-waterl evel
- all trees that lean over the channel and grow in the RMA
- all snags and downed wood in the channel and RMA
- no fewer than 30 live conifers, at least 11 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

Can some hardwoods and snags help meet the target?

Yes. All hardwoods left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, left in the RMA may count toward as much as 10 percent of the basal area target.

Use for

medium Type D or N streams, Type 1 or unclassified harvest and eastside geographic regions

Use when

the live conifer basal area in the RMA is more than the standard target

Table A-29 Basal Area Targets	
Geographic region	Standard target, square feet of basal area per 1,000 feet of stream
Eastern Cascades	60
Blue Mountains	60

RMA width – 50 feet

Leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA
- no fewer than 10 live conifers, at least 8 inches DBH, per 1,000 feet within the RMA
- enough conifer basal area within the RMA to meet the standard target

Can some hardwoods and snags help meet the target?

Yes. All hardwoods left in the RMA may count toward the basal area target.

Sound conifer snags, at least 6 inches DBH and at least 30 feet high, can make up as much as 5 percent of the basal area target.

Use for

small Type D streams, all types of harvest and all geographic regions

RMA width – 20 feet

There are no basal area targets for these streams.

However, leave the following on each side of the stream:

- all understory vegetation within 10 feet of the high-water level
- all trees within 20 feet of the high-water level
- all trees that lean over the channel and grow in the RMA
- all snags and down wood in the channel and RMA

Use for

small Type N streams, all types of harvest and all geographic regions

No RMA width designated

There are no basal area targets for these streams.

However, leave the following on each side of the stream:

- Understory vegetation and unmerchantable conifers (those less than 6 inches DBH) for 10 feet on each side of the high-water level for the perennial channels indicated below.

Table A-30 Vegetation Retention

Geographic region	Where required
Coast Range	None required
South Coast	Perennial channels where the upstream drainage area is greater than 160 acres
Interior	Perennial channels where the upstream drainage area is greater than 330 acres
Western Cascades	None required
Siskiyou	Perennial channels where the upstream drainage area is greater than 580 acres
Eastern Cascades	All perennial channels
Blue Mountains	All perennial channels

A stream is considered to be perennial if it usually has summer surface flow after July 15, as determined by ODF.

To minimize stream warming, operators are encouraged to leave understory vegetation and non-merchantable trees (those less than 6 inches DBH) along all perennial streams in operation areas.

How to plan for and calculate peak flows for stream crossings

If you're planning to install or replace a stream crossing, there's a key question to answer: Are there fish in the stream?

If yes, it's best to get help from a professional, because designing and installing the stream crossing can get complicated. Stream crossings must allow for fish passage, and this involves more things to consider. For example, the slope of the stream may require a different crossing design that makes the installation more costly. It's wise to check with experienced people.

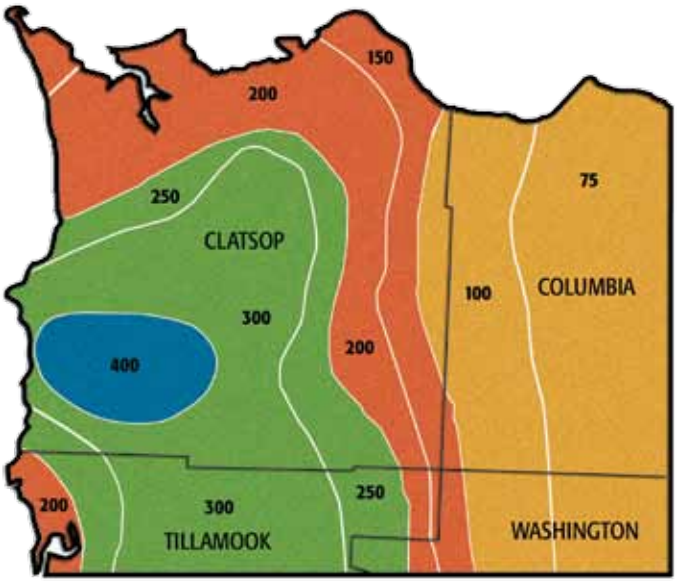
If no, your stream crossing is probably more straightforward.

Follow these steps to calculate the size of the culvert needed if the crossing is not on a fish-bearing stream. In some situations the same size culvert also may be adequate for a stream that has fish, but this should be verified before construction.

Remember that if the fill depth for your planned stream crossing is more than 15 feet (see page 125, it requires a written plan.

What flow level must the crossing be able to handle?

Forest practices rules require that a culvert or bridge crossing be sized to handle at least a 50-year peak flow (sometimes referred to as the 50-year storm).



This is the ODF's "Peak Flow for Forest Streams" map for the north-west corner of Oregon. Lines on the map indicate the 50-year peak flow in cubic feet per second per square mile of drainage area. For this area of Oregon, 50-year peak flows vary from 75 cfs per square mile on east side of the map to 400 cfs on the (wet) west side.

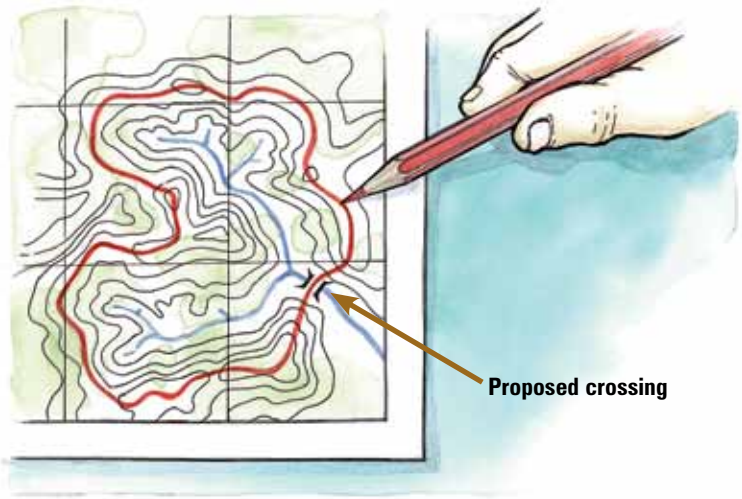
What this means

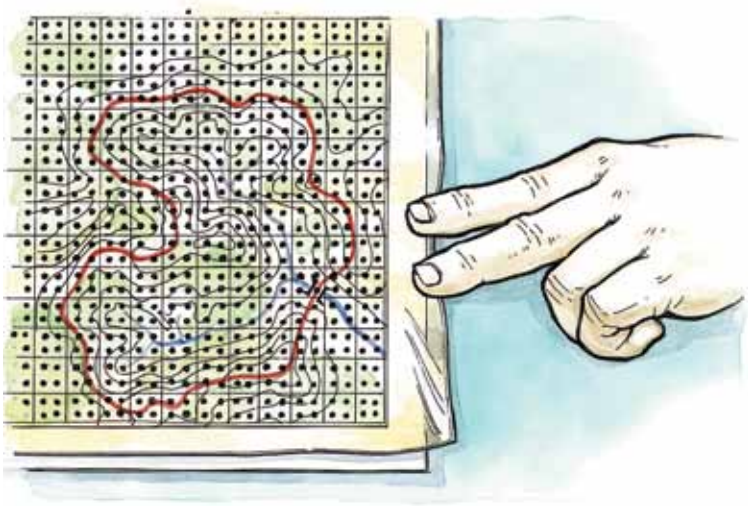
You need to be sure the structure you're installing can handle a very large storm and the runoff it produces. If not, the resulting damage or washout can require a costly replacement, along with stream and fish habitat damage below the failure and the inconvenience of a closed road.

The "50-year peak flow" actually refers to the local storm flow that has a 2 percent chance of occurring in any given year. When averaged across many years, a flow of this size occurs only about twice a century, but it's important to understand that the occurrence of such a storm flow does not affect the likelihood of the next big event – there's still a one in 50 chance (2 percent) a similar flow will occur in any following year.

How do you determine the peak flow?

Without a long-term gauging station on your stream, you can't know for sure what the 50-year peak flow is for a particular stream crossing location, but it can be estimated from an ODF map that's based on other local records and information. Here's how to do it.





STEP 1

Use a "Peak Flows for Forest Streams" map available at your local ODF office. The northwest corner of this map is illustrated on page 178.

Find the location of your planned stream crossing on the map. What is the value of the closest line? If your crossing is between two lines, figure out the average value of the two closest lines.

Example: Let's say you're planning to install a culvert in a location where the map indicates the 50-year peak flow to be 100 cfs per square mile of drainage. The next thing you have to figure out is the size of the drainage above your planned crossing.

STEP 2

Determine the size of the drainage upstream of your crossing.

- Use a 7.5-minute topographic map or software. Outline the drainage boundary (highest terrain above the stream crossing) with a pencil or electronic drawing tool (see illustration above).
- Use a 1:24000 dot grid to determine the size of the drainage. Dot grids are printed on clear plastic so you can lay them on top of topographic maps and see drainage boundaries (see illustration above). If you have map software, it may have a tool that can determine areas within such boundaries.
- Count the number of grid intersections that fall within the drainage boundary.
- Multiply the number of grid intersections by .036. This is the drainage area in square miles.

Example: If the number of squares counted within the drainage boundary is 23, the drainage is .83 square miles.

Here's the calculation: 23 x .036 = .83

STEP 3

Calculate peak flow for the size of your drainage.

From Step 1 we know the peak flow: 100 cfs.

From Step 2 we know the size of the drainage: .83 square miles.

How many cubic feet per second must the culvert handle?

The culvert must be sized to handle a flow of at least 83 cfs.

Here's the calculation: 100 x .83 = 83

STEP 4

Determine what size culvert is needed.

From Step 3 we know the peak flow in cfs.

Go to Table A-31. It lists the flow capacities for common sizes of round culverts.

The table shows that a 54-inch circular culvert has a capacity up to 87 cfs. With good conditions it would likely handle a flow of 83 cfs, but a larger pipe would provide an extra margin of safety.

Table A-31
Flow Capacity For Circular Culverts

Diameter (inches)	Capacity (cfs)
18	Less than 5
24	5-11
30	12-20
36	21-31
42	32-46
48	47-64
54	65-87
60	88-113
72	145-178

For other information sources, see the Appendix, pages 183-184.

Glossary

Although some important terms are included here, many are specifically defined in sections of the Oregon Forest Practices Act (ORS 527.620) and Rules (OAR 629-600-0100). Always verify these definitions to help ensure compliance with the act and rules.

Acre
a land area of 43,560 square feet, in any shape. If square, it would measure approximately 209 feet per side

Active management target
the minimum basal area required to protect the RMA when a landowner agrees to do stream improvement work on a Type F stream

Afforestation
planting a forest in an area where the previous vegetation or land use was not forest

Aggregate
mechanically crushed, angular rock used for forest road surfacing

Alternatives to burning
methods to reduce or avoid the need for slash burning (e.g., lop and scatter, chipping and biomass utilization)

Anadromous fish
fish that are born and reared in fresh water, move to the ocean to grow and mature, and return to fresh water to reproduce (e.g., salmon, steelhead, shad)

Aquatic life
organisms (e.g., plants, insects, animals) that spend all or a portion of their life in water

Aspect
the direction toward which a slope faces

Basal area
the cross-sectional area of the trunk of a tree, 4.5 feet above the ground, often calculated from the diameter at that height: basal area = tree diameter squared, times .005454

Biomass
the wood product obtained by chipping or grinding all or some portion of trees (e.g., tops, limbs, unmerchantable stems and other residues) usually for renewable energy production

Blowdown
trees felled by high winds

Bog
a hydrologically closed (no significant water flow) wetland, characterized by saturated peat soils and specialized plant communities

Cable yarding
moving logs from the stump to the landing using an overhead system of winch-driven cables to which logs are attached with chokers

Clearcut
a logging and reforestation method for shade-intolerant tree species, in which the entire timber stand, except required leave trees, is harvested

Cobble
the name for a specific size class of rock: 3 to 12 inches in diameter

Conifer
a tree with cones, often called "evergreen" because it keeps its foliage year-round (e.g., pine, spruce, fir and larch trees) and also known as "softwood" from its wood characteristics

Culvert
pipe that channels water under a road

Cutslope
the slope above a road, created by a cut into the face of a hill slope during road construction

D stream – see "Type D stream"

DBH (diameter at breast height) the diameter of a tree outside of the bark at breast height (i.e., 4.5 feet above the ground, measured on the uphill side of the tree)

Default standard
the minimum basal area required to protect the RMA when the existing basal area is less than half of the standard target and Alternative Prescriptions #1 and #2 are not applicable

Deforestation
clearing a forest and putting the land into a nonforest use

Domestic water use
the use of water for human consumption and other household human use

Down log
a green tree or an existing log intentionally left on the ground after a harvest for wildlife habitat and other benefits

Downspout
an attachment (e.g., a half-round culvert section) to a culvert outlet that carries water beyond the fill slope to control erosion

Drain dip
a shallow depression in the road surface to provide for surface drainage without interrupting vehicle traffic

End haul
moving excavated roadway material by dump truck to another location, in contrast to sidecasting the material next to the road

Estuary
a body of water semi-enclosed by land and connected with the open ocean where saltwater and freshwater mix (e.g., all estuary waters, tidelands, tidal marshes and submerged lands extending upstream to the head of tidewater)

Every reasonable effort
actions required by the landowner or operator if a fire starts in an active operation, which maintain limited liability exposure; can vary based on amount and type of available resources

F stream – see "Type F stream"

Fledgling
a young bird learning to fly

Flush
any activity that causes a sensitive wildlife species to leave its nest, roost or perching tree

Free-to-grow
the point when a tree or stand has a high probability of remaining or becoming dominant over competing vegetation; reforestation rules require this be achieved within six years

Geotextile
synthetic fibers formed into woven or non-woven fabric used to separate, filter or reinforce; used in road surfaces to reduce rutting, stabilize the ground and increase the load-carrying capacity

Gradient
the slope of a road surface in the direction of travel, usually expressed in percent; e.g., a 10 percent grade equals a change along the road of 10 feet vertical in 100 horizontal feet

Granite soils (decomposed granites; granitics)
light-colored soils with a coarse texture due to particle sizes ranging from sand to small gravel; loose and highly erodible due to low clay content that does not hold particles together

Ground-based yarding
moving logs from the stump to the landing using a dozer or rubber-tired skidder; attached logs are pulled behind the machine with chokers or one end of the logs lifted and dragged with a grapple

Hardwood
a broadleaf, usually deciduous, tree (e.g., oak, maple, cottonwood, ash, madrone)

Headwall
the steep, often bowl-shaped, upper reaches of a drainage

High-water level
the water level reached during the average annual high flow; often corresponds with the edge of streamside terraces, a change in vegetation or a change in soil or litter characteristics

Hog fuel
logging debris (e.g., defective logs, chunks, branches) that is ground up at a log landing and sold to and/or used by a mill to create electricity

Juvenile fish
immature fish or fingerlings; stream crossings must not impede their movement up and downstream

Landowner
any individual, combination of individuals, partnership, corporation or association of whatever nature that holds an ownership interest in forestland, including the state and any political subdivision of the state

Limited liability (fire suppression)
a landowner or operator is responsible for fire suppression costs of no more than $300,000, given "every reasonable effort" and no willful, malicious or negligent actions found to cause the fire

Log landing
the area where logs may be collected, delimbed and loaded onto trucks.

Marsh
a wetland formed in a shallow pond, depression, river margin or tidal area; characteristic plants include grasses, sedges, cattails and bulrushes

N stream – see "Type N stream"

Notification of Operation
a document required to be filed with the ODF 15 days prior to starting a forest operation

Operation
any commercial activity relating to the establishment, management or harvesting of forest tree species

Operator
any person, including a landowner or timber owner, who conducts an operation

Peak flow
the highest stream flow from a large storm or snowmelt event; a 50-year return interval flow for stream crossing design

Perennial stream
a stream that has running water after July 15 under normal climatic conditions

Plantation
a reforested area composed primarily of trees established by planting or seeding practices

Pole
a young tree between 1 and 10 inches DBH (see DBH)

Prescribed burn
the deliberate burning of wildland fuels for the purpose of fire hazard reduction, with consideration of local weather, soil moisture, populated areas and time of day

Prior approval
formal permission from ODF for certain forest practices before the activities begin

Ravel (dry ravel)
the particle-by-particle erosion of loose rock or dry soil fragments from steep slopes, driven by gravity and not water; common on road cutslopes and on steep slopes after wildfire

Reforestation
the re-establishment of forest cover either naturally or by planting or seeding

Resource site
unique area used by sensitive, threatened or endangered species where protection measures are required; includes nesting, roosting, watering and foraging locations

RMA (riparian management area)
an area along each side of specified waters of the state with special vegetation retention and management requirements for the protection of water quality, fish and wildlife habitat

Road prism
the cross-section of a road between the points of excavation and fill

Rule of thumb
a simple guideline or procedure based on general concepts or experience, which provides roughly correct but not strictly accurate or reliable results

Scarify
mechanically remove competing vegetation or interfering debris, and/or disturbing the soil surface, to improve reforestation success

Scenic highway
designated highways with special requirements for forest operations within specified distances

Seedling
a young tree less than 1 inch DBH (see DBH)

Seep
water emerging from the ground along an extensive line or surface; in contrast to a spring where the water emerges from a localized spot

Shelterwood
A harvest and reforestation method in which most trees are removed but some are retained to shade seedlings that otherwise would be susceptible to heat and drought

Shovel
an excavator equipped with a grapple, used instead of a skidder or dozer to move logs

Side channel
a channel other than a main channel of a stream that only has flowing water when high-water levels occur

Significant wetland
those wetland types that require site-specific protection

Site class
a grouping of site indexes that indicates relative productivity

Site index
a measure of forest site quality based on the height of the dominant trees in a stand at a specified age, usually 50 or 100 years

Site preparation
any treatment that enhances site conditions for plantation establishment or natural regeneration

Skidding
in ground-based logging, the process of dragging logs from the woods to a landing; called "yarding" in cable or helicopter logging

Slash
tree tops, branches, bark and other natural debris, left after a forest operation

Slope (degrees or percent)
an incline measured as the change in surface level within a given horizontal distance, expressed in degrees or as a percentage (e.g., a rise of 2 feet that spans 100 feet is a 2 percent slope or an angle of 1.15 degrees)

Snag
a dead standing tree or section of the stem at least 30 feet tall and at least 11 inches DBH (see DBH)

Sound snag
a dead tree with some intact bark or limb stubs; conifers can have merchantable wood

Squash pipe
a type of culvert used to cross streams in areas with low road clearances or wide channels; also can provide better conditions for fish passage

Standard target
the minimum basal area of specified tree types and sizes that must be retained in the RMA when harvesting near a Type F or D stream

Stream-associated wetland
a wetland that is not classified as significant and that is next to a stream

Stream improvement
actions to improve aquatic habitat, including placing logs, trees or boulders in streams, fencing out livestock, constructing side channels and afforestation

Stocking
the number of trees on a given area, as in the case of trees per acre required to be planted after a harvest

Subgrade
the layer of a roadbed on which the base or surface course is placed; on an unsurfaced road, this is the wearing surface (top layer upon which vehicles travel)

Talus
slope formed by an accumulation of rock debris, sometimes from a cliff or road cut above

Temporary crossing
a stream crossing installed and used during a harvest and promptly removed when the operation is completed or prior to seasonal runoff, whichever comes first

Temporary fill
material (e.g., soil and rock) used to construct a temporary crossing that must be removed from below the high water level of the stream at the completion of the operation

Threatened or endangered species
any species of plant or animal listed as in danger of becoming rare or extinct throughout all or a significant portion of its range, as defined by the Endangered Species Act of 1976

Topography
the surface forms, elevations and contours of an area of land

Turbidity
the cloudy appearance of a water body, caused by suspended or dissolved solids, algae, etc.; can indicate natural or accelerated erosion

Type 1 harvest
a harvest operation that requires reforestation because the number of seedlings, saplings or poles left does not meet the local stocking standards; however, wildlife leave trees are not required

Type 2 harvest
a harvest operation that requires wildlife leave trees but not reforestation because an adequate number of seedlings, saplings or poles are left; sometimes called a "green clearcut"

Type 3 harvest
a harvest operation that requires reforestation and, if larger than 25 acres, wildlife leave trees and down logs; limited to 120 acres and typically a clearcut

Type D stream
a stream that has domestic water use, but no fish use

Type F stream
a stream with fish use, or both fish use and domestic water use

Type N stream
a stream with neither fish nor domestic water use

Unclassified harvest
a harvest operation that meets the standards for both reforestation stocking and wildlife trees; typically a commercial thinning

Understory vegetation
those plants growing below the canopy formed by other, taller plants in a forest

Waste disposal area
a location for excess soil, rock and other debris from road construction that is stable and from where the material will not enter waters of the state

Water bar
a diversion ditch and/or hump constructed diagonally across a road or skid trail to control runoff and prevent erosion of road and trail surfaces

Wetland
an area sufficiently inundated or saturated by surface or ground water that local plants are typically those adapted to wet soil conditions; includes marshes, swamps, bogs and similar areas

Wildlife tree
a green tree at least 30 feet tall and at least 11 inches DBH (see DBH), planned for and left after a harvest to supply habitat for birds and other wildlife

Written plan
a document prepared by an operator or landowner that describes how an operation will be conducted and will protect resources; required by the ODF for several types of operations and/or activity locations

Other information sources

OAR = Oregon Administrative Rules

ORS = Oregon Revised Statutes

(copies available from ODF or www.oregonforestry.org)

From page 6 – Section: How to comply with the Oregon Forest Practices Act

1. OAR Chapter 629-Division 605, Planning Forest Operations
2. A Guide to Legal Requirements for Preventing and Controlling Fires in Operations on and near Forestland in Oregon – ODF

From page 12 – Section: How waters of the state are classified and protected

1. OAR Chapter 629-Division 635, Water Protection Rules: Purpose, Goals, Classification and Riparian Management Areas
2. OAR Chapter 629-Division 640, Water Protection Rules: Vegetation Retention Along Streams
3. OAR Chapter 629-Division 645, Water Protection Rules: Riparian Management Areas and Protection Measures for Significant Wetlands
4. OAR Chapter 629-Division 650, Water Protection Rules: Riparian Management Areas and Protection Measures for Lakes
5. OAR Chapter 629-Division 655, Water Protection Rules: Riparian Management Areas and Protection Measures for "Other Wetlands," Seeps and Springs

From page 18 – Section: You want to harvest timber on your property. How do you plan for it?

1. OAR Chapter 629-Division 630, Harvesting Rules
2. ORS 527.620, Definitions
3. ORS 527.676, Leaving snags and downed logs in harvest type 2 or type 3 units; green trees to be left near certain streams

From page 29 – Section: You want to harvest timber along a stream. What do you need to know?

1. OAR Chapter 629-Division 635, Water Protection Rules: Purpose, Goals, Classification and Riparian Management Areas
2. OAR Chapter 629-Division 640, Water Protection Rules: Vegetation Retention Along Streams

From page 31 – Section: You want to harvest timber around a lake. How do you meet the requirements?

OAR Chapter 629-Division 650, Water Protection Rules: Riparian Management Areas and Protection Measures for Lakes

From page 33 – Section: You want to harvest timber in or near a wetland. How do you meet the requirements?

OAR Chapter 629-Division 645, Water Protection Rules: Riparian Management Areas and Protection Measures for Significant Wetlands

From page 36 – Section: What are the requirements for leaving wildlife trees, snags and down logs?

1. Oregon Guidelines for Selecting Reserve Trees, Associated Oregon Loggers
2. ORS 527.676-Leaving snags and downed logs in harvest type 2 or type 3 units; green trees to be left near certain streams

From page 45 – Section: How do you protect sensitive wildlife sites when you harvest?

1. OAR Chapter 629-Division 665, Specified Resource Site Protection Rules

2. Forest Practices Note #8 (Revised), Spotted Owl, Dec. 1994
3. Forest Practices Note #10, Osprey, Sept. 1992
4. Forest Practices Program News Note, Summary of wildlife tree and down log retention requirements
5. Bald eagle management guidelines for Oregon and Washington. U.S. Fish and Wildlife Service, 1981. 10p.
6. Edge, W.D., Managing wildlife habitats in forested ecosystems. Oregon State University Extension Service, 12p.
7. Pederson, R.J., Managing small woodlands for cavity nesting birds. Woodland Fish and Wildlife Project. World Forestry Center, Portland, Oregon, 1991. 6p.
8. Forestry and wildlife. Oregon Forest Resources Institute, Portland, Oregon, 1998. 5p.

From page 47 – Section: What are the requirements for harvesting near scenic highways?

ORS 527.755, Scenic highways; visually sensitive corridors; operations restricted

From page 50 – Section: What are the requirements where rapidly moving landslides may occur?

1. Storm Impacts and Landslides of 1966. ODF Technical Report #4
2. Landslides and Public Safety Issues. ODF

From page 62 – Section: What should you know when ground yarding outside RMAs?

1. Designated Skid Trails Minimize Soil Compaction, Garland, John, Extension Circular 1110, Oregon State University Extension Service, reprinted 1993.
2. OAR Chapter 629-Division 630, Harvesting Rules
3. Forest Practices Note #5, Ground Based Harvesting, July 1999.

From page 67 – Section: What should you know about slash treatment and site preparation?

OAR Chapter 629-Division 615, Treatment of Slash Rules

From page 79 – Section: You're planning a harvest; do you need to reforest?

1. Rose, R, and Morgan, P., Guide to Reforestation in Western Oregon, Oregon Department of Forestry and College of Forestry, Oregon State University, Corvallis, 2000. Step-by-step instructions for planting and taking care of seedlings.
2. Forest Practices Notes Number 2, Oregon Department of Forestry, Dec. 1994
3. Summary of Oregon's Reforestation Requirements, The Forest Practices Program News Note
4. OAR Chapter 629-Division 610, Reforestation Rules

From pages 97 and 101 – Section: What are the requirements when applying chemicals, using other petroleum products and disposing of waste?

1. Harrington, T.B. & Parendes, L.A., Forest Vegetation Management without Herbicides, Forest Research Laboratory, Oregon State University, Dec. 1993
2. OAR Chapter 629-Division 620, Chemical and Other Petroleum Product Rules
3. Forest Practices Note No. 3: Chemicals And Other Petroleum Products, Oregon Department of Forestry, Jan. 1997

From page 116 – Section: You want to build or reconstruct a forest road. What do you need to know?

1. OAR Chapter 629-Division 625, Road Construction and Maintenance Rules
2. Forest Road Management Guidebook, Oregon Department of Forestry, Jan. 2000
3. Forest Practices Note No. 4 (Revised July 1999): Road Maintenance, Oregon Department of Forestry, July 1999
4. DOGAMI – Department of Geology and Mineral Industries
5. Kramer, Brian W., Forest Road Contracting, Construction and Maintenance for Small Forest Woodland Owners. Oregon State University, College of Forestry, Research Contribution 35, Nov. 2001

From page 129 – Section: You want to build or improve a road across a stream crossing. What do you need to know?

1. Forest Road Management Guidebook, Oregon Department of Forestry, Jan. 2000
2. Fish Passage Guidelines for New and Replacement Stream Crossing Structures. ODF Forest Practices Technical Note Number 4, May 10, 2002

From page 142 – Section: How to know the site class for your harvest unit leave trees and reforestation requirements

Estimating Site Productivity on Your Woodland. Oregon State University Extension Circular 1128

From page 178 – Section: How to plan for and calculate peak flows for stream crossings

1. Estimating Streamflows on Small Forested Watersheds for Culvert and Bridge Design in Oregon, Oregon State University
2. Checklist for Storm-Proofing Rural Roads: Stream Crossings. Oregon State University
3. Determining the 50-year Peak Flow and Stream Crossing Structure Size for New and Replacement Crossings, ODF Forest Practices Technical Note Number 5, May 10, 2002

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