Idaho Department of Lands
Agency Guidance Document
Forest Practices Program
Coeur d'Alene Staff Office
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Forest Practices Forester Forums

In accordance with Executive Order 2020-02, Transparency in Agency Guidance Documents, guidance documents promulgated by the department are not new laws. They represent an interpretation of existing law, except as authorized by Idaho Code or incorporated into a contract.

This document may reference other documents that are not currently available online. Copies of these reference documents may be obtained by filing a public records request at https://www.idl.idaho.gov/public-records-request.

Agency Contact

Forest Practices Program Manager

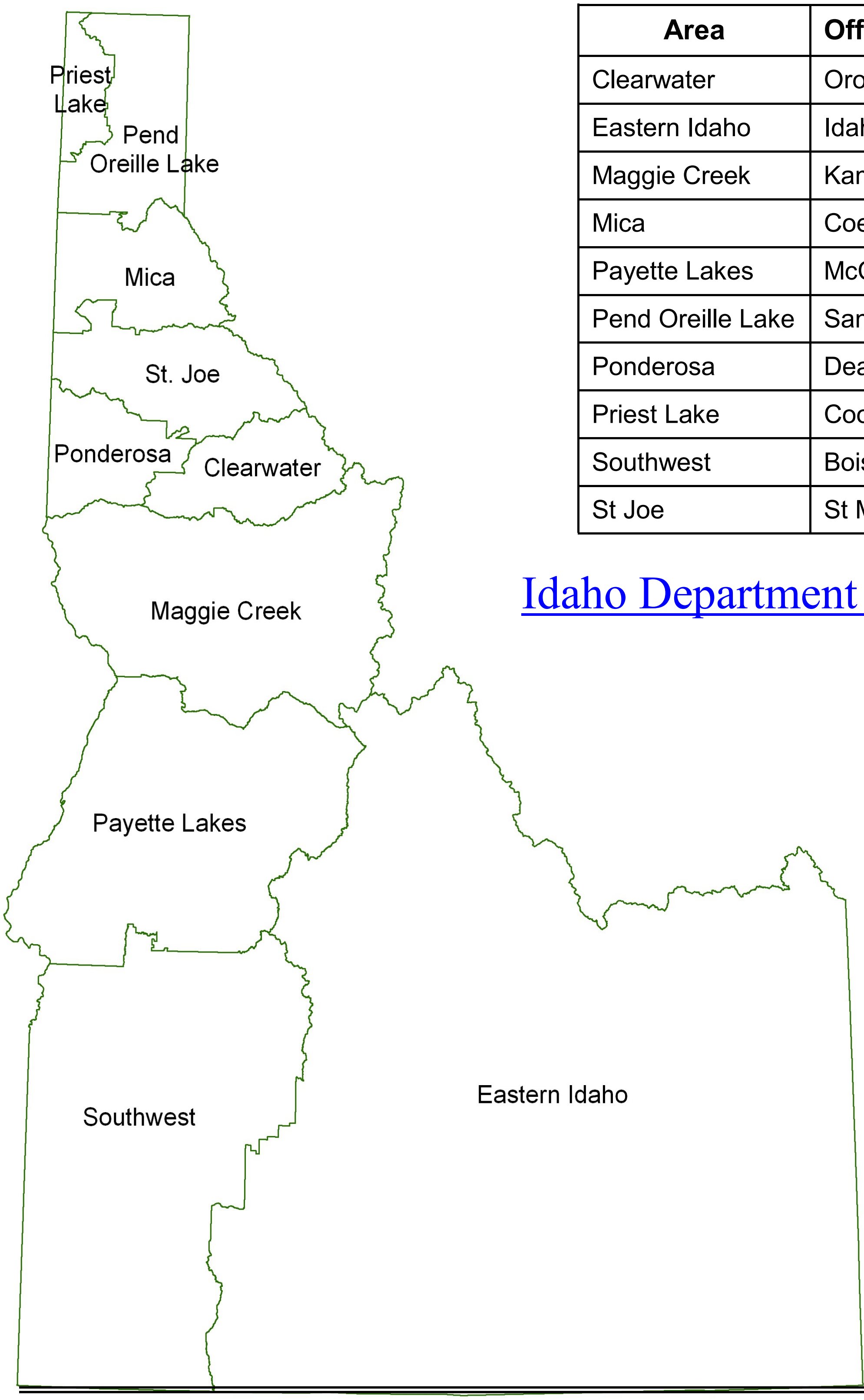
Any Idaho Department of Lands Private Forestry Specialist

Contents

FOR MORE INFORMATION CONTACT ANY IDAHO DEPARTMENT OF LANDS PRIVATE FORESTRY SPECIALIST

Area	Office Location	Phone
Clearwater	Orofino	(208) 476-4587
Eastern Idaho	Idaho Falls	(208) 525-7167
Maggie Creek	Kamiah	(208) 935-2141
Mica	Coeur d'Alene	(208) 769-1577
Payette Lakes	McCall	(208) 634-7125
Pend Oreille Lake	Sandpoint	(208) 263-5104
Ponderosa	Deary	(208) 877-1121
Priest Lake	Coolin	(208) 443-2516
Southwest	Boise	(208) 334-3488
St Joe	St Maries	(208) 245-4551

Idaho Department of Lands Forestry



IDAHO FOREST PRACTICES ACT

Want to harvest trees in Idaho?
Here's what you need to know.

IDAHO DEPARTMENT OF LANDS

State Forester Forum

The Idaho Forest Practices Act (FPA) was passed by the 1974 Idaho Legislature to assure the continuous growing and harvesting of forest trees, while maintaining forest soil, air and water quality. The intent of this statute is to promote the active management of timberlands, while also protecting forest health, wildlife habitat and aquatic resources. The FPA requires compliance with its coordinating administrative rules (Forest Practices Rules) to protect and enhance natural resources on Idaho's forestlands.

Private Forestry Specialists, located at Idaho Department of Lands (IDL) Area Offices statewide, can provide technical assistance prior to any timber harvest for forest landowners and operators who wish to learn more or seek advice about forest practices. When an operation is found in violation of the rules and corrective measures are not taken in a reasonable amount of time, IDL will take enforcement action against the responsible Operator.

Forest Practices Rules

The FPA provides for an advisory committee of forest landowners, operators, informed general public representatives, and other natural-resource experts to recommend rule amendments and additions. This advisory body, the Idaho Forest Practices Advisory Committee (FPAC), represents statewide interests as new rules are promulgated.

This Forester Forum provides highlights about the FPA and the Forest Practices Rules. For a booklet of the Forest Practices Rules, contact the nearest IDL Area Office. Audits performed across the state show that the vast majority of forest operators in Idaho conduct harvest operations in full compliance with the Forest Practices Rules.

Notification of Forest Practice

Operators must notify IDL of forest practices prior to commencing an operation. Notification is achieved by providing information for a *Notification of Forest Practice*. This notification shares a form with the *Certificate of Compliance—Fire Hazard Management Agreement,* and is often referred to as a "compliance." Five categories of forest-management activities are defined as forest practices:

1. Timber harvesting, related road construction and installation of stream-crossing structures
2. Road construction, reconstruction or maintenance of existing roads out of the operational area but associated with harvesting
3. Reforestation
4. Use of pesticides, fertilizers and petroleum products for forest-management purposes
5. Management of slash, resulting from forest management or the use of prescribed fire

The conversion of commercially harvested forestland to another land use requires a notification if timber is removed and sold as a commercial product.

A *Notification of Forest Practice* can be submitted at any local IDL Area Office. The Operator assuming responsibility for compliance with the Forest Practices Rules must sign the notification. The forest practice may begin after IDL accepts the notification.

Special practices may be required in some watersheds. IDL recommends pre-operational consultations with Private Forestry Specialists prior to conducting harvesting operations, especially in areas containing fish-bearing,

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Forest Practices

No. 1

August 2018

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Class I streams.

The *Notification of Forest Practice* and *Certificate of Compliance—Fire Hazard Management Agreement* is valid for a maximum of two years. Upon expiration, the notification must be renewed before the practice can continue. Extensions and other changes in the notification must be made within 30 days by the Operator.

Notification of emergency forest practices due to fire, flood, windthrow or earthquake may be made up to 48 hours after such practices are started.

Notification Exemptions

No notification is required for the following practices performed on forestlands:

1. Routine road maintenance, recreational uses, grazing by domestic livestock, cone picking, culture and harvest of Christmas trees (on lands designated solely as Christmas tree plantations), or harvesting of other minor forest products.
2. Non-commercial cutting and removal of trees by a person for personal use.
3. Clearing forestland for conversion to mining operations under a reclamation plan or dredge mining permit.

Non-Resident Operators

Operators who do not own property in Idaho must submit a performance bond to IDL prior to starting a forest practice. The bond amount is $200 per acre (in the contract area), with a minimum of $5,000 and a maximum of $15,000.

Penalties

Violation of the Forest Practices Rules is a misdemeanor. If an Operator fails to perform requisite remediation for a violation, IDL can make repairs to any operational area experiencing resource degradation due to a forest practice. IDL can then take civil action to recover remediation costs and associated legal fees. IDL will not accept notifications from Operators who have outstanding violations that have not been remedied. Operators that repeatedly violate these rules may be required to submit a bond to perform future operations.

Use of a Forest Practice Notification in a fraudulent or illegal manner is a felony under Title 18, Chapter 46 Idaho Code, Section 18-4630.

Filling Out

The Notification of Forest Practice

To adequately fill out the *Notification of Forest Practice* and *Certificate of Compliance—Fire Hazard Management Agreement* , an Operator will need to supply IDL the following information:

1. Name and address of ***Operator*** (assuming responsibility for compliance with the Forest Practices rules)
2. Name and address of ***Contractor*** (assuming responsibility for compliance with the slash-management rules)
3. Name and address of the landowner
4. Complete legal description of the operational area covered by the notification
5. A map of the operational area covered by the notification
6. The mill purchasing the harvested logs
7. The estimated harvested volume
8. Road construction associated with the harvesting operation
9. Use of herbicides or chemicals associated with managing trees
10. Reforestation plans (e.g., planting seedlings)
11. The presence of Class I (fish-bearing or domestic-water use) or Class II streams in the operational area
12. The presence of steep (over 45%) slopes in the operational area
13. The presence of highly erodible or unstable soils
14. Descriptions of planned stream-crossing installations (e.g., bridges, fords and culverts)

Forest Practices and

Steam Channel Alterations

If the Operator plans on installing or removing a culvert or bridge, or plans to construct a ford, across a perennial Class I or Class II stream, a Stream Channel Alteration Permit will likely be required. If the stream-crossing structure is being constructed as part of the forest practice covered by the notification, and it falls within certain size parameters, an IDL Private Forestry Specialist may be able to administer this permitting process. If a culvert is being installed on a Class I, fish-bearing stream, the culvert must comply with very specific fish-passage standards (See Forest Practices Forester Forum No. 12).

SLASH REMOVAL FROM STREAMS

State Forester Forum

The Idaho Forest Practices Act administrative rules (Forest Practices Rules) stress harvesting, road-work, and site-preparation practices that prevent slash blockage in streams. Slash and debris deposits in or over streams can block the channel, causing diversion of the flow and washout of adjacent and downstream banks, side slopes, roads, skid trails and culverts. In the most severe cases, the release of stream-blocking slash and debris jams may cause debris torrents and downstream obliteration of stream banks, resulting in miles of damaged streambeds and ruined fish habitat.

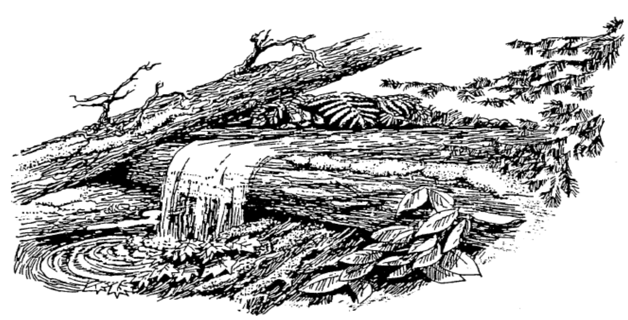
NOT THIS

There are several requirements in the Forest Practices Rules for Class I and Class II streams:

1. On Class I streams, any slash or debris deposited in the stream must be continuously removed during the entire operation.
2. On Class II streams, any slash or debris deposited in the stream must be removed when there is a potential for stream blockage or stream transport of the deposited material.
3. Slash and debris that has the potential to block a culvert must be cleaned out of the channel above the culvert inlet to ensure the culvert will not be plugged or blocked during high-stream flows. Channel cleaning of slash should be done for at least 25 feet upstream on small streams and up to 100 feet on larger streams.
4. Large Organic Debris (LOD) is defined as snags or tree stems over 20 feet long, or stumps and root wads of sawlog-sized trees that may fall, or have fallen, naturally into or along the stream. Natural LOD should not be removed from the stream or bank unless it appears unstable or presents a potential blockage problem. Care should be taken not to destabilize LOD while removing slash that has been deposited during a harvesting operation.

Prevention of slash accumulation in streams is always the least costly choice for Operators. Cleanout work is time consuming and labor intensive. Operators must look at natural or operation-caused slash above culvert-installation sites to see if potential for blockage exists. Plugged culverts and washed-out roads are costly, in terms of both money and regulatory issuances.

The Idaho Department of Lands (IDL) Private Forestry Specialists are available to help Operators plan their operations to minimize slash delivery to streams.



BUT THIS

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Forest Practices

No. 2

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Forest Roads
Compliant and Non-Compliant Characteristics

State Forester Forum

Properly planned, designed, constructed and maintained roads are essential to sound forest management. Well built and maintained roads are an asset to the landowner; they benefit the operator by allowing for the responsible transport of forest products, while protecting aquatic resources and meeting water-quality standards. The Idaho Forest Practices Act administrative rules (Forest Practices Rules) contain several road construction and maintenance rules that focus on prevention of road washouts and avoidance of sediment delivery into streams.

GENERAL ROAD CONSTRUCTION / MAINTENANCE GUIDES

Rule-Compliant Road Characteristics	***Potentially Non-Compliant Road Characteristics***

PLANS AND ROAD STANDARDS

Rule-Compliant: Widths and grades are suitable for needs and intended uses. Cost allowances are carefully analyzed. Roads are constructed with grades of 2% to 10%; these road slopes are least costly to drain and can be used most of the year if conditions are not too wet. Road layout is planned to fit the natural terrain features so that width, cuts, and fills are minimized.

Potentially Non-Compliant: Roads are excessive in width, resulting in excessive costs; large fill slopes require more drainage and more surface area to stabilize. Roads are constructed with near-zero grades; flat grades can form mud holes by pooling water. Roads are overly steep; (10%+) grades accelerate water runoff velocity, causing unwanted rilling and gullying.

LOCATION

Rule-Compliant: Roads are on stable landforms and gentle slopes outside the Stream Protection Zones (SPZs), entering the SPZ only for approaches to stream crossings. Greater amounts of vegetation are left undisturbed to dissipate and filter water, stabilize stream banks, protect aquatic habitats and maintain the integrity of the soil near streams.

Potentially Non-Compliant: Roads are built in the Stream Protection Zones (SPZs), or existing roads are used within the SPZ without an approved variance. Roads are constructed in which fills may erode into streams, road beds are laid on soft, wetter ground, or excessive SPZ vegetation is removed. Roads are located on steep, unstable slopes or on landforms which are subject to mass wasting.

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Forest Practices
No. 4
August 2018

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FOREST ROADS
COMPLIANT AND NON-COMPLIANT CHARACTERISTICS

Rule-Compliant Road Characteristics | ***Potentially Non-Compliant Road Characteristics***

DRAINAGE

Rule-Compliant:

The road-drainage plan has every running foot planned with a combination of drainage structures to match the site and terrain.

a) Roads are insloped with inside ditches and frequent cross-drainage structures.

b) Roads are outsloped with drainage moving onto stabilized fills or filter strips of vegetation.

c) Roads are insloped, outsloped or crowned with appropriate water-diversion structures.

d) Surfaces of cuts, fills, berms, and roads are stabilized by grass, mulch, or fabric.

e) All sediments and water diverted off the road are dissipated and filtered by undisturbed vegetation and slash filter windrows.

Potentially Non-Compliant:

Roads are constructed with no thoughtful drainage system apparent. Mudholes, rills, gullies, washouts, and slumps occur on cuts and fills; water and sediments reach Class I and II streams. Inside ditches deliver directly to streams at crossings. Cuts and fills for switchbacks are in draws or creek bottoms. Cuts, fills and berms are not stabilized by grass seeding, mulching, erosion fabric, or slash filter windrows. Drainage systems for active and inactive roads are not maintained. On abandoned roads, drainage systems are not obliterated, culverts not pulled, and the road is not closed to vehicles.

RELIEF CULVERTS

Rule-Compliant:

Adequately located, sized, installed and maintained metal or plastic relief culverts are spaced under the road to disperse inside ditch, springs, seepage, and other water flows. They are sloped, tamped, and bedded firmly, and covered sufficiently. The inlets are armored with rock and constructed to remain unplugged. The outlet is armored or down-spouted to protect fills or extend beyond the toe of the fill slope.

Potentially Non-Compliant:

No cross drainage is provided for inside ditches, road surface water, or water from springs and seeps. Culverts are too small or infrequent to provide adequate drainage relief. The inlets will be plugged by cut bank sloughing, maintenance grading, or debris. There are no culverts to supply proper drainage for intermittent streams.

CROSS DITCHES/ROLLING DIPS

Rule-Compliant:

On infrequently used roads, cross ditches are installed after each use and spaced properly (see State Forester Forum on Cross-Ditches), stabilized, and maintained. For frequently used roads, rolling dips are permanently built into the road surface, with gradients less than 8 percent.

Potentially Non-Compliant:

Cross ditches or rolling dips are not installed, or if installed, are not adequately draining water off of the road, or are causing water and sediments to be delivered to a Class I or Class II stream.

FOREST ROADS
COMPLIANT AND NON-COMPLIANT CHARACTERISTICS

Rule-Compliant Road Characteristics	***Potentially Non-Compliant Road Characteristics***

FILTER WINDROWS

Filter windrows are used when fill slopes pose a potential sediment-delivery threats to streams. They are constructed sediment barriers at the toe of fill slopes, made of slash and other woody debris (see State Forester Forum No. 13, Slash Filter Windrows). Windrows can trap 75 to 85+ percent of fill slope erosion in or near SPZs.

Filter windrows are not used and sediment from unstable fill slopes is being delivered to an SPZ. Filter windrows are installed, but not properly constructed.

MUD AND DUST

Where natural rock is lacking and soils easily turn into mud or dust, 3-inch-minus sized rock material is applied at least 10 inches deep on the surface of the road.

Mud or dust is generated, causing obstructions in operations, rutting in the roads, and threats to safety. Rock surface is lacking.

GRADES IN CURVES

Road grades on sharp curves are reduced to 7% or less. Grades are flattened out at stream crossings. Road junctions and truck turnarounds are not built near stream crossings or in SPZs.

Grades over 7% are sustained in sharp curves on switchbacks and at stream crossings. Road junctions and truck turnarounds are built near stream crossings and in SPZs.

INACTIVE OR ABANDONED ROADS

Inactive Roads: All drainage systems and structures are cleaned, stabilized, and maintained annually to prevent erosion. Access is controlled where seasonal traffic is allowed.

Permanently Abandoned Roads: Drainage systems are left in a stabilized condition with all stream crossings removed and stream gradients returned to their natural slope. Roads are closed to vehicular traffic.

Inactive Roads: No post-operation stabilization or drainage cleanout is done. No planned regular or annual maintenance is completed.

Permanently Abandoned Roads: No final or post-operation stabilization and drainage cleanout is performed. No permanent road closure structures or barriers have been installed.

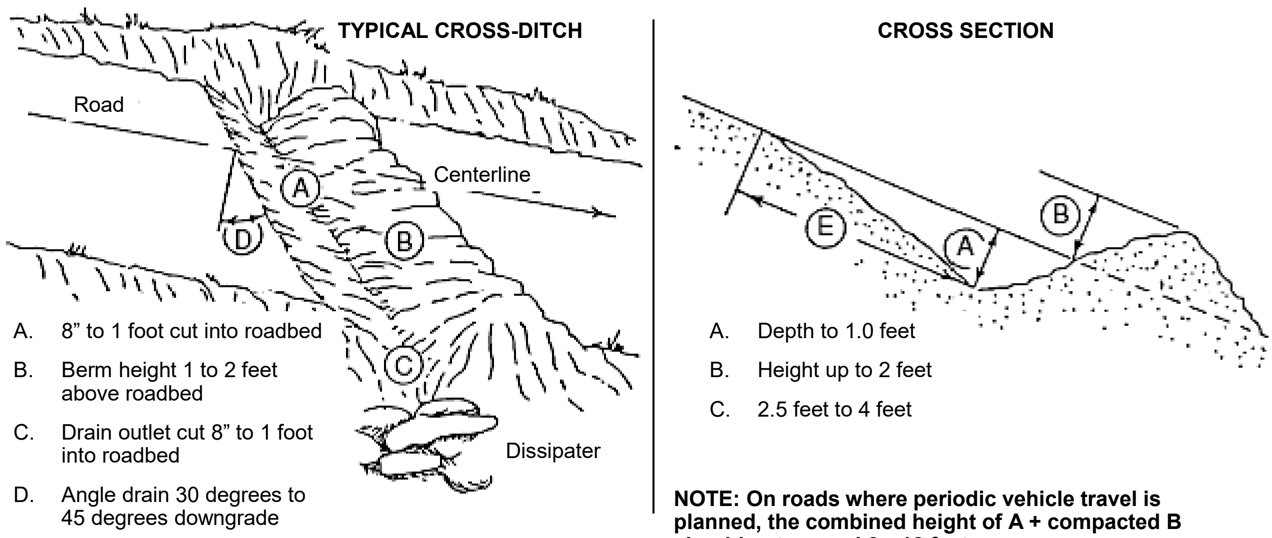
On-the-ground help and written materials on Forest Roads and Water Quality are available from your nearest Idaho Department of Lands Private Forestry Specialist.

CROSS-DITCHES

State Forester Forum

Cross-ditches (waterbars) are constructed on roads, skid trails, and landings to prevent rills and gullies from forming and prevent sediment from getting into streams. The goal is to move the water across and off the road or trail where it will be absorbed into the roadside vegetation, infiltrated into the soil, and avoid direct sediment delivery to streams and water bodies.

Cross-ditches control the volume and velocity of water moving over a road or trail surface. The typical cross-ditch is illustrated below.



NOTE: On roads where periodic vehicle travel is planned, the combined height of A + compacted B should not exceed 8—12 feet

Placement of cross-ditches is critical for their effectiveness. Cross-ditches should be placed above sections of steep grades to prevent water-flow from increasing in velocity on the steep grades. They are placed above intersections of roads, skid trails, and landings. Cross-ditches placed in swales, gullies, or low areas function as dams and should be avoided.

Cross-ditches should be cut into the soil at least 8 inches and have a berm of at least 12 inches on the downhill side. The alignment should be at an angle of 30 to 45 degrees downhill across the road to the fill slope. Cross-ditches should be firmly tied into the cut slope. The outlet should be open and free-flowing onto a stable area. Runoff should be dissipated by rocks, slash, vegetation, or less erodible material, particularly on fills.

Whenever possible, cross-ditches should be constructed from the bottom to the top of the grade on roads and trails. This is done to avoid driving over the structure and flattening the berm before it can settle and firm up. Driving over new, soft or wet cross-ditches and the berms is the main cause of ditch failure.

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Forest Practice

No. 5

August 2018

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CROSS-DITCHES

Recommended Cross-ditch Spacing Distance for Roads and Trails		
Grade of Road or Trail (%)	**Unstable Soils High Erosion Hazard**	**Stable Soils Low Erosion Hazard**
2	135 feet	170 feet
5	100 feet	140 feet
10	80 feet	115 feet
15	60 feet	90 feet
20	45 feet	60 feet
20+	30 feet	40 feet

For help in determining the soil stability/erosion hazard in your area, contact an IDL Forest Practices Advisor or your Soil Conservation District.

STREAM PROTECTION ZONE (SPZ)

State Forester Forum

What Are Stream Protection Zones?

Every forest stream in Idaho, whether one foot or one hundred feet wide, exhibits the collective impacts of the man-made and natural changes and activities occurring along its banks and adjoining uplands. This extremely sensitive environment, including the stream bottom, banks and lands adjacent to the stream's high-water marks, defines the *riparian area*. In the realm of forest management, Idaho defines this riparian area as the Stream Protection Zone (SPZ). Similar shore-side environments exist for lakes.

The SPZs are a very special geographic part of the forest containing water-impacted rock, soil, plants and animals. The SPZs are important because they are ecologically active with waterborne fish, insects, reptiles, water-dependent birds, mammals, and plants ranging from mosses to a multitude of grasses, shrubs, and tree species.

Why Are SPZs Important?

SPZs protect streams and lakes from road and skid trail sediment runoff, maintain stable temperatures with shade and weather buffering (thermal cover), and provide stream stability and structure with plant roots and woody debris. The wetter riparian areas have mixed soil structure and organic matter layers that make up a complex water-filtering sponge, supporting hundreds of interdependent species of plants and animals. Protecting SPZs from logging impacts is important to maintain water quality and fish and wildlife habitat.

What Is Required by the Idaho Forest Practices Rules?

For simplicity in protecting and regulating forest practices near streams and lakes, the SPZs are defined in the Forest Practices Rules as lands extending 75 feet (slope distance) out from each side of the high water marks for a Class I stream; similarly, the SPZ of a lake consists of the lands extending 75 feet out from the high-water mark of the shoreline. The SPZs for a Class II stream (non-fish-bearing and no domestic use) extend 30 feet of slope distance on each side of the high water marks. These distances are minimums, and the distances should be wider under certain conditions. Wider SPZs are often recommended for streams or lakes with a fishery or domestic use (Class I) adjacent to steep sideslopes. *Lakes require an approved site-specific riparian management plan prior to conducting forest practices*.

The SPZ widths should vary with the landforms, vegetation, and stream orientation. SPZ width above major domestic water intakes should be increased beyond the 75-foot minimum. A non-fish-bearing stream that is used for domestic-water purposes must be given a 75-foot minimum SPZ on each side for one-quarter mile (1,320 feet) upstream from water intakes. Operators are cautioned to note that both Class I and Class II streams may have dry beds part of the year. Forest practices are not excluded in SPZs, but soil and stream disturbance must be avoided and vegetation disturbance kept to a minimum. Ground-based harvesting equipment is not allowed in SPZs. Road and trail construction within SPZs can only be done for approaches to crossings.

Cumulative Watershed Effects (CWE) rules are for special streams where a group of landowners, a Watershed Advisory Group (WAG) or the IDL cooperatively develops site-specific Best Management Practices for a

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Forest Practices

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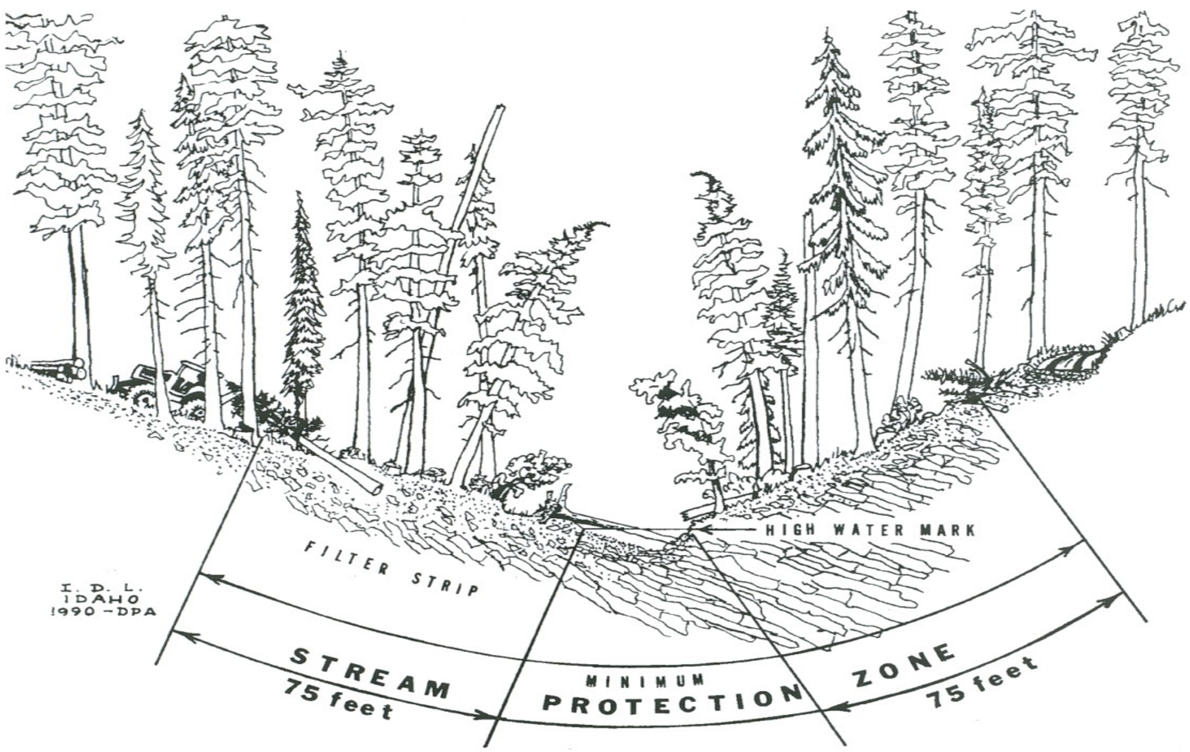
special, selected watershed.

HOW DO WE PROTECT SPZS?



CLASS I

Roads and Trails: New roads, landings, and skid trails are generally not allowed in the SPZ along streams. Use of old roads or skid trails in the SPZ requires an approved variance and can be allowed if opening up an old, existing road will not impact water quality. All drainage and erosion-control systems (e.g., culverts, ditches, berms, cross-ditches, mulching) should be checked and maintained prior to the wet season and whenever operations are shut down or completed. Trails shall be cross-ditched when not in use and at the end of the operating season, or at job completion.

Stream Crossings: When constructing, reconstructing, or reusing a stream crossing (e.g., culverts, bridges or fords), contact a local IDL Private Forestry Specialist for guidance on required permits and proper construction techniques. With some limitations, most stream-crossing structures installed as part of a forest practice can be permitted through IDL. A signed, approved permit (Supplemental Notification Form) must be issued to the operator prior to installation.

All stream-crossing installations must be minimum in number and comply with the Stream Channel Alteration Rules.

When installing bridges, culverts or fords, special care for water quality and fish habitat must be taken. This includes thoughtful timing of installation and careful consideration of all fish-passage rules (see Forester Forum No. 12). The sediment caused by these necessary disturbances can be made negligible by construction between periods of fish migration and egg incubation. For example, there are seven to eight months in the year when cutthroat trout are not reproducing. The IDL Private Forestry Specialists or Interdisciplinary Team technical specialists can advise operators on stream and fish situations and appropriate timing of streambed alterations.

Culverts: Permanent culverts should be large enough to carry the stream's 50-year peak flow, which may occur in any given year. Permanent *relief culverts* must not be less than 12 inches in diameter. Culvert installations on fish-bearing Class I streams must also meet all of the fish-passage criteria listed in the Stream Channel Alteration Rules. Extra care must be taken in the design and installation of hydraulic-design, non-embedded culverts to ensure fish passage. Carefully read IDL State Forester Forum No. 12 to obtain information on fish-passage rule compliance. Also, refer to the table listed under rule *040.02.e* in the Forest Practices Rules to determine required culvert sizes.

Fords: A stream-alteration Supplemental Notification Form must be approved and signed prior to the installation of a ford. Fords should cross the stream at right angles and ensure fish passage. During times of salmonid spawning and egg incubation, and in areas around domestic water intakes, ford installations must be limited to low-water, dry or frozen conditions. The streambed must be rocky, and rock and gravel must cover the approaches and bottom to prevent sediment discharge into and down the stream. (See IDL State Forester Forum No. 7—*Fords: When, Where, Why, and How*)

Temporary Crossings: These are used to keep equipment out of Class I and II streams. An approved variance may be required. They must be removed immediately after use or prior to the end of the operating season.

Timber Falling: Use directional falling techniques and skills to keep timber out of the creeks; trees should be felled to fall away from streams. Do not limb in or over the streams. Near streams, use whole-tree skidding and do limbing and trimming where the debris will not get in the stream. Maintain all leave-tree minimums in the SPZs of Class I and Class II streams; there should be a relatively continuous distribution of these required leave trees left along the streamside areas.

Skidding and Yarding: Keep equipment and disturbance away from streams and SPZs. Use cable on tractors/skidders or cable systems to remove timber from the SPZ. Do not drag logs or skid in or through streams. Cross ditch all sloping trails immediately after using them. On logged areas adjacent to Class I or Class II streams, ground-based skidding should not be conducted on slopes exceeding 45% without an approved variance.

Large Organic Debris and Shade Requirements: A mix of snags, hardwood trees, and conifers must be left in the SPZ along Class I and Class II streams. Large organic debris (LOD) are those trees and snags within 50 feet of a stream that maintain bank stability, and as they naturally fall, over time, provide the pools and riffles that enhance fish numbers and water quality. In many circumstances, these snags and trees protect fish from winter-freezing kills and overly warm waters in summer. The LOD-formed pools and riffles reduce the stream flow velocity and the bank and channel-cutting energy of the stream. The LOD-formed pools and riffles trap and store sediment, and provide resting and cover habitat for aquatic animals.

Portions of felled or bucked trees not meeting the LOD definition must be removed from streams. Slash resulting from harvesting operations must be continuously removed from Class I streams.

Specific tree and vegetation retention requirements for Class I and Class II streams are detailed in the FPA Rules under Rule 030.07.e. Stream Protection. Alternatives are allowed in IDL-approved, site-specific riparian management plans.

STREAM PROTECTION ZONE (SPZ)

Winter Logging: Stream crossings of snow and ice usually have some dirt and slash in them which must be pulled and piled above high-water marks of streams. Packed-snow skid trails are often acceptable in SPZs when the ground is frozen. Where snow and ice are used for a temporary stream crossing, or packed snow is used to allow equipment entry into the SPZ, an approved variance is required.

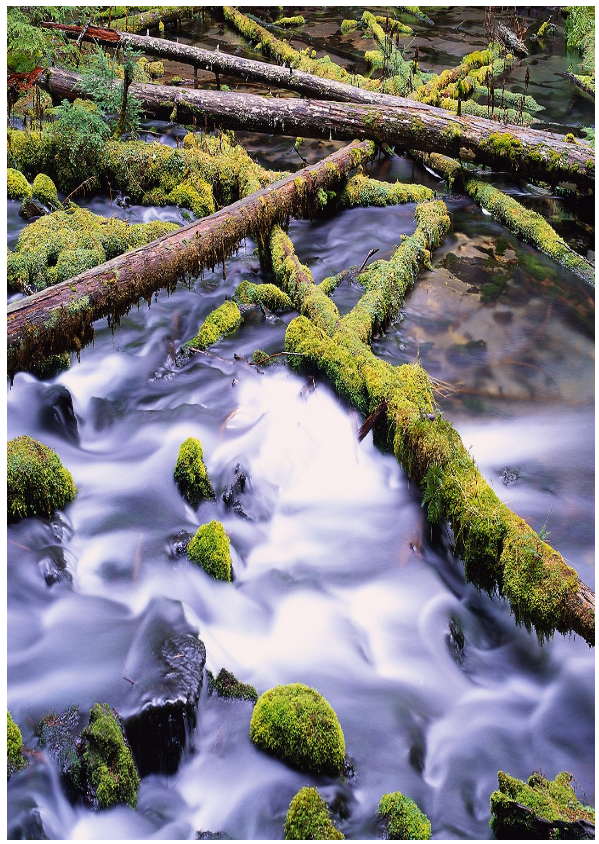
Burning Debris: Burning in or near the SPZ may cause erosion, nutrient flushes into the water, and soil sterilization where riparian vegetation should grow. Direct ignition of prescribed burns is limited to hand piles within the SPZ of streams; all other direct ignitions shall occur outside of SPZs. Hand piles must be at least 5 feet from the ordinary high-water mark of streams. No mechanical piling of slash or fuels is allowed in a stream's SPZ except for the construction of filter windrows for erosion control. Always pile and burn outside of the SPZ (or as distant as possible) to minimize burning effects on the stream.

Chemicals and Petroleum Products: With the exception of chemicals approved for aquatic use, pesticides and herbicides shall not be applied within 25 feet of a stream by hand, or 100 feet by aircraft. Ground application of fertilizers will be restricted to leave at least 10 feet untreated on each side of all streams, ponds and lakes.

Petroleum products in mobile or stationary tanks, with over a 200-gallon capacity, shall be kept 100 feet or more from streams with impervious containment dikes.

Fueling operations should never occur where spillage could result in the introduction of these petroleum chemicals into a stream, lake or other area of open water.

Consult the Forest Practices Rules for detailed information and requirements on forest practices in the STREAM PROTECTION ZONE.



FORDS: WHEN, WHERE, WHY AND HOW

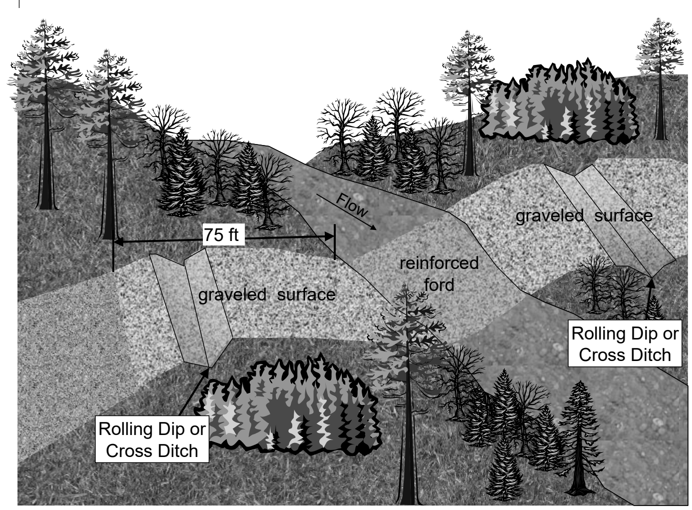
State Forester Forum

When the appropriate site conditions exist, fords can be a preferred alternative for a stream crossing from an economical and environmental perspective. This Forum examines the benefits of using a ford, the conditions when fords are appropriate, and basic ford construction techniques.

When constructing, reconstructing, or reusing a ford crossing, contact a local IDL Private Forestry Specialist for guidance on required permits and construction techniques that comply with the Forest Practices Rules.

WHY USE A FORD?

1. Under the appropriate conditions, fords are easier and less costly to construct and maintain than other types of crossings. Often, ford construction requires only the placement of rock on the stream banks and its approaches. Installation of a culvert or bridge would require much more time and expense. Properly constructed fords prove to require little maintenance, while culvert and bridge maintenance can be expensive.
2. The construction of most fords requires minor earthwork and rocking of the stream banks and its approaches, which contributes minimal sediment to a stream. Culvert installations involve much more earthwork and greater potential of sediment delivery to streams.
3. On streams that have high bedload movement or large amounts of woody debris or commonly develop ice dams, fords eliminate washout failures by allowing rock, debris, and ice to pass freely. In these conditions, culverts and occasionally bridges may have blockage and subsequent failure, causing severe impacts to the aquatic environment.
4. A proper ford will not obstruct natural stream flow, fish passage, or use of the flood plain. Culverts and bridges may disrupt stream flow by constricting the channel, causing upstream ponding, increase downstream water velocities, and limit use of the floodplain. These conditions increase stream scour and sediment transport, and culverts often restrict upstream fish migration.



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Forest Practices
No. 7
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FORDS: WHEN, WHERE, WHY AND HOW

WHEN IS IT APPROPRIATE TO USE A FORD?

1. Fords are suitable for crossings with low-volume seasonal traffic. High flow would restrict traffic use during spring runoff, and heavy traffic could cause excessive erosion and sediment delivery to the stream.
2. Fords should not be used or constructed during times of salmonid spawning and egg incubation. Crossing vehicles could disrupt nearby spawning activities and reduce spawning success by introducing sediment to spawning gravels. More specific dates of times to avoid should be obtained from a biologist with local fisheries knowledge.
3. Fords should not be constructed or used in streams above household drinking water intakes to protect public health.
4. Ephemeral streams with high width to depth ratios are the preferable sites for a ford. Fords may also be constructed in small, shallow (< 2 ft. stream depth) perennial streams (less than 20 ft. stream width) with rocky substrates and flat gradients (less than 2%).

SALMONID SPECIES	SPAWNING	YOUNG EMERGE FROM GRAVEL
Rainbow trout	Mid March – Late June	Early June – Late August
Cutthroat Trout	Late March – Early July	Early June – Early Sept.
Chinook Salmon	Early August – Early Oct.	Late March – Late May
Bull Trout	Mid August – Late Oct.	Late March – Late May
Brook Trout	Early Sept. – Late Nov.	Mid March – Late May
Brown Trout	Late Sept. – Early Dec.	Early April – Early March
Kokanee	Early Sept. – Early Jan.	Early March – Late May
Lake Whitefish	Early Oct. – Late Jan.	Early April – Late May
Mt. Whitefish	Mid Oct. – Early Feb.	Early April – Late May

Fords may be appropriate on wider streams when they have poorly confined channels that often change course from excessive bedload. Fords are not appropriate on deep, narrow stream channels.

5. Fords are appropriate in low public-use areas where people will not be tempted to drive motorized vehicles in the streambed. Fords constructed in high-use areas should be gated when in use and when no longer needed, large woody debris and/or boulders should be placed to prevent access to the streambed. Vegetation should also be restored along the stream. Consult a hydrologist if large woody debris or boulders are to be placed within the stream channel.
6. Remember that there are many types of stream crossings and fords are not always the best choice.

CONSTRUCTION RECOMMENDATIONS

1. On small, low-gradient streams (less than 2%) with semi-angular to angular rock bottoms (>1-inch diameter rock) and minimal traffic (no more than five crossings per day), the following is needed for a successful ford:

   A. If appropriate, a ford should be constructed at a right angle to the stream on a straight, shallow section of stream. Fords constructed on stream bends can result in erosion damage or failure due to channel movement.

   B. Each approach to the ford should have a rolling dip or cross ditch or divert any water that may run down the road. Dips or cross ditches should drain into dense vegetation or filter strips, to prevent sediment from entering the stream.

   C. Approaches and stream banks should be rocked with angular gravel or pit run material for the entire width of the flood plain, ensuring that rocking occurs for at least 75 feet on each side of the stream. Rocking the approaches provides a suitable running surface, protects the stream banks and flood plain and keeps soil from sticking to tracks or tires, and washing off in streams. If the soil type for the approaches is fine grained, it is recommended to use a woven geotextile fabric between the subgrade and the gravel surfacing for added strength and separation (Figure 2). For lighter traffic, material should only be added to the streambed to level it out. For heavier traffic (including log trucks) even streams with course, angular substrate may need to be reinforced with additional rock, however, the added rock should not raise the level of the streambed significantly higher than the existing level or fish passage problems may result.

   D. The amount of vegetation removed adjacent to the crossing should be minimized and bank cuts should be revegetated immediately following construction.

2. If a ford is needed on a stream with silt, sand, fine gravel (less than 1-inch diameter) or rounded coarse material bottoms, steeper gradients (more than 2%), or that requires more than five crossings per day, an expert should be consulted.

3. Removal of fords—When a ford is no longer needed, it should be obliterated. This consists of placing large woody debris and/or boulders to prevent access to the streambed, restoring the riparian vegetation, and barricading the road. These actions help eliminate recreational use of the ford, increase stream bank stability, and provide future shade and structure to the stream.

POTENTIALLY UNSTABLE SLOPES AND LANDFORMS

State Forester Forum

OVERVIEW

Landslides occur naturally in forested basins and are an essential process in the delivery of wood and gravel to streams. Wood and gravel play significant roles in creating stream diversity that is necessary for fish use as habitat and spawning grounds. When the potential for instability is recognized, the likelihood that sediment and debris would travel far enough to threaten a public resource or public safety is considered. Many factors are part of that concern including initial failure volume and nature of a landslide, landslide runout distance, and landscape geometry.

<u>Landslide Types and Effects</u>

Shallow landslides occur in bedrock hollows, convergent headwalls, and inner gorges with slopes, on toes of deep-seated landslides with slopes, and on the outer edges of meander bends. There are generally three types of shallow landslides: debris slides, debris flows, and hyper-concentrated floods. They are distinguished from each other by the ratio of water to solids contained in them.

Debris slides consist of aggregations of coarse soil, rock, and vegetation that lack significant water and move at speeds ranging from very slow to rapid down slope by sliding or rolling forward. The results are irregular hummocky deposits that are typically poorly sorted and non-stratified. Debris slides include those types of landslides also known as shallow rapid, soil slips, and debris avalanches. If debris slides entrain enough water, they can become debris flows.

Debris flows are slurries composed of sediment, water, vegetation, and other debris. Solids on average compose >60% of the volume. Debris flows usually occur in steep channels, as landslide debris becomes charged with water (from soil water, or on entering a stream channel) and liquefies as it breaks up. These landslides can travel thousands of feet from the point of initiation, scouring the channel to bedrock in steeper channels. Debris flows commonly slow where the channel makes a sharp bend and stop where the channel slope gradient becomes gentler than about 3 °, or the valley bottom becomes wider and allows the flow to spread out.

Hyper-concentrated floods are flowing mixtures of water, sediment (dominantly sand-sized), and organic debris with solids that range between 20% and 60% by volume (Pierson and Scott, 1985). In forested mountains, they are commonly caused by the collapse of dams, such as those formed by landslide dams or debris jams. Impounded water and debris released when the dam is breached sends a flood wave down the channel that exceeds the magnitude of normal floods. Such hyper-concentrated floods can rise higher than normal rainfall or snowmelt-induced flows along relatively confined valley bottoms, driving flood waters, sediment, and wood loads to elevations high above the active channel and, if present, the active floodplain.

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POTENTIALLY UNSTABLE SLOPES AND LANDFORMS

Debris flows and hyper-concentrated floods can occur in any unstable or potentially unstable terrain with susceptible valley geometry. In natural systems, debris flows and hyper-concentrated floods caused by dam-breaks are responsible for moving sediment and woody debris from hill slopes and small channels down into larger streams. But debris flows can also cause damage to streams by scouring channel reaches, disturbing riparian zones, impacting habitat and dumping debris onto salmonid spawning areas. Debris flows can cause elevated turbidity, adversely affect water quality downstream, threaten public safety, and damage roads and structures in their paths (Figure 1).

Figure I. Road-initiated debris flows in inner gorges, main stem Beaver Creek, North Fork Clearwater River.

At least two of these visible torrent tracks were active within the last several years, and sediment and debris appears to have been delivered across the lower road to Beaver Creek. The debris slides originated at an existing road at the gorge break-in-slope and torrented down the steep inner gorges (swales).

Deep-Seated Landslides

A more detailed explanation of deep-seated landslides is covered later in this section because deep-seated landslides are also landforms. Despite the failure mechanism, deep-seated landslides are those in which the slide plane or zone of movement is well below the maximum rooting depth of forest trees (generally greater than 10 feet) and may extend to hundreds of feet in depth often including bedrock. Deep-seated landslides can occur almost anywhere on a hill slope and are typically associated with hydrologic responses in permeable geologic materials overlying less permeable materials. The larger deep-seated landslides can often be identified from topographic maps or aerial photos.

Certain key areas of deep-seated landslides may be sensitive to forest practices. The bodies and toes of deep-seated landslides are made up of incoherent collapsed material weakened from previous movement and therefore may be subject to debris slide and debris flow initiation in response to harvest or road building. Sediment delivery from shallow landslides on steep stream-adjacent toes of deep-seated landslides and steep side-slopes of marginal streams on the bodies of deep-seated landslides is common.

POTENTIALLY UNSTABLE SLOPES AND LANDFORMS

SLOPE FORM

Slope shape is an important concept when considering the mechanisms behind shallow land sliding. Understanding and recognizing the differences in slope form is key in potentially unstable landform recognition. There are three major slope forms to be observed when looking across the slope (contour direction): divergent (ridge top), planar (straight), and convergent (spoon-shaped) (Figure 2). Landslides can occur on any of these slope forms but divergent slopes tend to be more stable than convergent slopes because water and debris spread out on a divergent slope whereas water and debris concentrate on convergent slopes. Convergent slopes tend to lead into the stream network, encouraging delivery of landslide debris to the stream system. Planar slopes are generally less stable than divergent slopes but more stable than convergent slopes. In the vertical direction, ridge tops are convex areas (bulging outward) and tend to be more stable than planar (straight) mid-slopes and concave areas (sloping inward) (Figure 3).

Additionally, slope steepness can play a significant role in shallow land sliding. Steeper slopes tend to be less stable. The soil mantle, depending upon its make-up, has a natural angle at which it is relatively stable (natural angle of repose). When hill slopes evolve to be steeper than the natural angle of repose of the soil mantle, the hill slope is less stable and more prone to shallow landslides, especially with the addition of water. The combination of steep slopes and convergent topography has the highest potential for shallow land sliding.

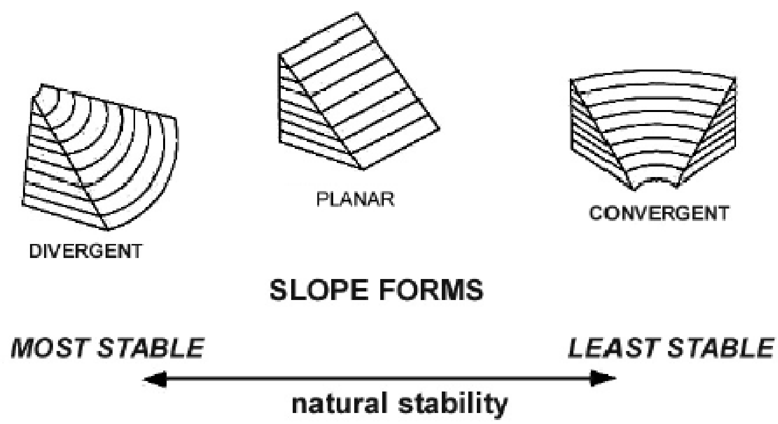

Figure 2. Slope configurations as observed in map view

This figure shows three major slope forms (divergent, planar, and convergent) and their relative stability. These slope form terms are used in reference to contour (across) directions on a slope. Convergent areas with slope greater than 60% are the most shallow landslide-prone.

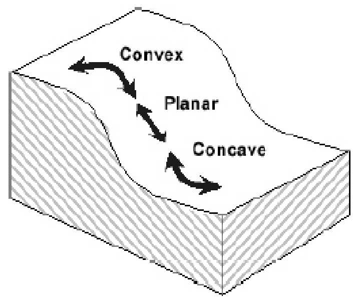

Figure 3. Slope configurations as observed in profile: convex, planar, and concave. These terms are used in reference to up and down directions on a slope (Drawing: Jack Powell, WDNR, 2004)

DESCRIPTION OF UNSTABLE AND POTENTIALLY UNSTABLE LANDFORMS AND PROCESSES

Areas of unstable landforms can usually be identified with a combination of topographic and geologic maps, aerial photographs, CWE mass failure hazard rating maps, and modeled slope stability morphology (SHALSTAB, SINMAP, LISA) output maps. However, field observation is normally required to precisely delineate landform boundaries, gradients, and other characteristics.

Bedrock Hollows, Convergent Headwalls, Inner Gorges

These three landforms are commonly associated with each other as shown in figures 4 and 5.

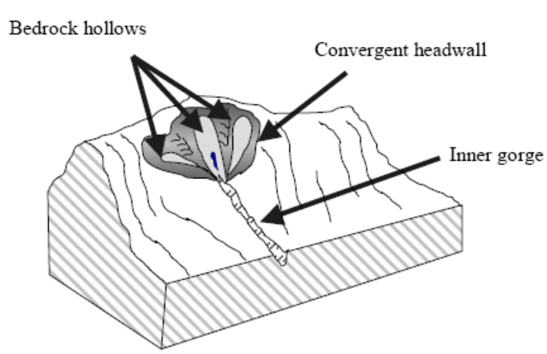

Figure 4. Typical hill slope relationships between bedrock hollows, convergent headwall, and inner gorge (Drawing: Jack Powell, WDNR, 2003)

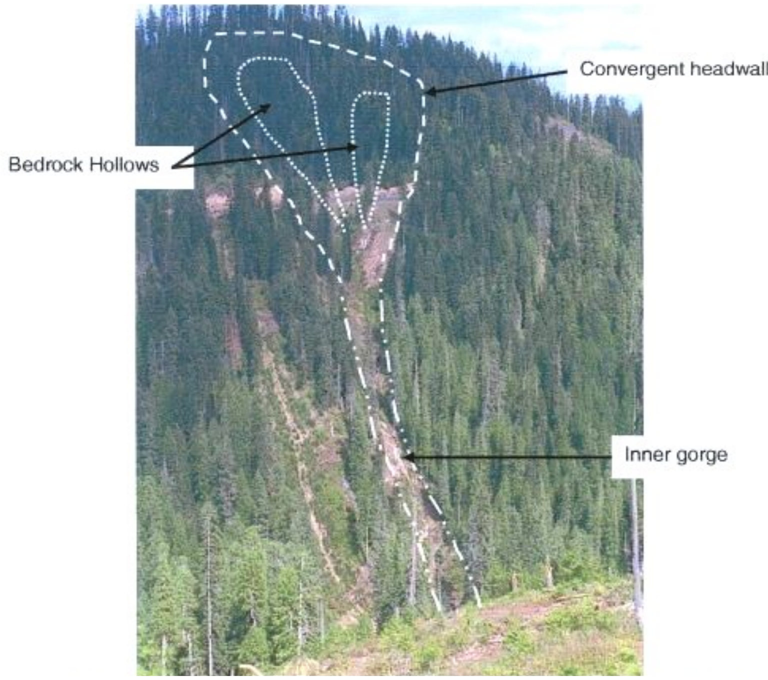

Figure 5. Common hill slope relationship: bedrock hollows in convergent headwalls Draining to inner gorges (Photo and drawing: Scott Marshall, IDL, 2005)

Bedrock hollows are also called colluvium-filled bedrock hollows, zero-order basins, swales, bedrock depressions, or simply hollows. Not all hollows contain bedrock so the term "bedrock" hollow can be a misnomer. Hollows are commonly spoon-shaped areas of convergent topography with concave profiles on hill slopes. They tend to be oriented linear upland down-slope. Their upper ends can extend to the ridge or begin as much as several hundred feet below ridge line. Most hollows are approximately 75 to 200 feet wide at their apex (but they can also be as narrow as several feet across at the top), and narrow to 30 to 60 feet downhill.

Hollows usually terminate where distinct channels begin. This is at the point of channel initiation where water emerges from a slope and has carved an actual incision. Steep bedrock hollows typically undergo episodic evacuation of debris by shallow-rapid mass movement, followed by slow refilling with colluvium that takes years or decades. Unless they have recently experienced movement by a landslide, hollows are partially or completely filled with colluvial soils that are typically deeper than those on the adjacent spurs and planar slopes. Recently evacuated hollows may have water flowing along their axis whereas partially evacuated hollows will have springs until they fill with sufficient colluvium to allow water to flow subsurface.

The common angle of repose for dry, cohesionless materials is about 36^0 (72%), and saturated soils can become unstable at lower gradients. Thus, slopes steeper than about 35^0 (70%) are considered susceptible to shallow debris slides. "Bedrock" hollows are formed on slopes of varying steepness. Hollows with slopes steeper than 70% (approximately 35^0) are potentially unstable in well-consolidated materials, but hollows in poorly consolidated materials may be unstable at lower angles.

Vegetation can provide the critical cohesion on marginally stable slopes and removes water from the soil through evapotranspiration. Leaving trees in steep, landslide-prone bedrock hollows helps maintain rooting strength and should reduce the likelihood of land sliding (Figure 6). However, wind-throw of the residual trees following harvest can be associated with debris slide or debris flow events. In high wind environments, it is essential to harvest in a manner that will limit the susceptibility of the residual trees to wind-throw as well as to reduce the potential for landslides (for example leaving wider strips, pruning or topping trees in the strips, or feathering the edges of reserve strips).

Figure 6. Example of leave areas protecting unstable slopes (Photo: Venice Goetz, WDNR, 2004)

Convergent headwalls are funnel-shaped landforms, broad at the ridge top and terminating where headwaters converge into a single channel. A series of converging bedrock hollows may form the upper part of a convergent headwall. Convergent headwalls are broadly concave both longitudinally and across the slope, but may contain sharp ridges that separate the bedrock hollows or headwater channels.

Convergent headwalls generally range from about 30 to 300 acres. Slope gradients are typically steeper than 70%. Unlike bedrock hollows, which exhibit a wide range of gradients, only very steep convergent landforms with an obvious history of landslides are called convergent headwalls. Soils are thin because landslides are frequent in these landforms. It is the arrangement of bedrock hollows and first-order channels on the landscape that causes a convergent headwall to be a unique mass-wasting feature. The highly convergent shape of the slopes, coupled with thin soils (due to frequent landslides), allows rapid onset of subsurface storm water flow.

Inner gorges are canyons created by a combination of stream down-cutting and mass movement on slope walls. Inner gorges are characterized by steep, straight or concave side-slope walls that commonly have a distinctive break in slope (Figure 7). Debris flows, in part, shape inner gorges by scouring the stream, undercutting side slopes, and/or depositing material within or adjacent to the channel (Figure 8). Inner gorge side-slopes may show evidence of recent landslides, such as obvious landslides, raw un-vegetated slopes, young, even-aged disturbance vegetation, or areas that are convergent in contour and concave in profile. Because of steep slopes and proximity to water, landslide activity in inner gorges is highly likely to deliver sediment to streams or structures downhill. Exceptions can occur where benches of sufficient size to stop moving material exist along the gorge walls, but these are uncommon.

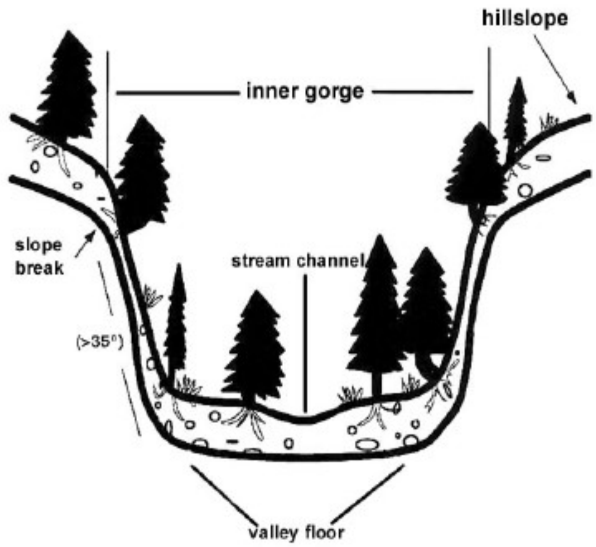

Figure 7. Cross-section of an inner gorge. This view emphasizes the abrupt steepening Below the break-in-slope (Drawing: Benda, et al, 1998)

Figure 8. Photograph showing how debris flows help shape features related to inner Gorges. (For example, V-shaped profile, buried wood, distinctive break in slope along Margins of inner gorge (Photo: Scott Marshall, IDL 2003)

The geometry of inner gorges varies. Steep inner gorge walls can be continuous for great lengths, as along a highly confined stream that is actively down cutting, but there may also be gentler slopes between steeper ones along valley walls. Inner gorges can be asymmetrical with one side being steeper than the other. Stream-eroded valley sides, which can be V-shaped with distinct slope breaks at the top, commonly do not show evidence of recent land sliding as do inner gorges which tend to be V-shaped.

Other Indicators of Slope Instability or Active Movement

In addition to the landforms above, other indicators of slope instability or active movement may include:

(a) topographic and hydrologic

- bare or raw, exposed, un-vegetated soil on the faces of steep slopes
- Boulder piles
- Hummocky or benched surfaces, especially below crescent-shaped headwalls
- Fresh deposits of rock, soil, or other debris at the base of a slope
- Ponding of water in irregular depressions or undrained swampy areas on the hill slope above the valley floor
- Cracks in the surface (across or along slopes, or in roads)
- Seepage lines or springs and soil piping
- Deflected or displaced streams (streams that have moved laterally to accommodate landslide deposits)

(b) vegetational

- jack-strawed, back-rotated, or leaning trees
- Bowed, kinked, or pistol-butted trees
- Split trees
- Water-loving vegetation (horsetail, skunk cabbage, etc.) on slopes
- Other patterns of disturbed vegetation

No one of these indicators necessarily proves that slope movement is happening or imminent, but a combination of several indicators could indicate a potentially unstable site.

Deep-seated landslides are those in which the slide plane or zone of movement is well below the maximum rooting depth of forest trees (generally greater than 10 feet). Deep-seated landslides may extend to hundreds of feet in depth, often including bedrock. Deep-seated landslides can occur almost anywhere on a hill slope and can be as large as several miles across or as small as a fraction of an acre. The larger ones can usually be identified from topographic maps or aerial photographs. Many deep-seated landslides occur in the lower portions of hill slopes and extend directly into stream channels whereas deep-seated landslides confined to upper slopes may not have the ability to deposit material directly into channels.

One common triggering mechanism of deep-seated landslides results from the over-steepening of the toe by natural means such as glacial erosion or fluvial undercutting, fault uplift, or by human-caused excavations. Initiation of such landslides has also been associated with changes in land use, increases in groundwater levels, and the degradation of material strength through natural processes. Movement can be complex, ranging from slow to rapid, and may include small to large displacements.

Deep-seated landslides characteristically occur in weak materials such as thinly layered rocks, unconsolidated sediments, deeply weathered bedrock, or rocks with closely spaced fractures. Deep-seated landslides can also occur where a weak layer or prominent discontinuity is present in otherwise strong rocks, such as clay or sand-rich interbeds in the basalts of central Idaho.

POTENTIALLY UNSTABLE SLOPES AND LANDFORMS

There are three main parts of a deep-seated landslide: the scarps (head and side), along which marginal streams can develop; the body, which is displaced slide material; and the toe, which also consists of displaced materials. The downslope edge of the toe can become oversteepened from stream erosion or from the rotation of the slide mass. A deep-seated landslide may have several of each of these parts because small deep-seated landslides can be found nested within larger slides. These three main parts are shown in Figures 9 and 10. The head-and side-scarps together form an arcuate or horseshoe shaped feature that represents the surface expression of the rupture plane. The body and toe area are usually hummocky and the flow path of streams on these landslide sections may be displaced in odd ways due to differential movement of landslide blocks. The parts of deep-seated landslides that are susceptible to shallow landslides and potential sediment delivery are steep scarps (including marginal stream side slopes) and toe edges.

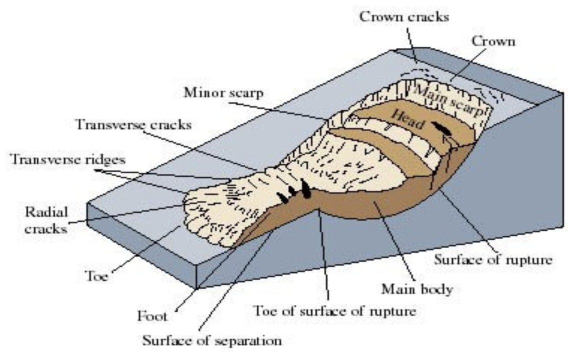

Figure 9. Rotational deep-seated landslide. Rotational displacement of blocks of soil commonly occur at the head of the landslide. Slow flow (an earth flow) may be found at the toe.

Figure 10. Deep-seated landslide showing the head scarp, body, and toe. Cecil Lake, British Columbia.

The sensitivity of any particular landslide to forest practices is highly variable. Deep-seated scarps and toes may be over-steepened and streams draining the displacement material may be subject to debris slide and debris flow initiation in response to harvest or road building. Movement in landslides is usually triggered by accumulations of water at the slide zone, so land use changes that alter the amount or timing of water delivered to a landslide can start or accelerate movement. Generally, avoiding the following practices will prevent most problems: destabilizing the toe by the removal of material during road construction or quarrying; overloading the slopes by dumping spoils on the upper or mid-scarp areas, or compacting the soil in these places which could change subsurface hydrology; and directing additional water into the slide from road drainage or drainage capture. The loss of tree canopy interception of moisture and the reduction in evapotranspiration through timber removal may also initiate movement of the slide.

Groundwater Recharge Areas of (Glacial) Deep-Seated Landslides

Groundwater recharge areas of deep-seated slides are located in the land up-slope that can contribute subsurface water to the landslide. In some cases this can include upslope portions of the landslide itself. Cemented soil horizons, fine-grained soils, and/or the presence of glacial till can be factors controlling the infiltration and flow of groundwater (Vaccaro et al., 1998). Groundwater perching and the characteristics of the overlying groundwater recharge area can be important factors in a deep-seated failure, especially for landslides in glacial sand and other unconsolidated sequences that overlie glacial-lake clay deposits or till (Figure 11).

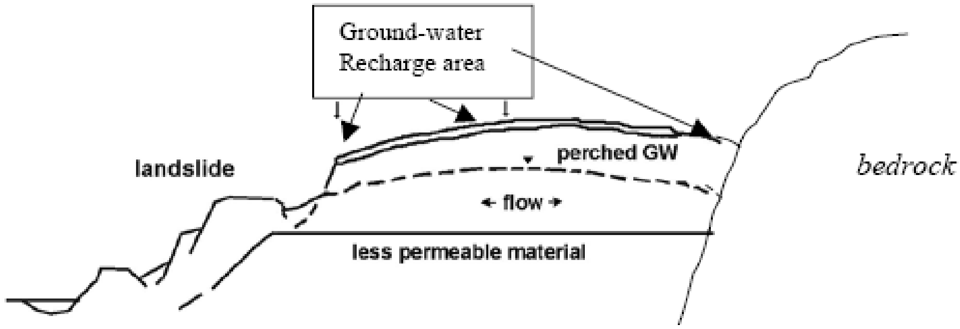

Figure 11. Groundwater recharge area for a glacial deep-seated landslide.

Outer Edges of Meander Bends

Streams can create unstable slopes by undercutting the outer edges of meander bends along valley walls or high terraces of an unconfined meandering stream (Figure 12 and 13). The outer edges of meander bends are susceptible to shallow land sliding including debris avalanching and small-scale slumping, and deep-seated land sliding. The outer edges of meander bends are protected by the stream protection zone (SPZ).

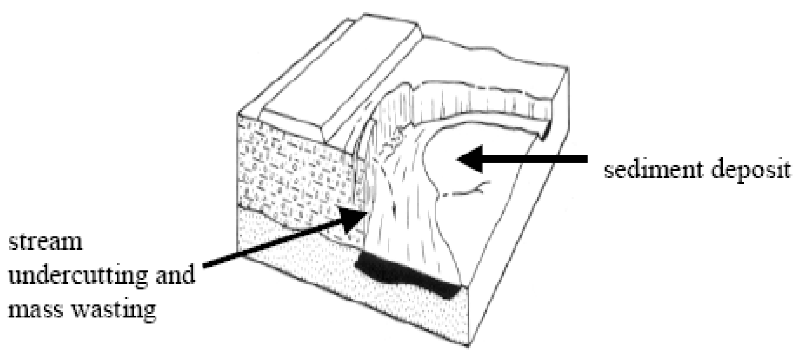

Figure 12. Outer edge of a meander bend showing mass wasting on the outside of the bend and deposition on the inside (adapted from Varnes, 1978).

Figure 13. Landslide on outer edge of meander bend on Pack River in northern Idaho, debris blocked river momentarily (Photo: Scott Marshall, 2002).

DELIVERY

Landslides occur naturally in forested basins and are an important process in the delivery of wood and gravel to streams. Wood and gravel play important roles in creating stream diversity that is essential for fish use as habitat and spawning grounds. When the potential for instability is recognized, the likelihood that sediment and debris would travel far enough to threaten a public resource or public safety should be considered. Many factors are part of that consideration including the initial failure volume of a landslide, the runout distance of a landslide, and landscape geometry.

It is difficult to prescribe guidelines for delivery distances because each situation has a special combination of process and topography. Deep-seated landslides can move anywhere from a few inches to a few miles depending on a friction of the slip plane, the forces pulling the landslides down, and the shear strength resisting those forces. Larger landslides are more likely to be able to move great distances at gentle gradients, but they are also less likely to be significantly affected by forest practices activities.

Timber harvest and road building can cause shallow landslides on steep slopes. Travel distances for such landslides depend on the amount of water contained in or entrained by them. Considering that rain, snowmelt, or some other extreme water inputs trigger the vast majority of landslides in the Pacific Northwest, it should be noted that almost all landslides contain some amount of water that tends to mobilize the soil or rock. Debris slides that do not reach streams usually deposit their debris on the hill slope; and are typically unable to move far across large areas of flat ground. However, since most landslides occur during storm conditions, a large proportion of debris slides do reach flowing channels and create the opportunity to entrain enough water to become debris flows. These flows are quite mobile, and can travel great distances in steep or moderate gradient channels.

Travel distance of a debris flow once it reaches a low-gradient surface is a function of its volume and viscosity. The solid volume of a debris slide or flow deposit is a function of soil depth, distance traveled down the hill slope, and the gradient of the traveled path. The proportion of water is the main control on viscosity. Field or empirical evidence should be used for determining the runout distance.

Even if the main mass of a landslide or debris flow comes to rest without reaching a public resource, there is the possibility that secondary effects may occur. Bare ground exposed by mass movement and disturbed piles of landslide debris can be chronic sources of fine sediment to streams until stabilized by revegetation. If flowing water (seepage, overland flow, or small streams) can entrain significant volumes of fine sediment from such surfaces, the possibility of secondary delivery must be evaluated, along with the likelihood of impact by the initial movement event itself.

To assess the potential for delivery and estimate runout distance, analysts can evaluate the history of landslide runout in the region, use field observations, and/or use geometric relationships appropriate from the scientific literature. In any situation where the potential for delivery is questionable, it is best to have a geotechnical expert examine the situation and evaluate the likelihood of delivery.

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ROLLING DRAIN DIP

State Forester Forum

Purpose and Application

Rolling drain dips are installed in secondary roads to reduce road surface and fill slope erosion by intercepting storm and seasonal runoff and diverting it to a safe disposal area. Dips provide temporary or permanent drainage control on roads where grades do not exceed 8 percent. When properly installed, they do not increase wear on vehicles and will accommodate speeds up to 10 miles per hour.

Dips are commonly used on low standard outsloped roads, but can be used on insloped sections if proper inside ditches and cross drain culverts are installed. The bottom of dips should be oriented at a right angle to the road centerline and should have a slope of 2 to 3 percent to be self-cleaning.

Rolling drain dips are normally built into the road at the time of construction as a permanent drainage feature, suitable for continued traffic over a long-term management period. They are more costly to build than cross-ditches. Rolling drain dips should not be confused with cross-ditches which are put in a road after temporary use and/or closure. Cross-ditched roads are only suitable for occasional or rare vehicle use.

Rolling Drain Dip Options

There are two basic kinds of construction for rolling dips; depending on vehicle use, road grade and surface erosion potential.

Option A: On road grades exceeding five percent where intended road use does not include low-clearance vehicles and long low-clearance trailers or recreation vehicles, the shorter more abrupt dips illustrated as Option A can be used.

Option B: On road grades less then or equal to 5 percent, and roads where long low-clearance vehicles and trailers will be used, the dips constructed with sag and crest vertical curves, nearly equal in length, can be used. This type of dip is described by B. W. Kramer (2001) and illustrated as Option B on page 3. Driving downhill into the sag curve, the point of cross drain is approximately 70 feet from the uphill start of the structure. The easy roll of the structure then extends downhill up to an additional 140 feet with a crest curve about 100 feet long at the lower end.

Planning Considerations

1. Rolling drain dips can be used as the primary drainage system on low standard roads and may be mixed with outsloped or insloped systems. Crowned roads with engineered ditches, berms and culvert or other cross-drain systems do not need rolling dips except as supplemental, special locality features.
2. When the road is intended to accommodate long, low-clearance trailers, low boys or recreational vehicles, use the long dimensions with careful control of the cross-drain depth.
3. If the soils at the planned dip location are soft and of low strength, which are subject to rutting and displacement by the intended traffic, woven geotextile fabric and rock lift surfacing are needed to protect the entire structure. Dip structures with soft, low-strength soils lacking a mix of native rock can also be obliterated by maintenance blading if allowed to become dry/dusty in summer or when unfrozen in winter. Rock armoring is advisable.

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Forest Practices

No. 11

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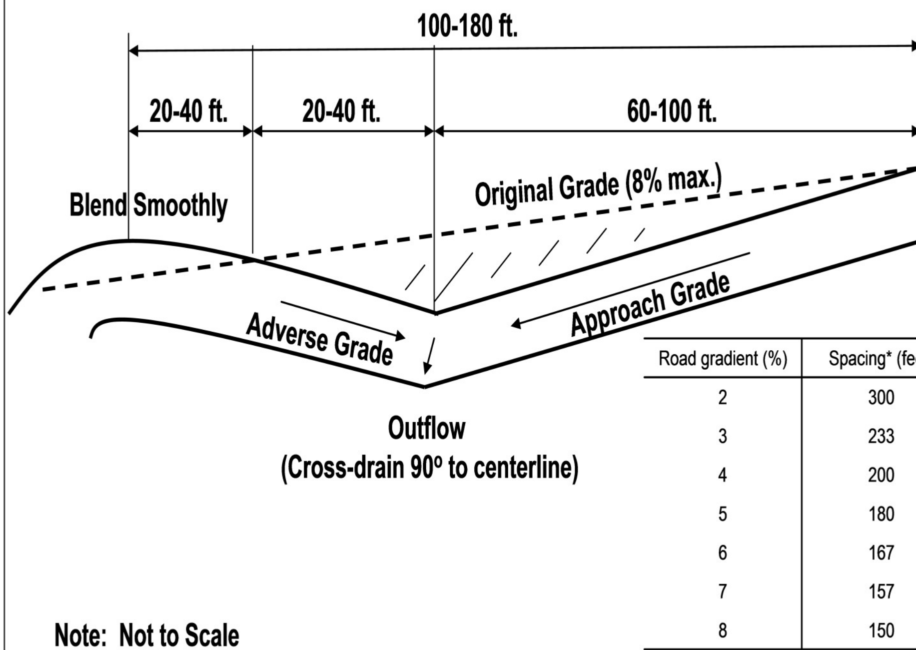
OPTION A: Rolling Drain Dip profile



Road gradient (%)	Spacing* (feet)
2	300
3	233
4	200
5	180
6	167
7	157
8	150

* For low to moderate erosion hazard soils, in high erosion hazard soils these distances should be reduced by 20 to 30 percent.

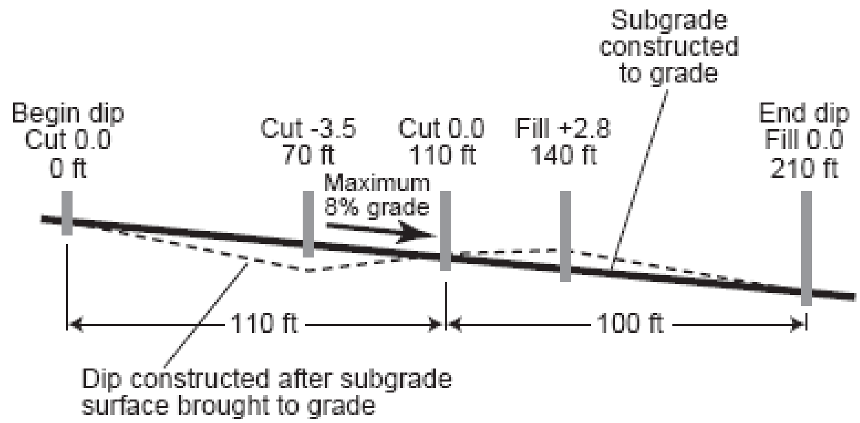
4. It is important that cross-drains be oriented at right angles (90 degrees) relative to the road centerline to maintain vehicle speeds of up to 10 mph and to eliminate twisting strain on vehicle axles, frames and loads. The cross-drain should slope across the entire road at 3 percent, which is about 6 inches on a 16-foot wide road bed.
5. The structure must be built across the entire road bench from toe of cut slope to edge of fill slope. In the case of insloped structures that drain into an inside ditch, additional ditch relief drainage structures must be installed. For outsloped roads, when the fill material consists of erosive material, crushed rock should be placed on the fill slope below the drain dip to prevent erosion.
6. In the illustration shown as Option B there are three important advantages:

   A. The long horizontal drain dip transition permits log trucks, passenger buses and lowboys easy passage.

   B. The length, depth, and height of the dips are large, obvious features of the road grade, so road maintenance operators can see and feel the grade and are less likely to inadvertently

ROLLING DRAIN DIP

OPTION B



Example road surface drainage spacing (ft)

Soil composition	Road gradient (%) 2-4	5-8
Granitic or sandy	400	300
Clay or loam	500	400
Shale or gravel	600	500

Drain dip construction staking data.

Road grade (%)	Drain dip construction stake data (ft) 0 Cut	70 Cut	110 Cut	140 Fill	210 Fill
2-3	0.0	-1.30	0.0	+1.0	0.0
4	0.0	-2.00	0.0	+1.4	0.0
5	0.0	-2.30	0.0	+1.8	0.0
6	0.0	-2.70	0.0	+2.0	0.0
7	0.0	-3.00	0.0	+2.3	0.0
8	0.0	-3.50	0.0	+2.8	0.0

From Kramer, B.W. 2001. Forest Road Contracting, Construction, and Maintenance for Small Forest Wooland Owners. Oregon State University, College of Forestry, Research Contribution 35, 84p

obliterate the structures.

C. Staking drain dips to the standards described in the table is easy after the initial road subgrade profile is constructed.

7. Spacing for Option A rolling dips in low to moderate erosion hazard soils can be calculated by using the formula below. This provides the distance between points of cross drain for a series of dips. Also, see chart in Option A figure.

$$\text{Spacing in feet} = \frac{400}{\text{Road Grade \%}} + 100$$

8. Roads on high-erosion hazard soils generally require rock lifts (surfacing) in the dip structures. Roads might be drained at less cost with road crowning, surfacing with rock, inside ditches, and culvert cross drains. A careful planning cost comparison should be done before choosing the drainage method.

FISH PASSAGE GUIDELINES WHEN INSTALLING STREAM CROSSINGS

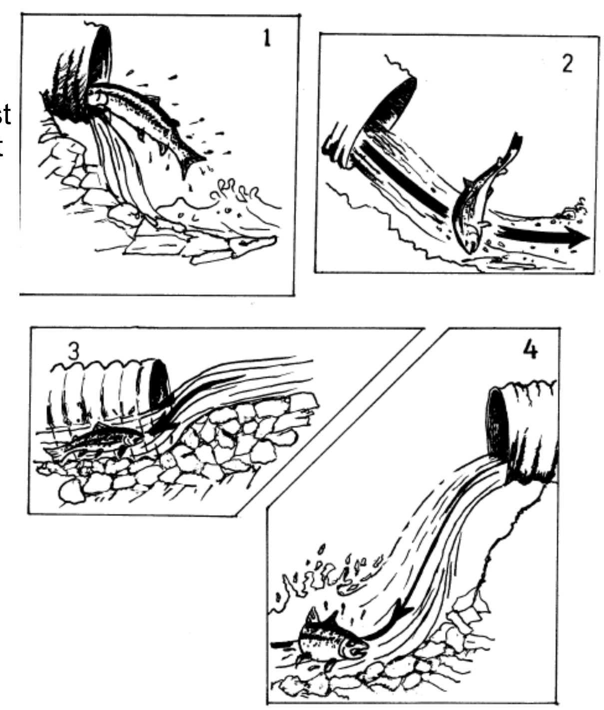
IDAHO DEPARTMENT OF LANDS

State Forester Forum

Under the Idaho Forest Practices Act and the Stream Channel Protection Act, all stream crossings on fish bearing streams must provide for fish passage. This Forester Forum provides guidelines that will help individuals design and install stream crossings that will not impede or delay fish passage. This is accomplished by: 1) stating the minimum standards for fish passage at stream crossings required by Idaho law, 2) providing design alternatives for traditional non-embedded culverts that meet hydraulic requirements of Idaho law, 3) providing design alternatives for stream crossing structures other than traditional non-embedded culverts that attempt to simulate the natural stream channel. Step-by-step guidelines for choosing an appropriate stream crossing structure are provided. These guidelines were developed in cooperation with the Idaho Departments of Fish and Game and Water Resources.

Minimum Requirements by Law

The requirement and direction to provide fish passage at forest road crossings can be found in State of Idaho law. The Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code, pertaining to road construction, reconstruction and maintenance (Rule 040) states: “Culvert installations on fish bearing streams must provide for fish passage.” Specific guidelines are found in the Rules Pertaining to Stream Channel Alteration, Title 37, Chapter 03, Idaho Code. These rules state that in streams where fish passage is of concern, the following criteria must be met to ensure that passage will not be inhibited by a proposed crossing:



1. Minimum water depth at crossing will be at least 8 inches for salmon and steelhead, and at least 3 inches in all other cases.
2. [Depending on the type of fish present, salmon/steelhead, resident fishes, or both] Water velocities shall not exceed those shown in the Alaskan Curve for more than a 48 hour period (see Figure 1).
3. Upstream drops at culvert entrance (inlet) will not be permitted.
4. A maximum outlet drop of 1 foot will be permitted if an adequate jumping pool is maintained below the drop.

Hydraulic Design Procedure for Installing Traditional Non-Embedded Culverts

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FISH PASSAGE GUIDELINES WHEN INSTALLING STREAM CROSSINGS

The rules stated above require a design process that attempts to match the hydraulic performance of a culvert with the swimming abilities of a target fish species. For the purpose of developing this guidance, a 6 inch cutthroat trout was used as the target fish species requiring passage through a culvert during high flows that are exceeded 5% of the time during average flow years. Allowing a 6" cutthroat trout to pass at high design flow should allow smaller fish and aquatic organisms to pass as flows through the culvert decrease.

Hydraulic analysis of the velocity component of the Stream Channel Alteration rule using the stated target fish and design flow has led to the following specific guidelines (Chart 1, and Figure 2A) for installing traditional non-embedded culverts at stream grade. This guidance assumes the culvert is properly sized to handle a 50-year-peak flow event as required by Idaho's Forest Practices Act.

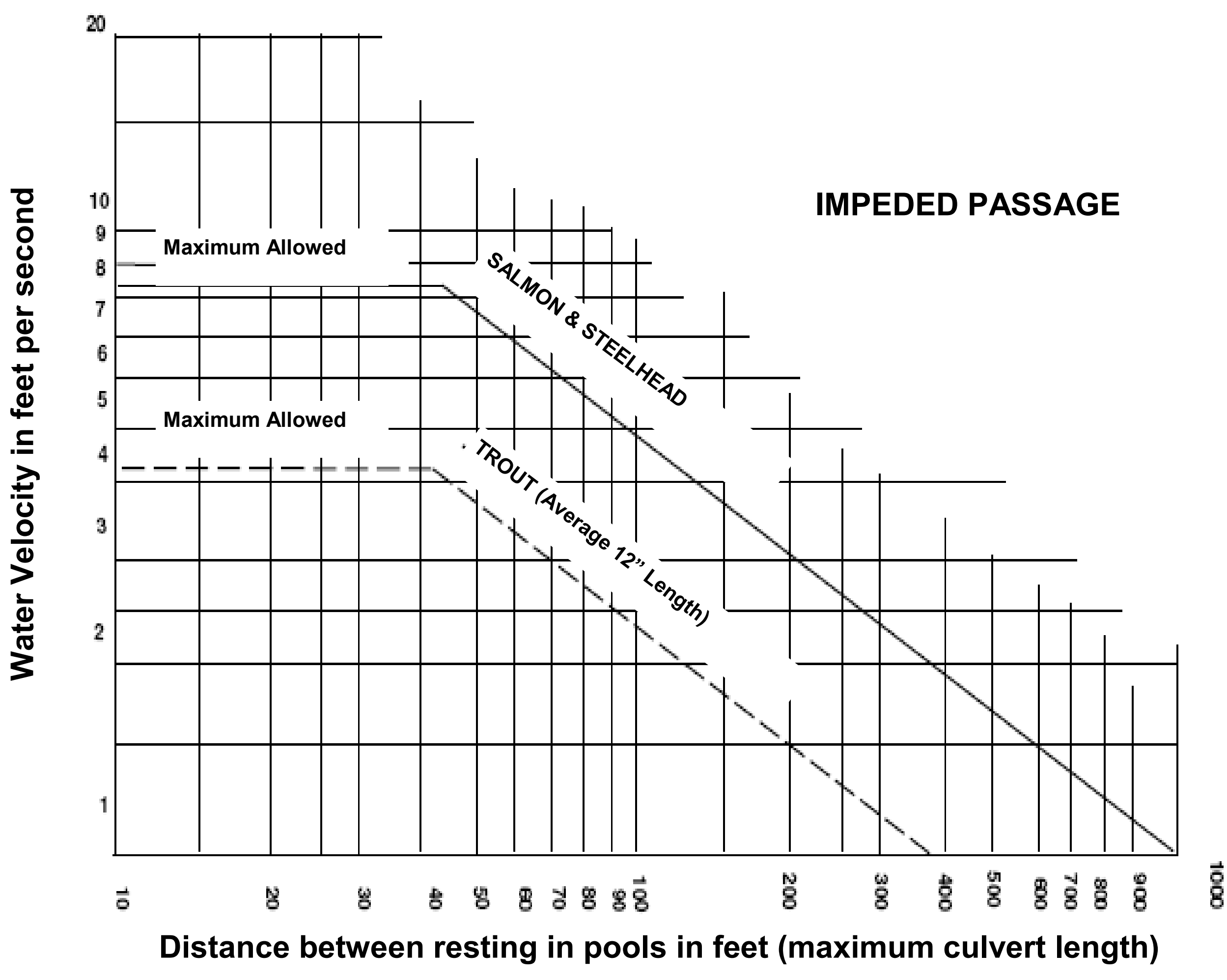


FIGURE 1. Swimming capability of migrating salmon and trout (Alaskan Curve)

FISH PASSAGE GUIDELINES WHEN INSTALLING STREAM CROSSINGS

Chart 1. This table shows the maximum allowable gradient at which a traditional non-embedded culvert can be installed that will meet Idaho's hydraulic design criteria for fish passage. This table assumes that the culvert is sized to pass a 50-year-peak flow event.

Drainage Area (Acres)	***Maximum Allowable Gradient of Installed Culvert***
<200	3%
201-350	2%
351-1000	1%
1001-2600	0.5%
2601-8200	0%

By looking at Chart 1, one can see that the use of traditional non-embedded culverts on fish bearing streams is limited to relatively low gradient streams.

Outlet drops are not permitted unless an adequate resting/jumping pool is maintained below the culvert outlet. Ideal jumping conditions exist when the ratio of pool depth to jump height is 1.25:1. In order to avoid the formation of inlet and/or outlet drops, non-embedded culverts must be installed at stream grade.

The process for applying Chart 1 is as follows:

1. Determine watershed size (acres) and stream gradient (use survey equipment to determine stream gradient %); if stream gradient is greater than 3% at the site of the proposed crossing, choose a stream crossing structure other than a traditional non-embedded culvert.
2. Determine maximum allowable culvert gradient by watershed size.
3. When the stream gradient is less than or equal to the maximum allowable culvert gradient, install culvert at stream gradient.

Newly installed stream crossings are subject to regulatory inspection by private forestry specialists employed by the Idaho Department of Lands. For regulatory purposes, an unsatisfactory condition exists if the maximum allowable gradient of installed culvert exceeds that shown in Chart 1 for a given drainage area.

The following are examples of how to apply Chart 1:

Example 1: Stream XY at a proposed stream crossing has a surveyed stream gradient of 1.5% and watershed drainage area of 325 acres. Look up drainage area on Chart 1 to determine the maximum allowable gradient of installed culvert. At 325 acres, the maximum allowable gradient of installed culvert is 2%. Since stream gradient (1.5%) is less than maximum allowable gradient for this particular site, the culvert can be installed at stream gradient and meet Idaho's hydraulic design criteria for fish passage. For regulatory purposes, the culvert will be measured to ensure that it was installed at less than 2%.

Example 2: Stream AB at a proposed stream crossing has a surveyed stream gradient of 4% and watershed drainage area of 1350 acres. Look up drainage area on Chart 1 to determine maximum allowable gradient of installed culvert. At 1350 acres, the maximum allowable gradient of installed culvert is 0.5%. A traditional non-embedded culvert will not meet Idaho's hydraulic design criteria for fish passage at this location.

Stream Channel Simulation

Stream simulation is based on the principle that, if fish can migrate through the natural stream channel, they can also migrate through a man made channel that simulates the natural stream channel. Taking this approach eliminates the need to consider such parameters as target species, timing of migration, and fish passage hydrology because it simply mimics what already exists. The criteria required in the State's hydraulic design criteria (velocity and depth) do not have to be calculated. Culverts and other structures designed to simulate stream beds are sized to match or exceed the channel width, and the bed inside the structure is sloped at a similar gradient to the adjacent stream reach.

The rest of this forum is dedicated to discussing and depicting alternative stream crossing methods and designs that will provide uninhibited fish passage at all stream grades. Based on use requirements, these stream crossing alternatives have been divided into permanent and temporary structures. After the various stream crossing alternatives are discussed, a section is included that provides a step-by-step guide to help the landowner choose an appropriate stream crossing.

Permanent Stream Crossing Structures

Permanent structures are placed at stream crossings where the transportation network requires years of continuous use. These types of crossings are usually installed on main haul routes, and major access roads. Careful consideration of alternative transportation and logging systems should be considered prior to installing new permanent stream crossings.

Permanent stream crossing structures that allow for fish passage include:

1. Culverts
2. Culverts installed with fish ladders
3. Structures such that simulate the natural stream bed
4. Bridges that span the stream to allow for long-term dynamic stream channel stability.

Table 2 (page 6) lists the different kinds of permanent stream crossing structures, and provides information that will help the landowner choose the appropriate structure for a given crossing. Figure 2 B-D depicts various embedded culvert and fish ladder design considerations.

Temporary Stream Crossing Structures

Temporary stream crossings are installed across a stream or watercourse for short-term use (a period of less than one year) then removed. Unlike permanent stream crossings, temporary stream crossings are not necessarily required to pass fish as long as the structure is removed prior to important fish migration and spawning times. Specialized knowledge of the type of fish present and important migration and spawning times is required prior to installing a temporary stream crossing that is not designed for fish passage. Temporary stream crossings may consist of a ford, log crossing, culvert, existing crossing structure or bridge.

Table 3 (page 7) lists the different types of temporary stream crossings, and provides information that will help the landowner choose the appropriate structure for a given crossing.

Table 1 (page 5) lists the general spawning and migration times of salmonid species in Idaho. These spawning and migration times may be further refined by consulting a fish biologist with local knowledge.

Table 1. Timing of migration and spawning of salmonids in Idaho.

FISH SPECIES	*TIMING OF SPAWNING MIGRATION*	*TIMING OF SPAWNING*
Rainbow trout	Mid Fed.—Late June	Mid March—Late June
Cutthroat Trout	Early March—Early July	Late March—Early July
Chinook Salmon	Mid May—Late Sept.	Early August—Early Oct.
Bull Trout	Late May—Early Oct.	Mid August—Late Oct.
Brook Trout	Early July—Late Oct.	Early Sept.—Late Nov.
Brown Trout	Mid July—Early Jan.	Late Sept.—Early Dec.
Kokanee	Late July—Early Jan.	Early Sept.—Early Jan.
Lake Whitefish	Early Oct.—Late Jan.	Early Oct.—Late Jan.
Mt. Whitefish	Early Oct.—Mid Feb.	Mid Oct.—Early Feb.

Table 2. Information on various **permanent** stream crossing alternatives that can help with design

Stream Crossing Alternatives	Maximum stream gradient allowing fish passage	Technical Difficulty (low/ med/high)	Culvert Oversizing Needs	Potential of Plugging (low/ med/high)	Problems with minimum depths during low flow	Additional Comments
1. Culvert installed at stream grade	~0%, >2601 acres ~0.5%, 1001 - 2600 acs ~1.0%, 351 - 1000 acrs ~2.0%, 201 - 350 acres ~3.0%, < 200 acres	low	No need to oversize culvert	medium	Yes	Smooth or concrete culverts require flatter slopes than those listed. Round culverts maintain the deepest depths during low flows. If depths < 3" occur during low flow, consider another alternative.
2. Culvert with fish ladder	4.0%	medium	increase culvert size 1 diameter class	medium	No	The detachable fish ladder can be removed from a culvert if complications occur. Must be seeded with adequate substrate at installation and maintained over time.
3. Culvert with buried inlet and outlet	5.0%	Medium/high	encompass bankfull width	medium	Usually Not	Backfill culvert with cobble and boulder substrates. Culvert width must encompass bankfull width for substrate to remain in pipe. May not work in streams dominated by boulder, bedrock, or all fine grained.
4.Culvert with inlet burried more than outlet	6.5%	Medium/high	encompass bankfull width	medium	Usually Not	Backfill culvert with cobble and boulder substrates. Culvert width must encompass bankfull width for substrate to remain in pipe. May not work in streams dominated by boulder, bedrock, or all fine grained.
5.Culvert with baffles; Inlet and Outlet burried	8.0%	high	encompass bankfull width	medium	No	Backfill culvert with cobble and boulder substrates. Culvert width must encompass bankfull width for substrate to remain in pipe. May not work in streams dominated by boulder, bedrock, or all fine grained.
6. Open bottom structures	15.0%	medium	NA	medium	No	Structure must encompass bankfull width. This type of structure may not be appropriate on fine grained alluvium (silt and sand).
7. Ford	any stream grade	low-high depending on stream gradient	NA	low	No	Fords typically do not allow year round or heavy traffic. On stream gradients > 2% special designs are required. Use of crossing may be limited by flow conditions and timing of fish spawn.
8. Bridges	any stream grade	medium	NA	low	No	Although this alternative is the most expensive, it is usually considered the best for fish passage, has longevity, and minimal maintenance requirements.

Table 3: Information on various **temporary** stream crossing alternatives.

Stream Crossing Alternatives	Maximum stream gradient allowing for fish passage	Technical Difficulty (low/med/high)	Seasonal Timing Issue	Potential of Plugging (low/med/high)	Additional Comments
1. Glulam Mat	any stream grade	low	Yes	medium	Utilize on crossings for minimal disturbance. Ends of Mat should bear on even level ground at least 5 feet wide. Place mats next to one another to achieve desired crossing width.
2. Steel Bridge (Pass Through Design)	any stream grade	medium	No	low	Typical pass through bridge design geometry, with bridge structure removed when not needed. Footings may be left in place or removed depending on next use. Rip rap of approaches may or may not be needed.
3. Log Crossing	15.0%	low	Yes	high	Cut to length log crossing utilizing at least one 18 to 24 inch diameter culvert, cables placed on bare ground for less disturbance at removal. Geotextile fabric used at bottom and top of logs. Highly restrictive time of use based on fish species present.
4. Culverts Designed for Fish Passage	see Table 1	low to high	No	medium	Smooth or concrete culverts require flatter slopes than those listed. Round culverts maintain the deepest depths during low flow. If depths < 3" occur during low flow consider another alternative. `
5.Culverts Not Designed for Fish Passage	any stream grade	low	Yes	medium to high	Temporary culvert installation should be sized for 50 year event. Highly restrictive time of use based on fish species present. Must have good fish species information to utilize this option.
6. Removal of Existing Stream Crossing	any stream grade	low to medium	Yes	none	Remove existing stream crossing structure at end of timber sale. Lay back or remove fill approaches, and construct sediment mitigation structures; possibly barricade road. May be an opportunity to construct a ford crossing.

FISH PASSAGE GUIDELINES WHEN INSTALLING STREAM CROSSINGS

Choosing an Appropriate Stream Crossing Structure

To choose an appropriate stream crossing structure, consider long range planning objectives, timber harvest methods, cost, stream gradient, seasonal use, and ease of installation and maintenance. Tables 1 – 3 and Figure 2 discuss and depict the different stream crossing alternatives and can be used as a guide when planning and installing a stream crossing that meets Idaho's requirements for fish passage. When deciding which alternative to use, consider the following steps:

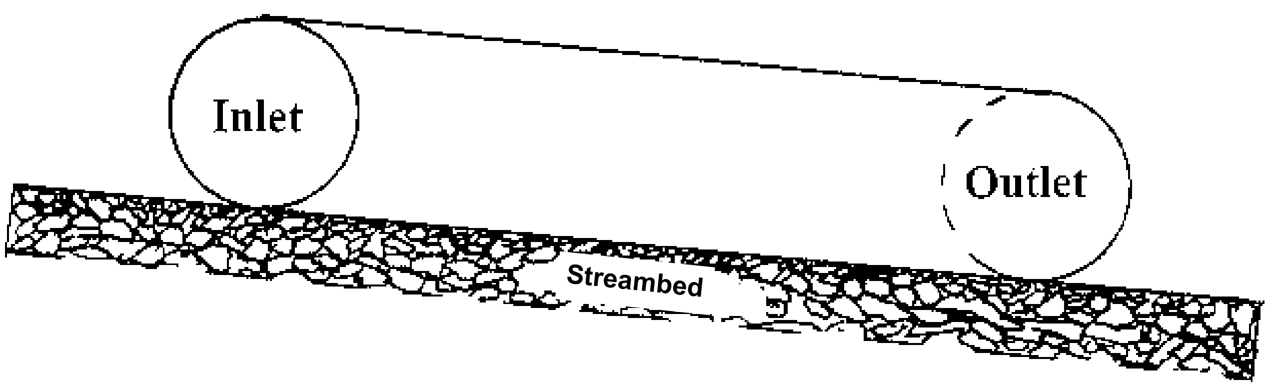
1. Determine if a permanent or temporary crossing is the best choice given long-term transportation requirements or seasonal use.
2. ***Determine the slope of the stream channel at the proposed crossing site using survey equipment***, clinometers and hand levels can not provide the level of accuracy necessary to design and install culverts.
3. Based on the stream's slope and transportation needs, use Chart 1, Tables 1-3, and Figure 2 to determine which types of stream crossings will allow fish passage.

Taking into account site conditions, cost, ease of installment and maintenance, choose the most appropriate stream crossing. Tables 2-3 and Figure 2 A-E provide general guidelines for installation. If unfamiliar with installation procedures for the chosen structure, consult a hydrologist, engineer, or fish biologist.

FIGURE 2. Details for installing various stream crossing alternatives.

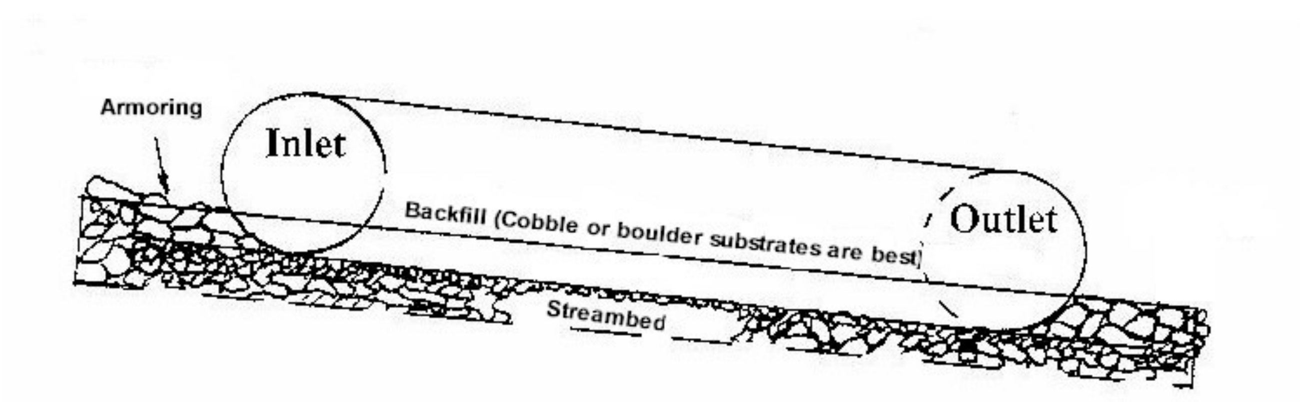
A. Traditional non-embedded culvert at stream grade.

- A culvert should be selected that passes the 50-year-peak flow event.
- The resultant culvert grade should be the same as the original stream grade and comply with Chart 1.



B. Culvert with Buried Inlet and Outlet

- The culvert will have to be oversized in order to pass the design flow and encompass bankfull width.
- The outlet invert is countersunk below the channel bed by a minimum of 20% of the culvert diameter or rise.
- The inlet invert is countersunk below the channel bed by a minimum of 20%, and can be countersunk below the channel bed by a maximum of 40% of the culvert diameter or rise.
- Armoring and/or a grade control structure upstream and downstream of the culvert will minimize erosion and help substrates remain inside the culvert. Drops between grade control structures should not exceed 1.0 foot. It is best to backfill inside the culvert with angular cobbles and boulders.



Culvert with Inlet Buried more than Outlet

- Recommendations from alternative B apply here.
- The resultant slope of the culvert should not exceed approximately 6.5%.

Armoring upstream and downstream of culvert will minimize erosion and help retain substructure

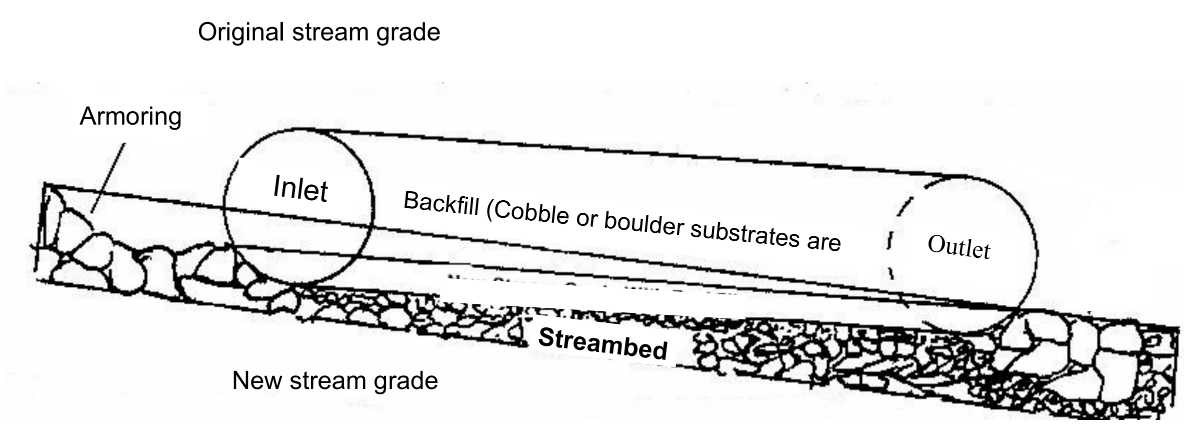
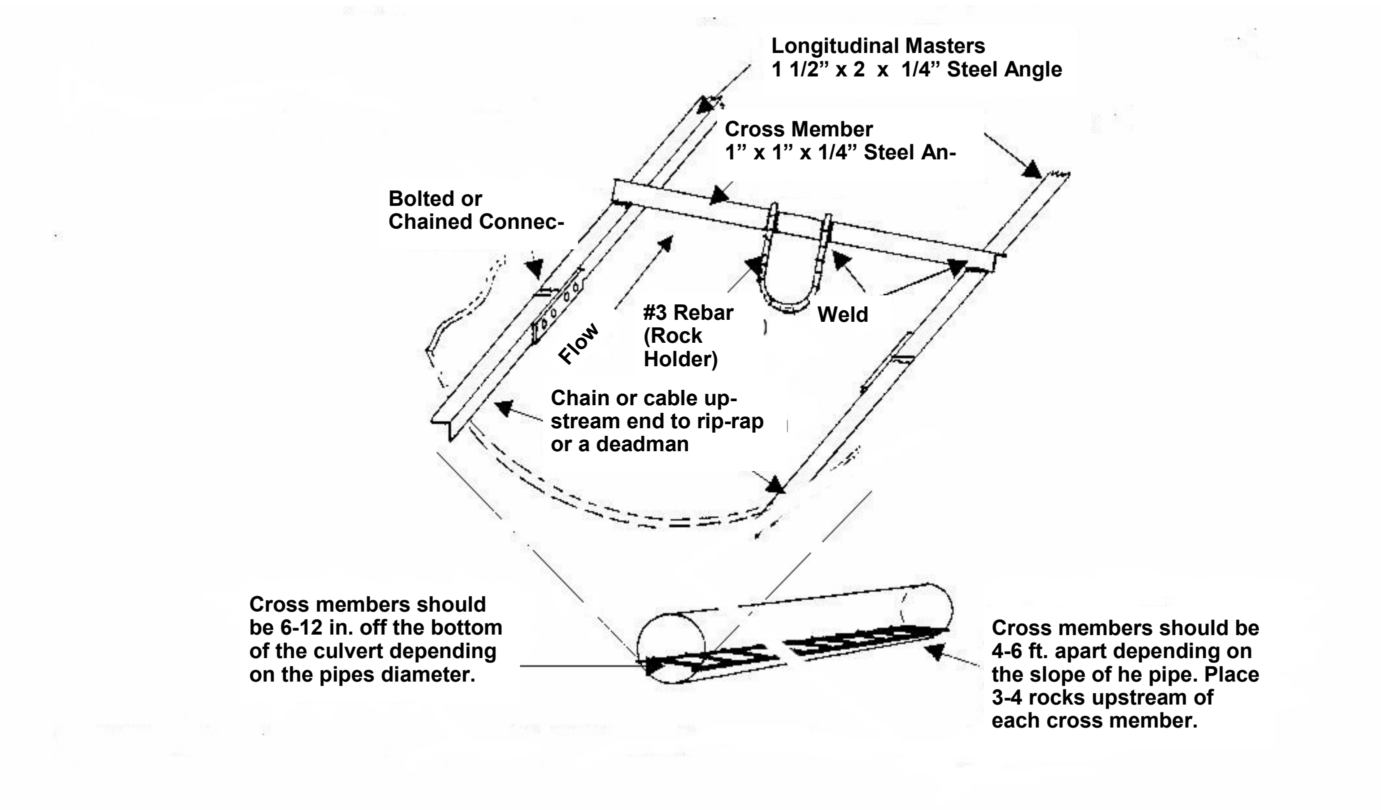


Figure 2. Cont. Details for installing various stream crossing alternatives.

C. Culvert With Detachable Fish Ladder



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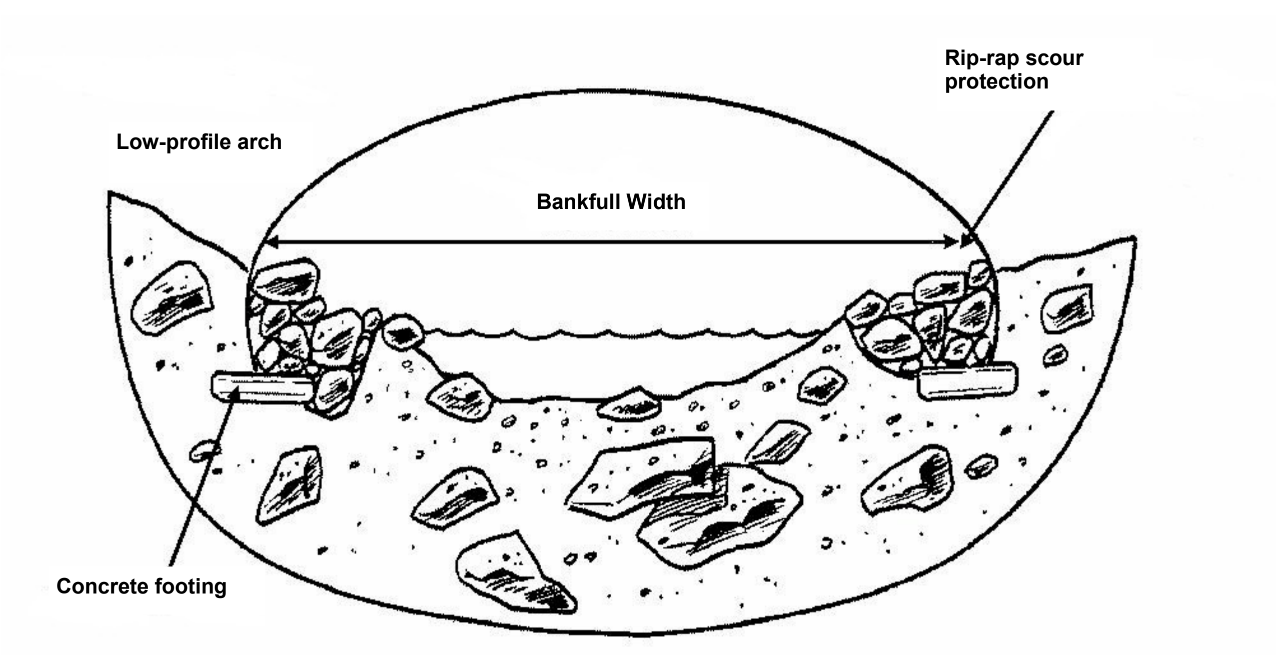


Figure 2. Cont. Details for installing various stream crossing alternatives.

E. Bridge Design Considerations

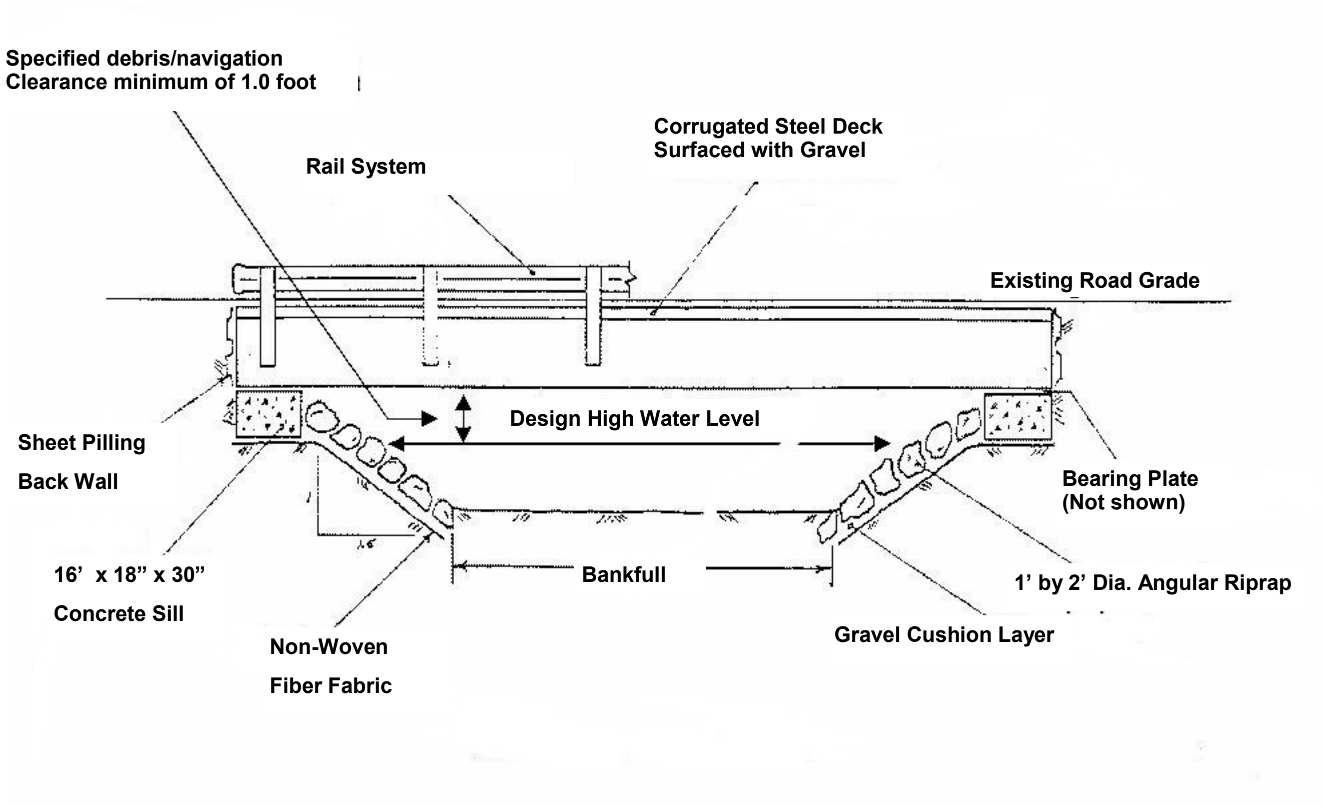


Figure 2. Cont. Details for installing various stream crossing alternatives.

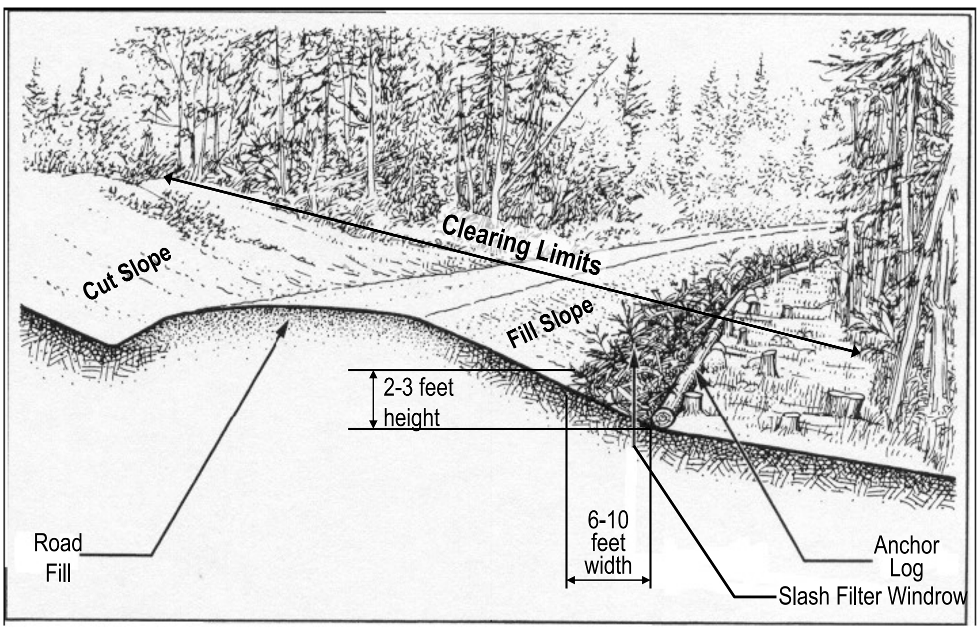
GLOSSARY	
Armoring:	A layer of stone armor placed on the stream bottom to protect erodible material lying underneath.
Backfill	Placing earth or a specified size of material in place of material removed during construction, such as in a culvert or trench.
Bankfull Width	The bankfull width is marked by a break in slope of the bank and change in vegetation, such as a change from point bar gravel to grasses and forbs. Bankfull discharge flow is sometimes synonymous with ordinary high water flow.
Culvert Diameter Class:	Culverts are built in certain sizes, which are classified in diameter classes. Each diameter class increases in six inch increments (18, 24, 30, 36, 42, 48, 54, 60, etc.).
Removable Fish Ladder:	Constructed angle iron placed into a culvert to improve fish passage.
Grade Control Structure:	A structure placed across a stream channel used to prevent the stream channel from headcutting and used to raise upstream water levels.
Headcutting:	The upstream erosion and displacement of stream bottom substrates. The stream channel erosion will often migrate in an upstream fashion.
Inlet:	Water flows into the inlet end of the culvert.
Outlet:	Water flows out of the outlet end of the culvert.
Resting/Jumping Pool:	A pool downstream of the outlet of a culvert that is deep and flows slowly to allow fish to rest before migrating through the culvert. If a drop occurs from the outlet of the culvert, the resting pool should be deep enough to allow fish to make a run before it jumps. Ideal jumping conditions exist when the ratio of pool depth to jump height is 1.25:1.
Salmonids:	The family of fish including all trout, char, salmon and whitefish.
Substrate:	Stream bottom sediments, which may include silt, sand, gravel, cobble, bolder, and bedrock.

SLASH FILTER WINDROWS

State Forester Forum

Definition

A slash filter windrow is a designed structure made of waste logs and compacted slash 2-3 feet high and 6-10 feet wide. It is usually built at the toe of road fill-slopes approaching stream crossings, and extends along the road for up to 400 feet. The purpose of the slash filter windrow is to protect forest streams from road surface and fill slope sediment delivery, as well as to stabilize road fills.



Modified from: Ministry of Natural Resources Ontario. 1990. Environmental Guidelines for Access Roads and Water Crossings.

Usefulness—Where, When and Why

The slash filter windrow may be used in mountainous terrain where cut-and-fill roads cross streams. This design has been shown to intercept up to 99 percent of sediment eroding from road fills less than 20 feet in height as compared to similar sites where slash filter windrows were not used.

On-site studies showed movement of road surface and fill-slope sediments were usually totally blocked by slash filter windrows. In a few places, sediment moved an average of four feet below the windrow. In comparison, similar non-windrowed fill slopes experienced sediment movement an average of 41 feet below the toe of fill.

This windrow is also effective in the prevention of initial stream sedimentation when constructed at the time the roadway is being pioneered and completed. Other methods, such as seeding, mulching and matting, are effective over the long term but do not provide the immediate beneficial effect of the slash

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filter windrow. A combination of these BMPs in addition to slash filter windrows, however, would be most effective at reducing sediment delivery to a stream.

Precautions or Constraints

The slash filter windrow is not a right-of-way slash disposal substitute; normally only a small part of right-of-way debris and slash is used in the designed windrow. Slash filter windrows are most effective when constructed at stream crossings. For proper filter windrow placement, it is important to provide enough culvert length so that the windrow is located at the toe of the fill and above the top of the culvert. Windrow length should extend no more than 300 to 400 feet each way from the stream crossing unless the road parallels the stream. If the windrow extends more than 400 feet, it may be advisable to leave wildlife corridors every 200 feet.

No stumps or root wads should be used in the windrow. An improperly built slash filter windrow 5 or more feet deep, 15 or more feet wide, and hundreds of feet in length, full of stumps, root wads and hollow cull logs will create a potential fire and air quality hazard.

Windrow Construction

Construction starts by stockpiling needed tree tops, limbs, brush not exceeding 6 inches in diameter, and cull logs, not less than 18 inches in diameter, either above or below the clearing limits as the right-of-way is being cleared. The cull logs should be approximately 12 feet in length and are to be used as anchors.

Sufficient slash of 6-inches in diameter and smaller is also stockpiled with the anchor logs at locations for best access to construct the windrows after road grade excavation and shaping is completed. To minimize costs, a 360-degree swing, track-mounted pull shovel with hydraulic thumb should be specified for the road clearing, excavation, culvert installation, and windrow construction.

After fill construction is completed, the filter windrow is built by the pull shovel, placing anchor logs just at or below the toe of the fill. They should be anchored against stumps, rocks, or trees parallel to the fill toe line. The pull shovel then packs slash by tamping above and along the length of the anchor logs. The slash is embedded in the fill slope in quantities sufficient to make a sediment-impervious windrow 2-3 feet high and 6-10 feet wide.

As mentioned earlier, the windrow may be built as soon as road subgrade and fill is completed, providing immediate sediment pollution prevention. To ensure maximum effectiveness, fill slopes must be limited to slopes no steeper than 1½ to 1, horizontal to vertical. Also, with use of the hydraulic thumb pull shovel, no manual labor is needed in slash filter windrow construction. Construction cost is approximately $100 per hundred feet.

Follow-Up

During the first fall season after construction, fill slopes should be grass seeded, fertilized, and hydromulched, to establish stabilization for subsequent years.

References

Cook, M.J. and J.G. King. 1983. Construction Cost and Erosion Control Effectiveness of Filter Windrows on Fill Slopes. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT, Research Note INT-335, 5p.

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Correctly Classifying Streams to Protect Fisheries and Domestic Water Supplies

State Forester Forum

The Idaho Forest Practices Act

Harvesting of forest tree species is a part of forest management by which wood for human use is obtained and by which forests are established and tended. It is recognized that during harvesting operations there will be a temporary disturbance to the forest environment.

One of the purposes of the Idaho Forest Practices Act (IFPA) is to establish minimum standards for forest practices that ensure the continuous growing and harvesting of tree species while protecting and maintaining the benefits provided by forest resources such as the forest soil, air, water resources, wildlife and aquatic habitat. To ensure that beneficial uses such as domestic water supply and salmonid spawning are protected, streams are classified as Class I or Class II based on the presence of domestic water users or fish.

Rule 010.58.a of the IFPA defines a Class I stream as those streams that are used for domestic water supply or are important for the spawning, rearing, or migration of fish. Domestic use waters shall be considered to be Class I upstream from the point of diversion for a minimum of 1320 ft. Domestic use waters do not include streams that provide water only for livestock, irrigation, or other uses not directly associated with human health.

Rule 010.58.b of the IFPA defines Class II streams as those streams that are usually headwater streams or minor drainages that are used by few, if any, fish for spawning or rearing. The rule states that "Where fish use is unknown, consider streams as Class II where the total upstream watershed size is less than 240 acres in the north forest region and 460 acres in the south forest region." The principle value of Class II streams lies in their influence on water quality downstream in Class I streams. Stream classification calls are primarily based on direct observation and professional judgment, and should not rely on the acreage breaks stated in this Class II definition as an absolute.

Generally, Class II stream designation (few if any fish) is given to streams without any historic or existing fish populations. This means that any

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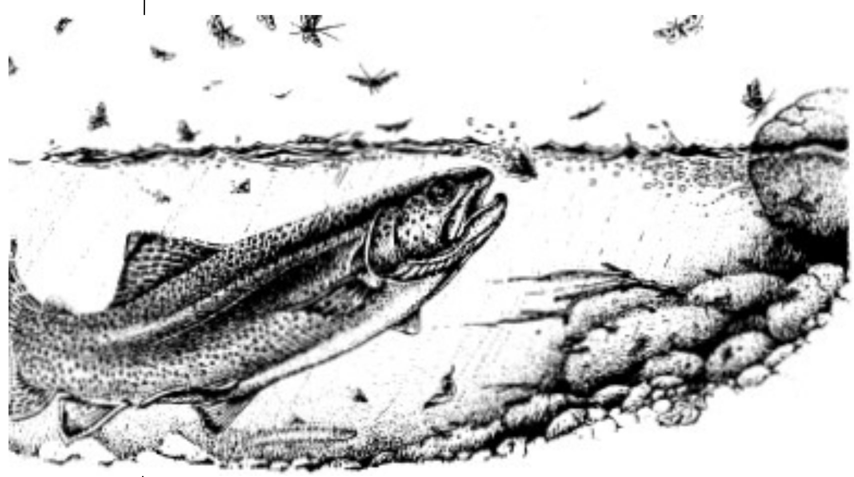
stream that historically had fish and is capable of supporting them in the future through proper management can be classified as a Class I stream.

The IFPA stream protection rules were designed to ensure fish habitat and water quality are protected. These rules state the minimum amount of shade, large organic debris, and vegetative buffer that must be left along a stream based upon its classification. It is important to remember that the intent of these rules is to ensure that forest practices do not impair beneficial uses of streams. The IFPA specifies only the minimum standards for the conduct of forest practices, and consequently will not apply in all situations. Steep side slopes, unstable or overly wet conditions, low elevation trout bearing streams or streams with important fishery needs are all cases where the listed minimum standards may not provide the protection a stream needs to maintain a self sustaining fish opulation or provide clean water for domestic users.



Determining Stream Classification

Domestic Use

Domestic water use can sometimes be confirmed by the Idaho Department of Environmental Quality (IDEQ) and/or Idaho Department of Water Resources (IDWR). The IDEQ maintains a list of public water supply watersheds (>25 users) and IDWR registers water rights and domestic water sources. Presence or absence of a water right does not constitute domestic use and should be verified. Numerous other domestic users are not registered with DEQ or IDWR and must be investigated case by case. The Idaho Department of Lands will conduct (by policy, not rule) a preoperational inspection for logging operations that occur in public water supply watersheds.

Fish Presence

Stream Classification by fish presence can be difficult to determine, particularly on smaller streams, and has resulted in the misclassification of many streams in the past. Often, all it takes to determine if fish are present in a stream is to walk along it slowly during lower flows when the water is clear. Do not assume fish do not use a stream just because they are not observed. Many fish blend in with their surroundings or seek security during daylight hours. Fish may only use a stream seasonally or for specific life stages. Finally, the stream may have been degraded by historical practices (skidding down stream channel), causing the fish population to be lost altogether. Such streams, if properly managed, can recover and support fish.

Do not assume that fish will not exist above impassible barriers, overly steep gradients or in small or intermittent streams. An impassable barrier, while it limits the upstream distribution of migratory species, does not prevent fish from living upstream. Salmonids (trout, whitefish and salmon) began colonizing Idaho over a million years ago, before many of today's barriers were formed. The Pend Oreille, Spokane, and upper Snake Rivers all have impassible barriers but were colonized by salmonids before these barriers were formed. Fish may also colonize above barriers through headwater capture, which occurs when a downcutting stream intercepts another stream and alters its path. Fish in the redirected headwater become established in another watershed. Many salmonids colonized the Lost River and Bear Lake drainages through headwater capture. Finally, fish introductory programs have placed fish populations above many impassible barriers.

Small and intermittent streams can be very important to fish. In fact, many salmonids will only spawn in small streams, and it is not unusual for trout to spawn in streams that dry up or flow subsurface for part of the year. The fry in these streams will migrate to lakes or other streams, stream sections where year-round flow occurs or seek refuge in stranded pools until the water level rises. Trout can even survive beneath gravel in dry streams, if subsurface flows and inter-gravel spaces are adequate. Small streams also provide a cool water refuge for fish during warm summer months and support ideal habitat for juvenile trout.

In many cases, impassible barriers do mark the upstream limit of fish, especially in smaller streams. Falls, steep gradients, intermittent flow and subsurface flow are all conditions that may limit upstream distribution of fish.

The height of a falls a fish can ascend depends largely on the species and size of fish present and the type of jumping pool available. A good rule of thumb is, a fish can jump 2-3 times as high as its body length, with a adequate jumping pool to start from (varies by species). A 24 inch rainbow trout, for instance, can ascend 6 ft. falls under the proper conditions.

Perhaps the most readily observed and accurate predictor of fish presence or absence in a stream network is stream gradient. Extensive surveys have revealed that fish do not occupy stream segments with sustained gradients exceeding 22%. The reason for fish absence is that the stream is incapable of maintaining adequate pool habitat necessary for fish to rest and maintain position at this steep gradient. Gradients exceeding 22% often reveal the upstream extent of fish occupancy in mountainous settings. Further investigations in the Coeur d'Alene River drainage have revealed that stream gradients from 15% up to 22%, if sustained over a ½ mile distance, limit the upstream distribution of fish.

Correct stream classification is vital if streams are to be protected and their designated beneficial uses maintained. If uncertain about the presence of fish in a stream: either follow rule 010.58.b of the IFPA, (which states that where fish use is unknown, consider streams as Class II where the total upstream watershed is less than 240 acres in the north forest region and 460 acres in the south forest region). Or consult your local Forest Practice Advisor or a fish biologist. Remember, stream classification calls are based on observation and professional judgment and should not rely on the acreage breaks as an absolute.

Sidehill Roads: Abandonment Closure Guidelines

State Forester Forum

FILL PULL-BACK CRITERIA

A large number of existing roads were built using sidehill cut-fill construction. In many places these fills are "perched" on steep sidehills. Sometimes they appear to stay in place because of the support of trees, stumps, or brush clumps. Many sidehill fills are of questionable stability as evidenced by tension cracks and past sloughing. Often, road "closure" evaluations will involve consideration of pulling back some of the unstable or questionable sidehill fills.

Determinations of what fill to pull back and what fill to leave is not a perfect science. Generally speaking, "unstable fills" should probably be pulled back for either permanent or "long-term" road closure. Usually, the stability standards for leaving fill in place should be higher for permanent closure situations than for long-term closure. Based on experience and observations, we have developed a set of criteria to assist evaluation of the pull back question. These suggested criteria may be briefly summarized as follows:

A. Look for segments of fill that are of "precipitous" inclination and that are clearly caught on brush clumps, stumps, trees, or slash. These fills are virtually certain to fail when the supporting structure eventually rots out.

B. Look for "very steep" fill areas that exhibit chronic seepage. This is indicated by wet conditions during the driest season of the year and/or by a significant growth of reeds and other water-loving vegetation along the road and on the face of the fills. Ground water is one of the most important factors in long-term fill stability; therefore, steep areas with chronic seepage are certain to be a stability risk over time.

C. Look for any areas with evidence of tension cracking and/or downsets of the edge of the road. This is a clear indication of instability.

D. Look for areas where the road prism is constructed partly by excavation into sound rock and partly by fill on steep sideslopes. In such areas, it is likely that the fills are resting on a surface of inherently limited stability. Any subsurface seepage (seasonal or not) is likely to be concentrated above the rock surface in the fill, or in the residual soil zone just beneath the fill.

E. Look for areas where bedding or foliation patterns in the rock are parallel or nearly parallel to the cut and fill slopes and the hillside. This provides a number of potential failure surfaces in the most unfavorable direction possible.

Obviously, judgment and experience are important in applying these criteria. It is generally true, however, that a fill area which fits two, three, or more of the criteria is likely to be in a more precarious stability situation than fills that fit one of the criteria or none. Also, the environmental sensitivity of the situation must be considered. A higher stability standard may be appropriate in an area where a sensitive stream segment lies immediately downhill of, and in close proximity to, the fill in question. In areas where there is a substantial separation between the fill and any possible water quality impacts, a lower stability standard may be acceptable.

ROAD ABANDONMENT—FILL PULL-BACK GUIDELINES

1. Use an excavator to pull reachable perched, cracked, or very steep fills back

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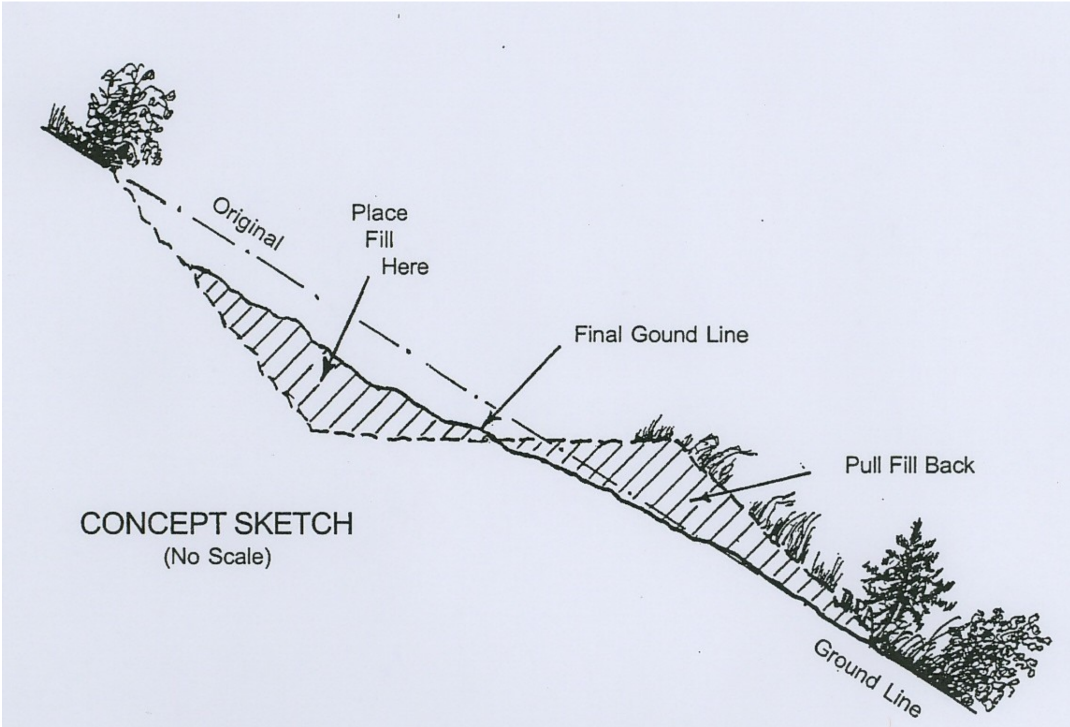
SIDEHILL ROADS: ABANDONMENT CLOSURE GUIDELINES



up to the road surface. Leave an overall fill slope inclination of about 2 to 1 (h:v) or flatter. (Refer to sketch cross-section above.)

2. Extract any buried slash, stumps, logs, etc., from fill and leave or place it on surface of lower slope.
3. Place and drift pulled-back material on remaining road surface and against base of cut slope. (Refer to cross-section sketch above.)
4. "Dress up" reshaped area to a smooth, generally planar surface without low areas or swales that can trap or concentrate surface water.
5. Where natural swales or draws exist on the hillside, continue these features across the "road" alignment.
6. Fill pull-back exposes bare soil like the original road construction with similar risks of erosion. It is important to scatter available slash, logs, plant grass, and straw mulch over the exposed area. Near streams use slash, berms, silt fences, straw bale dams, log weir dams, and rock dams. Consult an IDL Private Forestry Specialist with questions.

DIP PONDS

IDAHO DEPARTMENT OF LANDS

State Forester Forum

Installing Ponds for Fire Control and Dust Abatement Relating to Forestry Practices

Though water is often available in forested areas it is seldom found in sufficient quantities needed for firefighting practices. The construction of a storage facility (pond) allows for a greater quantity of water to be accessed by water tenders or helicopters. To receive Hazard Offset Points (0-3 points deduction) the water source needs to supply a minimum of ten thousand (10,000) gallons during an operational period (roughly 0.03 acre-feet [or approximately 3' deep x 21'x 21']) and be within one mile for water tenders, or three miles for helicopter bucket use, of the forest practice area (Idaho Forestry Act - IDAPA 20.04.02.120.02). Most ponds filled by diverting surface water will require a water right permit from Idaho Department of Water Resources (IDWR), while excavated ponds filled from overland flow (snow melt/rain) do not require a permit. This overland flow usually comes from swales above the Class II streams where no bed and banks are observed. Please contact IDWR for more information and clarification. No permit is required to use water for fire fighting and dust abatement (see exemptions 42-201-3).

Site Selection

A pond should be designed to provide for the expected type(s) of use: engine, helicopter, or a combination. The presence of replacement inflow should be considered along with the possible number of uses per day (i.e. helicopter trips) when sizing the pond. For a helicopter dip pond, plan the pond depth for a typical helicopter bucket that requires at least 3 feet of water to fill. For safe helicopter operation clear trees around the pond a minimum of 1.5 times the rotor diameter of a helicopter that would use the pond to fill a bucket. Avoid locating ponds in ecologically sensitive areas.

Construction Techniques

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DIP PONDS

Proper construction techniques need to be applied to ponds and dams to protect habitat and downstream life and property. The main components of proper dam design are a cut-off trench, proper freeboard, and sufficiently sized emergency spillway. For the dam to function properly there are also construction techniques that need to be implemented along with the design features:

- Clear dam area of all top soil, and save; also remove boulders and vegetation debris; removal of tree root wads may require special attention (fill) to avoid piping.
- A cut-off trench should be excavated the length of the dam and be a minimum of 1 foot deep and 8 feet wide and may include an impervious liner (Figure 1).
- All dam material should be applied in shallow layers and compacted, including the cut-off trench, with heavy construction equipment. Do not use frozen fill material or place fill material on frozen foundations.
- The dam should be designed and built with slopes of at least 1:2 for the downstream face and 1:3 for the upstream face (Figure 1).
- The top width of the dam should be at least 6 feet. If the top of the dam is to be used for a roadway the top width should be increased, providing for a shoulder on each side of the roadway to accommodate the planned vehicle width.
- The freeboard (dam height above water surface) should be a minimum of 1 foot and should be over built to accommodate for settling after construction. The primary outlet/spillway elevation should be the control of the water elevation.
- The emergency spillway should be designed and built to pass the 50 year peak flow and may serve as the primary outlet for the pond (Figure 2). The spillway should be constructed in a manner to direct water away from the dam face and to avoid erosion of the spillway: use a gentle slope (approximately 1:12), line with geo-textile fabric and rock, or seed with grass soon after construction.
- The underwater contour of the pond should be steep to allow for more useable storage volume and less surface area for evaporation. Include a ramped section to allow for escape if an animal were to fall into the pond.
- The pond bottom and dam face may require clay or synthetic lining to increase water holding ability depending on the soil types.
- Use the saved top soil, from clearing for the dam, on the downstream face of the dam and grass seed soon after construction to avoid excessive erosion (Figure 1).

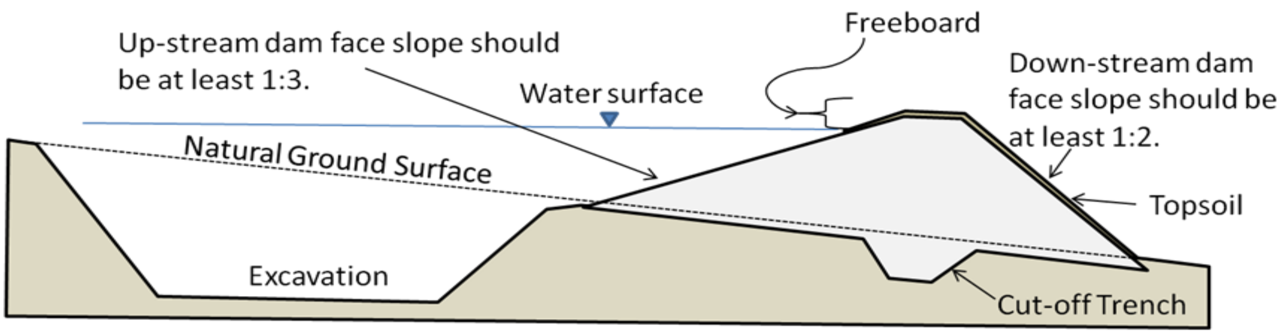

Figure 1. Example cut –away view of dam and pond excavation.

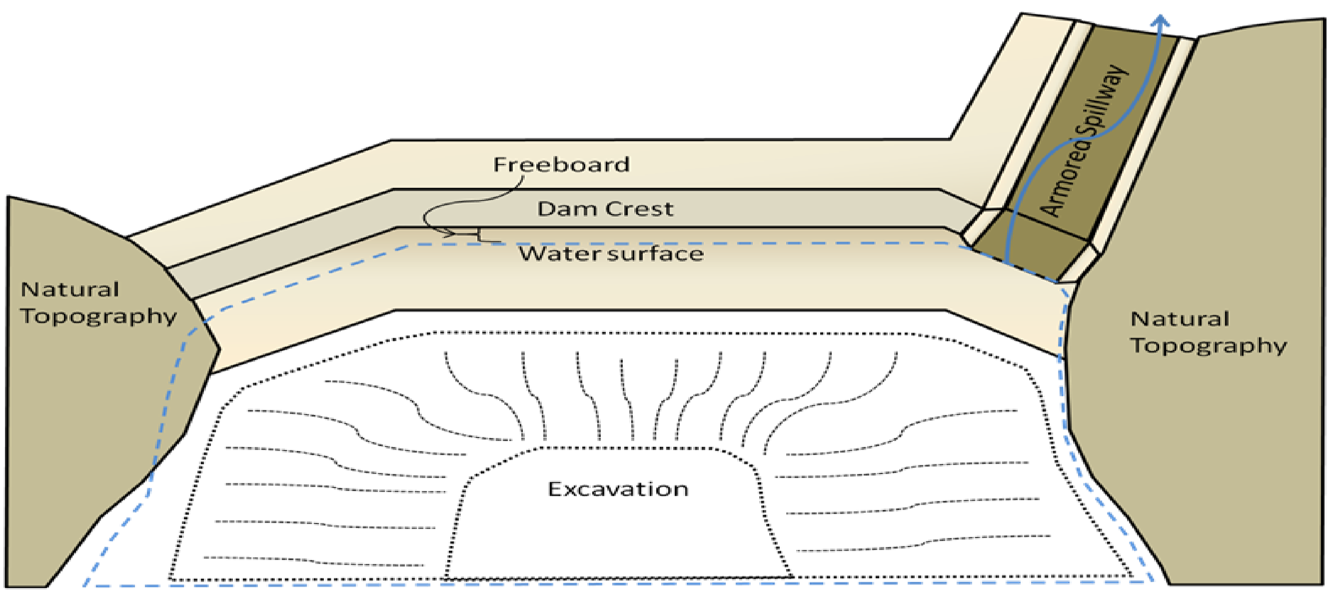

Figure 2. Example plan view of dam and pond excavation showing the spillway directing water away from the dam.

Construction Material

Proper construction techniques need to include using proper soil types for an effective and safe dam. Soils high in clay and silty clays are excellent for dam construction; sandy and gravelly clays are satisfactory. Coarse-textured sands and sand-gravel mixtures are highly pervious and therefore usually unsuitable for dam construction. The following soil characteristics are ideal: More than 10% clay, more than 20% silt, presence of sands and gravels in reasonable quantity to supply structural strength. Clay with moderate dispersion, some dispersion is necessary to have sufficient mobility to help seal pores without causing piping. Low shrink/swell capacity and negligible organic matter content.

Maintenance

Dam structures and ponds require maintenance to sustain their usefulness and safety over time. Keep the dam face clear of woody vegetation as the roots can create pathways for water. Do not allow trees to establish on the dam face as they are prone to wind throw and the failure of the root structure could cause catastrophic damage to the dam. If the pond silts in over time the bottom may require dredging to restore its storage capacity. Keep trees and rubbish out of the pond that might snag a helicopter bucket.

Installing Ponds That Require a Water Right

Acquiring a permit for in-channel ponds or diverting water for ponds can be difficult, adding to the financial and time consideration of the development. In-channel ponds pose design challenges such as higher flows and fish passage. In-channel ponds require dams and spillways to be designed and built to pass higher stream flows and their usable lifetime can be shortened by sedimentation behind the dam, reducing storage. Ponds that are in-channel on Class I streams must provide for fish passage over the dam usually requiring a fish ladder type structure. Off-channel ponds on Class I streams would be required to have fish friendly diversions to adhere to the permitting process. Examples of fish friendly structures include infiltration galleries and permanent screened diversions. Consult Idaho Fish and Game for information regarding fish passage over in-stream dams or for assistance installing fish friendly diversion structures.

References

Ponds: Planning, Design, Construction. 1982. Natural Resources Conservation Service. Agricultural Handbook No. 590. 51pp. http://www.in.nrcs.usda.gov/pdf%20files/PONDS.PDF

Cummings, D. 1999. Soil Materials for Farm Dam Construction. Landcare Note LC0069. ISSN 1329-833X.

Soils for Dam Construction

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CLASS I STREAMSIDE TREE RETENTION RULES

State Forester Forum

Retaining trees near fish-bearing streams is an important component of the Idaho Forest Practices Act. This State Forester Forum explains the Idaho Forest Practices Act streamside tree retention requirements (Shade Rule) and describes a process for landowners and operators to determine streamside management options within harvest units.

The Shade Rule applies to all forest landowners in Idaho, large or small, including all private, state and federal landowners, that have Class I streams on their property.

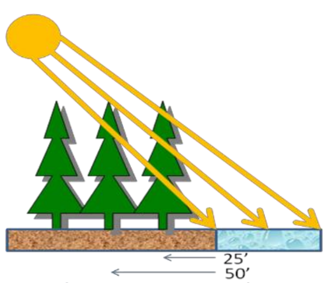
The Idaho Forest Practices Act Advisory Committee (FPAAC), a nine member citizen technical committee, developed the Shade Rule and the methods for selecting trees to leave along Class I streams.

The rule intent is to allow active management along Class I streams while maintaining essential riparian functions.

As defined in Idaho Forest Practices Rules, Class I streams are important for spawning, rearing or migration of fish or are used as a domestic water supply. Class I Stream Protection Zones (SPZ) en-compass an area of 75 feet (slope distance) on each side of the stream's ordinary high water mark. For more information on defining stream protection zones, review IDL's Stream Protection Zone.

The Benefits of Shade

Shade over streams benefits fish habitat in a myriad of ways. It keeps water cool for successful spawning, and, creates structures when trees fall into the stream channel forming pools that enhance the ability of fish to feed, spawn, rest, and migrate upstream.



Trees next to the stream typically provide the majority of the shade cast by a riparian buffer.

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CLASS I STREAMSIDE TREE RETENTION RULES

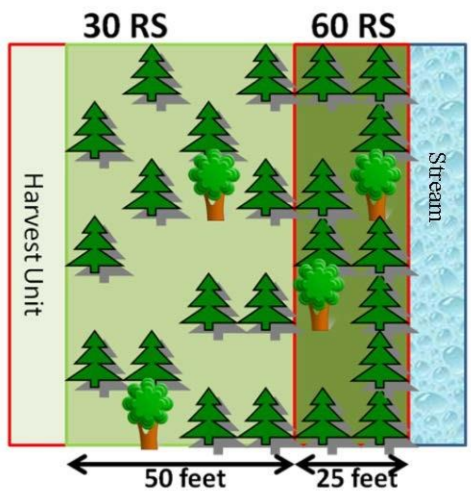
The Shade Rule requires a 75 foot wide buffer on each side of Class I streams and provides landowners with two management options for retaining trees in this area. Only one (1) option can be implemented within the stream protection zone of a harvest unit covered by a single notification.

The Rule

30.7.e.ii. *Adjacent to all Class I streams, to maintain and enhance shade and large woody debris recruitment, landowners must comply with one of the two following options defining tree retention. The Relative Stocking per acre (RS) referenced in the options is calculated according to the relative-stocking distribution table. (*Table 1).

Option 1

Option 1 requires more trees to be left in the inner 25-ft. next to the stream and fewer trees in the outer 50-ft. of stream protection zone.

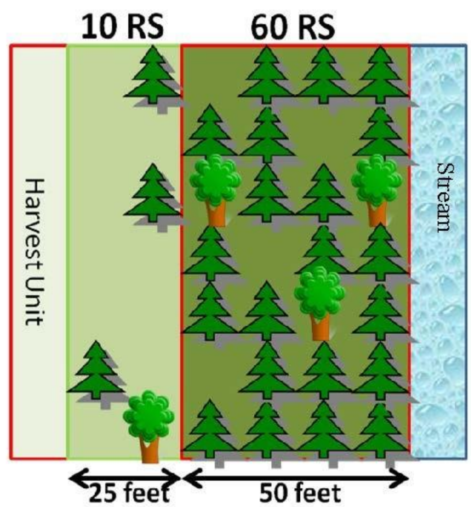


Within twenty-five (25) feet from the ordinary high water mark on each side of the stream, live conifers and hardwoods will be retained to maintain a minimum relative stocking per acre of sixty (60).

A relative stocking per acre of thirty (30) must be retained in the stream protection zone between twenty-five (25) feet and seventy-five (75) feet from the ordinary high water mark on both sides of the stream.

Option 2

Option 2 requires more trees to be left in the inner 50-ft. next to the stream and fewer trees in the outer 25-ft. of the stream protection zone.



Within fifty (50) feet from the ordinary high water mark on each side of a stream, live conifers and hardwoods will be retained to maintain a minimum relative stocking per acre of sixty (60).

A relative stocking per acre of ten (10) must be retained in the stream protection zone between fifty (50) feet and seventy-five (75) feet from the ordinary high water mark on both sides of the stream.

How to Implement the Rule

To determine what trees can be harvested along a Class I stream, follow the six-step process outlined below. The process includes determining forest type, management options, locating stream protection zones, and inventorying trees within the SPZ to provide the current relative stocking. Once the current stocking level is known and, if the current stocking exceeds the required minimum to protect the stream, trees can be selected for harvest.

If no harvest occurs in the SPZ, an inventory is not needed.

Tools used for determining shade retention along a Class I stream are found at: SPZ Harvest Information.

Step 1. Determine forest type

There are five distinct forest types in Idaho that are defined in the FPA rules. The forest type found within the SPZ will determine the site's potential relative stocking. For assistance, contact your local Private Forestry Specialist: IDL Supervisory Areas.

Idaho Forest Types

Determine which of the following forest types applies to the harvest area.

- ⇒ **A. North Idaho grand fir/western red cedar (NIGF):** moist to wet interior forests with western red cedar, western hemlock, and grand fir being primary climax species, found in forests north of the Clearwater/ and Lochsa Rivers.
- ⇒ **B. Central Idaho grand fir/western red cedar (CIGF):** productive conifer forests found in forests between the Lochsa River Basin and the Salmon River, characterized by stands having western red cedar and grand fir as climax species, with a mixed conifer overstory increasingly comprised of ponderosa pine, Douglas-fir, and larch in the river breaks canyon lands. Stocking levels are generally lower than that of the NIGF stands.
- ⇒ **C. South Idaho grand fir (SIGF):** mixed-conifer forests, dominated by ponderosa pine and Douglas-fir, found south of the Salmon River with grand fir and occasionally western red cedar being the stand climax species.
- ⇒ **D. Western hemlock-subalpine fir (WH):** higher-elevation, moist, cool interior forests dominated by western hemlock, mountain hemlock, and/or subalpine fir.
- ⇒ **E. Douglas-fir-ponderosa pine (PP):** drier forests dominated by ponderosa pine and Douglas-fir, generally found in lower-elevation, dry sites.

Step 2. Decide which management option best suits your goals.

The rule provides two options and the option a landowner selects is determined by landowner objectives and existing riparian conditions. A pre-harvest inventory (step 4) will help inform which option is best.

The inventory can also help meet specific landowner goals. For example, if the objective is to remove trees that pose a forest health risk, selecting one option over the other may provide a greater opportunity to harvest these trees.

In certain cases, a site-specific riparian management plan may be needed.

Site Specific Riparian Management Plans

Certain streamside silvicultural and forest-health conditions may alter how the intent of this rule is best met. In this situation, managers may choose to develop and submit for approval a Site-Specific Riparian Management Plan. Site-specific plans will be allowed if they meet or exceed, over the long term, the intent of the streamside tree retention rule –to move the forest to appropriate stocking levels that provide improved shade and woody debris recruitment over streams.

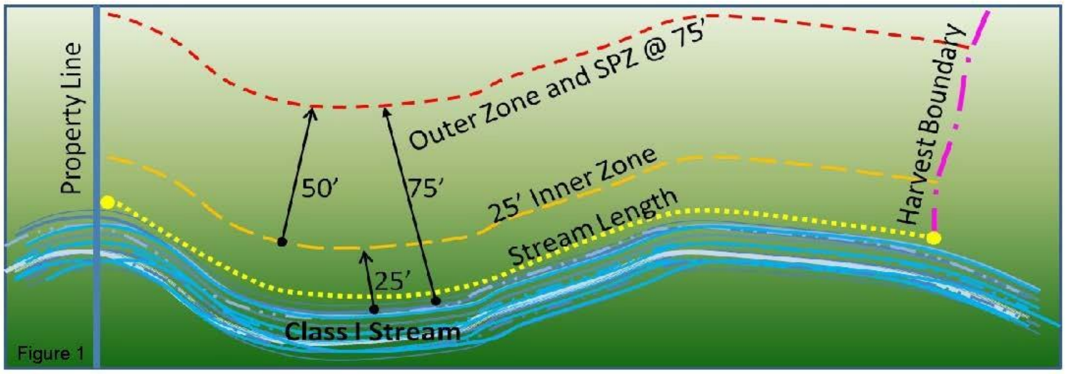
How to Implement the Rule

Step 3. Locate the stream protection zone boundaries

To determine relative stocking, begin by delineating the inner and outer boundaries of the stream protection zone on each side of the stream. For option 1 delineate a 25' inner and 50' outer zone (Figure 1). For option 2, delineate a 50' inner and 25' outer zone. Both options will provide a 75' SPZ.

Tip

⇒ When it is not clear what option is best, divide the SPZ into three 25' zones. The inner zone (0—25' from the stream) will always require a minimum relative stocking of 60 percent. This method provides the landowner with calculations for either option allowing the landowner to make the optimal decision.



Step 4. Conduct the pre-harvest SPZ tree inventory

Tips

⇒ Use IDL's Tree Retention Zone Inventory Form or worksheets to record data and determine relative stocking. The form and worksheets are available on IDL's website: SPZ Harvest Information.

⇒ DBH = diameter at breast height, a measure taken 4-1/2 feet above the ground on the uphill side of the tree. To find DBH, wrap a standard measuring tape around the trunk of the tree. Divide the measurement by 3.14 to get the diameter.

Select Inventory Option

Option 1

1. From the ordinary high water mark, determine the 25' inner and 75' outer zones. This creates a 25' wide inner zone and a 50' wide outer zone. Flagging the boundary lines will help when counting trees.
2. Measure the stream length and calculate the acres for each zone. Acres = length x width (square feet) / 43,560.
3. Within each zone, **count all live trees** (including hardwoods) greater than four inches diameter at breast height (DBH). Record the trees by diameter class (Table 1) within each zone.

Option 2

1. From the ordinary high water mark, determine the 50' inner and 25' outer zones. This creates a 50' wide inner zone and a 25' wide outer zone. Flagging these boundary lines will help when counting trees.

The "two options approach" is unique in the West and demonstrates Idaho's leadership in developing solutions that balance landowner rights, provide flexibility, and protect Idaho's forest and water resources.

How to Implement the Rule

Step 5. Calculate existing relative stocking

Relative stocking is a measure of site occupancy calculated as a ratio comparing existing stand density to the biological maximum density for a given forest type, and, it shows the extent to which trees utilize a plot of forestland. Relative stocking is expressed as a percentage and should be under 100. If it is greater than 100, verify the data and forest type. On highly productive sites, the relative stocking may be over 100.

To calculate relative stocking:

1. Enter tree measurements (from step 4) into the IDL spreadsheet. The spreadsheet will automatically calculate the relative stocking based on relative stocking by diameter class (Table 1).
2. **The inner zone for either option must be greater than 60,** or no harvest can occur in the inner zone. For Option 1, the outer zone must be greater than 30, and for Option 2, the outer zone must be greater than 10.

The table below represents the per tree contribution by forest type and diameter class to determine relative stocking.

	Per Tree Contribution to Relative Stocking by Diameter Class						
	Diameter Class (DBH in inches)						
Forest Type	**4-7.9"**	**8-11.9"**	**12-15.9"**	**16-19.9"**	**20-23.9"**	**24-27.9"**	**28-31.9"**
NIGF (North Idaho Grand Fir)	0.097	0.209	0.347	0.506	0.683	0.878	1.088
CIGF (Central Idaho Grand Fir)	0.113	0.244	0.405	0.59	0.797	1.024	1.27
SIGF (Southern Idaho Grand Fir)	0.136	0.293	0.486	0.708	0.957	1.229	1.524
WHSF (Western Hemlock-Subalpine Fir)	0.123	0.267	0.442	0.644	0.87	1.117	1.385
DFPP (Douglas-fir-Ponderosa Pine)	0.151	0.326	0.54	0.787	1.063	1.366	1.693

Table 1

Step 6. Conduct Harvest

If the relative stocking exceeds the required zone minimum, trees can be selected for harvest.

Landowners are encouraged to retain all trees immediately adjacent to the stream. Often, these trees can be difficult to remove. Keep in mind the physical limitations of removing them.

Space trees evenly within the SPZ to provide consistent shade and large woody debris recruitment.

Tip

⇒ Leave more than the minimum required relative stocking to account for trees damaged during harvest and to ensure minimum stocking will be met after harvest.

Consult the Idaho Forest Practices Rules for detailed requirements on forest practices in the SPZ.

References

Teply, M.; 2012, Using Stream Shade and Large Wood Recruitment Simulation Models to Inform Forest Practices Regulations in Idaho.

Optional Plot Sampling Method

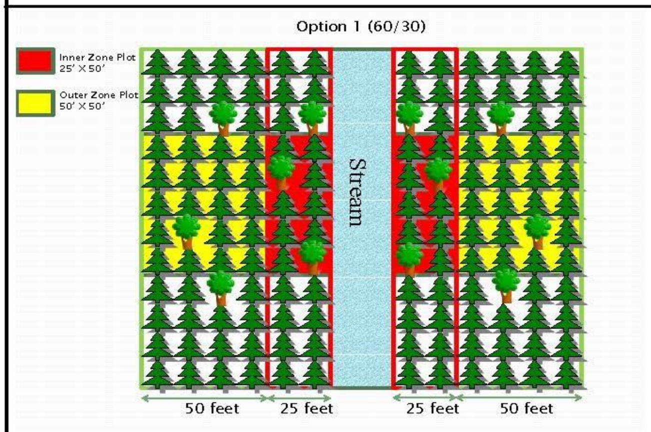
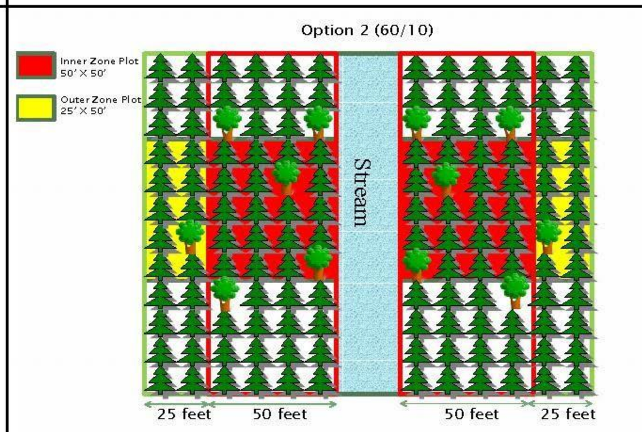
For stream segments over 1000', plot sampling is an acceptable method for determining relative stocking. A minimum 20 percent sample is recommended when using plots.

Step 1

Choose harvest option 1 (60/30) or option 2 (60/10). If unsure which option is best, divide the SPZ into three parallel 25' zones. Measure each zone separately and determine which option would best meet landowner objectives.

Step 2

Flag or designate the boundaries of the selected option.

Option 1: (60/30) flag the inner zone 25' from the ordinary high watermark (OHW) and outer zone 75' from the OHW	**Option 2:** (60/10) flag the inner zone boundary at 50' from the OHW and the outer zone and SPZ boundary at 75' from the OHW.
	

Step 3

Start at the intersection of the stream and harvest boundary . To locate the first plot, measure a fixed distance (100' for example) from the boundary. This will minimize potential error introduced by the boundary.

Step 4

Establish the first plot. Create a rectangular plot which extends 75' from the stream and encompasses 50' of stream length. The plot will include the inner zone and outer zones.

Step 5

Count each tree in the inner zone, measure and record them by the DBH class. Count each tree in the outer zone, measure and record them by DBH class.

Step 6

From the first plot, measure 200' stream distance and establish the next plot. The intention is to sample 20% of the SPZ.

Appendix 1

Optional Plot Sampling Method

Step 7

Continue this process throughout the SPZ harvest unit. Inventory both sides of the stream. Some plots may have openings such as roads, trails or meadows. Include these areas if they fall within the plot.

High stocking on one side of a stream does not justify harvesting the other side below rule requirements. Each side of the stream should be measured separately, unless they are comparable.

Step 8

Determine acres to be harvested within the stream protection zone. Using IDL's spreadsheets, enter tree data and calculate the pre-harvest relative stocking. Using the fixed plot method, if the relative stocking is near minimum levels, harvest is not recommended. If the relative stocking is above the minimum required, harvesting in the SPZ can occur.

Step 9

Designate trees for removal. Evenly space the leave trees. To compensate for sampling error and to ensure minimum stocking will be met after harvest, leave a few more trees than the minimum number. Note: Often, trees close to the stream can be difficult to remove, keep in mind the physical limitations of removing them. Harvesting large clumps of trees will create openings and may not meet the rule.