Oregon

forest practices **monitor**

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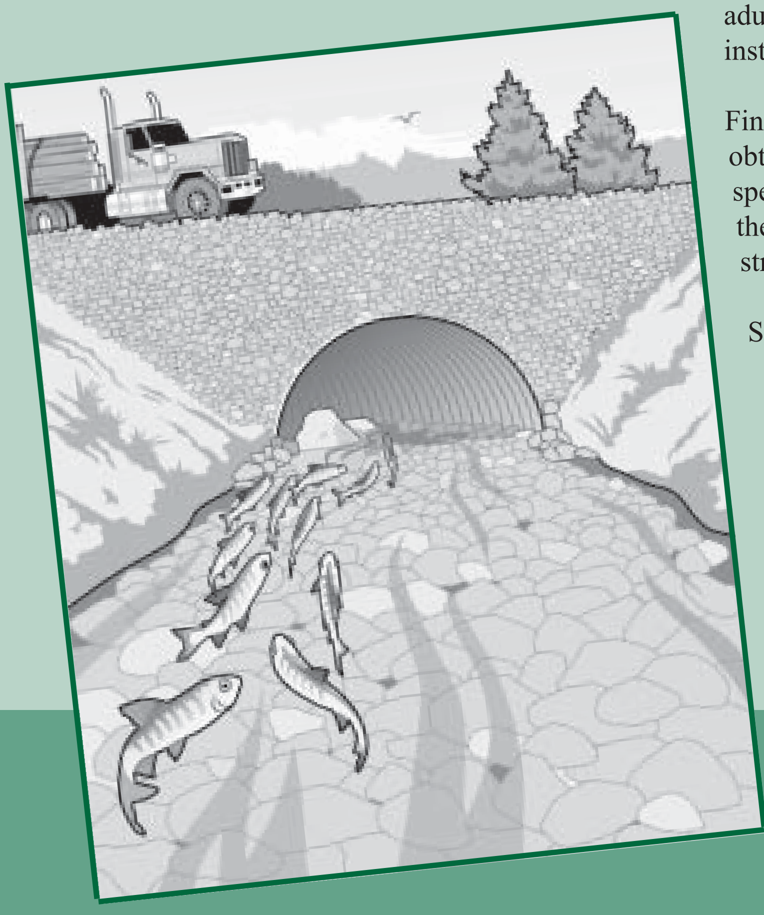
Scientific Monitoring of Oregon's Forest Practices - An Oregon Department of Forestry Newsletter

How well are Oregon's Forest Landowners and Operators Complying with Fish Passage Requirements at Stream Crossings?

Much has been learned in recent years about how roads crossing streams affect the upstream migration of fish, especially juvenile fish. Since 1994, Oregonís forest protection laws require that new or reconstructed stream crossings, such as culverts, pass peak water flows and allow for the passage of both adult and juvenile fish.

Inside these pages, we highlight a monitoring study done by the Oregon Department of Forestry, with support from the Oregon Plan for Salmon and Watersheds. By evaluating 98 stream crossings in the field, the study looked at how well landowners and operators complied with stream crossing guidelines regarding choice, design and installation to ensure peak flow and fish passage. The study results indicate that certain stream crossing designs had a substantially different level of success than others in providing passage for adult and juvenile fish. Only 25% of the baffled culvert designs had a high likelihood of passing fish. Overall, 71 percent of all the stream crossings monitored had a high likelihood of passing juvenile and adult fish during all periods of flow, based on the installation characteristics as measured in the field.

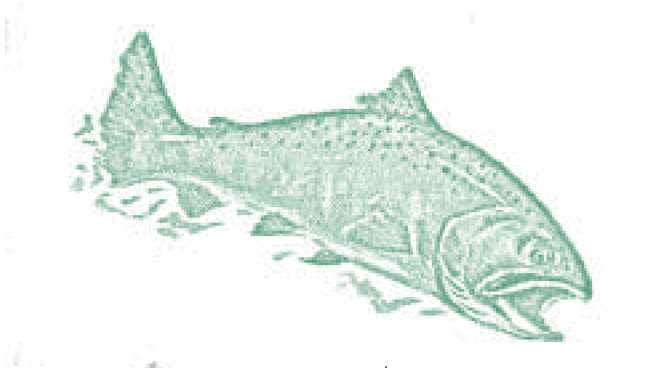


Findings from the study reinforced the importance of obtaining proper field measurements that assess the specific characteristics of stream crossing sites, and then implementing design plans for stream crossing structures accordingly.

See inside for more...

INSIDE

ODF's Monitoring Staff



Jim Cathcart, Acting Forest Health and Monitoring Manager

B.S. in Forest Resource Management (Humboldt State University, 1982)
M.S. in Forest Economics (University of Idaho, 1988)
Ph.D. in Forest Management & Economics (Virginia Polytechnic Institute & State University, 1989)

Fifteen years experience in forest policy, management planning, inventory analysis, economics and communications, including five years experience with ODF. Cathcart is ODF's staff lead on policy and technical work of forest carbon sequestration and carbon credits. He is a member of the Oregon Society of American Foresters, a Certified Forester and a tree farm inspector for the Oregon Tree Farm System.

Jennifer Weikel, Wildlife Biologist

B.S. in Wildlife (Humboldt State University, 1994)
M.S. in Forest Science (Oregon State University, 1997)

Strong background in forest ecology, works with both the ODF Private and Community Forestsí Forest Health and Monitoring Unit and the State Forests Technical Services Unit. Weikel spent seven years working in the northern Coast Range of Oregon conducting research on effects of commercial thinning on songbirds and on the foraging ecology of cavity-nesting birds. She has worked as a consultant, a researcher for OSU, and as a technician for the USDA Forest Service.

Owen Burney, Monitoring Specialist

B.S. in Forest Biology (University of Georgia, 1997)
M.S. in Silviculture (Oregon State University, 2002)

Worked with the University of Georgia Forest Soils Department examining the utilization of paper mill sludge as a nutrient source, and with Westvaco, Summerville, SC, doing vegetative propagation research. After relocating to Oregon, he worked with ODFís reforestation unit in Tillamook. He continues his work on studies designed to understand animal damage, herbicide-root interactions, and stock type (size) limitations.

Jerry Clinton, Monitoring Assistant

BS in Geography (Oregon State University, 1992)

Ten years experience with the ODF, Forest Practices Act stream classification data management, as well as various cartographic and riparian monitoring projects that include field coordination, data collection and data management. Clinton applies for and administers ODFís permits for scientific research. He also obtains authorization to conduct fish presence surveys in areas where endangered species may be present.

fp monitor

is a newsletter published by the Oregon Department of Forestry.

Its purpose is to provide scientific information about Oregon's forest practices monitoring projects. Project findings, summaries and recommendations, as well as other related information from the scientific community, is shared to help the public and policymakers determine the effectiveness of Oregon's forest practice rules and to help set monitoring priorities for future study.

**Oregon Department of Forestry
Private & Community Forests Program
2600 State Street
Salem, Oregon 97310
(503) 945-7200**

Arlene M. Whalen, Editor/Design & Layout
awhalen@odf.state.or.us

Technical Illustrations:
Phil Fehrenbacher

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Compliance with Fish Passage & Peak Flow Requirements at Stream Crossings

Forest Practices Monitor Vol. 2, No. I - 2004

CONTRIBUTORS: Jim Paul, ODF Hydrologist, Liz Dent, ODF Riparian and Watershed Specialist, and Jim Cathcart, ODF Acting Forest Health & Monitoring Manager

SUMMARY ó

Over the past few years, much has been learned about how forest road stream crossings, such as culverts, can impede the passage of fish, especially juvenile fish. In Oregon, forest landowners and operators are required by law to design and install stream crossings that pass peak water flows AND allow for the passage of both juvenile and adult fish. Since 1995, the Oregon Department of Forestry (ODF) has been developing and updating guidance that explains how landowners can ensure fish passage and provide for peak flows when reconstructing or installing stream crossings. In 1999 and 2000, ODF conducted a field study to monitor how well stream crossing structures were designed and installed to comply with the law. The study evaluated 98 stream crossings for compliance with the 1997 fish passage guidelines in four areas:

- Adequacy of Written Plans
- Compliance with Fish Passage Guidelines
- Juvenile Fish Passage Compliance based on Actual Design and Installation
- 50-Year Peak Flow Compliance based on Actual Design and Installation

The study focused on the engineering of stream crossings for the likelihood of juvenile and adult fish passage, but did not observe actual fish passage. The study found 77% of the stream crossings were implemented as described in their written plans. Culverts were installed in accordance with the guidelines at 74% of the sites. Seventy-one percent of all the stream crossings had a high likelihood of passing juvenile fish during all periods of flow, based on the installation characteristics as measured in the field. Ninety-five percent of the installations were estimated to pass the ODF-calculated 50-year flow. Culvert installations designed to retain sediment were more likely to succeed than culverts designed to back up water. The monitoring showed the peak flow requirement for stream crossings could still be met when juvenile fish passage is the focus of proper culvert design and placement. The study results were used to update the 1997 fish passage guidelines for desired content in written plans, the use of measuring equipment in the field, and a streamlining of available stream crossing alternatives. Additional monitoring and continued landowner and operator education is needed.

BACKGROUND

Over the past few years much has been learned about how forest road stream crossings such as culverts can impede the passage of fish, especially juvenile fish. Forest roads, a necessary aspect of commercial forest management that provides a transportation network for the removal of timber and access for fire control and recreation, often have stream-crossings, such as bridges, arches and culverts. Landowners, foresters and fish biologists have learned that stream crossings, especially culverts, need to be specifically designed and installed to allow for both the upstream and downstream movement (i.e., passage) of small, primarily juvenile fish.

Unlike adult fish, juvenile fish are limited in their ability to jump and swim, and they require places to rest and conserve energy when navigating through culverts. The upstream movement of juvenile fish is especially important to their life historyóyoung fish move upstream to avoid predators and gain access to necessary feeding and rearing habitat. To provide for the upstream movement of juvenile fish, culverts must be designed and installed to avoid any outlet drops, maintain adequate water depths, and keep water velocities low (Robison et al., 1999). Installing culverts with nearly zero gradient or slope, and incorporating sediment retention designs that utilize rocks and gravel in the culvert, improve juvenile fish passage by simulating natural streambed conditions and reducing water velocities (Figure 2, column b, page 5).

In Oregon, forest landowners and operators are required by law to design and install stream crossings that pass peak water flows AND allow for the passage of both juvenile and adult fish. Oregonís forest protection laws and implementing administrative rules (see sidebar, page 2) require that new or reconstructed stream-crossing installations pass a peak flow that at least corresponds to the

(cont. on page 2)

Oregonís Forest Protection Laws.

Oregonís Forest Practices Act (Oregon Revised Statutes (ORS) 527.610 ñ ORS 527.992) are implemented through a set of administrative rules (Oregon Administrative Rules (OAR) 629 Division 600 ñ OAR 629 Division 680) for the purpose of encouraging economically efficient forest management for timber production. At the same time, it provides basic resource protection for soil, air, water, fish and wildlife resources and scenic resources within designated visually sensitive corridors.

The forest practice rules require that forest landowners or operators notify the State Forester prior to conducting a commercial forest operation on state, private, county and municipal forestland. If an operation is located within 100 feet of waters of the state, landowners/operators must also prepare and submit a written plan (ORS 527.670(3)). A written plan must specifically describe how a forest operation will be conducted to meet the minimum standards for resource protection required by the Forest Practices Act. For example, forest operations subject to the fish passage and flow requirements necessary to protect small, medium or large fish bearing streams often include the construction or re-construction of a road or the replacement of an existing stream crossing structure. The site characteristics (e.g., stream gradient, streambed material, active stream channel width, and depth of streambed material to bedrock) identified in a written plan help determine the appropriate stream crossing alternative to use. Specific requirements for evaluating site characteristics, as well as the choice of alternatives available for use, are found in the Oregon Department of Forestryís technical guidance for fish passage and flow (e.g., ODF 2000(a) and ODF 2002(b)).

(Background, cont.)

50-year return interval. The resulting installation must preclude ponding of water higher than the top of the culvert (OAR 629-625-0320 2a) and allow migration of juvenile and adult fish upstream and downstream during conditions when fish movement in the stream normally occurs (OAR 629-625-0320 2b). Culverts must also be maintained to pass juvenile and adult fish (OAR 629-625-600 8).

The ODF has been developing and updating guidance that explains how landowners can meet their responsibility of ensuring fish passage and providing for peak flows when reconstructing or installing stream crossings. In 1995, a year after the Oregonís forest protection laws were amended to specifically require juvenile fish passage, ODF provided forest landowners detailed guidance on how to design and install stream crossings that would meet the peak flow requirement and pass juvenile fish (Mills and Stone 1995, as updated in Robison 1995). The guidance was further updated through the Oregon Watershed Enhancement Board (OWEB) as part of the Oregon Plan for Salmon and Watersheds (OWEB 1997), in agreement with the Oregon Department of Transportation, the Oregon Department of Fish and Wildlife, the Oregon Department of Agriculture, the Division of State Lands and the Federal Highway Administration. Figure 2 (column a, page 4) summarizes the 1997 guidelines. Based on the monitoring study discussed below, the stream-crossing guidelines were again updated in 1999 (OWEB 1999).The latest guidance (ODF 2002(a), ODF 2002 (b)), further incorporated the monitoring results, collapsing the original seven alternatives into six. Figure 2 (column b) illustrates five of the stream crossing alternatives in use today. (Complete removal of the crossing is not shown here.)

MONITORING STUDY

The ODF conducted a field study to monitor how well stream crossing installations were designed and installed to comply with the law. The rapid pace at which stream crossing guidelines were being developed and updated, combined with increased landowner action to address the fish passage problem, triggered the need to formally monitor whether stream crossings were being installed in accordance with the 1997 guidelines. Ninety-eight stream crossings were randomly selected from ODFís Forest Activities Computerized Tracking System (FACTS) database ñ a database that records forest operations on non-federal lands based on the

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notification requirement in Oregonís forest protection laws (see sidebar). The study sampled operations involving new road construction or re-construction completed during 1998, and which took place within 100 feet of streams.

The study assumed that any one of the following stream crossing types noted below, when properly matched to the site-specific stream characteristics and installed in accordance with key specifications, would have a high likelihood of passing juvenile fish:

1. Bridges and open-bottom arches
2. Bare culverts at or less than half a percent gradient with no outlet drop (i.e., outlet of culvert no higher than stream bottom) and providing for sufficient water depth throughout
3. Sediment retention culvert designs (contiguous streambed material throughout) with no outlet drop
4. Culverts with structures below the outlet that back water up through the entire culvert

The actual design and installation of the culvert alternatives were measured in the field to determine whether key site and design specifications allowing for juvenile fish passage had been met. Any stream crossing found to be consistent with any of the above was considered successful for juvenile fish passage, even if the installation proved to be different from what was specified in the written plan or from the type of installation required by the 1997 guidelines.

All of the visited sites were on fish bearing streams located throughout the forested regions of Oregon (Figure 1). Stream size varied. Bankfull stream widths ranged from one and one-half to 44 feet, with the majority (54%) falling between six and 10 feet. The results of the study are based on the physical conditions of design and installation that are thought to provide for juvenile fish passage. The results are most applicable to stream crossings on industrial forestlands, since this landowner group hosted a majority of the sites visited. For a detailed compilation of the preliminary and final study design and results, see Dent and Allen (2000) and Paul *et al*. (2002).

The study addressed four key monitoring topics:

1) Adequacy of Written Plans
2) Compliance with Fish Passage Guidelines
3) Juvenile Fish Passage Compliance based on Actual Design and Installation
4) 50-Year Peak Flow Compliance based on Actual Design and Installation

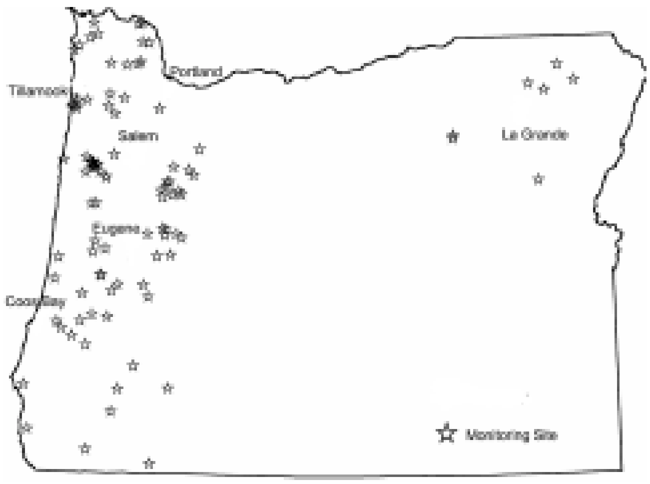

Figure 1

Fish Passage Sample Sites

Location of 98 stream crossing monitoring sites across Oregon that were visited in 1999 and 2000

RESULTS

Adequacy of Written Plans

Seventy-seven percent of the stream crossings were implemented as described in their written plans. Eighty-six out of 98 written plans (88%) contained the necessary information to determine which alternative was being used. For those written plans where it was not possible to determine the intended alternative or stream crossing installation, only 33% had a high likelihood of passing juvenile fish. In contrast, installations with adequate written plan detail had a combined rate of 77% with a high likelihood of passing juvenile fish.

Compliance with Fish Passage Guidelines

Culverts were installed in accordance with the guidelines at 74% of the sites. Only 36 out of the 98 installations (37%) had enough information in the written plan to determine if the installation specifications for the alternative met the specifications in the guidelines. Of these 36 installations, 80% met the guidelines. Of the 62 installations that did not have adequate data included in the plan to evaluate against the guidelines, 47 complied with the guidelines in the field (76%).

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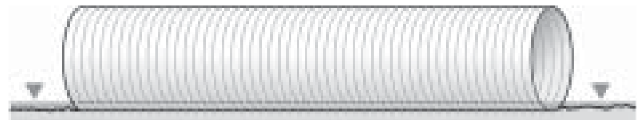
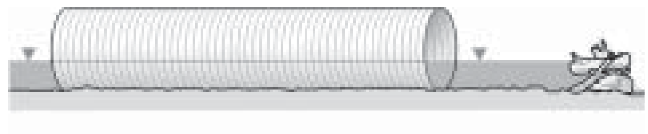
Figure 2: Types of

Column A -- Original culvert alternatives

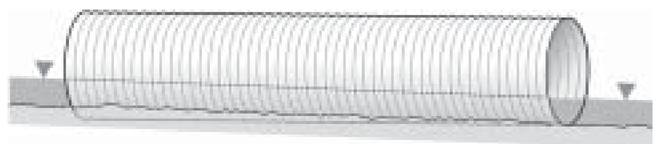
Alternative 1: Culvert with no use of stream channel material. Culvert installed with ≤ 0.5% gradient to achieve low velocities.



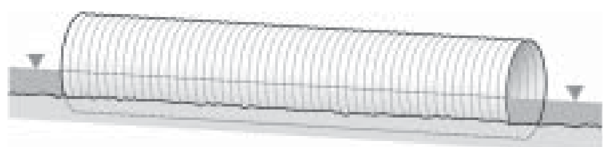
Alternative 2: Culvert placed at/below stream grade with downstream control structure(s) that back up water throughout the culvert.



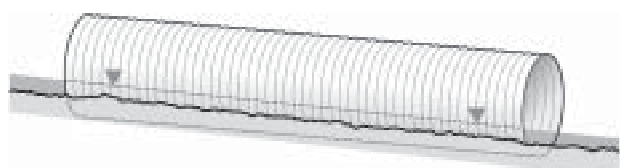
Alternative 3: Culvert partially buried with no use of stream channel material.



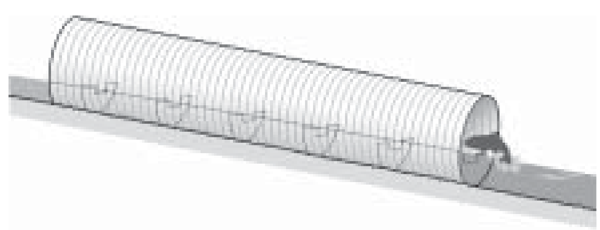
Alternative 4: Culvert partially buried at inlet and outlet to allow some use of stream channel material.



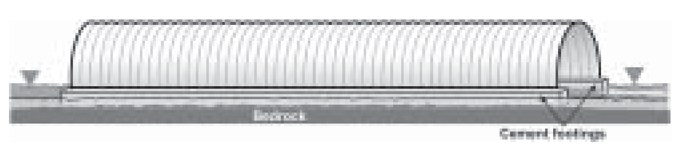
Alternative 5: Culvert partially buried at both ends, but deeper at inlet.



Alternative 6: Baffled culvert--has flow obstructions inside the culvert to increase depth or roughness.



Alternative 7: Open-bottom arch--culvert placed on footings with a natural streambed below.



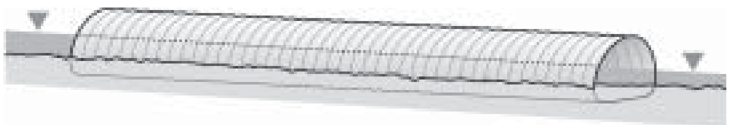
[Based on the results of this monitoring study, bold lines represent how the original alternatives were combined into the recommended alternatives in use today.]

Column B -- stream crossing alternatives recommended today

(Culvert at zero grade has replaced “original” culvert alternatives 1, 2 & 3)

Culvert at Zero Grade

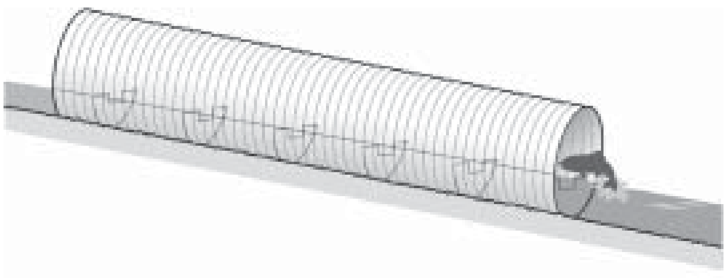
Culvert buried at least six inches, and deeper at the inlet to achieve culvert gradient of $\leq$ 0.5%.



(Streambed simulation has replaced “original” culvert alternatives 4 & 5)

Streambed Simulation

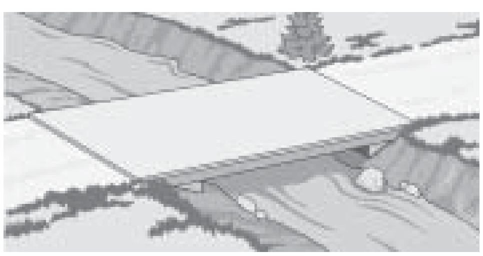
Culvert sunk evenly or deeper at inlet to maintain stream channel material throughout the culvert.



Hydraulic Design

Has flow obstructions inside the culvert to increase depth or roughness. For use only in specialized situations under the direction of a qualified engineer or hydrologist.

(Channel spanning structure (bridge/open arch) has replaced “original” culvert alternative 7)



Channel Spanning Structures - Bridge or Open Arch

Structure spans active stream channel and placed on stable footings. Fish passage not an issue with this design.

Ford

Use larger cobble or bedrock for low traffic conditions on gated roads.

(compliance with fish passage, cont.)

The most common reason for sites not meeting the guidelines was installing culverts at too steep a gradient for the chosen alternative.

The most common reason for the sites not meeting the guidelines was installing culverts at too steep a gradient for the chosen alternative. Specifying the wrong gradient in a written plan increases the chance that a culvert will be placed at the wrong gradient or elevation, potentially preventing fish passage. Specifying the wrong gradient can also result in choosing an alternative that is not appropriate for the specific site characteristics. This holds true whether a written plan overestimates or underestimates the stream gradient.

Juvenile Fish Passage Compliance based on Actual Design and Installation

Seventy-one percent of all the stream crossings had a high likelihood of passing juvenile fish during all periods of flow, based on the installation characteristics as measured in the field. Figure 4 indicates the likelihood of juvenile fish passage decreased when a ìstreambed simulationî strategy (retaining a continuous layer of streambed material throughout the length of the stream crossing) was not used. Partially buried culverts at the inlet had the highest success rate for fish passage (Alternative 3, 93%), followed by culverts embedded at both the inlet and outlet, but deeper at the inlet (Alternative 5, 79%) and then by culverts partially buried at both ends, but not deeper at the inlet (Alternative 4, 71%). Culverts that did not retain or incorporate streambed material (Alternative 1) and culverts with inside flow obstruction to increase depth or roughness (Alternative 6 - baffled culverts) had the lowest success rates, 55% and 25% respectively.

Partially buried culverts at the inlet had the highest success rate for fish passage.

The study showed that stream crossing designs that at least sunk the inlet of the culvert were likely to pass fish, even if they fell outside the 1997 guidelines. Many of the installations monitored using Alternative 3 were successful due to the retention of streambed materials throughout the length of the culvert, even though this was not the intended outcome. For Alternative 3, 4 or 5 sites that stayed within the 1997 guidelines for stream and culvert slope specifications, 92% (23 of 25) had a high likelihood of passing fish, compared to only 60% (6 of 10) of those installations falling outside the slope specifications. Culverts installed at a flat gradient (less than half a percent) and not designed to retain streambed materials were much less likely to pass fish.

50-Year Peak Flow Compliance based on Actual Design and Installation

Ninety-five percent of the installations were estimated to pass the ODF-calculated 50-year flow. Fifty-year flow calculations tended to be overestimated in written plans. As a result, installations consistent with written plans erred by accommodating more flow, not less. Differences between ODF and landowner calculations were attributed to discrepancies in acreage estimations. The five sites with insufficient flow capacity installed a different-sized structure than what was described in the written plan. Had this not been the case, four of the five sites would have met the 50-year flow capacity.

DISCUSSION

Culvert installations designed to retain sediment were more likely to succeed than culverts designed to back up water. Many of these installations were successful because they retained sediment, rather than backwater throughout the length of the culvert, as was the intent of their design. For example, Alternative 3 in Figure 2 has the highest success rate, as 93% of the installations were likely to pass juvenile fish. In many cases, this alternative retained sediment, even though that was not the intent of

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Example of a culvert with proper gradient and sediment retention for juvenile fish passage.

(discussion, cont.)

the design. Not knowing if this unanticipated sediment retention would persist and remain functional over time was one of the reasons Alternative 3 was combined with Alternatives 1 and 2 in the current ODF guidance (ODF 2002(a)). Alternatives 5 and 4 follow, with respective success rates of 79% and 71%. Culvert installations designed to be placed flat (Alternative 1 in Figure 2) were relatively unsuccessful, indicating this alternative is not adequate for passing fish passage.

The study results were used to update the ODF guidelines for written plans, the type of measuring equipment used in the field and various stream crossing alternatives. Landowners, operators, and ODF personnel are still learning how to achieve successful juvenile fish passage at stream crossings. The results of this study advanced Oregonís knowledge by documenting the inherent design and installation complexity of baffled culverts. It has also identified the low success rate of Alternative 1 culverts that are designed to be placed flat (less than half a percent).

By reviewing landownersí and operatorsí written plans and determining how well the plans incorporate current fish passage guidelines, the study revealed just how important it is for them to use specific designs and carefully assess channel characteristics. For Alternatives 3, 4 and 5, which were generally successful due to the retention of sediment, 92% of the installations following the 1997 guidelines were successful, as opposed to only 60% of those that did not. This shows that when the implementation of an alternative complies with available guidelines, it has a substantially higher likelihood of being successful in providing for fish passage. Landowners and operators should use the written plan as a means of incorporating fish passage guidelines into their operations.

The following conclusions helped establish the current update of the 1997 guidelines (ODF 2002(a), ODF 2002(b)).

- Current guidance requires that written plans provide greater detail to identify what the landowner/operator hopes to achieve by referencing a specific guideline alternative and listing the recommended elements (e.g. resulting culvert grade, stream gradient, valley fill) for that alternative.

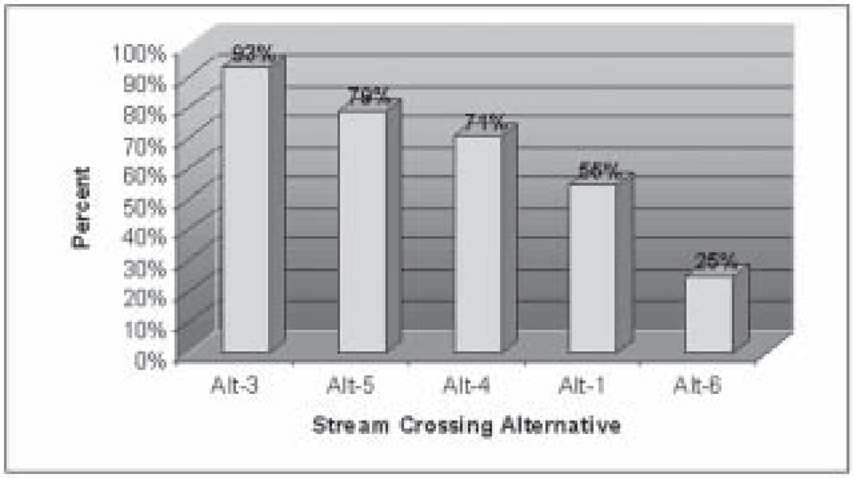
- The guidance now requires the use of a hand level (or similar instrument that can be re-calibrated before each use) and stadia rod (or similar instrument that will allow for an accurate height measurement) for stream and culvert slope measures.

- Specifications for bare culverts were changed to ensure adequate water depths throughout the culvert.

- The construction of weirs (a dam in a stream that raises the water level or diverts its flow) and the use of baffled culverts requires further evaluation from an ODF hydrologist.

Figure 4

Installation success (percent of installations likely to pass juvenile fish) for the range of culvert installation alternatives evaluated. See Figure 2 for a summary of alternatives.



The study focused on the engineering of stream crossings for the likelihood of juvenile and adult fish passage, but did not observe actual fish passage. It is important to keep in mind that sites determined not likely to pass fish might pass some larger juvenile (greater than 2 inches in length) and adult fish under higher flow conditions - periods when fish movement is likely to occur. The study did not address the effectiveness of the 1997 guidelines for actual juvenile fish passage, as fish movement through installations was not monitored.

Additional monitoring and continued landowner and operator education is needed. Continued monitoring is needed to determine the effectiveness of various alternative designs in aiding juvenile fish passage. This should be done by observing actual fish passage. In

(cont. page 8)

(landowner and operator education, cont.)

addition, ODF should conduct a follow-up monitoring study to determine the longevity of the various fish passage installations over time. Maintenance needs of the installations should also be explored to ensure continued fish passage over time.

Future compliance monitoring should include a greater sample size on non-industrial forestlands, as there are some important differences in available resources between industrial and non-industrial forestland owners that could influence their ability to successfully install stream crossings. The Oregon Department of Forestry, working closely with Oregon State University Extension Service and the Oregon Forest Resources Institute, should continue to provide training on stream crossing fish passage and flow requirements for landowners, operators and ODF personnel. Training on the guidelines needs to include the field methods for measuring stream and other needed site parameters so that landowners and operators have the best information to choose the appropriate alternative for fish passage.

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Recommended Reading

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Contact Jim Paul, ODF Hydrologist,
if you'd like to obtain a copy of the scientific studies above.
jpaul@odf.state.or.us, (503) 945-7200

“Enlightening Dialogues”

Dr. George Ice,
Principle Scientist,
National Council for Air & Stream Improvement (NCASI), Corvallis, OR

In what ways have you interacted with ODF’s monitoring staff?

I am a Certified Professional Forester (Society of American Foresters) and Professional Hydrologist (American Institute of Hydrology) directing the National Council for Air and Stream Improvement (NCASI) Forest Watershed Program. The mission of NCASI is to assist the forest products industry in meeting its environmental goals. The monitoring work carried out by ODFís monitoring staff represents a highly significant source of information about the effectiveness of Oregonís forest practices rules and their implementation rate.

I have served on technical advisory committees for a number of ODF monitoring projects and rules development efforts. I am currently serving on the team reviewing the Riparian Function and Stream Temperature (RipStream) study. I have also provided technical comments on a number of ODF monitoring staff reports including ODF Final Report, Storm Impacts and Landslides of 1996. In addition, I am currently a member of the board of the Oregon Headwater Research Cooperative (OHRC), which is working with ODF to better understand headwater forest streams, their functions, and response to forest management. I recently co-authored a paper in the Journal of Water, Air, and Soil Pollution Focus on BMP monitoring and research in the western United States (Ice et al. 2004). ODF research and monitoring was highlighted in that article.

Why do you feel ODF’s Monitoring Program is important?

One of my responsibilities with NCASI, and as past chair of the SAF Water Resources Working Group, is to synthesize our understanding about the effectiveness and rate of compliance with state Best Management Practices (BMPs) nationwide, including the Oregon Forest Practices Act (FPA) Rules. As an example, I recently helped the National Association of State Foresters summarize the status of state nonpoint source (NPS) control programs (Ice and Stuart 2001). Iím currently working with the University of Georgia to redesign, update, and complete the usabmp.net web site that summarizes state BMPs and silvicultural NPS control programs (Jackson 2003). The ODF monitoring program is one of the best, if not the best, programs in the nation, providing cost-effective, well-designed monitoring of both BMP effectiveness and compliance. Until recently most people have felt that states with regulatory NPS control programs based on forest practices acts should have very high compliance rates and that monitoring of compliance was not warranted. We find that all assumptions about program and practice effectiveness are being challenged by various interest groups. The transparent monitoring conducted by ODF has provided quantification of compliance rates. The targeted monitoring of significant effectiveness questions has provided timely information to ongoing debates about shade and wood recruitment requirements, culvert impacts on fish passage, landslide rates, and chemical applications.

What do you believe ODF’s monitoring priority areas should include?

Most of the research on forest streams has been for fish bearing streams (type F) that probably would be classified as small or medium type F streams. The OHRC has targeted research to understand headwater streams that are often not fish bearing streams but that may be important for amphibian or other aquatic organism habitat and as part of the connected stream network. The practical significance of these headwater streams is that they compose 70 to 90% of the length of the stream network, so regulations on these streams can have tremendous impacts on economic viability and biological communities. The ODF approach has been to focus on specific FPA rule questions to provide as precise an answer to questions as possible. We now see a watershed cooperative at Oregon State University beginning to address the effectiveness of current FPA rules across the board. These two approaches (focused rule test versus all rules watershed-scale test), in conjunction with the OHRC efforts, provide a really powerful monitoring and research effort for Oregonís forested watersheds.

What do you feel are the strengths of ODF’s Monitoring Program?

ODF monitoring is designed with testable hypotheses on focused questions. Sometimes this can be upsetting when we want all the answers immediately. For example, the monitoring design might not be able to answer whether current riparian buffers during aerial chemical spray operations are effective in protecting small type N streams (non-fish bearing), but the monitoring can answer with as much certainty as possible that medium and large type F streams are not experiencing frequent and high concentrations of chemicals. The monitoring is targeted at the key resource questions, given the limits on staff and funding. Through the use of technical advisory committees and excellent use of the World Wide Web, the ODF monitoring program is transparent about its priorities, monitoring approaches, and conclusions.

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(Ice, cont.)

How could ODF's monitoring efforts be improved?

The ODF Monitoring Program seems to be a highly efficient program. It is well respected by the forestry community. Monitoring program information has been readily accessible on the Web. The recent redesign of the Oregon Department of Forestry website has created some difficulty in accessing ODF monitoring program products.

ODF monitoring program staff has also recognized the need to ask ìbiological significanceî questions to better answer policy questions with monitoring findings. Just because we can detect a 0.5∫C change in the 7-day moving average of the daily maximum stream temperature doesnít allow decision makers to assess the significance of that change. What would be the biological significance of the change to coho salmon? What concentrations, exposure timing, and duration of exposure cause lethal or sublethal effects to salmon or other aquatic species? What concentrations, exposures times, and durations avoid impacts? We need improved information about these performance measures if we are to improve monitoring designs (design to determine conditions where significant effects can occur) and support the Board of Forestry as it makes decisions.

Reference

Ice, G.G., and Stuart, G.W. 2001. 2000 progress report: State nonpoint source pollution control programs for silviculture sustained success. Washington, DC: National Association of State Foresters.

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Jackson, B.D. 2003. USABMP.NET-National website for forestry nonpoint source pollution control information. In Total Maximum Daily Load (TMDL) Environmental Regulations II. 249-253. American Society of Agricultural Engineers, St. Joseph, Michigan.

Do You Have An Enlightening Dialogue?

Peer reviews and feedback from major stakeholders help ensure that ODFís monitoring work is scientifically credible.
We want to hear YOUR comments, concerns and questions.
Contact: Jim Cathcart, ODF Acting Forest Health & Monitoring Manager
jcathcart@odf.state.or.us, (503) 945-7493

Nature will bear the closest inspection. She invites us to lay our eye level with her smallest leaf, and take an insect view of its plain.
—Henry David Thoreau, Naturalist (1817-1862)

Oregon Department of Forestry
Private & Community Forests Program
2600 State Street
Salem, OR 97310