

# Executive Summary

## Oregon Department of Forestry: Fish Passage and Peak Flow Requirements at Stream Crossings 1998 Pilot Study Results

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### INTRODUCTION

The emphasis on fish passage through culverts, especially juvenile fish passage, has grown in importance over the last five years as the number of salmonids on the endangered species list has

***Forest practice rules require that stream crossings be installed and maintained to pass a 50-year peak flow and to pass juvenile fish. (OAR 629-626-320).***

grown. Peak flow capacity of stream crossings has also been emphasized as the Pacific Northwest experienced flows of record on numerous streams in the late 1990's. The forest practice rules require that stream crossing installations pass a peak flow that at least corresponds to the 50-year return interval (OAR 629-625-320 2a). The resulting installation must also allow migration of adult and juvenile 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 (629-625-600 8).

The forest practice rules provide no specific information as to how to provide fish passage or pass the 50-year peak flow. However, the Oregon Department of Forestry (ODF) has issued guidelines describing how to design stream crossings to allow for adult and juvenile fish migration and to accommodate a 50-year peak flow. Traditionally, stream crossing designs sought to maximize the speed and efficiency of water and debris passage with the smallest and least expensive structure. Changing from this to designing culverts that provide the low-velocity environment needed to allow upstream movement of juvenile fish is a dramatic paradigm shift.

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### MONITORING GOALS AND OBJECTIVES

It is the responsibility of ODF to monitor the effectiveness and implementation of forest practice rules. The ODF forest practices monitoring program implemented a project to monitor compliance

with stream-crossing rules and guidelines on non-federal forestland. The monitoring project is a three-year project designed primarily to look at how the department, landowners and operators are implementing the forest practice rules and guidelines at stream crossings. The overarching goal of compliance monitoring is to determine if adjustments to program administration are needed. For example, the project may reveal areas where forest practice rule language can be clarified, administration of the rules can be improved, or where additional education and training is needed.

The first year of the monitoring project was used to implement a pilot study. The main objectives of the 1998 pilot study were to:

- Test and refine the efficiency and effectiveness of site-selection and data collection protocols developed to address the stream-crossing monitoring questions.
- Provide preliminary data to answer the monitoring questions (below) on compliance with stream-crossing rules and guidelines.

Results from the 1998 pilot study were used to improve the site-selection and data-collection protocols. They were also used to calculate the sample size needed to estimate compliance, with 95% confidence, within  $\pm 10\%$ . Over the next two years, the final version of the stream crossing

***Over the next two years the final version of the stream-crossing BMP compliance monitoring project will be implemented on 100 sites.***

compliance monitoring project will be implemented on 100 sites, and a final report will be available in 2001.

What follows is a description of the key monitoring questions, study design and results from the pilot study. The monitoring questions will remain the same for the finalized version of the study.

### KEY MONITORING QUESTIONS

The key questions that this study is designed to answer include:

1. *What percent of stream crossings are in compliance with their written plans?*
2. *What percent of stream crossings have a high likelihood to pass juvenile fish?*
3. *What percent of stream crossings have been designed and installed in accordance with ODF guidelines?*
4. *What percent of stream crossings have been designed and installed with adequate capacity for a 50-year flow?*

## STUDY DESIGN

At each stream crossing site, the structure (bridge, culvert or ford) was evaluated for compliance with the written plan, likelihood to pass juvenile fish, and capacity of the crossing to pass a 50-year stream-flow event. A description of the site selection process, and field methods follows.

### Site Selection

The focus of this project was to monitor stream crossings installed in 1996 or 1997 that had the potential to affect fish passage. A 1998 query of the Forest Activities Computerized Tracking System (FACTS) database identified 1505 road-construction sites that met the initial criterion for the pilot study. A random selection of 150 sites was taken from the 1505 crossings. Only 37 of the 150 sites were suitable for the study. Due to time constraints a second random sample of the 1505 crossings was not performed. Instead, 20 more sites were volunteered by landowners and FPF's for a total sample of 57 stream crossings on fish-bearing streams.

*For the pilot study, 57 sites were selected and surveyed to monitor compliance with rules requiring fish passage and adequate capacity for the 50-year peak flow event.*

### Field Methods

The stream crossing field protocol was designed to assess if structures were installed in compliance with written plans and current technical guidelines regarding adult and juvenile fish passage. At each crossing a number of parameters were measured including: structure type and dimensions, culvert gradient, culvert outlet drop, design and depth of countersinking, outlet mitigation design and dimensions, sediment retention patterns within culverts, valley and channel conditions, baffle/weir design and dimensions, and the cross-sectional area under bridges. These data were evaluated against both the written plan and the technical guidelines to assess compliance.

The likelihood of fish passage was rated as low or high for each site based on an analysis of the field data.

The following conditions were assumed to provide for adult

and juvenile fish passage: use of bridges and open-bottom arches, culverts installed at  $\leq 0.5\%$  gradient with no outlet drop, stream-simulation (sediment retention) culvert strategies with no outlet drop, culverts with baffles or weirs (engineered designs) and no outlet drop, or culverts with backwatering from outlet mitigation structures.

*A crossing was assumed to have a high likelihood of passing juvenile fish under the following conditions:*

- *a bridge or open-bottom arch was used*
- *culvert gradient was  $\leq 0.5\%$  with no outlet drop*
- *culvert achieved stream-simulation (sediment retention)*
- *culvert with baffles or weirs and no outlet drop*
- *culvert backwatered by outlet mitigation structure*

## RESULTS

The results presented in this paper are based on the pilot study. Since the pilot study sample was not entirely random and was a small sample (57

*The results presented in this paper are based on the pilot study, may not be representative and cannot be considered statistically reliable.*

crossings) the findings may not be representative and cannot be considered statistically reliable. Results from the larger random sample will confirm or reject pilot study findings with statistical validity. While the pilot study is not statistically reliable, the findings are reported here to assist landowners, operators and ODF towards greater success in implementation of fish-friendly stream crossing strategies.

### **Monitoring Question #1**

*What percent of stream crossings were in compliance with the written plans?*

The results indicate that 78% of the random sites were in compliance with their written plans. However, only 74% contained enough information in the written plans to determine installation

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***However, only 29% had sufficient detail for complete analysis, suggesting a need for increased emphasis on detailed written plans.***

objectives, and only 29% of the plans had sufficient details for a complete evaluation against the guidelines. These results suggest a need for increased emphasis on detailed written plans. The written plan is an important tool for department personnel to use when determining compliance, assessing the soundness of the operation proposal, and evaluating the effectiveness of proposed guideline alternatives.

### **Monitoring Question #2**

*What percent of stream crossings have a high likelihood to pass juvenile fish?*

Based on the conditions assumed to provide juvenile fish passage, only 59% of the random sites have a high likelihood to pass juvenile fish, while 80% of the volunteered sites are highly likely to pass juvenile fish. The overall average is approximately 67%. With such a small sample size caution should be used in trying to apply these numbers to the total population of new installations.

The most common barriers to fish passage included culverts installed at too steep of a grade and drops at the outlet.

***Based on the conditions assumed to provide juvenile fish passage, an average of 67% of stream crossings had a high likelihood to pass juvenile fish.***

***Most common barriers to fish passage included culverts installed at too steep of a grade and drops at the outlet.***

Despite the small sample size, the study does highlight four important points.

The juvenile fish passage guidelines have only been available for about five years and have been revised three times.

The stream-crossing alternatives designed to provide adult and juvenile fish passage are relatively new compared to other forest practices.

Improved communication between landowners, operators and ODF personnel via detailed written plans may improve success.

There is still a need for training regarding juvenile fish passage issues.

### **Monitoring Question #3**

*Have stream crossing structures been designed and installed according to ODF juvenile fish passage guidelines?*

Design of the crossing was considered by evaluating the written plan. Sixty-nine percent of the written plans designed for an installation that would have met the guidelines. The most common problem was that written plans proposed to install culverts steeper than recommended in the guidelines for the particular alternative.

The actual installation was evaluated from the field data. Fifty-two percent of the sites actually installed culverts in accordance with the guidelines. The most common reasons for sites not meeting the guidelines were for installing culverts at too steep a gradient for the chosen alternative and for selecting an alternative that was inappropriate for the channel gradient. Additional issues included outlet drops, culvert length, and installing culverts at gradients substantially less than the channel gradient.

***69% percent of the written plans designed for an installation that would have met the guidelines and 52% actually installed the crossing in accordance with the guidelines.***

***The most common problems were planning and installing a culvert too steep or choosing an installation design that was inappropriate for the channel gradient.***

### **Monitoring Question #4**

*What percent of stream crossings have been designed and installed with adequate capacity for a 50-year flow?*

Design of the crossing was considered by evaluating the written plan. Compliance with the 50-year flow calculation provided in the written plan was high (97%), but only 61% (35 out of 57) of the written plans actually contained complete peak flow calculations. Of the 35 written plans with peak flow calculations, 91% (32 out of 35) were considered accurate when compared to ODF calculations. Differences between ODF and landowner calculations were mostly attributable to discrepancies in acreage estimations.

***91% percent of the installations were estimated to pass the 50-year flow as calculated by ODF.***

Actual capacity to pass a 50-year flow was evaluated from the field data. Ninety-one percent (52 out of 57) of the installations were estimated to pass the ODF-calculated 50-year flow. Four out of the five with insufficient capacity did not provide peak flow calculations in the written plan.

## RECOMMENDATIONS

### Monitoring

*Implement Final Version of the Stream Crossing Monitoring Protocol.* ODF has initiated the implementation of this monitoring project on a larger random sample. Fifty sites were visited in 1999 and an additional 50 sites will be visited in 2000. The larger random sample will be used to confirm or reject the pilot study findings and delve into some of the issues that were not adequately addressed with this pilot study.

*ODF should develop methods to monitor the effectiveness of the alternatives to pass juvenile fish.* Current guidelines apply scientific knowledge about biological needs to culvert design. The assumptions are that (1) current guidelines accommodate juvenile fish physical limitations and that (2) passage can be provided if the physical needs (e.g. stream velocity, jumping heights) of the juvenile fish are met. These assumptions need to be tested in the field.

*ODF should develop methods to monitor maintenance issues associated with these fish-friendly stream crossings.* The guidelines propose designs to pass juvenile and adult fish and the 50-year flow, but still in question is how long they will last and what kind of maintenance program is required to assure fish passage and capacity for the design flow over time. These kinds of issues need to be monitored to determine the durability, longevity and maintenance issues with fish-friendly culverts.

### Policy

There is no indication at this point that the Forest Practices policies need to be changed. The FPA requires that juvenile fish passage is provided on all fish-bearing streams. The ODF guidelines represent the cutting edge of what is understood about juvenile fish needs and the ability to provide stream-crossing conditions that meet those needs. However there are three recommendations which may improve the program delivery:

*Increase the consistency and the amount of information that is exchanged between the department and the landowner in written plans for stream crossings.* Written plans should provide greater detail on what is trying to be achieved by referencing a specific guideline alternative (e.g. alternative 7: open bottom arch) and listing the recommended elements (e.g. resulting culvert grade, stream gradient, valley fill depth) for that alternative.

#### ***Recommendations:***

##### ***Monitoring***

***Develop methods to monitor effectiveness and maintenance***

***Improve administration of the current rules and guidelines***

***Increase awareness of current guidelines by placing summaries in official ODF guidance manual.***

***Increase detail in written***

*Refine the Forest Practice Rule and Statute Guidance Manual.* The ODF Guidance Manual is a document used by department personnel and available to the public, which provides greater detail on how rules should be implemented. A summary of both the necessary written plan data and the fish passage alternatives should be included in the guidance manual. Increased written plan detail would increase the ability of the forest practice forester, the ODF hydrologist and landowners to judge if the strategy is appropriate for the particular stream and to more accurately determine compliance.

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The stream crossing compliance monitoring pilot study and executive summary reports were prepared by forest practices monitoring program staff: Liz Dent and Marganne Allen.

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