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Chapter 7

Fish Passage

7-1 Introduction

Most rivers and creeks in Washington State contain one or more species of fish during all or part of the year. These fish must be allowed to freely migrate up and down the stream they occupy. If roadways are constructed across the stream without thought given to fish passage, the roadway can create a migration barrier. However, a correctly designed stream crossing will not hinder migration of fish. The WSDOT and the WDFW have been evaluating existing stream crossing through a cooperative Fish Passage Barrier Removal Program since 1991. Some of the fish barriers have been identified for repair and of those a few have been retrofitted and/or replaced. Prior to starting a project, designers should consult the following web link to determine if their project contains a known fish barrier.

(http://www.wsdot.wa.gov/environment/fishpass/state_highways.htm)

The Washington State Department of Fish and Wildlife (WDFW) developed guidelines for permanent road crossing culverts to facilitate upstream fish migration titled 'Design of Road Culvert for Fish Passage'. The guideline provides direction for projects involving new culvert construction as well as retrofitting or replacing existing culverts.

The purpose of this chapter is to summarize the WDFW design approaches, note the type of structures recommended and reference grade control. For guidance, designers should consult the WDFW guideline at the following web page:

(<http://www.wdfw.wa.gov/hab/engineer/cm/>). Questions should be directed to the Region Hydraulics Engineers.

7-2 Designing For Fish Passage

7-2.1 General

The basic concept used to ensure continued fish passage is to design the stream crossing to match the natural river or creek channel as much as practical. The idea being if fish migration occurred in the crossing, then migration should continue after construction (in other words post construction flow conditions should be similar to pre-construction or natural flow conditions). For some types of crossing structures, it is easy to create flow conditions exactly like the natural flow conditions, but for other

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types of crossing structures, a detailed analysis is necessary to accomplish an acceptable design. The first step in designing for fish passage is to determine which, if any, species of fish are in the stream. WSDOT Regional Environmental staff is the primary contact for this information and will contact the WDFW when necessary. The design criteria varies depending on the species of fish since the swimming and leaping ability of fish varies from species to species. Additionally, different species migrate through the stream during different times of the year, and as a result, the design flow used for the analysis must correlate with the time of year that the fish are migrating.

7-2.2 Types of Structures

For fish passage purposes, there are three basic types of stream crossing structures:

1. **Bridges** - Structures that have piers or abutments supporting some type of girder system. Bridges do not have a significant impact on fish migration and are the preferred method of spanning a body of water. HQ Hydraulics is responsible for all water elements concerning bridge design.
2. **Open Bottom Culverts** - Metal and concrete arches or three sided concrete frame structures that have no floor and are supported by footings.
3. **Full Culverts** - Metal, concrete, and plastic round, pipe arch, elliptical, and box-shaped culverts that are completely enclosed self supporting structures.

7-2.3 Culvert Design Approach

Adequate fish passage for open bottom or full culverts can be determined using 3 different design options:

1. **No-Slope Design Option** – Results in reasonably sized culverts without requiring much in the way of calculations. It is most effective for relatively short culverts at low-gradient sites. Culverts are typically larger than the hydraulic option, however the design avoids the additional cost of surveying and engineering.
2. **Stream Simulation Design Option** – Results in an artificial stream channel that is constructed inside the culvert, thereby providing passage for any fish that would be migrating through the reach.
3. **The Hydraulic Design Option** – Requires hydrologic and open-channel hydraulic calculations and specific site data, but usually results in smaller culverts than the no slope option. The analysis is based on velocity, depth and maximum turbulence requirements for a target species and age class.

In eastern Washington when the Hydraulic Option is selected, WDFW recommends the Research Approach developed by E. R. Rowland. This approach defines fish passage design per unit drainage area and regional maps can be found on the HQ Hydraulic Web page:

(<http://www.wsdot.wa.gov/eesc/design/hydraulics/fishpassage.htm>) Or, in ArcMap under the Environmental Workbench; Fish and Wildlife; Fish.

In addition to consulting the WDFW guidelines designers can reference the following WSDOT research documents developed for the Hydraulic Design Option:

- a. Modeling Hydrology for Design of Fish Passage (WA-RD 545.1).
- b. Culvert Design Flows for Fish Passage and Structural Safety in East Cascade and Blue Mountain Streams (WA-RD545.2).

7-2.4 River Training Devices

River Training Devices can also be used for fish passage as well as to protect streambanks by redirecting the flow away from the bank towards the center of the channel. The most common types of devices are made of rock, timber or concrete and reach from bank to bank. Designers should consult Chapter 4 for further design guidance.

WDFW has also developed guidelines for managing streambanks titled 'Integrated Streambank Protection Guidelines', located at the following web link:

(<http://www.wdfw.wa.gov/hab/ahg/ispdoc.htm>). Designers should direct questions to the Region Hydraulics Engineer.