Wakefield Creek
Culvert Replacement & Head-cut Control

Nicholas Testa
Oregon Department of Transportation

Laura Herbon
WALKER MACY
Landscape Architects

Project Context
Wakefield Creek Drainage

- Watershed Size: 2.25 Km²
- Fish Usage: Coastal Coho & Cutthroat Trout
- Landuse: Forestry

Aerial View of Wakefield Culvert during construction and Upstream Habitat. Also shown are work bridge, new and old Highways.
Biological Objectives

- Provide Improved Spawning & Rearing Habitat
- Increase Riparian & In-stream Function
- Improve Creek/Floodplain Interaction
- Restore Fish & Wildlife Passage

Pre-construction Inlet Condition
Wakefield Creek Information

- Creek Discharge: Average Annual Flood 60 cubic ft. sec. (1.7 cubic m/sec)
- Average Slope of Creek through Project Area: ~ 3.3%
- Bankfull Channel Width: 6.6-9.8 ft. (2-3 m)
- Bankfull Depth (Ave.): 2.6-4.6 ft. (0.8m to 1.4 m)
Wakefield Creek Culvert: Hydraulic Data

<table>
<thead>
<tr>
<th>Existing Culvert</th>
<th>Hydraulic Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Design Flood</td>
</tr>
<tr>
<td></td>
<td>Units</td>
</tr>
<tr>
<td>Recurrence Interval</td>
<td>Design Flood</td>
</tr>
<tr>
<td>Discharge (ft/s)</td>
<td>148</td>
</tr>
<tr>
<td>Average Velocity @ Culvert Outlet (ft/s)</td>
<td>16.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposed Culvert</th>
<th>Hydraulic Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Design Flood</td>
</tr>
<tr>
<td></td>
<td>Units</td>
</tr>
<tr>
<td>Recurrence Interval</td>
<td>Design Flood</td>
</tr>
<tr>
<td>Discharge (ft/s)</td>
<td>148</td>
</tr>
<tr>
<td>Average Velocity @ Culvert Outlet (ft/s)</td>
<td>3.6</td>
</tr>
</tbody>
</table>
Design Considerations

Solution
Headcut Control Design Objectives

- Stabilize Downstream Grade
- Prevent Headcut
- Maximize Downstream Length
- Match Upstream Creek Sinuosity
- Convey 50-Year Flood Event
- Concentrate Low Flow into Channel
- Stabilize Soils & Revegetate w/ Native Plants
NOTES:

1. The grade across the flood plain should be varied to provide a natural effect.
2. Large rocks shown only.

CHANNEL CROSS SECTION
ROCKS PLACED WITHIN 2M OF THE CHANNEL EDGE SHOULD BE PLACED IN IRREGULAR ROWS THAT ARE ANGLED UPSTREAM. MEDIUM AND SMALL ROCKS SHOULD BE USED TO GIVE STABILITY TO LARGE ROCKS. SEE "ROCKS IN CHANNEL" DETAIL THIS SHEET.

ROCKS ON CHANNEL EDGES
Construction
Completed Channel Construction

Spring Following Construction – April 2000
One Year Later – July 2001
Three Years Later – October 2003
High Flow Condition – December 2003
Average Velocity

<table>
<thead>
<tr>
<th>Transect</th>
<th>Ave Depth (ft) Of Samples</th>
<th>Top</th>
<th>Mid</th>
<th>Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transect A (below culvert)</td>
<td>1.20</td>
<td>1.70</td>
<td>0.80</td>
<td>0.35</td>
</tr>
<tr>
<td>Transect B (below culvert)</td>
<td>0.45</td>
<td>3.10</td>
<td>3.00</td>
<td>2.25</td>
</tr>
<tr>
<td>Transect C (inside culvert)</td>
<td>0.46</td>
<td>2.10</td>
<td>1.90</td>
<td>1.20</td>
</tr>
<tr>
<td>Transect D (in culvert)</td>
<td>0.56</td>
<td>1.30</td>
<td>1.10</td>
<td>0.50</td>
</tr>
<tr>
<td>Transect E (above culvert)</td>
<td>0.76</td>
<td>1.90</td>
<td>1.60</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Number of Samples = 45

ODFW Velocity Guidelines for Juvenile Salmon
- 2ft/sec over 60 ft distance (without rest)
- Transect Spacing 25 ft
Wakefield Creek Entrenchment Ratio

Transect B: Upstream of Culvert (unaltered Channel) Control

• BFW = 4.9m, FPW = 26m,  \( E = \frac{FPW}{BFW} \) = 5.3  Not Incised

Transect A: Downstream of Culvert (reconstructed channel)

• BFW = 2.4m, FPW = 11.5m,  \( E = \frac{FPW}{BFW} \) = 4.8  Not Incised

Coho Redds In Wakefield Culvert
Adult Coho Salmon Above Culvert

Oregon Coast Coho
6 Spawning Adult Fish
Observed

Juvenile Cutthroat & Coho
Project Summary

- Successful Collaboration Between ODFW, ODOT & Walker Macy
- Restored Fish & Wildlife Passage
- Resolved the Unanticipated Head-cut Issue Discovered at New Culvert
- Spawning & Rearing Opportunities Improved in the Lower Watershed
- Riparian & In-Stream Functions Improved

Wakefield Creek
Culvert Replacement & Head-cut Control

Nicholas Testa
Oregon Department of Transportation

Laura Herbon
WALKER MACY Landscape Architects