

## Culvert, Bridge, and Channel Restoration Design

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The state of Washington Department of Natural Resources (DNR) manages approximately 15,000 miles of logging roads on about 2 million acres of state-owned trust lands. Over 10,000 stream crossings are associated with the DNR road system. To promote successful designs for culverts, bridges, fords, and channel restoration projects, WEST Consultants, Inc. was contracted to help the DNR develop required training materials and conduct three 5-day hydraulic engineering training courses for DNR forest engineers and scientists.



The developed training materials included:

- Hydraulic Engineering Training Course Notebook
- A presentation on the design of stream simulation fish passage culverts by personnel of the state of Washington Department of Fish and Wildlife
- Hydraulic Design Guidance Manual
- Lectures on hydrologic and hydraulic design methods
- Lectures and demonstrations of hydraulic analysis using HEC-RAS and WinXSPRO
- Four computer-based workshops on the use and application of the HEC-RAS hydraulic analysis program were developed. This included:
  1. Creating plans with HEC-RAS
  2. Modeling culverts and bridges with HEC-RAS
  3. Steep-Culvert Design
  4. Dual Culvert Design
- Erosion and scour analysis techniques
- Stream instability and scour countermeasure design
- Riprap design methods
- Bioengineering design

**Project Owner:**

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