

simulation, no slope, and hydraulic design with culvert retrofit) is the most cost effective and practical way to help design and correct an estimated 1,500 WSDOT culverts needed to be fixed over the next 15 to 20 years.

What are the options?

WSDOT is asking for your help to identify where we can get support to continue research and operation of the CTB. The following is the course of action WSDOT is presently pursuing:

1. WSDOT is in current negotiations with PNNL to discuss their interest in leasing the facility. PNNL would solicit customers to utilize the CTB. WSDOT would have access to the testing data and the PNNL's customers would help pay for the maintenance and upkeep of the facility. This option would require that WSDOT continue to pay to lease the facility from WDFW.
2. WSDOT is conducting outreach to CTB partners to try and generate interest in continued research at the facility. A user fee could be charged to pick up the costs to operate the facility.
3. WSDOT could invest some funds in the facility to attract research opportunities through 2009. For example, the University of Washington and Washington State University are interested in student studies in hydraulics and fish behavior. PNNL is also interested in continuing their scientific work, if funds were available. We estimate \$168K for the rest of 05-07 and \$300K for 07-09 to operate and perform research at the CTB.

4. WSDOT could demobilize the CTB if research opportunities are not found. This is an obligation in the existing WSDOT/WDFW permit agreement. This option is considered a last resort and we would like to thoroughly exhaust all research questions through testing at the CTB before demobilization.

We'd like to hear from you

WSDOT is open to suggestions from its partners as to how to proceed next. What is the most valuable research that you think could be performed at the CTB in the next one or two years?

We would like to hear your thoughts on the future of this facility and research funding opportunities you may be aware of. Please contact Jon Peterson, of the Environmental Services Office, at peterjn@wsdot.wa.gov with your comments.



Various shapes and sizes of flumes were tested.

On the Web: To view culvert test bed research studies, visit our Web site at: www.wsdot.wa.gov/environment/fishpass/state_highways.htm#fish

Contact information

Jon Peterson
 Fish Passage Coordinator
 Environmental Services Office
 Washington State Department of Transportation
 310 Maple Park Avenue SE
 P.O. Box 47331
 Olympia, WA 98504-7331

phone: (360) 705-7499
 e-mail: peterjn@wsdot.wa.gov



WSDOT Culvert Test Bed

Increasing Fish Passage through Design of Fish-Friendly Culverts



The Department of Transportation (WSDOT) owns and maintains a Culvert Test Bed (CTB) facility designed for scientists to study how fish move through differently sized culverts.

IT WAS INTENDED THAT THE DATA COLLECTED from experiments conducted at the facility would be used by WSDOT and others to help design fish friendly culverts that increase fish passage for a variety of adult and juvenile fish. The CTB was constructed at a state owned fish hatchery and WSDOT leases property at the site in order to use the water and fish from the hatchery in experiments conducted at the facility. Several states and agencies were very interested in seeing the CTB constructed and provided money and support to implement the project. WSDOT is requesting your input on the future need and support of the CTB. The following Question and Answer format is intended to provide information on the facility and some of the difficult decisions WSDOT is facing regarding its future.

Why Create a Culvert Test Bed?

This unique facility, the only one like it in the world, allows for experiments and observations of juvenile and adult fish moving through culverts under variable conditions that can be utilized to design better and more cost effective fish passage projects.

In 2003, WSDOT in partnership with California, Oregon, Alaska, Federal Highway Administration (FHWA), the Pacific Northwest National Lab (PNNL), and the Washington Department of Fish and Wildlife (WDFW) constructed

the CTB at the Skookumchuck Fish Hatchery (located SE of Olympia, Washington) at a cost of over \$1 million dollars using pooled funds. The FHWA sponsors the Transportation Pooled Fund Program as a means for interested States, FHWA, and other organizations to partner when significant or widespread interest is shown in solving transportation-related problems. We are actively seeking continued funding of this pooled fund study (SPR-3(096)) from other interested parties.





How far along is the testing program?

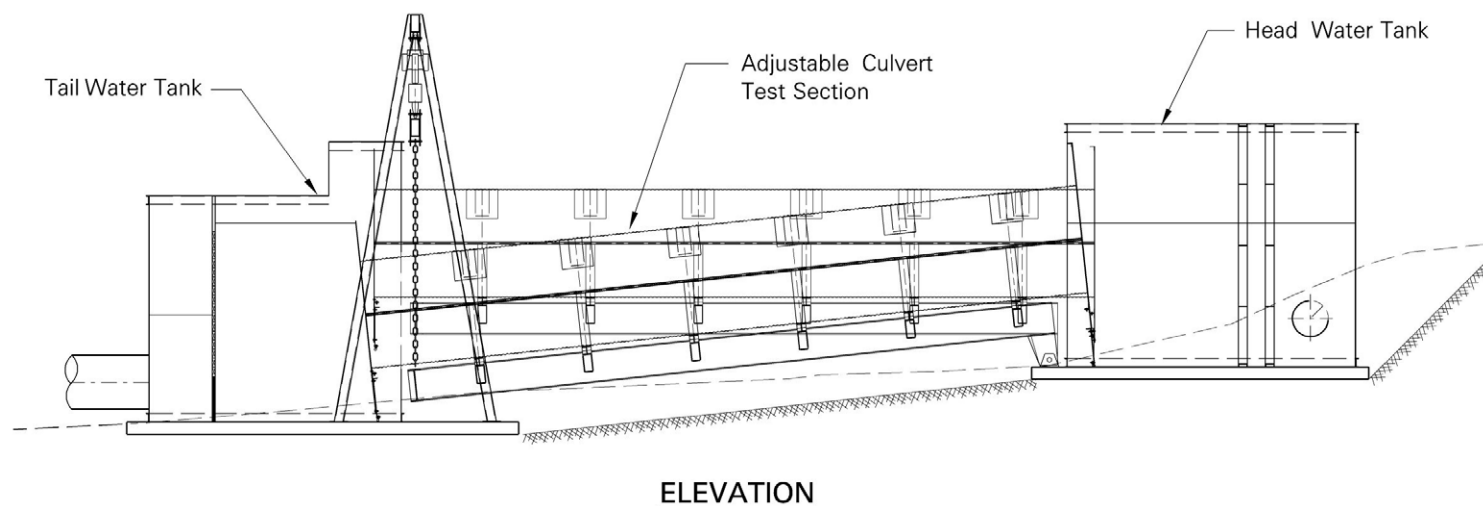
A five year scientific testing plan was developed with the Pacific Northwest National Lab but there are currently no funds available to continue testing. Two years of the testing plan has been completed with funding provided by the pooled fund, the WSDOT Research Office and a grant from FHWA. The latest round of testing was conducted using the culvert-baffle configuration recommended by WDFW to enhance upstream adult salmonid passage. What kind of passage success is achieved for juvenile salmon with the WDFW standard baffle was the question that was addressed with this most recent testing. The overall research at the CTB has the potential to save millions of dollars over the next few decades by the partners and others in fixing or retrofitting their fish passage barriers. There are a number of other scientific inquiries that could be performed using the test equipment if further funding is found.



Hydraulic testing of baffles in 2006.

What are the CTB's Capabilities?

1. Interchangeable 40' culverts – 2' round, 3' round, 6' round, 81" pipe arch & 60" box available
2. 0 to 20 cubic feet per second (cfs) hydraulic capacity
3. Slope adjustable up to 10%
4. Adjustable tail water elevation
5. Fish friendly passage, release, and capture
6. Multiple camera video monitoring & digital recording system including IR lights for night video
7. Acoustic Doppler instrumentation to allow fine-scale measurements of hydraulic conditions



What Studies Have Been Performed?

The following report citations document scientific research that has been conducted at the CTB facility to date.

Pearson, W.H. et al, *Protocols for Evaluation of Upstream Passage of Juvenile Salmonids in an Experimental Culvert Test Bed*, Battelle Marine Sciences Laboratory, May 2005

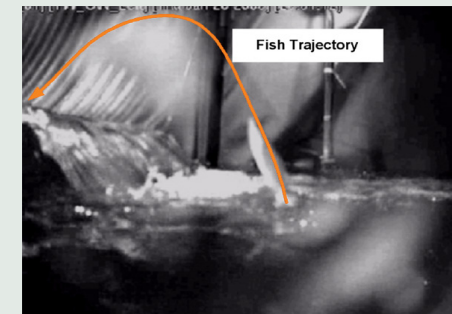
This report describes experiments Battelle conducted at the test flume with and without juvenile coho salmon to establish protocols for future research on bed conditions, culvert shape, etc.

Pearson, W.H. et al, *Evaluation of Juvenile Salmon Leaping Ability and Behavior at an Experimental Culvert Test Bed*, Battelle Marine Sciences Laboratory, June 2005

Describes results of tests conducted to determine the leaping ability of juvenile hatchery coho salmon as the fish entered a perched culvert. Results of the trials showed that entry rate and passage success decreased as outfall drop increased.

Pearson, W. H., et al, *Research on the Upstream Passage of Juvenile Salmon through Culverts: Retrofit Baffles*, Battelle Marine Sciences Laboratory, April 2006

Describes results of experiments with juvenile coho salmon in a 6-foot round culvert with and without baffles under different flow regimes. Behavioral observations indicate the fish used low-velocity pathways and that these pathways differed between the baffles and unbaffled conditions and perhaps differed with flow for the baffled condition.

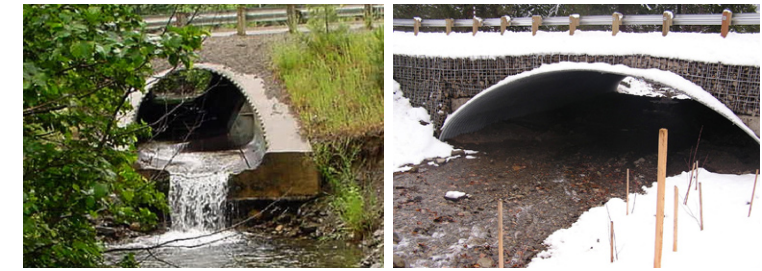


Fish have been observed at the testing facility passing through different types of culverts.

What future tests are envisioned?

The CTB was developed to evaluate retrofit culvert designs and associated hydraulic conditions. The next study phase envisioned for 2007 was to look at new baffle designs. Other study ideas include:

- Small diameter, steep-slope culvert testing
- Cutthroat trout adult and juvenile fish passage testing
- Use of PIT tags at the CTB
- Pacific Lamprey passage and retrofit testing
- Passage testing of juvenile steelhead and Chinook
- Refinement of Mannings-n values at low flows
- Validation testing for US Forest Service's Fish-Xing Model
- Evaluation of gravel bed configurations



Before: barrier culvert on SR 20 near milepost 181 on Little Boulder Creek After: the culvert was replaced with a steel plate arch in 2005.

- Evaluation of the effects of corrugation size and spacing on juvenile fish passage success
- How fish size affects passage success
- Development of innovative culvert coatings of surface roughness elements to aid fish passage
- Hydraulic characterization at high flows
- Evaluation of fish friendly tide gates

What is currently happening at the facility?

WDFW is presently upgrading the Skookumchuck Fish Hatchery this winter. This upgrade will add the possibility of testing juvenile steelhead and chinook in the future as well as the juvenile coho that are presently reared at the facility. Meanwhile, the CTB is aging and is in need of normal maintenance such as painting, etc.

What is the present status of the CTB?

Currently WSDOT leases property at the Skookumchuck Hatchery from WDFW for the CTB. It was intended that research use of the CTB would pay for continued operation and maintenance, leasing, and equipment upgrade costs associated with the test facility. WSDOT currently lacks funds to support the CTB and is looking for partnerships to continue use of this unique facility.

Why is the CTB still a good investment for WSDOT and others?

The CTB allows for controlled trials, within an appropriate statistical design, to be performed with relative ease with a rapid return of evaluations (more so than with field studies). WSDOT believes that continued research on a mix of culvert design options (stream