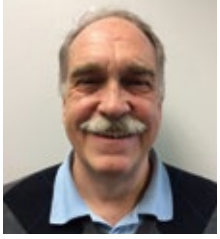
by Sarah Boon, PhD and Ian Miller, RPF



Remediation of Fish Passage at Stream Crossings on BC's Forest Roads

Road culverts installed at stream crossings are known to negatively impact freshwater habitat for fish. In 2009, the BC Forest Practices Board (FPB) confirmed the scope of the problem with a report concluding that these closed-bottom structures pose a province-wide risk to connectivity of fish habitat. While culverts are necessary to manage water flow near resource roads, they often constrict the natural stream channel, increasing stream velocity and causing a range of channel changes that are detrimental to fish. Most importantly, fish attempting to migrate or reach their food supply are unable to access upstream habitat due to these constricted stream crossings. The impacts are also economic: though BC's fisheries sector generated $2.2 billion in revenues and supported 13,900 jobs in 2011, revenues from salmon-related fisheries have declined since 2000, with loss of connected freshwater habitat considered a key contributing factor.

In 2007 the BC Government formed the Fish Passage Technical Working Group[1] (TWG) to address fish passage issues on forestry roads. An inter-agency group, the TWG includes members from the BC Ministries of Environment (MoE); Forests, Lands and Natural Resource Operations (FLNRO); and Transportation and Infrastructure (MoTI), BC Timber Sales (BCTS), and Fisheries and Oceans Canada (DFO). The TWG is funded mainly by the Land Based Investment Strategy (LBIS), as one of its key priorities is remediation of fish passage crossings with the goal of achieving maximum return on investment.

As of 2009, the TWG had identified an estimated 435,000 stream crossings province-wide, with 313,000 of those classified as potentially detrimental to fish habitat. A strategic approach was thus required to focus remediation on those crossings that would result in the greatest improvement to fish habitat.

First, large-scale mapping and modelling is applied to identify provincial watersheds that have high-value fish habitat. A four phase field approach to remediation is then applied within these high-value watersheds:

1. Fish passage assessment: Field assessments are conducted at all stream crossings in the watershed to determine which are barriers to fish passage.
2. Habitat confirmation: For those crossings identified in Phase 1, field assessments are used to determine the quantity and quality of fish habitat to be gained by remediation.
3. Design: The crossings identified in Phase 2 are ranked based on which would have the greatest benefit to fish habitat if remediated. Remediation site plans and designs are then developed in consultation with stakeholders.
4. Remediation: The design from Phase 3 is implemented.

Data from the large-scale analyses and all four remediation phases are available in the Provincial Stream Crossing Inventory System (PSCIS), including maps, photos, field notes, design drawings, and costs. The current governance model funds remediation of fish passage problems only at crossings constructed prior to 1995. For roads constructed after 1995, only Phase 1 and 2 field assessments are covered, as forest practices legislation since then has assigned the obligation to maintain fish passage to forest and range tenure holders.

To date (2008-2015), the fish passage program has received $17.8 million in funding. Although this funding varies considerably between years, on an annual basis approximately 5-10% is allocated to modelling and program support, 20-30% to performing site assessments (Phase 1), 5-10% to habitat confirmations (Phase 2), and 60-70% to site remediations (Phases 3 and 4). To date, >26,000 site assessments, >150 habitat confirmations, and 135 remediations have been completed, re-connecting approximately 750 km of fish habitat. While remediation costs can vary greatly - for example, when the cost of culvert removal alone is compared with culvert removal plus bridge installation - our average cost per km of reconnected habitat is approximately $15,000. This compares favourably with similar projects completed in Washington State, where 60 projects reconnected 351 kilometers of fish habitat at an average of $54,000 per kilometre[2].

The inter-agency approach taken by TWG has been highly effective. MoE, FLNRO, and DFO members developed the strategic approach in tandem with forest industry input, and review the background information on fish habitat to assess high priority watersheds. BCTS and district engineering staff serve as the delivery agent for field assessments and remediation, while MoTI provides technical support and funding, and resolves issues related to non-functional structures on public roads. Cost-sharing arrangements and cooperation on fish habitat improvements have been developed by working with the Society for Ecosystem Restoration in Northern BC, the Pacific Salmon Foundation, DFO's Recreational Fisheries Conservation Partnerships Program, and BC Hydro's Fish and Wildlife Compensation Program.

The TWG has also been active on the engineering and practice side, developing an online training program[3] for conducting fish passage assessments, and updating the engineering standards[4] for restoration of fish passage. They have also assisted FLNRO's Compliance and Enforcement branch in developing a guidance document to define what is meant by 'material adverse effect' when protecting fish at stream crossings[5], and have updated a 2002 Stream Crossing Guidebook to a 2012 edition[6]. For more information on the program, see the 2011 issue of Streamline Watershed Management Bulletin[7].

Given the scope of the issue, it's imperative that fish passage be addressed across resource industries, to avoid creating new problems and to continue to remediate existing problems; thus the PSCIS database and online training tools are available for broad use. The TWG is keen to develop new partnerships and find additional resources to apply this strategic approach to fish passage remediation in all regions of the province.

Science In Action

Olga Vasik - Fotolia

Do you have a Science In Action story you want to share?

E-mail your story idea to Doris Sun, editor, at dsun@abcfp.ca

Sarah Boon, PhD, has 15 years experience as a hydrologist, and as a freelance science writer and editor.

Ian Miller, RPF, has been a manager with Resource Practices Branch of FLNRO in Victoria since 2006. He is the past chair of the Fish Passage TWG, and works with many diverse teams on forest hydrology, visual resource management, effectiveness monitoring, and forest practices policy and legislation.

The TWG also includes: Brian Chow (FLNRO), Dave Hamilton (BCTS), Dave Maloney (FLNRO), Craig Mount (MoE), Holly Pulvermacher (DFO), Richard Thompson (MoE), Peter Tschaplinski (MoE), Sean Wong (MoTI), and Terje Vold (Contractor).

References

[1] http://www.for.gov.bc.ca/hfp/fish/FishPassage.html

[2] http://www.nfwf.org/results/evaluationreports/Documents/Fisheries_Benefits_Eval.pdf

[3] http://www.for.gov.bc.ca/hfp/fish/Fish_Passage_Training/player.html

[4] http://www.for.gov.bc.ca/ftp/hcp/external/!publish/web/fia/FishPassageActivityEngStdsFinalApril2-2013.pdf

[5] http://www.for.gov.bc.ca/ftp/HTH/external/!publish/web/frpa-admin/frpa-implementation/bulletins/CE-40-Material-Impact.pdf

[6] http://www.for.gov.bc.ca/hfp/fish/Fish-Stream%20Crossing%20Web.pdf

[7] http://www.for.gov.bc.ca/hfp/fish/Habitat%20Modelling.pdf

Restoration Of Fish Passage

ON ELBOW CREEK, SOUTHWESTERN BRITISH COLUMBIA

In the May-June 2015 issue of BC Forest Professional, we brought you the story of BC's Fish Passage Technical Working Group (FP-TWG), which included members from the BC Ministries of Environment (MoE); Forests, Lands, and Natural Resource Operations (FLNRO); and Transportation and Infrastructure (MoTI); and the BC Timber Sales (BCTS) program. This group is working to remediate fish passage at stream crossings on BC's forest roads.

In this issue we visit one of TWG's remediation sites, using it as a case study to describe how remediation takes place. The site is in the Elbow Creek watershed, located in the Harrison River Watershed Group, near Harrison Mills (100 km east of Vancouver).

In 2011, TWG-funded BCTS contractors conducted fish passage assessments at all stream crossings in the Harrison River Watershed, and identified a number of culverts that potentially restricted fish access to upstream habitat. Two of these culverts occurred where the Chehalis Forest Service Road (FSR) crossed Elbow Creek. When the contractors conducted follow-up habitat assessments, they confirmed that the culverts were impeding the ability of coho salmon, steelhead and cutthroat trout to access high value habitat. The TWG consulted with the federal Department of Fisheries and Oceans (DFO) and the project biologist in early 2012 and decided to prioritize these sites for restoration, with the initial plan being to replace the two offending culverts with bridges.

Both fish passage and ongoing road sediment delivery issues were solved by eliminating the two stream crossings and restoring the stream channel

Sarah Boon, PhD, has 15 years experience as a hydrologist, and as a freelance science writer and editor.

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BCTS's Dave Hamilton did a revised site assessment in June 2012, and realized that — instead of installing two bridges — a 410m section of the Chehalis FSR could be moved 35 metres west, out of the riparian zone, and the existing road could be deactivated. There were several benefits to this approach: it could be implemented over a shorter timeframe, would provide greater habitat benefits at a lower cost, and would also reduce sediment inputs to Elbow Creek. The revised design was also logistically easier to implement, as it was no longer necessary to close an active haul road that was also used extensively by the public.

This revised project remediation plan was directed jointly by the TWG and local FLNRO staff and funded through a partnership agreement between DFO's Recreational Fisheries Conservation Partnership Program (RFCPP), the Pacific Salmon Foundation (PSF) and FLNRO's Land Based Investment Strategy (LBIS). The final project cost about $100,000 less than if the originally planned bridge structures had been used, and opened the door to future partnerships with PSF.

Once DFO approved the new plan, a team of contractors and personnel was assembled to complete the work. These included Infinity Pacific Stewardship Group (Mike Petrie: road design, deactivation plan development, and project management), B & D Excavating (Frank Boccia: road construction and deactivation), MC Wright & Associates (Brandalyn Musial: sediment management plan and onsite environmental monitoring), and FLNRO Chilliwack District (Jeff Ladd: engineering officer).

The bypass road was constructed in July 2013 to the appropriate build standards required for a public road, and all traffic was redirected to this new road. In August of the same year, the two culverts from the old road were removed, and the stream channels at these locations restored. The old road was then deactivated by de-compacting the road bed, top-dressing with slash and other vegetation to improve stability and encourage regeneration, and seeding with grass. Follow-up work in spring 2014 included the planting of 600 trees and additional grass seeding. An informal camping area on the old road section near Elbow Lake was also decommissioned, as it was a source of pollution problems.

Both fish passage and ongoing road sediment delivery issues were solved by eliminating the two stream crossings and restoring the stream channel, and moving the road away from the creek. The project re-established fish connectivity both to Elbow Lake and to tributary streams to Elbow Creek, providing fish access to an additional 2.2 km of habitat.

Several stakeholders also benefitted from the project, as the Elbow Community Watershed supplies local communities and water licensees. One of the key water users was Eagle Point Development, a large residential subdivision. Residents there were initially concerned about additional impacts from sedimentation caused by moving the Chehalis FSR, as in the past they'd had to install a chlorination plant due to coliform problems from the informal campsite near Elbow Lake. Following project completion, however, Eagle Point was happy not only with the reduction in sedimentation issues, but also with the deactivation of the informal campsite. The local Sts'ailes First Nation was also involved; though there were no culturally significant sites in the area, BCTS employed a First Nations fisheries technician to assist the environmental monitor on the project.

Clockwise from top left:

Closeup of a culvert identified as detrimental to fish passage along the Chehalis FSR (note the road in the background).

Free-flowing creek after removal of the culvert that was blocking fish passage.

Construction of the bypass road on the Chehalis FSR. Note the old road at the left of the image, and the bypass road on the right.

New bypass road on the left of the image and deactivated forest road on the lower right of the image. This remediation work moved the road away from the stream bed and removed the need for culverts.

The road will be monitored by the forest licensee as per its road maintenance schedule and obligations. Given its easy road access, the Elbow Creek project also facilitates ad-hoc monitoring by field staff on the way to other sites in the lower Fraser Valley area. Sediment catch basins were installed in the event of any sediment mobilization following road reconstruction; however, none has occurred thus far. The site will also be used as a tour stop to showcase integrated resource management to a variety of audiences. A field trip by the FP-TWG in September 2013 identified the project as a huge success, and the project (among others) resulted in BCTS's Dave Hamilton being nominated for a P.J.J. Hemphill Award for Engineering Excellence.

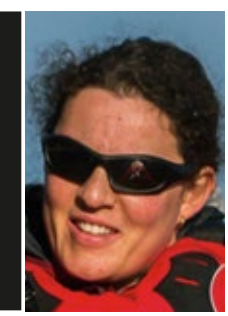
The project was completed on time, under budget, and with a great team — just one of several success stories from BC's Fish Passage Technical Working Group.

Reconnecting Fish Habitat Starts with Good Data Management

British Columbia's Fish Passage Technical Working Group (FPTWG) has spent the past nine years coordinating and overseeing the assessment and remediation of resource road infrastructure that negatively impacts fish passage and developing best practices for stream crossing infrastructure. To be eligible for *Land Based Investment Strategy* (LBIS) funding, the focus of this work has been on stream crossing culverts installed pre-1995 that are no longer under forest licensee obligation. To date, the FPTWG has funded the reconnection of approximately 770 km of fish habitat, with major benefits for fish. In two previous articles[1, 2] published in *BC Forest Professional* magazine, we've explored the remediation program itself, and highlighted a specific case study. This article examines the data generated by this program.

The Provincial Stream Crossing Inventory System (PSCIS) is a key component of the government's strategic plan to address fish passage issues, and contains information about crossing structures and the streams they traverse. The dataset is freely available to everyone, from government employees to the general public, via the BC government's online iMap geographic data platform[3].

Data is collected during each of the four program phases[4]: fish passage assessment, habitat confirmation, design, and remediation. Phase 1, the fish passage assessment phase, requires field data collection on stream channel properties (width, slope, observed fish and beaver activity, habitat value, etc.) and the existing stream crossing infrastructure (structure type, dimensions, slope, outlet drop/pool depth, etc.). This data is used to calculate a score for each crossing that indicates whether or not the structure is likely to allow fish passage. Contractors are provided with training as well as a standardized field data collection template which lists the required measurements and observations. Once populated, this Excel template is then submitted online for import into PSCIS.



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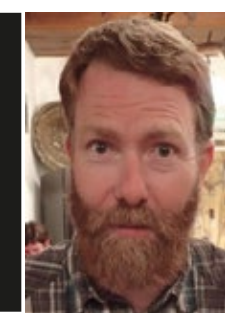


Craig Mount, MSc, PGeo, is the aquatic habitat geomorphologist with the BC Ministry of Environment. He has been on the Fish Passage Technical Working Group since its inception in 2007. Craig specializes in the study of fish habitat through the combination of the physical earth sciences and spatial technology such as GIS and modelling.

Phase 2 is the habitat confirmation phase. Only stream crossings identified in Phase 1 as failing to pass fish and potentially having upstream fish habitat (identified using a habitat model) move on to this stage. Field data is collected to assess both habitat quantity and quality. Indicators include channel type (riffle-pool, step-pool, etc.); flow type (perennial, ephemeral, intermittent); substrate; and presence of woody debris, undercut banks, aquatic vegetation, and riparian vegetation overhanging the channel. Data from the habitat confirmation also include maps and photos of the upstream habitat and the crossing site, as well as road tenure information and future access plans for the area, all of which is submitted to PSCIS via the web interface.

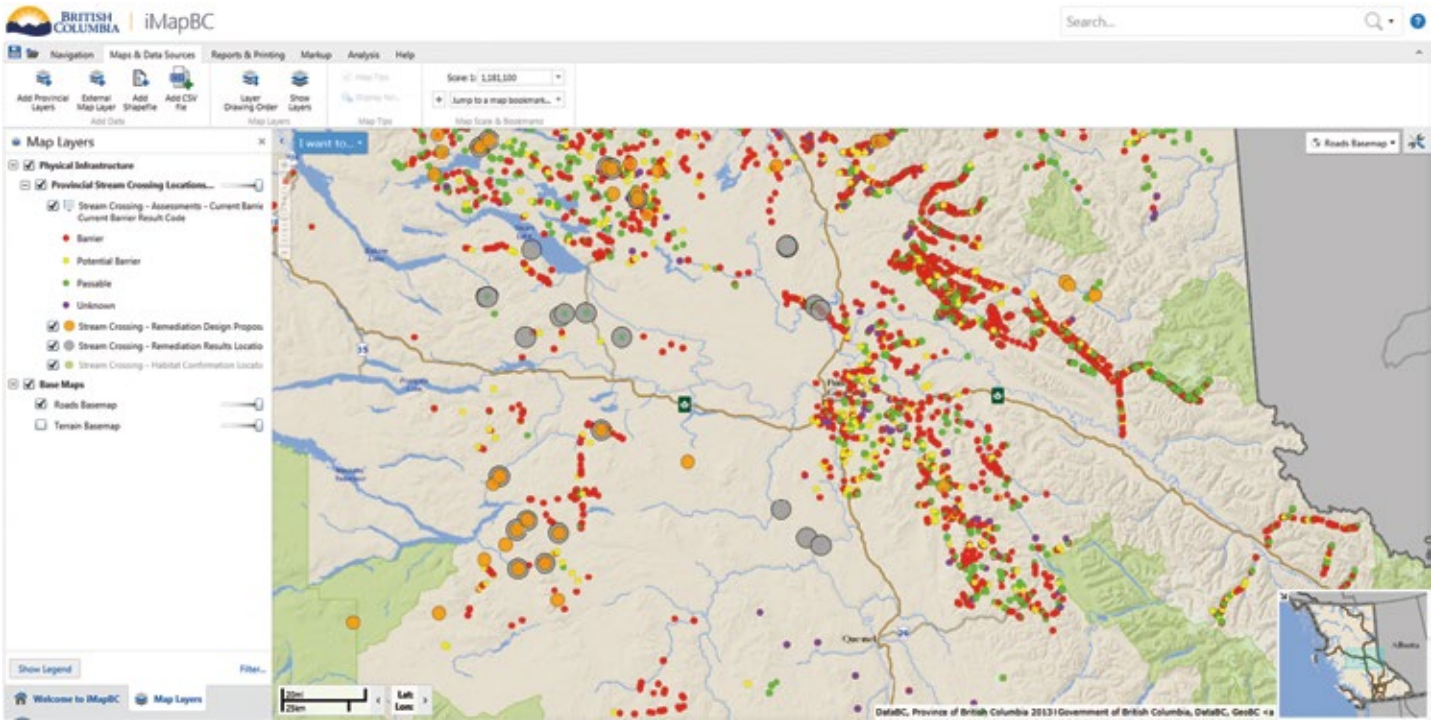
The FPTWG examines crossings assessed in Phase 2 to select those where the cost of habitat restoration will provide the best return on investment for improving both the quality and quantity of accessible fish habitat. Phase 3 then involves designing the new infrastructure for those sites. Data uploaded to PSCIS at this point is engineering related: site plans, design drawings, and cost estimates. Following the final infrastructure installation in Phase 4, data uploaded to PSCIS via the web interface includes final as-built plans and costs, plus photos of the site with the new infrastructure in place, and a final report.

All data in PSCIS is linked to the specific geographic coordinates of each stream crossing site. The data is quality controlled during the submission process using either macros built into the submission spreadsheet or specifically defined pull-down menus on the website.

The PSCIS database is used by a wide range of groups. The FPTWG itself uses the data to continually refine their understanding of the scope of the fish passage problem across the province. Each year they re-run their analysis using new assessment data to see which types of crossings or structures are the biggest problem, and to develop remediation priorities. They are currently updating the information on the number of stream crossings on resource roads, the percentage that are closed bottom structures (CBS), and the known failure rate of these CBS based on collected data.

FPTWG

The Fish Passage Technical Working Group (FPTWG) includes Sarah Boon, PhD, FRCGS; Brian Chow, PEng; Dave Hamilton, RFT; Dave Maloney, PAg; Craig Mount, PGeo; Holly Pulvermacher; Richard Thompson; Peter Tschaplinski, PAg; Sean Wong; and Terje Vold, RPF.



Provincial layer in iMapBC depicting provincial stream crossing locations (PSCIS), including stream crossing assessments - current barrier result locations, remediation design proposals locations, remediation results locations, and habitat confirmation locations in Northern BC.

Within government, staff in the Cumulative Effects Framework Program include the data in their analyses, as does the *Forest and Range Evaluation Program* for multiple resource value assessments (FREP-MRVA). The State of the Environment Report group also uses summary statistics from the program in its regular reporting, while the Forest Practices Board has used the data to report on the problem of fish passage at road crossings across the province.

Non-government groups using the data include the Pacific Salmon Foundation, which has incorporated PSCIS data from the north coast into their Pacific Salmon Explorer online tool, which focuses on the Skeena and Nass watersheds. BC Hydro has used PSCIS data through the Fish and Wildlife Conservation Program, in partnership with the FPTWG. First Nations also access the data to determine the impact of stream crossings on aquatic habitat in their traditional lands, and to help them prioritize sites for restoration.

Steps to access PSCIS data are included in *Using iMapBC 2.0 to Access Fish Passage Data*[5], created by FPTWG. Other iMap datasets that users of the fish passage data may be interested in include stream networks, fish observations, and fish obstacles.

Resources

1. Boon, Sarah, and Miller, Ian. "Remediation of Fish Passage at Stream Crossings on BC's Forest Roads." BC Forest Professional. May-June 2015. 22. Print.
2. Boon, Sarah, and Miller, Ian. "Restoration of Fish Passage on Elbow Creek, Southwestern British Columbia." BC Forest Professional. January-February 2016. 10. Print.
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