MARINE ENGINEERING

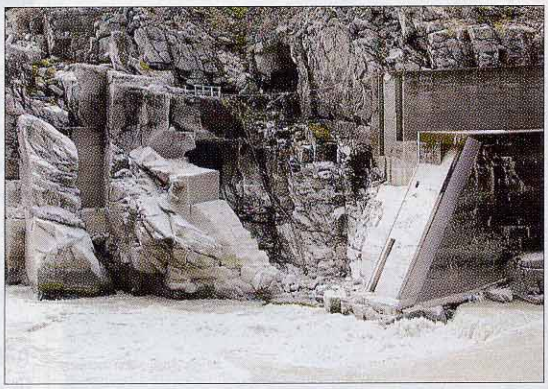
New Tunnel To Help Salmon Pass Hells Gate on the Fraser

British Columbia's Fraser River salmon are getting a break. A $263,000 fish tunnel passage, part of a five-year, $1.1-million capital program, should make it possible for more migrating fish to return to upstream spawning grounds.

The Fraser is one of the world's great salmon-producing rivers, draining a third of British Columbia and fed by hundreds of tributaries and a huge snow pack. But salmon runs plunged after a 1913 landslide at Hells Gate—a swift, deep choke point 70 miles northeast of Vancouver—made water velocity more fierce.

At that point, the Fraser squeezes through a canyon, only about 110 ft wide. The water depth varies from 110 ft in winter to 270 during summer's peak flows. Hells Gate has always been difficult for migrating species, but the slide—from railway construction—further narrowed the passage and drastically increased river velocity. Within a few cycles, it was obvious that the salmon were in serious trouble.

Following studies by the International Pacific Salmon Fisheries Commission and the universities of Washington and British Columbia, mechanical engineer and fisheries scientist Milo Bell designed and installed innovative, concrete vertical slot baffle fishways on both sides of the river in 1945. A tunnel and other fishways were built later.



▲ **Squeeze.** Landslide blocked fishway downstream portal.

Earlier passage improvements focused on the commercially valuable salmon species, sockeye and pinks. They migrate during high summer flows. Current work benefits other migrating fish—coho, sturgeon, steelhead and other trout. The effort continues 1988 and 1992 improvements. The goal is a system that keeps all passages open, giving all species a clear upstream route regardless of water depth.

Vancouver-based Wyllie & Norrish Rock Engineers designed the key component, a 230-ft-long, 6.9 x 7.9-ft modified horseshoe tunnel directly underneath the existing west bank main fishway. It eventually will connect to the original 1945 tunnel downstream.

The contractor, BAT Construction Ltd., Kamloops, B.C., is blasting through mildly jointed granite with some small faulting throughout. A century of data from Canada's Dept. of Fisheries and Oceans indicated a six-week low-water-work window.

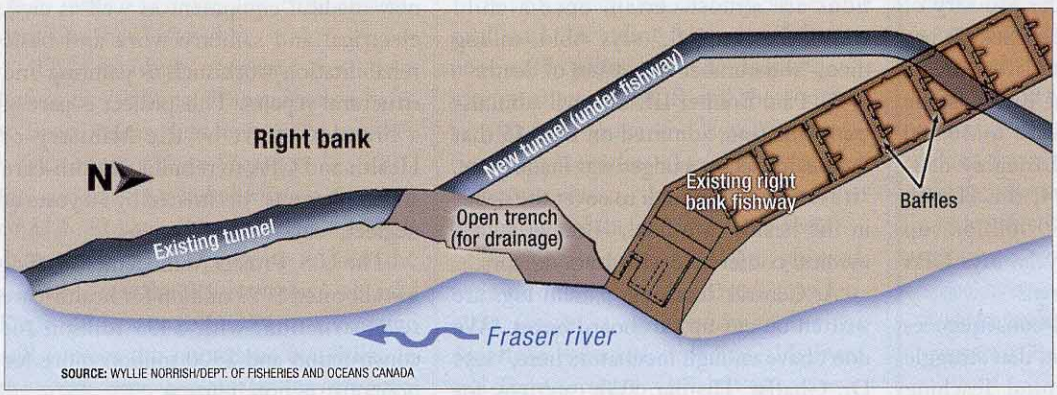
Working on a 24-hour schedule, BAT first removed spoil from the tunnel with a scoop tram and a slusher. "The hardest thing on this job was disposing of the rock from the low-level tunnel," says Bruce Thomson, BAT owner and principal. A 75-ton crane with a 1.3-cu-yd bucket extracted 520 cu yd of refuse. "The maximum we could lift was about 9,700 lbs. The angle of the boom and the lifting radius restricted our loading capacity," he adds.

The contractor removed 65 cu yd of weak rock from outside the tunnel's downstream portal. "Controlled blasting was important because we were really close to an existing fishway...the closest we got to existing works was about 1 ft," explains Thomson.

BAT averaged 15.5 ft per day of tunnel. The job is set to wrap up Feb. 17. To blast the central portion, the contractor drilled 5.9-ft-deep holes and used 37 holes per round with an average charge of 2.2 lb per delay. Closer to the existing works, the holes were only 3.9-ft deep, with an average charge ranging from 0.44 lb per delay to 0.88 lb per delay.

Roy McGechaen, DFO senior project engineer, believes that "an additional, longer tunnel [is] the only real option [but] we must first observe the beneficial effects of this new tunnel before we make plans for future civil work." ■

By Tonia Jurbin



▲ **Multilevel.** New tunnel runs below fishway and spills flow near upstream portal of old tunnel to keep it clear.