

# Ingenuity & Collaboration

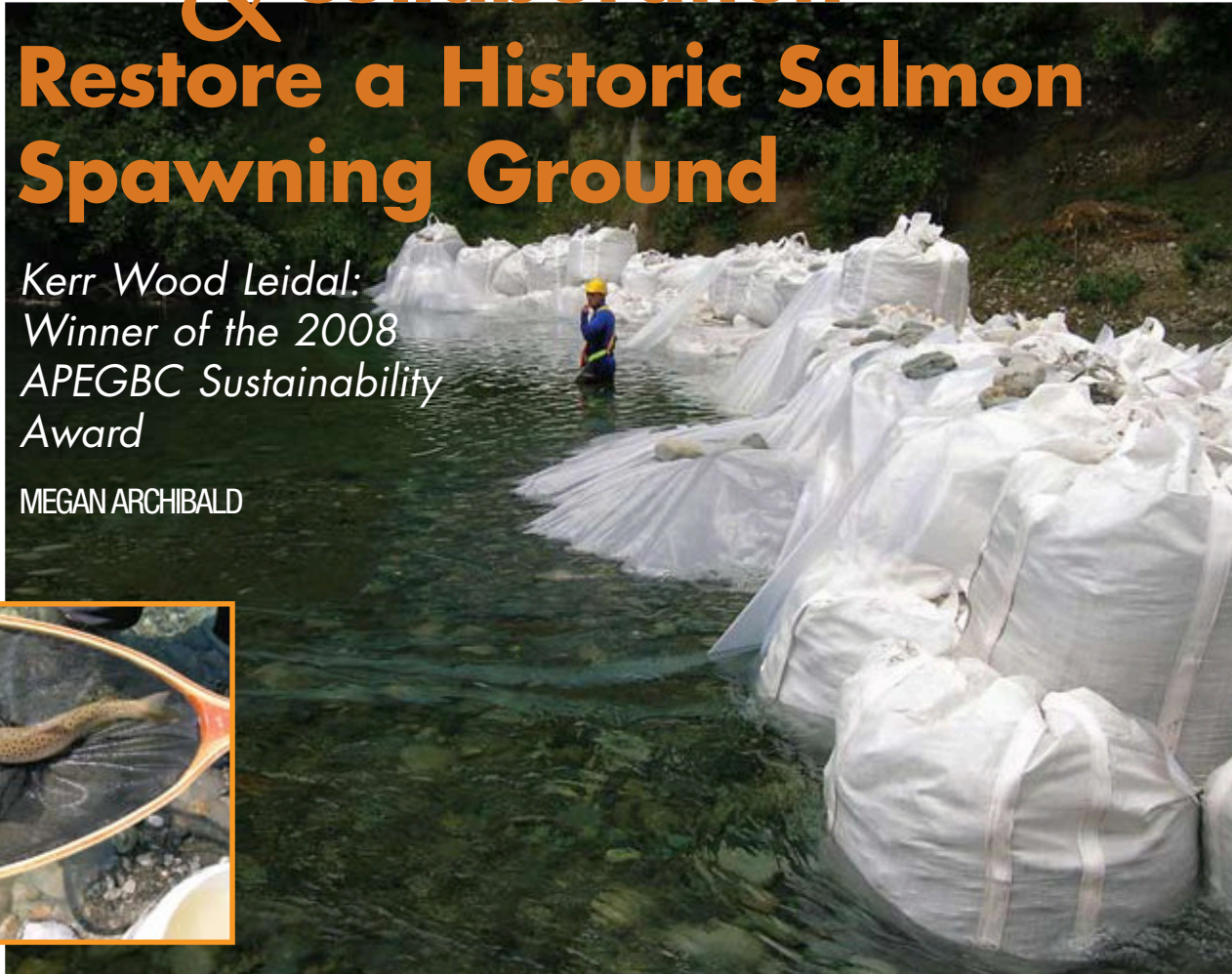
## Restore a Historic Salmon Spawning Ground

*Kerr Wood Leidal:  
Winner of the 2008  
APEGBC Sustainability  
Award*

MEGAN ARCHIBALD

*Right:* A bulk-bag dam diverted a 1 km stretch of river surrounding the bluff.

*Inset:* One of the 25,000–30,000 fish relocated during construction



The Cowichan River has long been one of British Columbia's greatest environmental treasures. From Cowichan Lake, it winds its way through rugged mountains and tall forests to the Strait of Georgia on the southeast coast of Vancouver Island. The warm temperature and steady current provide an exceptional habitat for salmon, trout, and steelhead. In addition to providing abundant fish stocks, the river is also used for industrial, commercial, and domestic water supply, and supports year-round recreation. The river, a designated BC and Canadian Heritage River, has an estimated direct economic value to the local economy of \$6.2 million per year, and has significant historical and cultural value as the ancestral home of the Cowichan Tribes.

For years now, however, the survival of salmon fry in the lower reaches of the Cowichan has been threatened by the slow erosion of the massive Stoltz Bluff. This glacial deposit, which stretches for more than 800 metres along the riverbank, is composed of compacted silts and sediments that have been eroding over time following changes in river geomorphology and groundwater hydrology as a result of both human and natural factors. The changing river gradually moved to connect with the toe of the bluff,

setting off a chain of events that spelled disaster for the fish downstream.

"There was a center bar that had formed and was pushing the water into the bottom of the bluff," says Craig Sutherland PEng of Kerr Wood Leidal, the civil engineering firm called in to stabilize the erosion. "The slopes themselves as a whole unit are quite stable, but the front face of them kept sloughing off." This undercutting of the bluff was sending between 10,000 and 28,000 cubic metres of sediment into the

river each year—effectively smothering the habitat and spawning grounds of the salmon downstream.

Incubator test results of salmon egg survival in the most affected portions of the river were dismal. Upstream of the Stoltz Bluff, the survival rate was approximately 86%; downstream, however, the survival rates varied between 0% and 6%.

When spawning, salmon create a bed for their eggs in river gravel called a redd. The salmon that spawned downstream of the bluff encountered river gravel laden with sediment that created a material similar to concrete, making it very difficult for them to create a redd. “Even if the salmon managed to create a redd and lay the eggs, [the silt material] drowned them out,” says Sutherland. “The eggs need oxygen from the water to survive.”

Kerr Wood Leidal’s formidable challenge was to design and construct river works that would prevent further bluff erosion and sediment movement without physically adjusting the bluff itself. The project would be the largest stream restoration project on Vancouver Island in 20 years and was a true community effort, involving partnerships with many agencies, including the Living Rivers Trust Fund, the Pacific Salmon Commission, the BC Conservation Foundation and members of the Cowichan Stewardship Round Table.

The project team at Kerr Wood Leidal undertook a detailed river survey, examined aerial photos, and studied background geomorphology to design an approach that focused on using natural materials and allowing the river to naturalize over time. What resulted was a multi-phased, multi-year project that required construction expertise and innovation in fish biology, geomorphology, and engineering practice.

The first phase began in the summer of 2006. The objective was to design river works that would limit lateral erosion and undercutting of the bluff using a variety of river engineering techniques. For the work to be effective, it had to occur “in the dry”—in other words, the 1 km stretch of river surrounding the bluff had to be diverted so that the riverbed could be drained.

Luckily, an old floodplain nearby was the perfect candidate for a temporary side channel. But beyond the obvious challenge of designing a system that would safely divert the river, the project team faced a few additional challenges. There was the daunting prospect of relocating the river’s many aquatic residents, as well as maintaining a safe channel for the roughly 3,000 river recreationalists that frequented the Cowichan.

With an environmental monitor on site at all times, the project team constructed a bulk bag dam using woven bags full of river gravels to divert the river flow. Team members carefully and patiently moved between 25,000 and 30,000 fish to the main stream below the work site.

Once the riverbed was dry, the project team began working to redesign the river channel. Using materials

from the riverbed, including much of the sediment from the centre channel bar, they constructed a large berm that ran parallel to the base of the bluff toe. The berm was designed to act as a barrier between the river and the bluff, preventing further erosion. The upstream end was slightly higher to prevent overtopping, and was protected with riprap to guard against river scouring.



Restored Stoltz Bluff and Cowichan River, May 8, 2007.

Because the berm shifted the riverbank away from the bluff by about 15 metres, the project team constructed a terrace between the berm and the bluff in order to capture loosening sediment from above. “The terrace is basically the old riverbed,” says Sutherland. “It’s now being used to contain the material as it is coming down the slope. Over time it will also act as a buttress as vegetation grows and it becomes more stable.”

With the curve of the river now altered beneath the bluff, the team had to ensure the river maintained its natural geography and velocity. A major concern of the project partners, approval agencies, and downstream community was the effect the project might have elsewhere on the river due to energy transfer.



Bendway weirs keep the river velocity even and allow for bioengineering along the riverbank.

Initially, the project team planned to line the riverside slope of the berm with riprap. To provide a more natural solution, however, they constructed bendway weirs along the entire length of the berm. The weirs, constructed of riverbed material covered



The terrace, berm, and riverbank bioengineering work together to prevent sediment from entering the river

with angular riprap, help to deflect the main current of the river away from the constructed berm and effectively slow the velocity of the river. The roughness of the constructed channel bed was also maximized to further control river velocities.

The introduction of bendway weirs also allowed for some innovative bioengineering. Where the river velocities were slower between the weirs, the project team installed soil wraps consisting of biodegradable geogrid interlaced with willow brush layers and live willow stakings. The soil wraps encouraged vegetative growth that would stabilize and strengthen the new riverbank.

With the berm, terrace, and bendway weirs in place, the team reintroduced flow into the main channel over a period of three days. A sediment-monitoring program was undertaken in 2007, with encouraging results. The river restoration successfully reduced delivery of the suspended sediment from Stoltz Bluff from 79% of the total suspended load the river in 2005/2006 to 39% in 2006/2007. Plans are underway to secure funding for the remaining phases of work, which includes gully and upslope bioengineering and stabilization techniques.

The river will be monitored over several years to fully determine the level of success of the project. Sutherland feels that success can be seen not only in the improved water quality of the restored Cowichan River, but also in the incredible teamwork and collaboration that characterized the project from start to finish.

"We were just one small piece of the puzzle," he says of Kerr Wood Leidal's contribution. "The engineering side was pretty interesting, but I think the more exciting part of the project was the cooperation between the different agencies involved and the community."

The many different communities that enjoy the bounty and serenity of the Cowichan, whether economically or recreationally, are also dedicated to its long-term health. "The construction ran through a provincial park, and we shut down one of their campgrounds for an entire summer," Sutherland says. "It was all those types of issues that had to be resolved and worked through with the community. The project wouldn't have happened without their support."

Ultimately, that community involvement is what makes this project more than just an environmental restoration—it's a true example of entrusting the care of our shared resources to the community that uses and enjoys them. "Over time, we will step away from the project, and our consultants and partners will step away, and it will become the community's project," Sutherland says. "They were involved in it right from the very beginning and they'll take ownership of the project in the long run. That's what the sustainable part of this project was."

"The environmental restoration was the end goal, but sustainability is how you get there, the process that you go through to reach that end goal. We want to let nature take over, but we'll give it a bit of a kickstart." ☒

"It's not what you look at that matters, it's what you see."

Henry David Thoreau

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