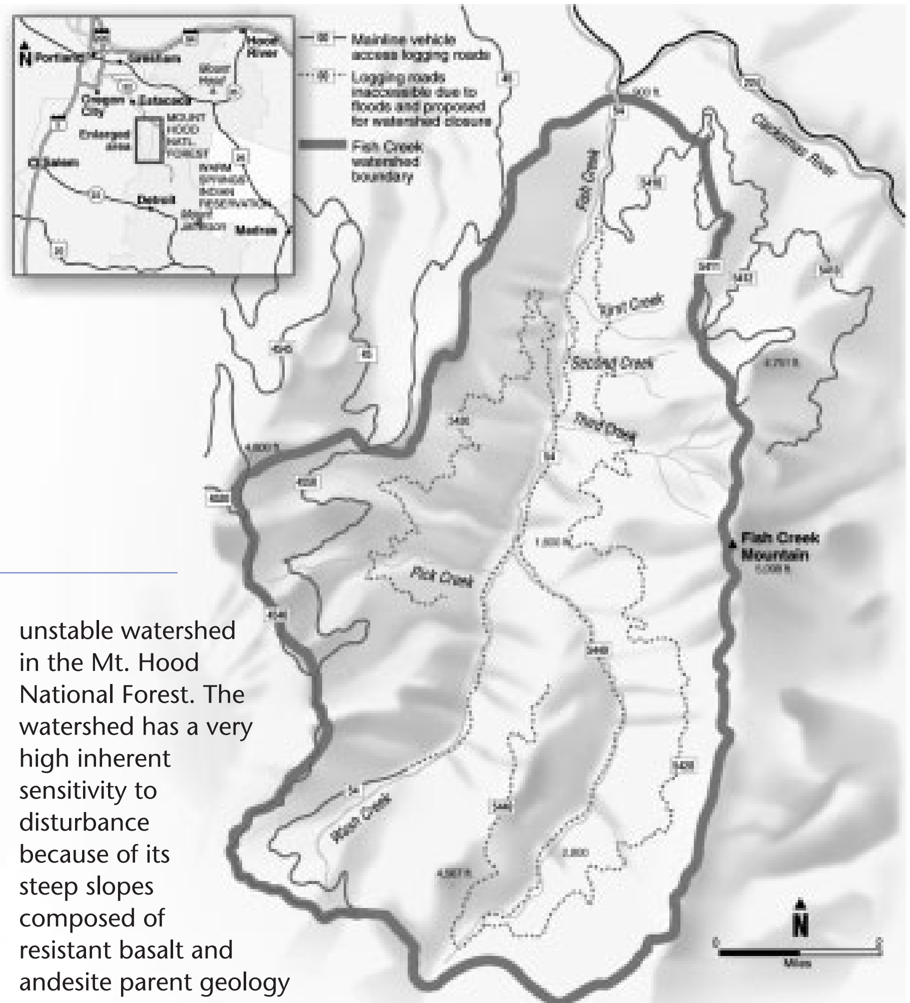
Fish Creek Revisited: Restoring a Whole Watershed



Credit: The Oregonian

Paved roads decommissioned.
Not shown are gravel and native surface roads also decommissioned.

Tracii Hickman and Dan Shively

Seven years have passed since an article on the Fish Creek Watershed was published in Streamline (Vol. 1, Issue 1). This article updates hillslope and instream restoration activities initiated since the winter floods of 1995–1996, and presents preliminary results of post-flood restoration monitoring, along with lessons learned from a watershed-wide restoration project.

Background

Fish Creek in Oregon State is a 12 052-ha (29 782-acre) watershed, tributary to the Clackamas River. Fish Creek supports a significant run of threatened winter steelhead (*Oncorhynchus mykiss*) and provides 21 km of habitat for anadromous salmonids. By 1996, 41% of the watershed had been harvested (primarily by clearcutting) and 227 km of road had been built. The road density was 1.9 km/km^2.

Under the Northwest Forest Plan (USDA and USDI 1994), Fish Creek is listed as part of a network of refugia watersheds that offer high quality habitat for aquatic species. A primary emphasis for key watersheds is restoration of roads, hillslopes, riparian areas, and aquatic habitats.

A 1994 watershed analysis identified Fish Creek as the most geologically unstable watershed in the Mt. Hood National Forest. The watershed has a very high inherent sensitivity to disturbance because of its steep slopes composed of resistant basalt and andesite parent geology interlain with weak, weathered pyroclastic deposits.

During the winter of 1995–1996, a series of storms struck the Pacific Northwest with unusual fierceness. Fish Creek was highly impacted due to its past timber harvest and roading history, and its high level of inherent sensitivity to disturbance. A storm in early February passed the 100-year flood mark, and the effects from the rain-on-snow storm were watershed-wide.

Following the 1996 Flood

Extensive field surveys determined the following flood impacts:

- 236 landslides (34% road related, 42% timber harvest related, and 24% in unmanaged areas);
- debris flows through 24 km of fish-bearing streams; and
- all road segments were damaged, either from stream channels eroding the base of roads next to streams, landslides plugging culverts that triggered road failures, or saturated road fills collapsing.

Many landslides gave rise to debris torrents in first-, second-, and third-order tributaries, and delivered massive quantities of sediment and large woody debris to Fish Creek and its primary tributary, Wash Creek. Also, many debris torrents plugged culverts, but adjacent road segments held. Road managers feared those culverts could fail during the next large storm event. In 1999, a 25-year storm event occurred in Fish Creek.

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The number and severity of landslides, combined with the massive damage to the road system, triggered a review of management goals and development of a restoration plan.

To develop an overall, comprehensive restoration strategy, several watershed plans were created, including the Fish Creek Watershed Analysis (1994), Fish Creek Restoration Environmental Analysis (1998), Fish Creek Water Quality Restoration Plan (2000), and most recently, the Fish Creek Watershed Restoration Monitoring Plan (2001) available from **http://www.fs.fed.us/r6/mthood/sitemap/publications.shtml**. In addition, in 1997 an interdisciplinary scientific panel of restoration specialists reviewed alternatives, and provided critical feedback to Forest Service management.

The scientific panel interpreted data from post-flood monitoring, performed independent field observations, and offered wide-ranging opinions and options. Of note were that upslope treatments are considered higher priority than instream channel work because of the role of hillslope processes and their critical role in the long-term recovery of the Fish Creek watershed. Instream fish habitat projects are considered an important, but short-term solution until natural hillslope processes return large wood and other roughness elements to stream channels.

In 1998, three options were considered to fix the hillslope and instream problems in the watershed:

1. Do nothing.

2. Repair and re-open the 227-km road system at current construction standards (estimated cost $18.2 million).

3. Decommission most roads and reconstruct some roads to restore hydrologic function and reduce road-related risks of landslides. An overall goal was to reconnect the hillslope and channel processes (estimated cost $2.3 million).


Connie Athman

Third Creek crossing on road 5420 immediately after the 1996 flood.

The restoration team decided to decommission 168 km (73%) of the road system. The remaining 59 km of roads on ridgetops or more stable terrain were reconstructed. In addition, other watershed restoration projects, such as riparian thinning and planting and instream habitat improvements, were implemented.

Restoration Challenges

Most of the restoration challenges were related to forest management decisions made over the previous decades, and were magnified after the 100-year storm.

- Young Douglas-fir clearcut plantations on steep, geologically weak slopes experienced a 10-fold increase in the number of landslides compared with unmanaged, old-growth areas. Plantations were thinned to accelerate development of mature trees with greater root strength.
- Roads built before 1964 using sidecast construction on unstable fill had twice the incidence of landslides and contributed a larger percentage of sediment. All older roads were obliterated; stream crossings were restored, and replanted with native vegetation.
- Roads preventing large wood from entering streams resulted in a loss of habitat complexity in stream channels. Road/stream crossings were removed so that future, naturally occurring landslides will deposit wood in streams.
- High road densities increased peak flows and channel scour and accelerated debris flows triggered by road-related runoff. The solution was to reconstruct some roads to improve their drainage and decommission other roads to restore hydrologic function.

A watershed perspective was vital for whole-watershed, post-flood planning and analysis.

- Road building in the valley bottoms and riparian areas resulted in a loss of large woody debris for streams, and a loss of connectivity to floodplains to dissipate stream energy.
- Stream cleaning and riparian timber harvest meant a loss of large woody debris in streams and a loss of future large wood. In a few locations, large woody debris was returned to streams. In addition, riparian area plantations were thinned and planted with other riparian species to increase plant community diversity.


Bob Bergamini

Third Creek crossing three years after culvert removal and road decommissioning.

Restoration Accomplishments

Roads (1998 and 1999)

- Decommissioned 168 km (73% of the road system)
- Reconstructed and storm-proofed 59 km
- Removed 1169 culverts
- Implemented erosion control (seed, fertilize, and mulch) on 222 ha
- Placed 600 m^2 erosion control mats

Hillslopes (1997)

- Thinned 579 ha of Douglas-fir plantation
- Planted 20 ha of landslides

Riparian Areas (1997)

- Thinned 832 ha of Douglas-fir plantation
- Planted 1 ha with a diverse mix of species such as western redcedar

Instream (1997 and 1998)

- Restored log jams in lower 3 km of stream
- Restored 1.5 km of side channel

Monitoring

In the 1980s, the research branch of the Forest Service established a long-term project to monitor instream habitat and juvenile fish populations. A nearby, similarly sized roadless watershed, Roaring River, is used as a control watershed. Since the floods of 1995–1996 and implementation of the watershed restoration project, monitoring has expanded to include hillslope processes, riparian area function, and instream conditions.

A smolt trap at the mouth of Fish Creek has been tracking migration of juvenile fish since 1985. Immediately following the 1996 storm migration numbers fell sharply, and offspring of the 1996 outmigrants are correspondingly low in number.

Following the 1999 flood, the methodology of the 1996 geologic inventory was repeated. Results showed a much lower number of landslides compared with the floods in 1996. Of the 14 landslides associated with the 1999 storm, 1 was in unmanaged forest, 2 were in timber harvest units, and 11 were associated with decommissioned roads. The overall sizes of the landslides were much smaller compared with those from the 1995–1996 floods. As decommissioned roadbeds stabilize and mature vegetation is established, overall landslide rates should continue to decline.

Lessons Learned

A watershed perspective was vital for whole-watershed, post-flood planning and analysis. Watershed planning allowed the interdisciplinary team to consider the different resources affected by the floods, and consequences of implementation of different restoration strategies (i.e., impacts to managed timber stands and recreation access).

The geographically and professionally diverse interdisciplinary scientific review panel provided a critical perspective on post-flood restoration.

Balancing the development of a sound, whole-watershed restoration plan with the urgency to complete stabilizing repairs was difficult. The restoration team recognized that emergency repairs could have, but did not influence or dictate later decisions.

The road-decommissioning contract produced unexpected negative results. The contract language did not allow much flexibility beyond removing the culvert and the overlying fill. As a result, many decommissioned stream crossings on the mid-slope roads are still erosion sources because the natural gradient

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was not restored and downcutting continues. It is likely that several more moderate to large storms, similar to the 1999 storm, will be necessary to erode enough fill to allow nature to stabilize the road/stream crossings. Future contracts should be done by "time and equipment," with an inspector directing the work at each stream crossing and removing enough fill to stabilize road/stream crossings and prevent unnecessary erosion.

What Next?

The watershed monitoring plan has been implemented, and data continue to be collected to further determine the effects of the completed restoration projects. The next scheduled date for an interdisciplinary report of monitoring results is 2010.

Acknowledgements

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Biotechnical Slope Stabilization in Sheep Creek

Pierre Raymond and Dave Putt

In the spring of 1999, a debris slide and earth flow occurred on Sheep Creek Road near Salmo, B.C. The following year, Terra Erosion Control Ltd., in association with Dave Putt of Forterra Consultants Ltd., was retained by the B.C. Ministry of Transportation and Highways (MOTH) to do a field review and recommend biotechnical slope stabilization treatments. Terra Erosion Control implemented the project in May 2001 as a trial for the MOTH. Though the site was challenging for slope stabilization, the work to date has significantly reduced slide and earth flow activity at a cost substantially lower than conventional engineering treatments (e.g., geotextile and rock ballast). This article describes the biotechnical stabilization methods, maintenance, and monitoring work undertaken on site 1 (above the road) and site 2 (below the road, directly above Sheep Creek).

> ***The work to date has significantly reduced slide and earth flow activity at a cost substantially lower than conventional engineering treatments.***

Background

The restoration site lies in the lower Sheep Creek drainage, approximately 11 km southeast of Salmo in southeastern British Columbia. Sheep Creek is a major tributary of the Salmo River, which has a high value sport fishery. This area receives about 750 mm of precipitation annually, most of which falls as snow. Mining development throughout the 20th century has been a major cause of impacts in this drainage. The initial debris slide and earthflow occurred in the spring of 1999, blocking Sheep Creek Road and running into Sheep Creek. A smaller debris slide and earthflow in spring of 2000 again spilled over the road into Sheep Creek. These failures may have been related to old mining activities that altered the drainage patterns on the area upslope, although inspection did not reveal obvious drainage concentration. Removal of toe support during road construction is a likely contributing factor to the instability of site 1.

In April 2001, the MOTH considered three options other than biotechnical slope stabilization:

- placing rock ballast on the toe and lower portion of the slide area above the road (site 1) ($150,000);
- constructing a berm at the toe of the slide ($30,000) with additional annual cleanout and endhauling costs; and
- annually cleaning the ditch and endhauling material deposited on the road ($2,500).

The total cost for the biotechnical slope stabilization project, including