

# As Rainier's glaciers recede, debris chokes rivers

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The fallout from Mount Rainier's shrinking glaciers is beginning to roll downhill, and nowhere is the impact more striking than on the volcano's west side.

"This is it in spades," said Park Service geologist Paul Kennard, scrambling up a 10-foot-tall mass of dirt and boulders bulldozed back just enough to clear the road.

As receding [glaciers](#) expose crumbly slopes, vast amounts of gravel and sediment are being sluiced into the rivers that flow from the Northwest's tallest peak. Much of the material sweeps down in rain-driven slurries called debris flows.

"The rivers are filling up with stuff," Kennard said from his vantage point atop the pile. He pointed out ancient stands of fir and cedar now up to their knees in water.

Inside park boundaries, rivers choked with gravel are threatening to spill across roads, bump up against the bottom of bridges and [flood](#) the historic complex at Longmire. Downstream, communities in King and Pierce counties are casting a wary eye at the volcano in their backyard. There are already signs that riverbeds near Auburn and Puyallup are rising. As glaciers continue to pull back, the result could be increased flood danger across the Puget Sound lowlands for decades.

"There is significant evidence that things are changing dramatically at

Mount Rainier," said Tim Abbe, of the environmental consulting firm ENTRIX. "We need to start planning for it now," added Abbe, who helps analyze Mount Rainier's river systems.

Similar dynamics are playing out at all the region's major glaciated peaks, from Mount Jefferson to Mount Baker, said research hydrologist Gordon Grant, of the U.S. Forest Service Pacific Northwest Research Station in Corvallis, Ore.

Climate experts blame global warming, triggered by emissions from industries and cars, for much of the ongoing retreat of glaciers worldwide.

North Cascades National Park has lost half of its ice area in the past century. Mount Rainier's glaciers have shrunk by more than a quarter. "Every year it's been either bad or really bad," Kennard said. "This year it was really, really bad."

Glaciers buttress immense moraines and stabilize steep slopes. As they pull back, the vulnerable terrain is exposed to weather and tugged by gravity. All recent debris flows on Mount Rainier have occurred in recently deglaciated areas, Grant said.

"The whole mountain is covered with unstable debris, it's steep -- and then you put a lot of water on it," he said.

Most debris flows are triggered by heavy rain. Climate scientists disagree on whether the entire Northwest is being hit by significantly stronger storms than in the past, but there's no doubt that's the case at Mount Rainier, Kennard said.

Precipitation records show more intense rainfall. According to stream-flow data, what was once a 100-year flood on the Nisqually River now

occurs every 14 years. In 2006, a November storm dumped 18 inches of rain on the park in 36 hours, sweeping away a campground and closing the park for more than six months.

"Even without climate change, you've got to say: 'Whoa, something is going on here,' " Abbe said.

Debris flows can carry boulders the size of buses and sweep staggering amounts of gravel and sediment into rivers. The bed of the Nisqually River below its namesake glacier has risen by 38 feet since 1910, largely as a result of debris flows from the margins of the rapidly retreating ice, Kennard said.

The park visitor center at Longmire, with its stone buildings and National Park Inn, now sits more than 30 feet below the Nisqually River. The park constructed concrete-reinforced berms to keep the water at bay.

Every river bed in the park is rising, or aggrading, because of the influx of gravel, Kennard said. The rate of buildup has increased nearly tenfold over the past decade.

The result is a constant and costly battle to keep popular recreation areas throughout the park open. It's a battle that's being lost in many places, like the Westside and Carbon River roads, which are partially closed.

Like conveyor belts, the rivers move the gravel downstream toward more heavily populated areas. A surprise flood that hit the city of Pacific in January 2009 can at least partly be blamed on volume reduction in the White River caused by accumulation of sediment, U.S. Geological Survey hydrologist Chris Magirl said.

Magirl, who has examined aggradation rates and historical records for

downstream river stretches, sees similar buildup in several locations. But channels appear to be deepening in other places, including portions of the Puyallup and Cowlitz rivers. That type of variation is expected in such a complex system, Magirl said. But the long-term outlook for the rivers is not good.

"The potential for glacial retreat to add new sediment is historically unprecedented," he said. "Clearly, water and rock are going to flow downhill."

Glacial retreat may be aggravating the flow of sediment, but the basic process is as old as the volcano itself. Past eruptions have unleashed mud flows that smothered surrounding valleys and reached all the way to Puget Sound.

From the 1930s through the 1980s, Pierce County dredged gravel from the Puyallup River system almost every year to reduce the risk of floods, said Lorin Reinelt, program manager for the county's flood-management plan.

Most dredging ended by the early 1990s, as concern for fish habitat took precedence. Officials also realized that digging out gravel provides only a brief fix, at best, Reinelt said. "In many cases it just fills back up during the next event."

Communities now are trying to figure out what rising levels of gravel and sediment from Mount Rainier will mean for future flood risks -- and what they can do about it.

Short of relocating Longmire, dredging is the only obvious way to keep the river from swallowing the park complex, Kennard said. Downstream, Reinelt said, a more effective approach might be to move levees back to give the rivers more room to spill their banks, meander and deposit

gravel without impacting homes or businesses.

"This is a pretty significant issue," he said. "It seems like we're on a trajectory that's not likely to reverse any time soon."

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