

DAMS AND LOCKS

Shake, Rattle, Respond

Keeping a close eye on dams in earthquake zones

By Matt Alderton

HURRICANE MARIA TAUGHT PUERTO Rico many difficult lessons when it devastated the island in September 2017. One was the importance of critical infrastructure — in particular, electricity. Maria caused the largest power loss in U.S. history, and it took nearly a year and \$3.2 billion to resolve.

Some two years later, electricity was top of mind when Puerto Rico found itself in the midst of yet another natural disaster. This time, earthquakes. Starting on Dec. 28, 2019, and concluding on Jan. 15, 2020, some 10 earthquakes rattled southwestern Puerto Rico.

When a 5.8 magnitude earthquake affecting the region's hydroelectric dams struck on Jan. 6, the government-run Puerto Rico

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Portugués Dam,
Puerto Rico

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Engineers inspect a wall inside the Portugués Dam after seismic activity in January.

Electric Power Authority (PREPA), which oversees the generation, transmission and distribution of electricity, called on the U.S. Army Corps of Engineers to look for damage. Three Corps engineers were dispatched to conduct inspections the following day.

That's when the largest quake — 6.4 magnitude — hit at 4:24 a.m.

"We woke up to the ground shaking," recalled Julio Soto, one of the engineers who, even as tremors continued underfoot, got out of bed and headed to the first of his inspections. Earthquakes continued rocking the island: a 5.6 magnitude quake at 4:34 a.m., a 5.0 magnitude quake at 4:50 a.m. and another 5.6 magnitude quake at 7:18 a.m.

"I was afraid because you never know if something even bigger might happen while you're inside," said Soto. "But that's the risk you have to take when you're an engineer. When a threat

comes, you have to respond."

Soto and his colleagues spent approximately two hours inside four hydroelectric dams near Guayanilla: Carite Dam in Guayama, Lucchetti Dam in Yauco and Portugués and Cerrillos dams in Ponce. At each site, the team analyzed the dam's structural and geotechnical conditions and compared its observations with past periodic inspections to identify any changes.

Fortunately, although they found there was apparent seepage at the toe and downstream face of Carite Dam, which they reported to PREPA for remediation, the Corps was able to report dams mostly were in excellent condition.

The ability to respond so quickly was crucial. "If the dams fail, electricity is affected," Soto said. "But also, lives are at risk. A lot of people live downstream of the dams; if they fail and people are not given enough time to evacuate, it would be a catastrophe."



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Corps geologist Erica Medley conducts rock mapping and inspection within the Fall Creek spillway near Eugene, Ore.

ADVANCE WORK

The Corps prepares for seismic activity in the Pacific Northwest

On Jan. 26, 1700, a 9.2 magnitude earthquake occurred along the Cascadia Subduction Zone, a fault line that extends from British Columbia to northern California. Now, 320 years later, seismologists say the Pacific Northwest has a 40 percent chance of experiencing another large earthquake within the next 50 years.

In response, the U.S. Army Corps of Engineers is mitigating potential impact by shoring up infrastructure — including 19 "high-hazard-potential" dams in Oregon.

"In the Willamette Valley, in particular, there's some really tall dams with some pretty large amounts of water behind them," said Ross Hiner, manager of the dam safety program within the Corps' Portland District. The dams there are vulnerable not merely because the impending earthquake could be so strong, but because they were not constructed with such hazards in mind.

"Because when they were built in the 1930s through the 1950s, and into the late 1960s, it was believed that there was very low risk for an earthquake in this region," explained Erica Medley, a geologist in the Portland District's dam safety program.

Now that more sophisticated science has yielded new earthquake models and predictions, Corps dam safety experts are in the early phases of a yearslong project to conduct analyses of dam conditions. While there's no evidence yet of an emergency situation — "there was a lot of conservatism in the original designs and the dams are very well built," Medley said — the Corps is taking action now to prevent catastrophe later. At Hills Creek Dam near Oakridge, Ore., for example, the Corps has eased pressure on the structure by reducing the water volume by 5 percent to 10 percent.

Although it expects the dams to perform well during most seismic scenarios, the Corps may consider physical modifications to dams if studies suggest they're necessary. "The Portland District is concerned about Cascadia Subduction Zone earthquakes because of the large population centers downstream of the dams," Hiner said. "Due to the potential consequences, we are analyzing the dams for the most extreme and unlikely earthquake scenarios."

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