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Shaking things up in the Paradox Valley

Dennis Webb

Bureau of Reclamation's Paradox Valley Salinity Control Unit facility.

When an earthquake struck on the morning of March 4 in the Paradox Valley in Montrose County, the reverberations were both regional and historic in scope.

As The Daily Sentinel reported at the time, the magnitude 4.5 event was felt as far away as the Grand Valley and Moab, Utah. And as the U.S. Bureau of Reclamation subsequently determined, it's the largest quake ever associated with the bureau's decades-old program of injecting salty water into a well deep underground in the Paradox Valley in an effort to reduce salinity in the Colorado River.

Lisa Block, a geophysicist for the agency, said reports by the public submitted to the U.S. Geological Survey indicate the temblor was felt as far away as Price, Utah, "which is really far away."

"We're kind of having a hard time believing that," she said.

However far the quake's reach, its occurrence served as a somewhat jarring example of the seismicity issues the Bureau of Reclamation has been dealing with at its Paradox Valley Salinity Control Unit going all the way back to 1991. Then, quakes were detected near the injection well within four days after the start of the first injection test.

In the ensuing years, there's been a whole lot of shaking going on in connection with the project. More than 6,000 quakes induced by the injection operation have been recorded, but most were too small to be felt, the agency says. And despite some bigger quakes occurring, the Bureau of Reclamation estimates that seismic events induced by the injection operations cumulatively have caused less than $500 in damages.

Andy Nicholas is the facility operator, working for the Bureau of Reclamation and managing the contractor running the injection operation. He has worked at the site for 27 years and lives in the community of Paradox, and said the earthquakes are more of a nuisance than anything else for local residents. But the quakes, and the agency's efforts to limit their size and number, have had significant impacts on the injection operation itself, which is prompting a current look at alternatives to the existing operation, including possibly beginning to inject in a new well.

River salinity

The facility is the only injection operation the Bureau of Reclamation knows of that is specifically designed to address river salinity. Oil and gas companies inject wastewater that includes salt and other chemicals underground, and that also sometimes causes earthquakes. The Paradox Valley project is designed to help the federal government control salt in the Colorado River to comply with the Colorado River Basin Salinity Control Act, the Clean Water Act and a 1944 treaty with Mexico.

It extracts brine groundwater from shallow wells and injects it 14,000 feet underground into a limestone formation, keeping the salty water from reaching the Dolores River.

The Bureau of Reclamation says the project has been removing about 95,000 tons of salt a year from the Dolores and Colorado river basins, accounting for about 7% of total salinity control in the Colorado River Basin.

But the injection well is reaching the end of its useful life.

"We've seen a decline in the performance of the injection well for several years," Nicholas said.

Pressure in the underground reservoir the well deposits the brine into is increasing, and with it, associated seismic activity.

That has forced the Bureau of Reclamation to substantially reduce brine disposal rates. After quakes of certain sizes, it shuts down the operation, reviews things, and decides whether to restart, sometimes with changes such as taking more rest days between injection operations.

Disposal operations at the well have been halted ever since the March quake. Coincidentally, Nicholas said, operations at the well were shut down just two hours before the quake occurred.

Nicholas and other local Bureau of Reclamation officials still are awaiting more information from a review Block and others in the agency are conducting, and Nicholas expects that they'll meet early next year and make a decision on what to do next.

"We're continuing to investigate and analyze that earthquake and make a determination on how best to proceed operationally," Nicholas said.

He expects the outcome will be a decision to resume operations with a further reduction in injection rates.

In the meantime, with the operation suspended, he said, "there's certainly more salt getting into the river now than there would have been if we had continued to operate."

That affects water quality, wildlife habitat and agricultural operations. But Nicholas said the agency wants to be cautious and not take any unnecessary chances.

A draft environmental impact statement reviewing the agency's long-term options for salinity control in the Paradox Valley says that earthquakes tied to the injection well have been observed 12 miles away. Block said that's a reference to the locations of their epicenters, and the reference is based on information that is a few years old. Quakes associated with the injection well are now occurring with epicenters 15 to 16 miles away from the well, she said.

"But they can be felt over a much wider area," she said.

Still, the ones occurring that far away are much smaller in size, with the larger ones occurring closer to the well, Block said.

The March quake's epicenter was about a mile from the well. Block said as pressures diffuse through the rock underground, the quakes spread out over time, but also get smaller in size.

At some distance from the well no quakes related to the injection will occur, but Block said she doesn't know what that distance will be.

Even after injections at the well stop, seismicity related to it is expected to continue for a few years, though the rates and magnitudes should go down over time, Block said.

"It's hard to predict exactly what it will look like," she said of that continuing activity.

2013 quake

In 2013, a quake measuring magnitude 4.4 occurred and was associated with the injection operation.

Block said that measurement was based on a scale different from the one used today, under which it would have been rated at magnitude 4.0.

“This (March quake) is considerably bigger than the one from 2013,” she said.

The Bureau of Reclamation believes the injection operation could induce quakes up to magnitude 5 to 5.2. Nicholas said that’s about the threshold when quakes cause structural damage.

“We certainly don’t want to get to that point,” he said.

The Bureau of Reclamation is considering three new approaches to its salinity control project in Paradox Valley, along with a do-nothing alternative in which use of the existing well eventually would reach its end and the Paradox Valley salinity control project would conclude. One alternative involves using evaporation ponds, and another is a heat-based crystallization plant.

A third involves using a new injection well.

The evaporation pond and treatment plant approaches each would remove more salt than a new injection well.

But both would require creating a landfill for the salt that is removed, and the evaporation ponds would have visual impacts and impacts to migratory birds.

The crystallizer approach would require a lot more energy than the other methods, and cost significantly more per ton of salt removed.

As for the third alternative, the Bureau of Reclamation would operate a new injection well at one of two locations, one a mile and a half or two from the current well, and the second about 20 miles away, Nicholas said.

The agency’s modeling indicates either of those wells would tap a much larger underground reservoir than the one reached by the current well, and that it could have a 50-year operational life, and result in less-frequent and smaller earthquakes than in the case of the current well.

The sites also are farther from populated areas, reducing potential seismic impacts to residents in places such as Paradox and Naturita.

The Bureau of Reclamation hasn’t identified a draft preferred draft alternative.

It is holding two upcoming meetings on its alternatives:

n Jan. 14 in Paradox at the Paradox Valley Charter School, 21501 6 Mile Road, at 5 p.m.

n Jan. 15 in Montrose at the Holiday Inn Express & Suites, 1391 S. Townsend Ave., at 6 p.m.

It also is accepting comments on the draft environmental impact statement through Feb. 4. They may be emailed to paradoxeis@usbr.gov or mailed to Ed Warner, Area Manager, Bureau of Reclamation, 445 West Gunnison Ave, Suite 221, Grand Junction, CO 81501.

The draft EIS may be found at www.usbr.gov/uc/progact/paradox/index.html.