

Utilities plan and budget for pipeline rehabilitation projects in advance. But when Mother Nature unleashed a magnitude 4.7 earthquake on one of its canals, the Truckee Meadows Water Authority shifted into high gear to maintain its water supply and repair an aged flume. **BY JENNIFER SANZI**

# MOTHER NATURE HASTENS PIPELINE REPAIR

**T**HE TRUCKEE MEADOWS Water Authority (Reno, Nev.) knows that preparation is the key to surviving a crisis, and that knowledge served the utility well on April 25, 2008, when an earthquake damaged a section of its Highland Canal in the northwest part of the city. Serving 330,000 residents as the largest water purveyor in the area, TMWA was confronted with the worst system damage in its history.

Between February and May 2008, Reno residents became accustomed to daily small earthquakes. The peak of what seismologists called an “earthquake swarm” occurred Friday night, April 25, at 11:40. Just a few miles from the epicenter, TMWA

shift workers felt the same shaking that woke customers throughout the service area. The quake rattled cupboards, broke glass, and cracked walls throughout Reno.

In northwest Reno, the earthquake triggered a rock slide that destroyed a 200-ft section of flume at the Highland Canal, TMWA’s primary raw water conveyance system, which supplies 50 mgd of raw water through gravity flow to the Chalk Bluff Water Treatment Plant. Built by Chinese laborers in the 1800s, the wooden flumes and some canal sections have been restored throughout the years. The Chalk Bluff Treatment Plant, owned and operated by TMWA, is the largest treatment facility in the distribution system.

PHOTOGRAPHS: TRUCKEE MEADOWS WATER AUTHORITY

A rockslide, triggered by an earthquake, destroyed a 200-ft-long section of flume that was close to homes in northwest Reno (top). Crews worked around the clock to minimize property damage and stabilize the slope (middle). The damaged section was bypassed with a temporary 54-in. aboveground HDPE pipe that was designed to withstand earthquakes of the same magnitude (background, bottom).



## Distribution



Damage from the earthquake caused the Chalk Bluff plant's net output capacity to drop from 83 mgd to 60 mgd—the maximum raw water pumping capacity from a pump station along the river below Chalk Bluff. The damage occurred as the city was entering the hottest part of the year and peak demands.

### SKILLED RESPONSE

TMWA staff immediately implemented an emergency shutdown plan for the canal, which had been developed by Bill Hauck, TMWA water supply and reservoir coordinator. As luck or strategy would have it, the plan had been reviewed by all hydro-electric generation personnel the morning of the quake. Hydro crews are responsible for operating the Highland Canal, and each crew member knew what to do and where to report in the event of flume damage.

Hydro plant operator Jackson Bergland was en route to the canal before the shaking stopped. Other crew members were also on their way to inspect the canal when a customer called to report serious damage to the flume. With his home only a half mile from the canal's headgate, Bergland was first on the scene, and

he secured the gate within about 10 min of the earthquake.

Simultaneously, Bob Hackbarth, another hydro plant operator, began pulling spill boards, allowing the canal to drain upstream of the damaged flume section. Hydro plant foreman Bob White headed to the primary spill structures and helped Bergland open additional gates to drain the canal. All this work was completed within 30 min of the earthquake. Crews continued to work throughout the night to assess damage, isolate the affected flume, and minimize property damage to nearby homes.

### RESTORING SUPPLY

To maintain customer service without water supplied by the Highland Canal, TMWA needed to immediately rely on its smaller, secondary Glendale Water Treatment Plant and 32 groundwater wells to offset the 23-mgd capacity loss from the Chalk Bluff plant, which then had no reserve raw water capacity. Unfortunately, because construction errors had caused two newly installed water pumps to fail, the Glendale plant had been drawn down to two-thirds of its capacity. With remaining

capacity at the Chalk Bluff plant, reduced capacity from the Glendale plant, and the groundwater wells, TMWA could supply a total of 116.5 mgd. Although April demand was about 95 mgd, summer was just around the corner, and peak demand was predicted to be 140–145 mgd on the hottest days.

**River Water.** TMWA managers and operators began researching options to offset the loss in system capacity, including renting pumps and pipes from a company that helped drain water in New Orleans after Hurricane Katrina. A temporary station was set up to pump water directly from the Truckee River, Reno's main drinking water source, to the Chalk Bluff plant at a 160-ft elevation gain. The pumps supplied 35 mgd of river water to the Chalk Bluff plant, providing enough raw water capacity to operate the Chalk Bluff plant at its 83-mgd capacity.

However, the 12 gas-guzzling diesel pumps—each using nine gal of diesel fuel per hr—cost TMWA \$390,000 per mo to move raw water to the plant. Additional costs included sound mitigation to protect neighboring homes from noise pollution and around-the-clock security monitoring. Although expensive, the solution was successful and gave TMWA time to find a more cost-effective solution for meeting summer demand.

**Cooperative Efforts.** Strong relationships with the board of directors and other entities, local contractors, and customers proved invaluable throughout the summer. On May 7, TMWA's board approved more than \$2.2 million in additional funding to operate the diesel pumps and construct a temporary, cost-effective solution that would keep water flowing to customers during summer demand.

TMWA's engineering, operations, and financial staffs needed ideas on how to restore the Highland Canal water supply to the Chalk Bluff plant and asked local contractors to help. A viable solution needed to include how to maneuver construction workers, vehicles, and tools up

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TMWA rented 12 diesel pumps and set up a temporary pump station to increase raw water supply to its treatment plant.



a steep slope laden with large, unstable boulders. Contractors rose to the challenge and responded with several resourceful designs.

Ultimately, a Nevada-based construction company bypassed the damaged section with a 54-in. aboveground high-density polyethylene (HDPE) pipe that was designed to withstand earthquakes of the same magnitude. Construction began in June, and by August the extensive work had restored gravity flow and eliminated the need for diesel pumps. The total project cost was \$780,235, which was offset by the energy and operational savings associated with the temporary diesel pump station.

#### **LOOKING TO THE FUTURE**

Although TMWA employees were trained and ready to respond to the earthquake damage, the events of April 25 changed the authority's outlook.

**Project Fast-Track.** When TMWA's board of directors approved funding for the temporary aboveground pipe, it also authorized TMWA to fast-track the Mogul Bypass project, which was already in the Capital Improvement Plan but

was deemed more urgent in the wake of earthquake damage to the Highland Canal. When completed, the \$14 million Mogul Bypass project will replace all of the Highland Canal/flume system with an underground pipe delivery system. The wooden flumes will be permanently replaced with modern resilient materials. In addition, HDPE pipe used for the temporary solution will be reused on another Highland Canal project that will increase the canal's delivery capacity. The project is currently scheduled for completion in early 2010.

In an effort to decrease the costs of providing Truckee Meadows residents with high-quality water, the Mogul Bypass project will also allow TMWA to expand Highland Canal's total capacity from 55 mgd to 95 mgd. Crews have installed 3,800 ft of concrete boxes—478 boxes, each measuring 12 ft x 5 ft and weighing 33,700 lb—that will allow gravity to convey raw water from the Truckee River to the Mogul Bypass. This gravity flow will eliminate the need to pump water to the Chalk Bluff plant, providing energy cost savings of more than \$400,000/yr.

**Technology.** When the earthquake damaged the flume on the Highland Canal, the canal's head gates couldn't be operated by TMWA's supervisory control and data acquisition (SCADA) system. Since that time, TMWA has reconfigured the system so the head gates can be closed automatically by the SCADA system. However, the spill structures are still operated by hand. TMWA also installed additional surveillance equipment at the flumes to allow staff members to monitor water levels more closely. This information feeds directly to the water treatment plant control rooms.

#### **PLANNING EQUALS SUCCESS**

Distribution system redundancy and a rapid, skilled response allowed TMWA to survive the worst damage in its system's history and continue delivering high-quality drinking water to its customers. The Chalk Bluff Treatment Plant remained in service, operating at 75 percent of normal capacity, while the rest of the community's water needs were met by wells, a second water treatment plant, a temporary pump station, and the HDPE pipe project.