By Pamela Flasch

Freezing Winter Storm Grayson Takes South Carolina's Infrastructure And Response Effort To The Bursting Point

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he Sea Islands near Beaufort, South Carolina, are known for year-round golf, beaches, and temperate winters that attract snowbirds. Most Januaries boast an average temperature that lies in the fifties. January 2018 was not like most.

Winter Storm Grayson dumped about four inches of snow on the area, the highest amount in nearly seven years. Temperatures hovered at or below freezing for a week, causing closures and damaged infrastructure–especially burst pipes– throughout the area. From the top to the bottom, team members at the Beaufort-Jasper Water & Sewer Authority (BJWSA) knew they had to be vigilant and prepared. Beaufort County is 38% water. Moreover, the Authority has waterlines that run alongside or under more than twenty bridges or causeways in the county.

A BREAK UNLIKE ANY OTHER

Winter Storm Grayson generated 189 work orders, of which close to 100 involved minor leaks. But one particular service call at the McTeer Bridge would be unlike any other on that day, previous days or subsequent days.

Thirty-year company veteran, Mark Throne, a utility compliance supervisor, who was six months from retirement, and his crew, typically experienced winter as a welcome break from long 90 plus-degree days with high humidity. But on that particular morning, bitter winds battered them atop the 90 plus-foot-high McTeer Bridge, and if not for the sturdy chin straps, would literally have blown the hard hats from the crew members' heads.

As Throne's team turned the water off to repair an air release valve on the bridge's attached twelve-inch

waterline, they noticed that a huge volume of water was continuing to gush from the line near the spot where the line was buried in the river. Unfortunately, the location of this newly discovered leak presented challenges that were unlike anything the crew had ever encountered, guaranteeing the need for unique repair solutions and methods.

Andy Mattie, current field operations manager for BJWSA, was part of that team. "The tide was up," he remembers, "and we could see that the water was stirring not far away from the valve we were repairing, making it difficult to determine the source of the motion in the water."

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It was not until low tide that Mattie and Throne saw the origin of the running water: a major 200 gallon-per-minute (GPM) leak on the twenty-inch waterline that coursed through the saltwater marsh adjacent to the bridge approach from Lady's Island.

Installed in 1992, this critical supply line involved twin twelve-inch lines attached to the bridge that connected to a twenty-inch mainline buried in the marshes. The waterline was critical to water operations for 9,400 customers on the Lady's, St. Helena, Dataw, Fripp, and Cat Islands. Without it, the service area would not be able to meet minimum service standards. Crews



determined that the leak was controllable and established protocols for its periodical inspection while a repair plan was developed.

The line's leaky fitting was very near piles that had been constructed during an expansion of the McTeer Bridge. The area around these piles had a tidal fluctuation of more than eight feet two times per day. Investigation suggested that the change in the river flow that the new piles had caused, had most likely eroded the cover over the pipe.

PHASED REPAIR, COLLABORATIVE EFFORT

Because of this criticality, the resulting project will be completed in two phases. The first phase covered the engineering and permitting efforts associated with the repair design. The second phase will cover the actual repair effort.

The immediate need-to find and stop the source of the leak-led BJWSA to partner with BRW Construction Group, LLC, from nearby Savannah,

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Georgia. The group made emergency repairs to reduce the leak from 200 GPM to less than 20 GPM by replacing the failed bolts. To stop the leak completely, a special repair sleeve was designed and installed sixty days after the emergency repair. The total cost of the repair effort was over \$90,000-with 90% of the amount covering such unusual expenses as barges and divers.

The waterline was buried deep in saltmarsh. Over the years, as the marsh mud had shifted, this section of the line had become exposed to the environment. As a result, the bolts holding the restrained joints together had rusted and failed.

"BRW certainly performed their due diligence," says Justin Thomas, director of field operations for BJWSA. "The section of waterline from the point it leaves the bridge up to the sandy part of the marsh was installed with the same restrained joint material. So one would assume there is a strong chance that, if one of the components has failed due to corrosion, that others would as well."

CONTINUOUS ANALYSIS AND ASSESSMENT

Black & Veatch (B&V) was hired to assess the condition of the pipe, estimate the remaining useful life (RUL) of the McTeer pipeline, and identify future assessment, repair, or replacement alternatives.

The firm conducted the condition assessment concurrently with the repair that BJWSA and BRW completed. To facilitate the gathering of additional data, the work plan for the condition assessment included additional inspections of the pipe in the area where it transitioned from being exposed to being buried near the bridge and at an adjacent section of pipe. BRW's barge provided workplace support of excavation during the inspection.

B&V subcontracted with Structural Integrity Associates (SIA) to perform guided wave testing (GWT) and B-scan ultrasonic surveys

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and analyses. GWT is an ultrasonic method that directs sound along the length of the pipe using G-scan equipment. The GWT system is a lowfrequency ultrasonic guided wave technique that detects internal and external corrosion. Ultrasonic methods provide data regarding the interior and exterior corrosion of a pipe as well as actual condition data.



MULTIPLE APPROACHES

B&V used a combination of approaches to assess the pipe in three inspection locations during the repair, including wall assessment that employed ultrasonic technologies, metallurgical testing, and soil testing.

The RUL analysis of the bolts from inspection of Location 3 showed that they had a RUL of at least five years assuming they remained in contact with backfill and were not exposed directly to seawater. From a conservative standpoint, it would be unwise to assume that all of the tide-influenced bolts were performing similarly well.

The RUL of the pipe was estimated using two approaches grounded in expected and observed pipe and soil properties. Both approaches involved comparing the estimated pit depth to the allowable pit depth based on external and internal load calculations. In the expected approach, the expected depth of current corrosion was estimated using typical parameters for iron pipe and field-identified values for soil resistivity, pH, and aeration.

The second approach, which was the observed approach, accounted for the maximum pit depths observed in addition to the soil parameters measured during the inspection. Based on the expected values, the pipe was predicted to have exceeded its useful life already because the soil was aggressive and the pipe was not protected.

However, the observed maximum pit depths showed substantially less corrosion than predicted, indicating that there was potential for remaining life. Given that the observed pit depths were based on limited data and varied significantly from the expected values, a more conservative model was used. It averaged the expected and observed RUL estimates to account for uncertainty in the unobserved sections of pipe.

SEEING LIGHT AT THE END OF THE PIPELINE

The resulting RUL was approximately five years. BJWSA has already initiated plans to replace the portion of exposed pipe that extends between the McTeer Bridge and the saltwater marsh. Due to the significant level of corrosion at this location, B&V recommended using shop-applied Ceramawrap epoxy coating by Induron for this installation. The final phase of construction/repair begins in early 2019–weather permitting.

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