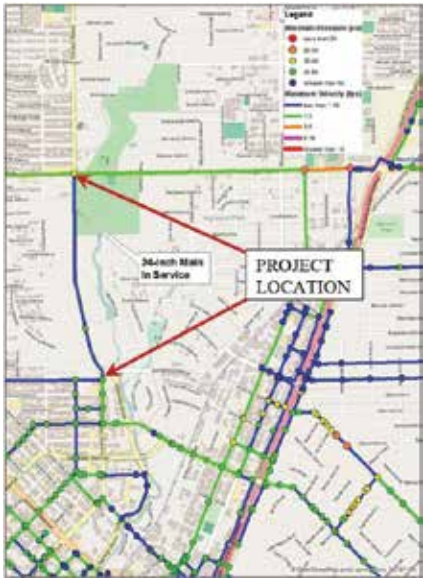
Dallas Water Utilities uses Sliplining to Rehab Aging Waterline in Urban Setting

By: Kevin Minkler, P.E., Pacheco Koch,
Eduardo Valerio, P.E, Dallas Water Utilities,
Thelma Flores Box, P.E., Pacheco Koch,
Shawn Garcia, P.E., Kyle Wroblewski, P.E., Underground Solutions Inc.



Preston Road is the major north-south thoroughfare in the Town of Highland Park

The Town of Highland Park ranks among the top 10 wealthiest communities in the U.S. The affluent community, surrounded by the City of Dallas, is home to many Texas sports and business icons. Preston Road is the major North-South thoroughfare through the Town. It's a collector with consistent heavy traffic flows and bordered by large estates. When construction is performed in this area, lots of emphasis is put forth to mitigate social impact to the community. This project would run adjacent to Jerry Jones' residence, the Dallas Country Club, and Highland Park Village, an upscale shopping plaza and National Historic Landmark.

In 2016, the Town of Highland Park, Texas began a street improvements project on Preston Road. This project caused Dallas Water Utilities (DWU), the wholesale provider to the Town, to evaluate options for the 5,100 linear feet of 24-inch water transmission main located under the road. This transmission line was originally installed in 1920. Decommissioning and removal from service was evaluated as well as full replacement and rehabilitation options.

Pacheco Koch Consulting Engineers, Inc. was contracted to evaluate these options for the water transmission main. They utilized a copy of DWU's H_2OMap hydraulic model, which included Summer Day and Winter Day Extended Period Simulation (EPS) scenarios. Since development near the project location was already near buildout and fully developed, there'd likely be no significant changes in demand patterns in the future.

Pacheco Koch ran the hydraulic model with the 24-inch main in Preston Road in service versus the main abandoned. This revealed only a slight difference (negligible velocity changes and system pressure) when comparing system performance with the 24-inch main in-service versus out-of-service. A parallel 36-inch transmission main located just east of Preston Road provides DWU significant north-south transmission capacity in the area even with the 24-inch main removed from service.

Although the DWU system performance was not impacted by the abandonment of the 24-inch transmission main, the Town of Highland Park needed to maintain service to its Emergency Interconnection, the only service point along this section of pipe. The decision was made to reduce the size of the main from 24-inches to 12-inches to match the piping at the Interconnection. This would improve the water quality by reducing the water volume and age.

Sliplining using FPVCP supports long pull length and large pull forces

DESIGN

Due to the high-profile project location, consistent heavy traffic flow, and affluent residential and business populations, it was established that a trenchless methodology would be a better option in lieu of open cut in order to avoid extensive disturbance to the area. Because system capacity wasn't an issue, and with consideration to the clay filled soil in the area, sliplining was determined as the most advantageous rehabilitation solution. The existing 24-inch main would provide a suitable casing host pipe, allowing for the sliplining process to be streamlined, and providing an additional barrier of protection from traffic loading above.

This method also allowed for minimum disruption to existing utilities. A storm sewer network of pipes parallels and

Existing 24-inch main provided suitable casing host pipe for the 12-inch FPVCP

crosses Preston Road. This includes inlets and manholes within the right-of-way. In addition, telephone conduits, that run the entire length of the project, are located on both the east and west sides of Preston Road. Buried telephone cable is also located within the project area. Gas lines traverse the pavement in both north-to-south and east-to-west directions. Electrical service is underground and runs along the length of the road.

Since as-built drawings for the 24-inch water transmission main were not available due to the age of the installation, ground penetrating radar was used to locate the main horizontally and vertically, and to establish the location and dimension of curves along the main.

The determination of the curvatures of installation was particularly critical in guiding the selection of pipe material. The maximum deflection angles of pipe joint are restricted by DWU to 80 percent of the manufacturer's recommendation. In addition, the maximum allowable pull-in force and maximum straight pull length were compared. DR14 Fusible Polyvinyl Chloride Pipe (FPVCP), DR14 RJ Polyvinyl Chloride Pipe, and DR7.3 High-Density Polyethylene Pipe were all evaluated during the selection of pipe material.

FPVCP was sole sourced as the pipe product for the project. Its jointless, gasket-less, fully restrained nature provided the benefits of a fused monolithic piping system as well as the traditional preference for Polyvinyl Chloride Pipe in water systems due to the material's inherent resistance to corrosion and hydrocarbon contamination. In addition, it had the largest Maximum Pull-in Force. Also, its curve radius would allow the pipe to be safely pulled through the existing vertical curves, while its uniform cross section would allow the pipe to rest on the invert of the host pipe and be fully supported along its length. The use of standard waterworks appurtenances was an added benefit as well, since connections to PVC pipe are common to DWU (Standard waterworks fittings used to tap, connect, and change direction).

BIDDING

In mid-April, 2018, the project to rehabilitate the 24-inch transmission main was bid simultaneously with the project to reconstruct Preston Road. In order to allocate costs appropriately, separate bid forms were included in the bidding documents. Seven bids were received on April 30, 2018. At $4,197,437.88, the low bidder for the combined projects was Ragle, Inc. This amount included $1,048,200.00 for the downsizing of the

Sliplining method allowed for minimum disruption to existing utilities

24-inch water main by North Texas Contracting, Inc., which was 63 percent of the engineer's $1,669,374.00 estimate.

CONSTRUCTION

Construction was started in August, 2018. Preston Road is a 4-lane road and required the closure of one north-bound lane of traffic, adjacent to the east-side curb line, for the fusion, insertion and pulling processes. The entry and exit pits were installed at approximately 800-foot intervals. Although the pipe could be pulled over greater lengths, the interval length was limited to accommodate the cable lengths available for cleaning, CCTV and sliplining.

12-inch diameter DR14 FPVC was delivered in lengths of 45 feet and fused on-site by Underground Solutions (UGS). UGS provided a technician trained and certified in the fusion of PVC pipe to ensure the integrity of the joints. Each joint fusion performed was recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report was generated by software developed specifically for the butt-fusion of FPVCP.

Prior to construction, the existing 24-inch transmission main was prepared for the insertion process. This included cleaning, pigging, and inspection using CCTV. Since the emergency interconnection, the only service point along the main, could be fed from either the north or the south, temporary water service was not required. Instead, the emergency interconnection would be fed from the north, while construction was being performed south of the interconnection, and fed from the south while the construction was being performed north of the interconnection.

The installation was performed in seven pulls of approximately 800 feet to meet standard cleaning cable length. Prior to each pull, two 300 to 400-foot lengths of pipe were fused. This length was based on the available laydown length, which was limited by driveways to the adjacent properties. The fusion at each joint required approximately 45 minutes (time varies with ambient temperature conditions). Near the end of the insertion of the first length of pipe, the second length of pipe was fused to the first and the insertion process continued to completion. Each pull was completed in the normal eight-hour workday.

Upon completion of sliplining, the newly installed pipe was pressurized per DWU requirements to test for any leaks. The test water remained in the pipe to keep it on the invert prior to grouting, which prevented any floating. Bulkheads at the ends of the section of pipe to be grouted, and vents equipped with ball valves and pressure gauges were installed. The annular space between the 24-inch and the 12-inch pipes was then filled using low-density cellular-grout with a density of 55 pcf. Low-density cellular-grout is highly flowable and highly pumpable, excellent at filling small irregular shaped voids, and lighter weight than standard sanded grout. It also has lower heat of hydration temperatures. These attributes make low-density grout ideal for annular space grouting. The ball valves and pressure gauges were used to monitor both the pressure testing and the grouting processes.

In total, the entire project to rehabilitate the 24-inch transmission main was completed in six weeks; however, this project experienced a three-month delay following the installation of the entry and

Each pull of approximately 800 feet was completed in a normal eight-hour workday

exit pits. The delay occurred because the valve required to shut off the water to the 24-inch main from the north was found to be inoperable. The upstream shut off point was at a pump station, which if exercised, would result in the loss of water service to many citizens and businesses. Instead, DWU opted to order a new 24-inch valve for installation by the contractor to replace the inoperable valve.

CHALLENGES AND LESSONS LEARNED

The project to rehabilitate the 24-inch water transmission main under Preston Road in Highland Park was constructed as designed. The difficulties encountered were associated with an inoperable valve that resulted in a three-month delay. The three-month delay extended the construction period into the Christmas Season, which resulted in demobilization to avoid interfering with shoppers' access to the upscale Highland Park Village. The delay in the construction schedule could have been avoided by exercising the cutoff valves prior to initiating construction and rectifying the issues presented.

Each joint fusion done was recorded by a data logger on the fusion machine

CONCLUSIONS

Sliplining using FPVCP provides the following benefits:

- Jointless, gasket-less, fully restrained piping system
- Resistance to corrosion and hydrocarbon contamination
- Small minimum curve radius to provide safe pulling through both vertical and horizontal curves
- Long pull length and large pull force
- Uniform cross section that allows the pipe to rest on the invert of the host pipe and be fully supported along its length
- Ability to use standard waterworks fittings/appurtenances at all cross-connections and tie-ins

The use of low-density cellular-grout to fill the annular space between host and carrier pipes also benefits projects by providing a support material with the following attributes:

- Highly flowable and highly pumpable
- Excellent at filling small irregular shaped voids
- Lighter weight than standard sanded grout

In combination, sliplining using FPVCP and low-density cellular-grout provides a piping system that is cost-effective and constructible. For the project to rehabilitate the 24-inch water transmission under Preston Road:

- Cost-effective: $205 per linear foot installed cost
- Constructible: Six-week construction time

Laydown length was limited by driveways to adjacent properties

ABOUT THE AUTHORS:

Thelma Flores Box, P.E. *is an Associate Principal with Pacheco Koch and is the Director over the Utility Infrastructure Group. She is involved in the development, design, construction, and management of water and wastewater treatment and conveyance projects and studies for public and private sector clients. She has 37 years of experience in utility infrastructure. Thelma received her Bachelor of Science degree in Civil Engineering from the University of Texas at Austin and her Master of Science degree in Civil Engineering from the University of Texas at Arlington.*

Shawn Garcia, P.E. *is a licensed Professional Engineer in the state of Texas and currently serves as the North Texas/Oklahoma Regional Manager for Underground Solutions, where he manages and oversees all business development, operations, and activities in the region. Shawn has over 18 years of engineering development, design, and construction management experience in the Municipal Water/Wastewater Infrastructure Rehabilitation and New Construction industry. He received a Bachelor of Science in Engineering from Texas Tech University.*

Kevin Minkler, P.E. *has been with Pacheco Koch for the past 7.5 years with a primary focus on the design of municipal facilities, public works, and utility infrastructure projects. He is currently involved in managing several DWU water/wastewater segments assigned to Pacheco Koch. Kevin received his Bachelor of Science degree in Civil Engineering from Texas A&M.*

Eduardo Valerio, P.E. *earned a Bachelor of Science degree in Mechanical Engineering from the University of Texas at El Paso and has a Professional Engineering License in the State of Texas. He has over 16 years of experience with Dallas Water Utilities, working in the Pipeline Project Management and Engineering Services programs.*

Kyle Wroblewski, P.E. *is a Regional Engineer for Underground Solutions. He has a degree in Civil Engineering and experience in utility design from working in consulting engineering, the PVC Pipe Association, and a manufacturer of waterworks gaskets and restraint products.*