

PIPE BURSTING WATER LINES IN LIMITED ACCESS LOCATIONS

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PROJECT HISTORY

The Town of Highland Park, Texas, occupies an area of approximately two and one-half square miles, encircled by the City of Dallas. The small, influential community first experienced development around 1900, and was mostly developed by 1940. In the oldest areas, the portion of the Town's water distribution system that services its residential customers is generally cast iron, and lies within narrow easements. The easements have had a 75-year opportunity for vegetation, trees, fences and other structures to encroach; in some cases restricting working space to less than 8-feet. Due to numerous water line breaks, exacerbated by an increased water demand from new large homes constructed to replace the original 1925 cottages, the Town is faced with replacing these water lines.



Figure 1- Average value of homes in Highland Park exceed \$500,000



Figure 2 - Easements in the project location were overgrown and congested with utilities

In 1997, The Town completed a Sewer System Evaluation Study (SSES) on the eastside wastewater collection system. Recommended improvements from the study were incorporated into a five-year rehabilitation program. A portion of the planned sewer line replacements is located within the same easements that the water lines occupy. The need to replace the water lines due to condition, as well as to increase the size from 6-inches to 8-inches, was addressed by inclusion of the water main replacements with the sewer replacement projects.

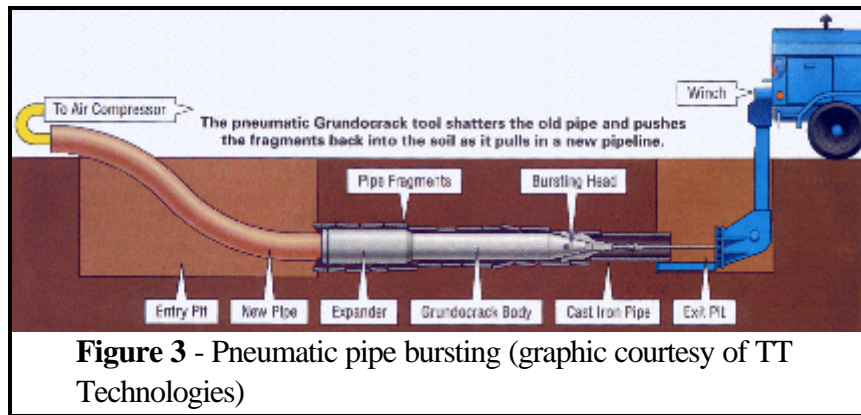
Earlier construction in similar easements using open cut methods resulted in high construction costs and lengthy, disruptive construction periods. In other areas of the Town, trenchless technology has been used successfully to replace sewer lines. Why not consider using the same technology to replace the water? The Town believed if the contractor were to replace the water using trenchless methods, the disruption would be minimal, and access would be less of a factor in

the construction costs. Once the decision was made to consider trenchless methods as a construction alternative to open cut, the next step was to evaluate the types of trenchless systems that were available for water replacement that have been successfully used for installation runs of at least 700 linear feet.

PIPE BURSTING

Pipe bursting had been previously utilized to replace undersized, deteriorated sanitary sewer in the Town. Since the water lines in need of replacement were cast iron, pipe bursting equipment could be used to burst them. Pipe bursting technology was developed in England by British Gas to replace gas lines where access was not possible by open cut. Two types of bursting methods are currently being used, hydraulic and pneumatic, both technologies licensed by British Gas to manufacturers in the United States.

The hydraulic process, as with the pneumatic process, requires a launch and exit pit. The hydraulic equipment is placed in the exit pit, and guide rods are assembled and pushed through the host pipe to the launch pit. The bursting head, expander, and new HDPE pipe are attached to the guide rods. The assembly is then pulled through the host pipe, crushing it into the surrounding soil.



The pneumatic bursting process is similar to hydraulic, except the bursting tool hammers the host pipe, fracturing it. The fragments are pushed into the soil as the tool progresses through the pipe. A cable is attached to the bursting tool that runs through the host pipe to a winch at the exit pit. Tension is kept on the cable during the bursting process, and serves mainly to guide the tool. The pneumatic tool, depending on soil conditions, size and type of pipe, and how much “upsizing” is required, is capable of bursting pipe segments greater than 700 feet.

The hydraulic tool cannot negotiate curves as well as the pneumatic tool. Since the water line quite possibly meandered in the easement, and the pneumatic tool can negotiate curves more easily, it was the preferred method to be used for this project.

HORIZONTAL DIRECTIONAL DRILLING

In addition to pipe bursting, horizontal directional drilling (HDD) was evaluated. Directional drilling has been used extensively in the oil and gas industry to install new conduit where access was difficult, or prohibited by surface conditions. Installations requiring large diameter pipe and drilling runs of as long

as 3000 linear feet have been completed, thus exceeding the Town’s requirements. Unlike pipe bursting, HDD does not rely on a host pipe for installation of the new conduit. The availability of Certaineed “Certa-Lok” PVC, a restrained joint pipe that has been successfully installed by HDD, made this an appealing construction method.

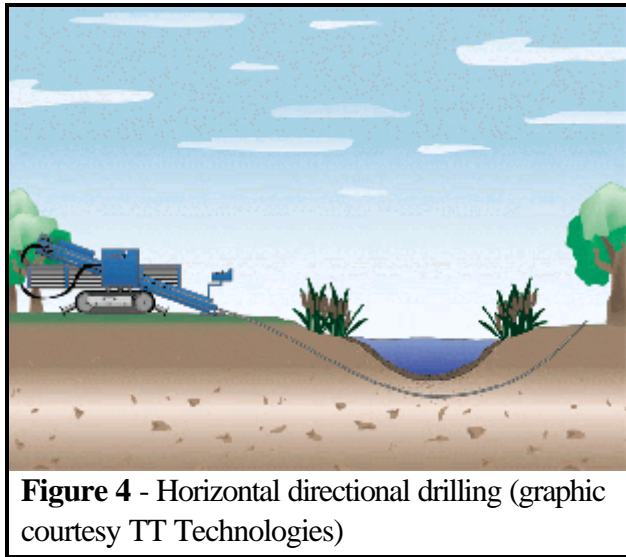


Figure 4 - Horizontal directional drilling (graphic courtesy TT Technologies)

HDD is a two step process. First, a pilot bore is made where the conduit will be placed. The drill head is equipped with a transmitter that generates a magnetic field that is interpreted by a receiver as depth and direction. This technology tracks the vertical and horizontal location of the drill as it progresses from the entrance to the exit location. Second, a drill large enough to accommodate the pipe to be installed is pulled back through the pilot bore. The conduit is attached to the drill and pulled behind it as it is withdrawn from the original entrance location.

CONSTRUCTION DOCUMENTS

After evaluating the trenchless methods discussed above, and determining each would be acceptable; the decision was made to specify pipe bursting, HDD, and open cut in the construction documents. By doing this, contractors that might be excluded by omission of a particular construction method, would have the opportunity to bid the project. The construction plans were designed and contract specifications prepared to give contractors the option to select the construction method. The successful low bidder selected pipe bursting for the water line and sewer line replacement.

CONSTRUCTION

Presented with the history of breaks in the cast iron water mains, the contractor, Barson Utilities, Inc., was directed to replace the water main prior to the sewer. Replacing the water main first prevented the possibility of its rupturing due to vibrations from the bursting tool during sewer replacement.

Since the water mains to be replaced were the only source of water for the residents, temporary water mains were installed prior to beginning



Figure 5 - Temporary water lines could meander within easements

replacement. Certainteed “Certa-Lok” 2-inch PVC pipe was used for the temporary water lines. Since there would be no large excavating equipment needed in the easements, the temporary water lines could



Figure 6 - Town park was available for equipment staging

be installed above ground without concern that they would conflict with construction activities. The existing water line was approximately 3.5 feet below grade, so access pits at the service connections were excavated by hand. Once the temporary lines were cleaned and tested, the line was pressured, and the residential services were connected.

Insertion and exit pits for the bursting equipment were constructed at the ends of the easements where access was not restricted. Although there was plenty of room for the pits, an area only ten feet long and six feet wide was necessary for each pit. High Density Polyethylene Pipe (HDPE)

DR-14 was specified for the replacement pipe; welded together to provide a continuous conduit for the entire length of pipe to be replaced. A Town park was available as the staging area for the new HDPE. Were this not possible, the pipe is flexible enough that it could have been placed along the curb line of the adjacent streets. Once the HDPE was attached to the bursting tool and in place, a cable was strung through the old pipe that connected the bursting tool to the winch at the exit pit. Bursting began, and the tool progressed at approximately three feet per minute. The entire bursting operation was completed without encountering any significant problems in four hours.

New service connections were made at each meter location using a full circle brass service saddle. Tees for fire hydrants were ductile iron, restrained with Mega-lug joint restraints. HDPE pipe manufactures now have saddles and fittings available that can be fuse welded to the pipe. Once the service connections were in place, the new line was cleaned and tested.



Figure 7 - Insertion pits were approximately 10' x 6'

The only problem encountered during the project was the length of time necessary to clean the line for a satisfactory lab test. Even though special filters were used on the air compressor to remove any oil that might get into the pipe, the line had to be chlorinated three times before an acceptable lab result was returned. This problem was due to the contractor using a bursting tool that was not cleaned prior to pipe installation. The use of a new, or thoroughly cleaned bursting tool, as well as a polyethylene cover slipped over the air hose would alleviate this problem.

After a “good” lab report was received, the new main was connected to the existing water main, and services changed over from the temporary water line. Access pits and service tie locations were covered, and the easement graded and sodded. The entire installation was completed in fifteen working days, exclusive of lab testing. Noise from the bursting equipment lasted for only four hours, as compared to a similar open cut project where over five weeks of equipment movement took place within the easement. Not only was noise pollution reduced, but there was no trench spoil to store, and no embedment to truck into the easement. The result; minimal citizen complaints during the construction period -- a welcome outcome on any project. The cost to the Town of Highland Park for clearing the easements, installing the new main with all appurtenances, grading and sodding was \$103 per foot. This represented a savings of nearly 30 percent over previous open cut replacement in a similar area.



Figure 8 - Completed project - water and sewer replaced in easements with minimal disruption to citizens

CONCLUSION

The project was completed successfully on the anticipated schedule, at a lower cost per foot than previous open cut projects, and with minimal disruption to the residents. Replacement of cast iron water lines can be accomplished using pipe bursting techniques. In areas of limited access, pipe bursting not only provides a replacement solution with minimal disruption to residents, but is a cost effective alternative to traditional open cut installation.

PRESENTED BY THOMAS A. HARRIS, P.E.

Thomas A. Harris is a Senior Project Manager with RJN Group, Inc. Mr. Harris has more than 21 years of progressive engineering experience, including six years as Water/Sewer Engineer for the City of Farmers Branch, TX. During his tenure at the City, he authored and implemented the City’s Water and Wastewater design manual, developed and administered water and wastewater Capital Improvement Programs, made project related City Council presentations, assisted in preparing annual project budgets, and provided project management for municipal infrastructure replacement and rehabilitation projects.

Mr. Harris' experience also comprises extensive work on SSES projects. He has performed comprehensive flow monitoring, and developed infiltration/inflow (I/I) reduction plans for municipalities. In addition, Mr. Harris has managed rehabilitation and replacement projects totaling more than 500,000 l.f. encompassing large diameter pipe replacement, micro-tunneling, and pipe bursting.

RJN GROUP, INC.

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- Flow Monitoring
- I/I Analysis
- Sanitary Sewer Evaluation Surveys
- Collection System Modeling
- Rehabilitation Design
- Utility Relocation Design
- Transportation
- Construction Administration
- Mapping
- Maintenance Management

Since 1975, RJN Group, Inc. has completed more than 1000 utility replacement, rehabilitation, and I/I reduction projects representing more than 200 million feet of water and sanitary sewer lines. The success of these projects and the innovative approaches used has established RJN Group, Inc. as an industry leader with a reputation for proven results.

If you would like more information concerning the services of RJN Group, Inc., please contact Tom Harris at (972) 437-4300 or via email at tharris@rjn.com.