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Pipe Bursting – replacing water mains in congested areas**

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ABSTRACT

Citizens Water evaluated several options for replacing aged water mains in the service territory where redevelopment was occurring. Conventional methods of open cutting and directional drilling had been the preferred methods for main replacement projects within these areas in the past. Alternative installation methods were investigated with the objectives of lowering costs and minimizing impacts within these congested areas. In researching alternative methods, Citizens decided to pilot two pipe bursting projects utilizing fusible PVC pipe. Both of these projects were ideal pipe bursting candidates because of the significant space restrictions within the public right of way. Miller Pipeline was selected as the contractor for both of these projects. Several benefits of using the pipe bursting method included, cost savings compared to conventional replacement methods, reduced impact to existing customers, minimal design work, less restoration and overall construction impacts to the area were greatly minimized.

Citizens Energy Group owns and operates multiple different utilities in and around the area of Indianapolis Indiana. The utility's distribution system has approximately 4,000 miles of water mains and 36,000 fire hydrants. When performing water main replacement projects, Citizens had historically used either open-cut or directional drilling as standard installation methods. Citizens had been actively seeking alternative installation methods that were less expensive, less invasive to the community and offered other advantages and benefits. Several employees participated in a pipe bursting demonstration at a national conference several years ago. Since then, the utility has evaluated pipe bursting on several pilot projects in addition to incorporating this replacement method into their decision matrix for water main replacement projects.

PILOT PROJECTS

Two water main replacement projects were selected to use the pipe bursting replacement technique on a trial basis. Prior to determining potentially suitable projects, there was a large amount of internal coordination required. The Capital Projects & Engineering group worked very closely with Water Operations to confirm the applicability of the two selected projects. Coordination with Citizens Supply Chain and Standards group was also required since the material to be installed on these two projects was new to the utility as well. Fusible PVC was the selected material for installation mainly due to its ability to be easily joined and easily tapped, its non-corrosion properties and overall ease of installation and maintenance. Next, the contractor; Miller Pipeline was engaged to review the two selected pilot projects from their perspective and to ensure that they were good pipe bursting candidates from a contractor's perspective.

The first replacement project consisted of replacing a six inch diameter cast iron water main dating back to 1880. The project included replacement of approximately 500 feet with a new 8 inch diameter water main to improve flow and pressure in the local area. The second project included replacement of approximately 900 feet of six inch diameter 1902 cast iron water main with new 8 inch diameter fusible PVC.

EXPECTED BENEFITS

The utility was looking for innovative design and installation methods that would allow for an increase in the amount of water main footage replaced annually without increasing the annual budgeted amount. From a cost perspective, these two pilot projects showed a substantial cost savings from conventional open cut methods of installation as shown below in Table 1.

Table 1. Total project cost estimate comparison

	Project 1	Project 2
Traditional Open-Cut	\$295,452	\$184,820
Pipe Bursting	\$236,742	\$120,180
Savings	\$58,710	\$64,640
% Savings	20%	35%

In addition to cost savings, the pipe bursting replacement technique allowed us to upsize our facilities to handle future load growth. The utility was also looking to build on its solid customer service reputation. Pipe bursting lends itself to enhancing customer service from the standpoint once underway, replacement projects can typically be completed quicker and with considerably less disruption than other methods, while minimizing inconveniences to customers. Another major benefit includes approximately 80-90% less restoration as compared with conventional open-cut installation. Most pipe bursting applications occur in highly developed urban areas with little to no room for additional utilities and making construction a major inconvenience for customers. Pipe bursting drastically minimizes the amount of disturbance and restoration required.

Pipe bursting allows for a more efficient project delivery method as well. Citizens was able to use a design-build approach on these pilot projects. The design team, construction team, and contractor were all on board during all phases of the project improving overall project coordination as well as overall project delivery.

OUTCOMES

In general, Project #1 achieved essentially all of the expected benefits noted above. Cost savings compared to open cut were approximately 20%, customer inconveniences were minimized, and the design-build approach allowed for a much quicker planning and design phase – all while upsizing the facility using a trenchless technique. One of the benefits not achieved with this project included the overall construction duration compared to alternate methods. With additional experience on the design and construction of pipe bursting projects, it is expected that duration of construction will be greatly reduced.

Project #2 achieved greater savings with the same benefits experienced as project #1. One major issue was encountered during construction. The cutter head became jammed and damaged, requiring replacement with a different type due to an existing concrete structure. Once the cutter head was replaced, the project proceeded without issue. Again, with additional experience and knowledge, project construction will proceed in a quicker fashion.

DESIGN CONSIDERATIONS

There are many design considerations to evaluate prior to deciding on a particular installation or replacement method. One of the first considerations for the applicability of pipe bursting is subsurface congestion with other underground utilities within the project area. Pipe bursting may be an ideal alternative if existing utilities conflict with other proposed methods of installation. Temporary service line connections must be evaluated to ensure that all appropriate fittings are available and on hand when needed. Ensuring that existing hydrants are available for the temporary water supply is essential for emergency reasons. Maintaining fire protection during construction is a critical factor that must be considered. Whether the project is located within a residential or commercial area, there

must be adequate coordination and communication with property owners and local fire department personnel regarding the project plan. Temporary water supply line locations need to be factored into the planning and design process to account for any driveway, street, and sidewalk crossings that might impact vehicles and pedestrians. Confirming the actual connection point to the customer is a requirement. Possible connection points include the existing meter pit, an external hose bib, or excavation of the existing service. Original installation records along with any subsequent maintenance records should be reviewed to determine if there are any potential conflicts that could negatively impact the pipe bursting process. Using the above considerations, Citizens has developed a decision matrix to assist in the construction method selection process.

DECISION MATRIX

Citizens has developed a matrix that includes tangible items that such as the cost of construction, material cost, restoration costs, and potential maintenance costs. It also incorporates intangible items such as customer inconvenience, the impact to streets and general traffic, extent of existing underground utilities, and operational material preferences. The implementation of this matrix required coordination with Citizens Capital Projects and Engineering, Asset management, and Operations groups to determine and finalize the appropriate categories and weighting factors for the matrix. The above allows for consistent decision making with regard to the use of various installation methods on water main replacement projects.

SUMMARY

As with most other utilities, Citizens has an aging infrastructure that requires a significant amount of maintenance and investment. As a part of its water main replacement program, Citizens has and continues to look for new and innovative means of construction that allow for more to be done with less capital expenditure. Pipe bursting is an additional method that the utility has recently added to its toolbox for replacement projects and is particularly well suited for upsizing situations. As discussed above, there are many factors that must be considered prior to undertaking a project using the pipe bursting methodology. However under the right circumstances, pipe bursting can allow for substantial project cost savings, while minimizing impact to the streets and neighborhood, thus allowing additional projects to be undertaken.