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**CITY OF TAYLOR EMBRACES PRE-CHLORINATED PIPE BURSTING  
AND DIRECTIONAL DRILLING**

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**ABSTRACT**

The City of Taylor, located in Wayne County, Michigan, has taken a proactive approach to rehabilitating aging water mains within targeted residential and commercial areas. The selected areas resulted from capital improvement planning that evolved from master planning efforts prepared in a collaborative approach by the City of Taylor and Wade Trim Associates. Water rehabilitation investment by the City of Taylor has exceeded \$10 million since the beginning design phase in 2011 through to the end of the 2018 construction season. During this timeframe, approximately 48,157 linear feet of fusible polyvinyl chloride pipe (FPVCP) has been placed through pre-chlorinated pipe bursting. An additional 16,433 linear feet of PVC pipe has been placed through directional drilling.

The intent of this paper is to highlight the proactive approach used to address the aging water infrastructure through an efficient, minimally disruptive and cost-effective methodology. Generally, when faced with water main rehabilitation, consideration is given to two options; traditional open-cut trench construction installation and a trenchless approach such as pipe bursting. Pipe bursting is not always the most economical approach; however, when weighing the potential benefits realized through bursting, the advantages may slant the scales in the direction of the trenchless technology approach.

**BACKGROUND**

The first City-wide analysis of the Taylor, Michigan water distribution system was completed in 1973. In 1982, master planning efforts were initiated in conjunction with the completion of the first computer model of the system. Since that time, periodic updates have been completed, with the most recent Master Plan publication occurring in 2015. The purpose of preparing and maintaining the plan was to determine the

existing capabilities of the system, attempt to identify deficiencies throughout the system and ultimately to prepare a capital improvement plan. The capital improvement plan prioritizes improvement locations and further provides an estimated cost for multi-year budgeting purposes.

Taylor's existing water distribution system consists of approximately 290 miles of water main that ranges from 4 inches in diameter to 24 inches in diameter. The system age varies from 80+ years to present day with a majority of the pipe installed in the 1950s and 1960s. Existing pipe materials include cast iron (approximately 62%), ductile iron (approximately 29%), concrete pipe for 24-inch diameter pipe, some asbestos cement and in newer areas and/or areas of recent rehabilitation, PVC pipe.

At the onset of the multi-year water rehabilitation undertaking in 2011, Wade Trim worked directly with the City to prioritize system improvement locations. The resulting locations considered both output from the computerized model and field conditions as reported by the Department of Public Works (DPW). The greatest identified needs included replacement of old cast iron pipe and looping of dead-end lines.

## **WE KNOW WHERE, WHY AND WHAT IS NEEDED, NOW HOW?**

Open cut trenching is the traditional construction approach designers and communities anticipate when faced with utility system improvements. This technique may be advantageous when combined with factors such as a coordinated approach with pavement replacement or the placement of a small length of run where bore pits and available space are limiting factors. When developing the multi-year program and ultimately deciding upon pipe bursting and directional drilling for a majority of the effort, consideration was given to the following:

- Prioritization (Master Planning effort and City experience/input with breaks and pressure concerns)
- Type of existing pipe (cast iron is ideal for pipe bursting operations)
- Looping to minimize dead-end sections, improve system redundancy with the additional benefit of increasing fire-flow capacity (locations were addressed through a combination of directional drilling and open-cut construction in "tighter" construction areas)
- Location of the existing main and other existing utilities (potential conflicts)
- Existing pipe material and diameter and proposed diameter of main
- Condition of the existing road
- Number of service connections and/or "spaghetti lines"
- Restoration costs relative to drive approaches, sidewalk, ADA ramps, greenbelts and roadways
- Overall design and construction cost
- Disruption to residents

Most of the water mains selected for improvement were within residential areas, many of which included narrow rights-of-way and congestion with other existing utilities. It is often a challenging task to align new utilities within older, congested and built-up areas. Pipe bursting allows the new water main to be installed in the same location as the old main. Essentially the old main is “pipe burst” in place while the new main is pulled (or pushed) through the old main. This assists in significantly minimizing unforeseen underground conflicts and in many cases minimizing the need to remove trees and aid in preserving the character of the neighborhoods.

System improvements called for various sizing increases. With the pipe bursting technique, aging 6-inch cast iron mains could be burst to new 8-inch PVC mains. Where potential surface uplift was deemed to have minimal impact, some aging 8-inch mains could be burst to 12-inch PVC mains. This was a significant benefit in selecting the trenchless technology.

Pipe bursting requires the existing main to be shut down during construction. It is common to maintain service to residents and businesses through the installation of a temporary, at grade, water service (adding cost to the project). However, with the installation of “pre-chlorinated” pipe, service lead connections can be established immediately after the pipe is placed. Pre-chlorination has been the preferred approach for the City throughout the program; it requires the new pressure pipe to be fully assembled, tested and chlorinated prior to bursting operations, allowing for reduced disruption time and ultimately happier customers.



Figure 1. Sample Staging Area; Open Right-of-Way Area

Various customers in the targeted areas were being serviced through long service leads as direct access to a fronting main was not available at the time their home was originally constructed. Recognizing the need to provide a fronting main within these areas, the considered method of construction options included open trench and horizontal directional drilling (HDD). Generally, prioritized replacement of the existing pavement in these areas was not in line with the prioritized placement of a new water main. Where spacing allowed due to existing minimal underground utility conflicts, mature trees, driveways, sidewalk and right-of-way, the selected overriding approach was HDD. Wherever possible, there was a noted preference for placement within greenbelt areas, in consideration of future maintenance access.



Figure 2. New Pipe; Residential Right-of-Way

### **NOW WHO CAN MAKE THIS HAPPEN?**

In 2012 design plans and bid quantities were finalized, necessary permitting was applied for and obtained (County and State) and the plans and specifications were publicly bid. Following a bidding period and a pre-bid conference, five (5) formal bids were received for the original 2012 bid. Upon reviewing bids, contractor experience and qualifications the work was awarded by City Council to Bidigare Contractors, Inc. of

Northville, Michigan. Work in the initial bid included approximately 16,000 linear feet of 8-inch water pipe bursting, 7,500 linear feet of directionally bored 8-inch water main, 950 linear feet of open cut water main installation and related appurtenances. City Council further authorized Wade Trim to provide full time inspection and construction engineering phase services.

## **HOW DO WE KEEP CUSTOMERS INFORMED?**

During the late winter months, prior to favorable spring construction weather, a Public Information Meeting was held for the original 2012 program to inform impacted residents and businesses of the pending construction activities. Residents were notified of the meeting via mail. The notification provided the names of both the engineering firm and selected contractor, the contact number of the engineering firm for any questions and an information sheet with responses to the following frequently asked questions (FAQ):

- What work is being done, and why?
- Who is doing the work?
- Where will work start?
- When will work start, and for how long?
- Will this affect my current water service?
- Will my street be closed?
- What about police, fire and rescue access to my home?
- Where will construction materials be stored?
- When will all restoration be complete?
- Who do I call if I have a question or problems come up during this Project?
- Will I experience any disruption in other utility services during construction?

A systematic approach to water shut-offs and phasing was absolutely necessary and ultimately realized through coordinated effort between residents, businesses, the City, the Contractor and Wade Trim Associates. Through advanced provision of the FAQ sheet and more immediate notification of shut-offs, customers were made aware they would potentially be without water service between 7:30 a.m. and 7:00 p.m. (noting service was typically restored by 4:00 p.m.). The notification emphasized that customers would not be without water service overnight. An emergency number was provided in the event this happened. Emergencies did occur in areas where unknown spaghetti line connections were encountered. The Contractor and DPW responded quickly to these instances.

## **HOW DO WE MINIMIZE CUSTOMER DISRUPTION AND COST?**

Planning is key to pipe bursting, because customer service must be restored, and pits preferably backfilled to grade before the end of the construction day. The plan dictated the Contractor would not burst further than services could be fully restored each day. In

addition, prior to pre-chlorinated bursting, the new pipe was assembled, tested and chlorinated, and all service locations and stop boxes were located and prepared for efficient connection to the new main once bursting operations were complete. Due to experience and efficiency, Bidigare Contractors, Inc. averaged placement of approximately 1,200 linear feet of new pipe per week and approximately 9 to 22 service line connections per day. Bi-weekly meetings between the City, Contractor and Engineer further assisted in verifying timelines and allowed for planning adjustments due to weather and necessary customer notifications.

When compared to pipe-bursting, directional drilling offers more flexibility in terms of the amount of time necessary to establish new connections. The new pipe is placed, pressure tested and, due to the time required for chlorination and associated testing, the pipe is allowed to briefly settle prior to connecting the new service leads. Existing services are maintained with the old main until the new connections are made; new services do not need to be connected the same day as the new pipe is installed and tested.



Figure 3. Directional Drilling Operation

Both trenchless methods allow for minimizing disturbance and restoration when compared to open trench construction. Entry and exit bore pits, typically planned at hydrant or valve locations, are made for the new pipe and excavation needs to occur in locations for new service connection points. Minimizing removal of pavement was emphasized where feasible. This resulted in significant cost savings for the City of Taylor. This approach also allows most driveways and roads to remain in service, requiring the placement of only minor traffic control measures. Soil erosion measures may also be reduced.



Figure 4. Pipe Bursting Head

Correction of spaghetti lines throughout the project areas was a high priority for the City. “Spaghetti lines” is a term used to describe unknown water service lead alignments that may be connected to a main one to two blocks from the building. These lines typically occur in older areas where water main was not immediately available in close proximity to the home/building upon original building construction. Correction of these lines through establishing a new service lead connection to the “fronting” main allows greater confidence in understanding the system in the event emergency shut-downs may be required. These locations presented the highest cost for restoration because determining existing run locations sometimes required exploratory trenching and alignment of new service leads led to rerouting of leads and placement of new stop boxes. Aside from typical quantity adjustments, most change order items evolved from correcting existing spaghetti lines and working around unidentified conflicts with existing utilities.



Figure 5. Pulling Operation; Tension Line and New Pipe

### **HOW DO WE CONTINUE WITH THE LONG-TERM EFFORT?**

Construction for the original contract continued into the fall of 2013. With very favorable results realized from the trenchless operations, the City and Wade Trim began to prepare plans and specifications for the next phase of the long-term, multi-year undertaking utilizing the same construction methodology. Bidding in 2016 included quantities of approximately 15,500 linear feet of pipe bursting and 3,375 linear feet of directional drilling. Five (5) bids were received, with the Project again being awarded to Bidigare Contractors, Inc., being recognized as the low bidder with sufficient demonstrated experience.

Successful completion of the 2016 work led to City Council extending the contract to Bidigare Contractors through a change order for the 2017 effort, essentially doubling the construction effort. A small project was also competitively bid and completed in 2018 through directional drilling in an area experiencing pressure concerns.

## WITH EXPERIENCE UNDER OUR BELTS, WHAT HAVE WE LEARNED?

Long-term continuance of the program is a testament to the success and favored construction approach that has been embraced by the City of Taylor. Throughout the process, the most significant challenges that arose included encountering unknown field conditions and unknown spaghetti line locations. Below is a brief summary highlighting “tips” that will hopefully provide guidance to communities looking to undertake pre-chlorinated pipe bursting and/or directional drilling:

### 1. Communication

- Hold a public meeting for affected businesses and residents in advance of construction. Once attendees heard the anticipated minimal disruption and confirmation of who was paying for what, discussion turned to more interest in understanding the construction methodology.
- Maintain consistent communication throughout construction.
- Provide contact numbers for questions and/or emergencies.
- Shut-off notices and/or drive-way closure notices must provide sufficient notice for customers to make adjustments to their personal schedules.

### 2. Pre-Bid/Pre-Construction

- Attempt to minimize unknown spaghetti line locations through pre-bid/pre-construction investigation. Unknowns will certainly arise; however, effort to locate stop boxes in advance of bidding will assist in minimizing change orders and construction downtime. Caution: a fronting stop box does not always mean the connection is to the fronting main or that a fronting main even exists!
- Know existing pipe material. Cast iron is ideal for pipe-bursting; ductile iron presents challenges to the standard method.
- Include bid line items for potential unknowns as best as possible (i.e. restoration of private landscaping (within reason), spaghetti lines, lead services, utility conflicts, exploratory trenching).

### 3. Construction

- Complete a pre-construction video or drone flight.
- Work directly with the Contractor to verify construction schedules and associated customer notifications.
- Conduct weekly or bi-weekly status meetings with the Contractor, Engineer and Owner.
- Verify sufficient staging areas for each bursting/drilling run. Agreements with property owners may be required for staging areas if sufficient right-of-way and/or public property is not readily available.
- Bursting lengths must not exceed abilities to reconnect customers the same day.
- Verify installation of safety measures associated with all bore pits, open excavation areas for service leads and daily construction shut-down.

- Sufficient temperature for testing and installation when nearing cold weather conditions; refer to pipe manufacturer recommendations (varies depending on type of pipe).
- Lead services; if encountered, regulations vary and are changing! You may be required to replace the service lead from the main right into the home.

#### 4. Restoration

- Once the main is installed and service has been restored, customers will look for prompt, complete and established restoration.
- We strongly recommend detailed language be provided in the contract requiring prompt restoration. Full payment to be provided once acceptable establishment has occurred (i.e. retention in accordance with contract documents).



Figure 6. Various Construction Phases

Realizing the benefits of both the pipe-bursting and directional drilling construction techniques for water main rehabilitation effort over the last eight years, Wade Trim is continuing to work alongside the City of Taylor to develop the next phase of its continuing dedication to water system improvements throughout the City. The program will continue to focus on prioritized areas conducive to trenchless technologies.

## **REFERENCES**

Wade Trim (November 2015) – Water Distribution System Master Plan, City of Taylor, Michigan