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When Capital Improvement Plans Align: How Moorhead Public Service Collaborates with the City of Moorhead for Effective Water Main Replacement

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1. ABSTRACT

The staff at Moorhead Public Service (MPS), a utility of the City of Moorhead, understands the benefit of trenchless technologies and continues to effectively utilize them every year as part of their Watermain Asset Management Program (WAMP). When water main replacement is required, but a full street reconstruction is not, trenchless construction becomes very attractive and cost effective. In the past ten years, many MPS projects have involved trenchless construction using horizontal directional drilling (HDD), pipe bursting, and sliplining methods.

While trenchless construction is the official term used for these utility rehab and replacement methods, many people in the industry know that trenchless construction still requires some open trench disturbances for service connections, tie-ins, and insertion pits. These open trenched areas require patching and restoration when construction takes place in roadways. As a result, MPS works with the City of Moorhead to target their trenchless water main replacement projects for areas where the City is planning a street surface rehabilitation project in the same construction season.

This paper will review the various trenchless technologies that MPS has employed and discuss how they coordinate with the City of Moorhead to maximize the benefit of trenchless technologies. Not only is MPS able to use trenchless construction to minimize disruptions to residents during construction, but their surface rehabilitation project coordination with the City reduces the cost of patching disturbed portions of pavement. The end result is a highly effective WAMP that makes efficient use of MPS's budget to maximize water main replacement.

2. INTRODUCTION

The City of Moorhead is the largest city in the northwest region of Minnesota and is bordered on the west by the city of Fargo, North Dakota. Moorhead was founded in 1871 when the building of the Northern Pacific Railway was making its way to the Pacific Ocean and reached Clay County (Figure 1). The city was named after the Northern Pacific Railway's director, William G. Moorhead. The railway created much economic and population growth for the city, as it transported farm products, consumer goods, and even passengers.

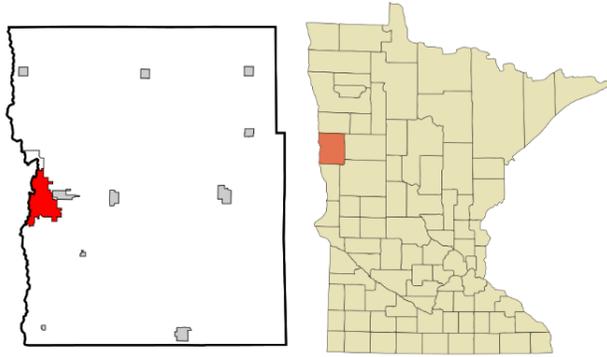


Figure 1: Location of Moorhead in Clay County, Minnesota.

Shortly after Moorhead was incorporated as a city in the early 1880s, water services were added to the city. The Moorhead Public Service was established to manage, control, and oversee operations of the water and electric utilities of Moorhead, serving approximately 46,000 customers. MPS owns and maintains approximately 215 miles of distribution pipe and is comprised of the City of Moorhead and City of Dilworth.

In 1986, the MPS decided to replace the original cast iron (CI) water mains that were installed in an effort to prevent future problems within the system, knowing that cast iron had a shortened lifespan. In addition, soils in the Northwest region of Minnesota have a particularly corrosive nature toward cast iron pipe. Initially the strategy was to coordinate with road rehabilitations and replace water mains in those areas as needed. However, similar to many water utilities within the United States, MPS was not completing enough water main replacement to keep up with the deteriorating nature of cast iron pipe within the distribution system.

Since water mains are the backbone for economic growth and safe drinking water, the staff of MPS developed the Watermain Assessment Management Plan (WAMP) in 2013. The WAMP outlines the goal of replacing all 33 miles of cast iron pipe over the next 15 to 20 years (approximately 10,000 feet of cast iron pipe per year) in the city of Moorhead.

The WAMP was approved and implemented in the fall of 2013. MPS determined that using trenchless technologies would be beneficial where water main replacement was required, but a full street reconstruction was unnecessary. As a result, trenchless technologies have played a fundamental role in replacing water mains in areas where open trenching proved to be impractical. In the past 10 years, many MPS projects have involved trenchless construction using horizontal directional drilling (HDD), pipe bursting and sliplining methods. MPS has worked to intentionally incorporate trenchless into its WAMP program, and the amount of trenchless utilized has generally been greater than 50% of its annual replacement program. Since implementation of the WAMP in 2013, approximately \$7,190,516.17 has been spent on the replacement of 34,533 feet (6.54 miles) of CI water main. This equates to a cost of approximately \$1.1 million per mile of replacement (see Figure 2). Establishment of the WAMP has enabled completion of water main replacement in several key areas, including areas that had an extensive history of excessive water main breaks.

HDD has worked well when installing new water mains in areas where previous infrastructure did not exist. It is also great for crossing under existing utility conflicts. Pipe bursting is beneficial when the replacement pipe needs to be installed in the exact alignment as the existing pipe and existing easements are limited. This has been especially effective in residential areas where the number of water services is not excessive. Sliplining has been used to maintain an efficient casing size on jack & bore projects and has also been used for rehabilitation by inserting a new pipe inside the existing pipe.

In order to make these trenchless technologies as cost effective as possible, it has been critical for MPS to properly sequence the projects within their WAMP, so they are able to coordinate their water utility improvement projects with road improvement projects through the City of Moorhead and other entities.

3. MPS PLANNING AND COORDINATION FOR TRENCHLESS PROJECTS

As many people in the trenchless industry understand, a more appropriate name for “trenchless” projects should be “less trench” projects. Even though trenchless projects can significantly reduce the amount of digging and disturbance that is required to replace existing utilities, they still require excavations for access pits, tail ditches, reconnections, and sometimes service reinstatements. These excavations often require pavement patching, which can be costly depending on the condition of the existing pavement. MPS understands that if they can minimize their pavement repair costs, then the economics of trenchless water main replacement become even more attractive.

As a result, when MPS directly combines their water main replacement project with another entity’s projects, pavement restoration costs can be significantly minimized. The entities that MPS works with could be the City of Moorhead, Minnesota Department of Transportation (MNDOT), Clay County, and others. Sometimes it is not possible to combine the water main improvements into the same bid package as the surface rehabilitation projects of other entities, so then MPS must account for pavement restoration in their bid. However, if MPS knows that roadway improvements from another entity will be following within the next year or sooner, then they can minimize the pavement restoration requirements in the MPS project. Instead of providing full depth pavement patching, they can get by with temporary pavement sections until the road is reconstructed or repaved.

Two key factors to making this program work successfully are advanced planning and proactive coordination from the MPS staff and their consultants. With the help of the Watermain Asset Management Plan (WAMP), MPS and Apex Engineering Group strategize the proper way to sequence their projects in advance of any larger road improvement projects. For example, when they know that a certain roadway is scheduled for reconstruction, they will consult the WAMP and their system water model to determine if the capacity of the infrastructure in that area needs to be increased in addition to being replaced. Even if additional capacity is not needed at the time of the roadway project, it still makes sense for them to make the investment in advance to save money on the overall project.

Aside from thoughtful infrastructure planning, coordination with the various entities carrying out the roadway surface rehabilitation projects is the other crucial component of the economically attractive trenchless program at MPS. Most often MPS is partnering with the City of Moorhead and their schedule of mill and overlay projects. As long as MPS is able to get their water main infrastructure replaced without holding up the City’s scheduled projects, the City has been very cooperative in working with MPS. One of the places where coordination between MPS and the City of Moorhead works very well is on residential pipe bursting projects. Since pipe bursting requires trench excavations at each water main service connection, bursting in a residential area can result in a number of small pavement disturbances. When the pipe bursting work is completed in advance of a mill and overlay project, these pavement disturbances only require a minimal patch until the mill and overlay is completed.

In addition to coordinating with the City of Moorhead on their roadway improvement projects, MPS also works with MNDOT and Clay County in a similar fashion to save money on their trenchless water main replacement projects. All of these planning and coordination efforts working in conjunction with the trenchless water main replacement program have resulted in real cost savings for MPS. The next section of the paper will compare and contrast the costs and benefits that MPS sees with trenchless water main replacement versus traditional open trench dig and replacement of water mains.

4. TRENCHLESS VS. OPEN TRENCH WATER MAIN COST SAVING DISCUSSION

One of the key drivers for trenchless installation in City of Moorhead coordinated project areas is the savings generated through diminished pavement replacement. During a coordinated residential pipe bursting project, such as the Southside Water Main Project (Southside Project), MPS completes the excavation, pipe bursting, and service reconnection prior to the coordinated mill and overlay project scheduled to follow the water main replacement. Additional details regarding the Southside Project are discussed in the Project Examples (Section 5) part of this paper. Currently, MPS utilizes a pavement restoration detail in mill and overlay coordinated project areas which allows for a 4-inch pavement section to be placed in areas where pipe bursting or service connection pits are located, even though the existing pavement section is 6-inch. MPS has worked with the City so that MPS does not need to replace the top 2 inches of pavement in areas in which excavation has occurred. This allows MPS to leave the pavement 2 inches below grade for several weeks until the Mill and Overlay is completed by the City. MPS then

places “uneven pavement” signs where necessary while the pavement section is below grade to ensure driver safety. When the mill and overlay is completed by the City, the top 2-inch of the entire street section is milled, including areas in which MPS has performed excavation and pavement restoration. MPS also coordinates with the City to remove and replace the curb, when necessary for service reconnections or pipe bursting pits. The typical cost for this type of joint trenchless and surface rehabilitation project is \$164 per foot when contracted out, or \$135 per foot when self-performed by MPS. This compares to a typical open trench cost of \$180 per foot when self-performed by MPS. Utilizing trenchless water main replacement in these situations results in an approximate cost savings of \$45 per foot.

Due to significant cost savings associated with reduced pavement replacement as a result coordination of water main replacement with the City of Moorhead, road conditions often dictate when water main is replaced, regardless of water main condition. However, in some cases, an MPS water main replacement project can initiate a City of Moorhead road reconstruction project. Typically, in these cases, MPS will still utilize a pipe bursting approach to save money on the water main installation. Following the MPS pipe bursting project, the City of Moorhead will conduct a full rehabilitation of the pavement section

This full pavement rehabilitation typically involves removal of the existing 6-inch pavement section and sub-cutting aggregate material to a depth of 3 feet. After the removal of subgrade materials, new material is brought in and a new 6” section of pavement is placed by City of Moorhead contractors. An example of this style of project is the 6th St replacement project, which is described in Section 5 of this paper. In cases where a full reconstruction of the pavement section is planned after the MPS project, pipe bursting is still beneficial to MPS because the removal of pavement is diminished. This allows MPS to backfill with gravel to grade and avoid the cost of any asphalt in the excavated areas. Because most of the roadway section is not disturbed during the trenchless water main installation, traffic can be maintained on the street and the cost of traffic control for MPS is minimized. The typical cost for this type of project, when self-performed by MPS is \$60 per foot, as a result of eliminating the asphalt removal costs.

Moving forward, MPS will continue to work with City of Moorhead staff to develop projects in which both parties benefit from a cooperative effort. In particular, MPS will continue forward with uncoordinated projects only when necessary. Utilizing actual construction data from 2017, it was determined that uncoordinated projects typically cost \$160-165 per foot to replace the water main when self-performed by MPS. Alternatively, coordinated water main projects typically cost \$130-135 per foot when self-performed by MPS. The \$25 to \$35 per foot cost savings could result in cost savings upwards of \$60,000 for a typical 2,000-foot water main replacement project. This amount of savings is significant enough to warrant continued coordination efforts between MPS, the City of Moorhead, and other entities.

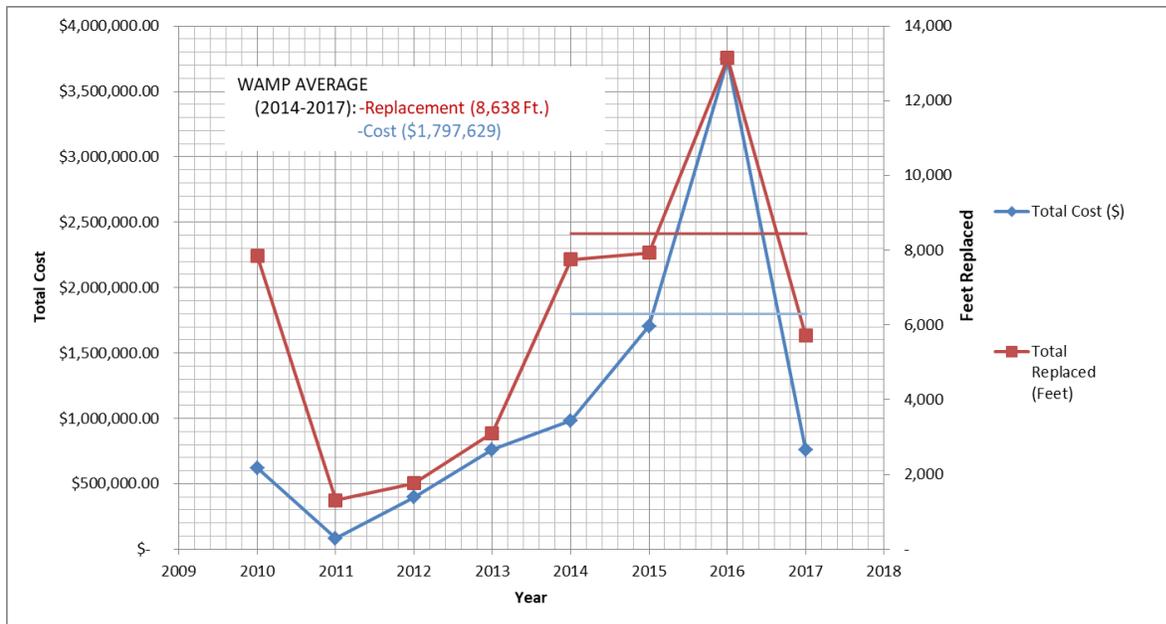


Figure 2: WAMP annual spending and feet replaced.

5. PROJECT EXAMPLES

Trunk Highway (TH) 10, TH 75, and Main Avenue Improvements (CIMS)

This project was slated as a Minnesota Department of Transportation (MNDOT) mill and overlay project for TH 10, TH 75, and Main Avenue in the heart of Moorhead. MNDOT and MPS were able to work together on the project to add trenchless water main replacement into the bid package. In addition to the roadway improvements, MPS included over 4,000 feet of 8-inch, 10-inch, and 12-inch DR 18 Fusible PVC water main pipe to be replaced using horizontal directional drilling (HDD).

The MNDOT portion of the project was primarily only a pavement mill and overlay versus a full-depth road reconstruction. As a result, trenchless construction of the water main was an ideal fit for the project. It allowed MPS to avoid the cost of tearing up the road subgrade and digging trenches in the middle of MNDOT roadways. Also, the project was located in a busy commercial area of downtown Moorhead with lots of businesses (Figure 3). Aside from the direct cost savings of the trenchless water main construction, drilling the water main also minimized disruption to existing businesses within the limits of the project.

Cooperating with MNDOT on this project not only resulted in a pavement restoration cost savings for MPS, but more significantly, piggybacking on another project saved MPS on the design, permitting, traffic management, and construction administration costs of having to bid their own standalone project.

The CIMS project was bid twice during a busy bidding market, which led to higher than normal prices for a project of this magnitude. Ultimately, the City of Moorhead and MNDOT elected to proceed with the second bidding process and the contract was awarded for approximately \$11.5 million. The water components of the project were less than 20% of the total cost. In total, 4,300 feet of water main and approximately 40 services in the heart of downtown Moorhead were replaced during the project. Also included was a 20" steel casing jack and bore beneath Burlington Northern – Santa Fe Railroad property.

Although unit prices for the water main replacement exceeded other projects MPS had completed, the cost saving for traffic control, accessibility, detours, and public involvement was greatly reduced with the limited scope compared to the City and MNDOT.



Figure 3: Fusible Pipe laydown in CIMS Project

Southside Water Main Replacement (Southside)

Unlike the previous project, the Southside Water Main Replacement Project was designed and bid as a standalone project by MPS and Apex. However, this project is an example of MPS coordinating a trenchless water main replacement project in advance of a mill and overlay project by the City of Moorhead. The scope of the Southside Project involved replacing over 3,300 feet of 6-inch cast iron pipe with 8-inch DR 18 Fusible PVC pipe.

MPS actually gave contractors the option of either open trench construction or pipe bursting within certain parts of the project to replace the existing 6-inch cast iron water main. The contractors chose pipe bursting, because the cost of gravel fill and asphalt for repairing the roadway made the open trench option more expensive. This project was located in a dense residential neighborhood with relatively small lots (Figure 4). As a result, there were a number of service connections that needed to be excavated. Even though these excavations required pavement patching at each lot, MPS was able to avoid paving the entire road because the City had a mill and overlay project scheduled for the same year.

To ensure safety during the project, snow fence was utilized around pipe bursting pits and crane mats were used to cover excavated areas while fusible pipe was being pulled into place (Figure 5). In order to maintain driveway access, pipe was pulled in the early morning and residents were notified to avoid conflict. One of the additional advantages of using pipe bursting within a residential neighbor is that local traffic was able to be maintained throughout a majority of the project. This was due to the limited excavation associated with the project. Typically, the pipe bursting pulls were in the range of 300-feet, which were often pulled in a 3-5 hour time span. This led to positive feedback received from residents with respect to the timeliness of the project completion.



Figure 4: Fusible Pipe laydown in Southside Project



Figure 5: Snow fence around pipe bursting pits for Southside Project

6th Street Water Main Replacement (6th Street)

Due to significant cost savings associated with the coordination of water main replacement with the City, road conditions often dictate when water main has been replaced regardless of the condition of the water main. For the first time in the last several years, in 2018, an MPS water main replacement project was one of the contributing

factors toward a City road reconstruction project (6th Street South from 12th to 16th Avenue South). MPS had experienced numerous water main breaks in this area due to poor water main condition (Figure 6). In addition to the water main breaks experienced on this 1,200 foot water main section, MPS staff had to complete routine flushing of the water main to attenuate iron deposit sloughing within the water main. During this project, MPS crews completed the water main replacement at a cost of approximately \$80 per foot due to diminished restoration costs associated with the project. MPS was able to complete the water main replacement with minimal interruption to traffic in the area as only the west lane (northbound) of traffic was needed for excavation (Figure 7). In this circumstance, the City completed a full reconstruction of the street section following water main replacement. As such, MPS did not need to replace any asphalt at bursting or service connection pits, resulting in a significant cost savings to MPS. Similar to the Southside project, the pipe bursting pulls were in the range of 300-feet, which were often pulled in a 3-5 hour time span. This led to positive feedback received from residents with respect to the timeliness of the project duration.



Figure 6: Water main Condition on 6th St S.



Figure 7: Fusible Pipe laydown in for 6th St S Water main Replacement Project

6. CONCLUSIONS

Trenchless technology at MPS has become a trusted and cost-effective tool for water main replacement and rehabilitation. MPS has figured out a blueprint for supercharging the cost benefits of trenchless technology by coordinating their infrastructure replacement needs with the projects of other entities within their service area. Through this process, MPS has built a sustainable model for economically utilizing trenchless construction on the majority of their water main replacement projects.

7. REFERENCES

City of Moorhead Minnesota Official Website. Retrieved from <http://www.ci.moorhead.mn.us/>