PILOT TUBE PROJECT SAVES TIME, MONEY AND TREES!

Tree-lined streets and multiple utilities presented challenges in St. Clair Shores, MI

Overcoming Challenges in St. Clair Shores MI

By: Steve Matheny, Logan Clay Products LLC

Within the City of St. Clair Shores, MI (population: 59,800) a small sewer district of 645 homes and businesses is served by a combined sewer system (with roof and footing drains connected to sewers). Recurring basement backups, some dating back more than 30 years, prompted several studies and evaluations of the area served by these combined sewers.

These studies consistently found that excess storm water from wet weather events overloaded the sewers, resulting in basement backups. Backups were occurring with storm events of as little as 1.4 inches of rainfall in 24 hours. The recommendations were consistent:

1. Disconnect roof drains from the sewer system.
2. Disconnect footing drains from the sewer system, and
3. Construct a relief sewer

Multiple large storm events occurred in 2014 and again in 2016, with one rainfall exceeding 5 inches in 24 hours. Hundreds of basements flooded resulting in a sense of urgency around finding and implementing a solution.

While continuing to explore the recommendations that will reduce demand and additional alternatives for reducing wet weather flows into the combined sewer system, in August 2016, the City Council authorized Anderson, Eckstein and Westrick, Inc. (AEW) to prepare the construction documents for a relief sewer.

Project Design

The Ten Mile Road corridor was slated for a complete reconstruction before the end of 2017. To allow time for resurfacing, government financing incentives for that portion of the project required that sewer construction be completed by September 1, 2017.

The project area was occupied with two water mains, several gas mains, the combined sewer, additional storm sewers and numerous large trees. The geotechnical report indicated a very soft clay for the full length of the installation. The design immediately focused on pipe sizing as well as the means and methods of construction. Because this project was strictly a relief sewer, there would be no need to disconnect or reconnect existing service lines. The trees in the area were seen as a community asset and part of the design directive was to save the trees.

The initial design contemplated the use of a traditional, open-cut method to construct 5,300 feet of a 21-inch relief sewer. Based on planned alignments and a sewer depth of up to 18 feet, nearly all of the mature trees would require removal, two lanes of pavement would need to be replaced, and a full road closure would be needed to accommodate construction efforts.

A variety of installation methods were considered, including an option to bore past individual trees in efforts to save as many mature trees as possible. This effort was bid as one of the project alternatives so the City could responsibly evaluate the cost impacts of saving existing trees.

Microtunneling was considered and bid as another alternative to the open cut method of constructing the project. With a significantly reduced impact to the construction area, this alternative

allowed for saving most mature trees while limiting removal of paved surfaces to the launch and receiving shafts.

The bid documents were being prepared in November of 2016, when AEW attended the "Microtunneling: Not just for Gophers" event hosted by the Southern Michigan branch of ASCE. The event included a site visit to an active Pilot Tube Method (PTM) project at the Little Mac project in Clinton Township, MI. The project featured Akkerman's GBM 339A system with a 22.5-inch powered-cutter head to install 18-inch jacking pipe. The small project footprint required for this installation method seemed uniquely suited to address the project challenges presented in St. Clair Shores.

Finding out more about the trenchless method was the first step.

Due Diligence

At the onset of the project, AEW met with City staff to review project design elements. This included alignments, pipe sizing, pavement and tree removals, traffic controls and consideration of existing utilities, and MDOT coordination for upcoming projects. Several visits were made to the project area to evaluate the construction zone impacts and traffic controls.

With project cost and tree preservation being driving factors, bids for alternative installation methods were requested. The City was then able to evaluate the costs and benefits associated with each of the various means and methods under consideration for the project: Open-cut construction, combination open-cut with steel cased borings under the tree roots, or the Pilot Tube Method (PTM).

Presentations were made to the City Council summarizing the costs, impacts and benefits associated with each of the alternatives. These presentations were designed to allow the Council to make an informed decision about the short- and long-term value of each installation method. PTM was approved as an equivalent method of construction to Microtunneling.

The general expectation is that an open cut project will be less expensive than a trenchless installation. For this project, the opposite was true. Using PTM was the responsible financial choice.

Bid Selection

Saving the existing tree corridor, minimizing disruption to traffic and utilities, and reducing repaving costs while constructing the relief sewer were all benefits that drove the final selection.

The general expectation is that an open cut project will be less expensive than a trenchless installation. For this project, the opposite was true. The minimum bid for an open cut installation ($3.2 million) came in at approximately 33% over the bid for PTM installation ($2.4 million).

MK Construction was awarded the contract in March of 2017. With the urban setting, MK Construction cited the following reasons as the drivers for their decision to bid using PTM as the most cost-effective option for this project:

- Open-Cut methods would require the excavation of the roadway (10 Mile Road) for approximately 5300 feet of the project.
- Existing utilities within the right-of-way - gas, electric, water, storm and existing sanitary would be undisturbed using PTM
- An open cut approach to the project would require removal of mature trees and temporary access construction for numerous driveways.
- Dewatering at each shaft versus along the entire trench would better limit risk and reduce costs.

AEW staff reviewed the bids and the alternate technologies. Ultimately, they were convinced that the use of PTM was the financially responsible choice. It was the only viable option for achieving the city's

The longer life and expanded maintenance options provided by VCP serves the long-term interests of the community.

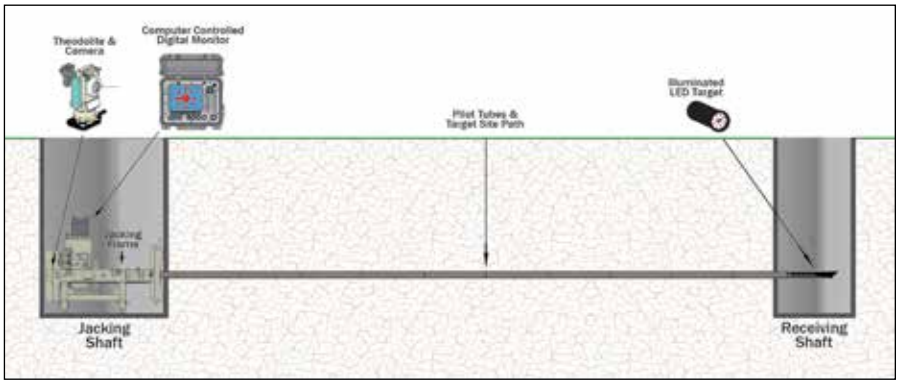
goals of protecting the existing utilities, old growth trees and other natural features while minimizing community disruption and completing the project on time.

Equipment & Set Up

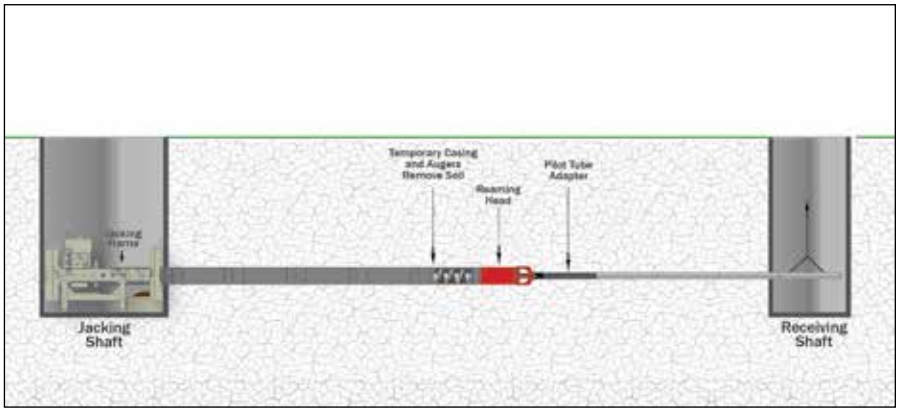
After being awarded the project, MK Construction went to work identifying the appropriate equipment for installing the 21- inch relief sewer. Because of the urban setting with residential homes on narrow single-family lots, the mature landscaping and multiple utilities, smaller equipment footprints were prioritized.

Of the available guided boring machine options, the Akkerman GBM 4800 Series system was identified as the best option for the complexities of this project. The system included a 26-inch powered reaming head, a P150 Power Pack and a 2325D lubrication pump. The jacking frame with this system is just 12 feet in length, which allowed MK Construction to limit the size of the jacking shafts.

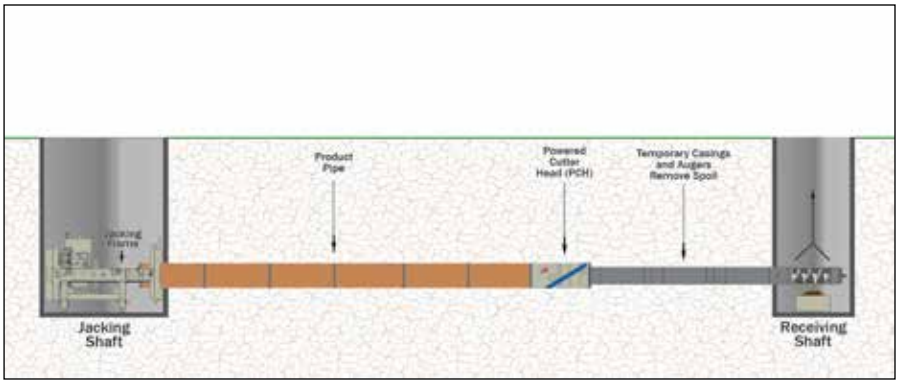
The length of the pipe was also a consideration. In this mature, urban area, shorter lengths were needed to minimize the size of the jacking shafts. Vitrified Clay Pipe (VCP) Jacking pipe is specially made for trenchless installation, coming in 1- (3.28 ft.) and 2-meter (6.56 ft.) standard lengths. With the 12-foot jacking frame, MK Construction used 8-foot jacking pipe section lengths for this project.



PTM STEP 1: Installation of pilot rods



PTM STEP 2: Installation of auger casings



PTM STEP 3: Installing the product pipe

The Pilot Tube Method

MK Construction excavated the jacking pits and receiving shafts and maintained them using a sheet piling and whaler system (for a rectangular structure).

Once the shaft construction was complete, the First Step (see PTM STEP 1 above) for the installation was to install the 4-inch pilot tubes on line and grade. During installation of the pilot tube, the ground was displaced by the slant-faced steering head and no spoil was removed.

The pilot tube was directed on line and grade by rotation during advancement. The hollow stem of the pilot tube provided an optical path for the camera to view the LED target displaying the head position and steering orientation. This step established the centerline of the new sewer installation; all remaining steps followed the path of the pilot tube. Once the pilot tubes reached the reception shaft, the theodolite, video camera, and monitor guidance system were no longer needed and were removed from the jacking pit.

Pushing the product pipe into place

The Powered Reaming Head in place and ready to follow the path of the pilot tubes

The Second Step was to follow the path of the pilot tube with an 11-inch OD reaming head. The front of the reaming head was fastened to the last pilot tube in the same manner the pilot tubes fasten to each other. Eleven-inch OD thrust (auger) casings advanced the pilot tubes and reaming head and transported the spoil (displaced ground around the pilot tubes) to the jacking shaft for removal. Once removed from the jacking shaft the spoils were transported off-site. During the installation of the 11-inch casings, the previously installed pilot rods were advanced into the reception shaft for disassembly and removal. This step was complete when the reaming head reached the reception shaft and all spoils were removed.

The Third Step on the 21-inch ID product pipe installation was to install a powered reaming head (PRH) that was modified to grind up nested cobbles around the auger casings; both advanced by the product pipe. The 26-inch OD PRH increased the bore to match the 25.5-inch product pipe OD. The remaining soil around the previously installed 11-inch OD auger casings (step 2) was taken into the PRH and discharged via the reception shaft by reversing the auger flight direction. The final product pipe was then installed directly behind the PRH. As each section of auger casing was removed from the reception shaft, a section of product pipe was installed in the jacking shaft. This step was complete when the PRH entered the reception shaft and the pipe lined the full length of the bore.

When using PTM for installation, VCP is the practical option for pipe material, MK Construction had the option to bid VCP or RCP jacking pipe. The high compressive strength, low-profile, zero-leakage joints of VCP Jacking Pipe (VCP-J) make it the obvious choice. The average compressive strength of VCP-J is 18,000 psi, so the pipe itself can resist the high jacking forces generated as the pipe is pushed through the ground, eliminating the need for an external casing pipe. Without the larger diameter steel casing, cost savings are realized not just by the elimination of the casing, but by a reduction in excavation and transportation of spoils.

VCP-J has the same lifecycle as all VCP and enables a greater range of cleaning options for long term operations and maintenance of the system. More municipalities are choosing to install a premium pipe to realize these long-term benefits.

Conclusion

The low-impact, high-accuracy installation made possible by PTM gives the owner, engineer and contractor greater control over the alignment and grade of the sanitary line while preserving the community's surface assets. The longer life and expanded maintenance options provided by VCP serves the long-term interests of the community.

The new pipeline was tested for acceptance using both a low-pressure air test and a CCTV inspection per the city's and engineer's specifications. The VCP lines showed no deficiencies and passed the "air-test" per ASTM C828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines. Line and grade specifications were also realized.

"We're thrilled when engineers and contractors get experience with the Pilot Tube Method of Guided Boring, said Jeff Boschert, President of the National Clay Pipe Institute. "Once they realize the pinpoint accuracy and minimal surface impact of the process, they become some of our best representatives."

ABOUT THE AUTHOR:

Steve Matheny, P.E., *joined Logan Clay Products LLC in 2016 as a business development engineer after more than 30-years in the field, working for municipalities and manufacturers. He is currently consulting on multiple projects throughout the Midwest. Many of those projects will employ the Pilot Tube Method for installation.*