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**City of Grand Rapids Utilizes Diverse Installation Methods for  
Concentrated Waste Force Main Along Market Avenue**

Lexie Burt, Hubbell, Roth & Clark, Inc., Grand Rapids, MI  
Randy Tseng, Underground Solutions, Inc., Poway, CA

**1. ABSTRACT**

The City of Grand Rapids, Michigan constructed a new 10-inch diameter force main from Founders Brewing Company to the Water Resource Recovery Facility (WRRF) to convey high strength waste separate from influent flow. The high strength wastewater discharged by Founders Brewing Company and SET Environmental is used to equalize flow during low influent loading periods with the goal of eventually digesting the high strength waste for methane production.

Grand Rapids is the second largest City in Michigan with an extensive existing underground infrastructure dating back over 100 years. The forcemain was installed within Market Avenue, one of the oldest streets in the City which contains a dense amount of existing utilities. Several installation methods were utilized to navigate this congested right-of-way including; traditional direct bury, jack-and-bore, horizontal directional drilling, pipe ramming, and bracket-mounting inside a major City trunk sewer. The creative, bracket-mounted installation within an approximately 12-foot wide by 14-foot tall trunk sewer employed the use of fused polyvinyl chloride pipe, expansion joints, and various other structural components to support the pipeline on the wall of the trunk sewer, thereby avoiding multiple utility conflicts and traffic impact that would have occurred if the pipeline were installed using typical direct bury techniques.

This paper will review the challenges associated with designing and installing a new utility in the presence of numerous existing utilities in a commercial area. It will focus on how an existing trunk sewer originally designed for combined sewer and sanitary flow, can now house a new 2,700-foot length of 10-inch force main.

**2. INTRODUCTION AND PROJECT BACKGROUND**

The City of Grand Rapids, Michigan, built the Water Resource Recovery Facility (WRRF) in 1931 to accommodate all the wastewater treatment needs of the City (WRRF 2019). Previous standard practices included allowing storm and sanitary flows to travel through combined sewers to the treatment facility. As a result, combined sewer overflow (CSO) points would emerge during wet weather events and overflow into the Grand River. As the City's population continued to grow over the years, now up to approximately 200,000 people, this combined sewer system experienced more CSO events and with greater frequency. Realizing the financial and ethical consequences of allowing this to continue, the City began an aggressive CSO control program in 1992 to separate their system to convey storm and sanitary flows through separate sewers (Grand Rapids 2019). The City completed their Sewer Improvement project in 2015 with the separation of all storm and sanitary flows, thereby eliminating all CSO points in the system (WRRF 2019).

In order to continue to address the growing population and additional sanitary waste generated, the City looked to alternate methods to treat it. One such method was by creating a biodigestion system to manage higher strength wastes from the pipeline and to recycle the methane produced into a renewable energy source, moving toward a net zero energy city. As a result, this project was designed to deal with the high strength waste nature of two businesses in the area, Founders Brewing Company and SET Environmental. Aside from Founders' brewery waste and SET Environmental's landfill leachate, a potential connection by the Coca-Cola facility on the north side of the Grand River was incorporated with a pipe stub for future connection.



Figure 1. Overview of project layout.

The most direct connection would be along Market Avenue, a road situated between the Grand River and a heavily occupied commercial area (See Figure 1). This presented various design considerations such as work space constraints and traffic concerns. Furthermore, Market Avenue is one of the oldest streets in the City and contained multiple existing underground utilities, with some dating back more than 100 years.

### 3. PROJECT DESIGN

A preliminary study was done in 2016 for the design of a new force main by Hubbell, Roth, & Clark, Inc. (HRC). This study revealed the complicated nature of this project due to the numerous major facilities in the area, heavy traffic flow, and existing underground utilities. The poor soil conditions around Market Avenue and the multiple commercial businesses in the area made a new pipeline installation difficult. Additionally, the proximity of the busy I-196 highway introduced traffic concerns that had to be taken into consideration. To further complicate matters, many utilities installed over the course of the last 100 years in Market Avenue did not have accurate as-built records.

The new force main was designed as a 10-inch diameter pipeline, taking into consideration Founders Brewing's projection of future flow and SET Environmental leachate discharging rates. This 8,300-foot force main would span along Market Avenue and connect Founders Brewing and SET Environmental with the WRRF. Traditional direct bury was a comfortable option; however, construction would have required the closure of two lanes on Market Avenue resulting in a major traffic interruption and dealing with the risk associated with the existing utilities present there. An alternative option was considered which involved a creative use of an existing approximately 12-foot wide by 14-foot tall trunk sewer that runs along the north side of Market Avenue with its northern wall acting as a river wall against the Grand River (see Figure 2).

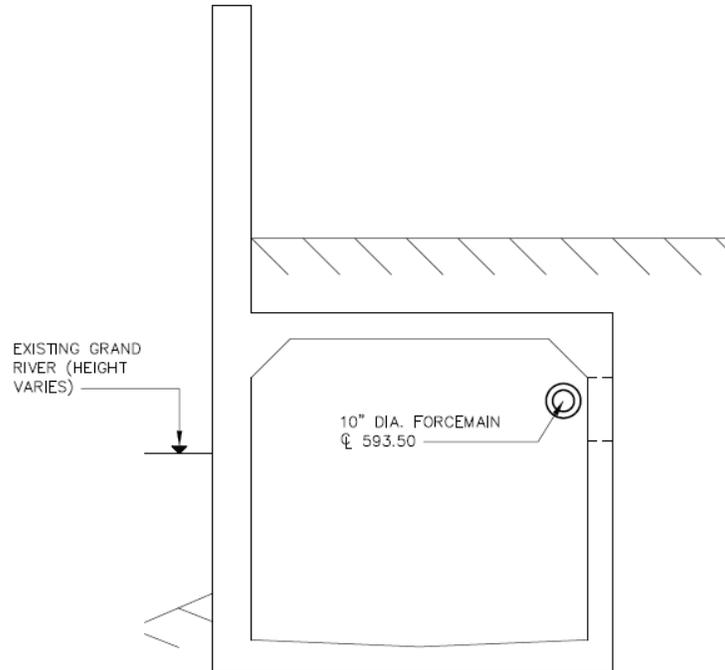


Figure 2. Design of 10-inch force main mounted on the wall of the trunk sewer. (Plans 2017)

As part of the City of Grand Rapids' recently completed Sewer Improvement project, all sanitary sewer and storm lines were completely separated. This meant that the existing trunk sewers had much less flow going through them and would be spacious enough to accommodate a pipeline mounted on the wall using brackets. Not only would this be more cost effective as it would eliminate the need for a trench along the length of the trunk sewer, it would also be less intrusive than open cut and would limit disruption to the traffic flow. Due to the exposed nature of the mounted force main and influent temperatures from Founders Brewing ranging from 64°F to 89°F, expansion joints were installed to account for thermal expansion along the length of pipe (see Figure 3). These expansion joints would relieve the pipe of any additional stresses associated with pipe expansion or contraction due to the varying temperatures the force main would experience relative to the thermal environment in the trunk sewer. Expansion joints were placed every 360 feet along the length of the force main with an anchor wall support staggered between each expansion joint and wall support straps every 12 feet. The pipe used for this application was fusible polyvinyl chloride pipe (FPVCP). FPVCP is a thermally butt-fused PVC pressure pipe material that creates a monolithic length of pipe without mechanical or gasketed joints. This product was used to create seamless, 360-foot lengths of pipe that were easy to place within the trunk sewer and to join using standard waterworks fittings for PVC material.

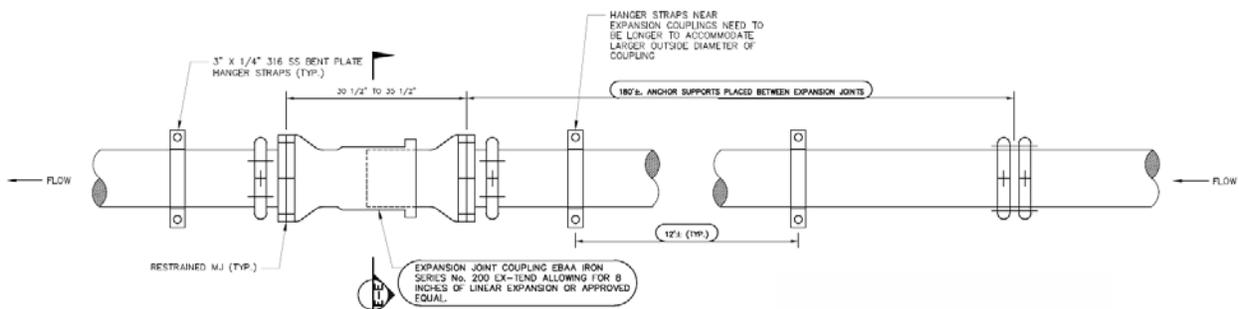


Figure 3. Design of expansion joint coupling detail. (Plans 2017)

Other sections along Market Avenue required different methods of installation, as the trunk sewer portion was only one-third of the 8,300-foot alignment. Traditional open cut was utilized under a sidewalk and when crossing large existing utilities. Otherwise a variety of trenchless methods were used in order to keep traffic impact to a minimum. Horizontal directional drilling (HDD) was used to cross Market Avenue for the SET Environmental service

connection to the force main. Jack-and-bore was used to cross Market Avenue at two locations to avoid interfering with four lanes of traffic. The substructure of a bridge along Market Avenue was utilized to install the force main within an unused casing under the bridge span. Similar mounting to the trunk sewer installation was used within the bridge, without the use of expansion joints. Maneuvering the pipes buried at the WRRF site required the use of pipe ramming to install the pipe beneath a 72-inch pipe, as the crossing would have been challenging with an open cut approach.

#### 4. PROJECT BIDDING

HRC advertised the Sanitary Forcemain in Market Avenue project with a bid date of May 2, 2017. The bid schedule listed out estimated total quantities for each installation method included in the design of the Common Route (Base Bid), which excluded the section installed within the existing trunk sewer. The remaining portion of the project was broken out into two alternates, with 'Alternate 1' for a 2,780-foot bracket-mounted trunk sewer design (Route A) and 'Alternate 2' opting for a 3,366-foot traditional open cut approach (Route B). The project would be awarded based on the low bid resulting from either the Common Route + Route A or the Common Route + Route B. Three bids were received; Diversco Construction Co. was the successful bidder, selecting Route A and was awarded the project later that month. The trunk sewer installation segment was subcontracted out to Harper Industrial. Construction began after the Michigan Department of Environmental Quality (MDEQ) permit was issued on July 12, 2017.

#### 5. CONSTRUCTION

Construction crews arrived on site in July 2017 to commence the open cut work beginning at the Grand Valley Regional Biosolids Authority (GVRBA) Control Building on the WRRF site. Work continued toward Founders Brewing Company located northeast of the WRRF. Most of the open cut portion of force main installation only required one lane of closure on Market Avenue; however, two-lane closure was required in a few locations where utility crossings occurred. At one of the two jack-and-bore locations, construction occurred while another nearby construction project had a total road closure in the work area (see Figure 4). Road closure allowed for flexibility when two unknown pipes were discovered while performing jack-and-bore; excavation was required to decipher the pipe network and adjust the force main alignment. Pipe ramming was also used at the connection to the WRRF to avoid impacting the 72-inch line nearby (see Figure 5).



Figure 4. Jack-and-bore installation of pipeline



Figure 5. Pipe ramming near the connection to the WRRF.

The trunk sewer section required Harper Industrial, the mechanical contractor, to obtain a confined space entry certification to enter. The entrance and exits for the trunk sewer work were made in vacant parking lots which avoided any road disruptions a direct bury route would have caused. When pipe fusion began, the assembled pipe sections were laid out in 360-foot lengths (see Figure 6).



Figure 6. Canopy set up to shield fusion process from rainy weather and pipe fusion continued as normal.

During normal flow, the depth in the trunk sewer was approximately two feet; during wet weather events, the flow depth could rise to four feet, so a motorized cart was designed to keep construction workers out of the flow while allowing them to move along the sewer and install the pipeline (see Figure 7).



Figure 7. Custom built motorized cart to aid workers in pipe installation inside the 12-foot wide by 14-foot tall trunk sewer.

The eight expansion joints were installed along the length of the trunk sewer (see Figure 8), assembled inside the trunk sewer and used as connection points for the 360-foot lengths of FPVCP. The possibility of a future connection to the Coca-Cola facility located north of the Grand River required a 6-inch service lead capped a few feet below the existing ground (see Figure 9). Upon successful installation, the force main in the trunk sewer was pressure tested on January 8, 2018 at 100 psi for 1 hour.



Figure 8. Expansion joint installed along wall-mounted force main in trunk sewer.



Figure 9. Existing trunk sewer with new force main pipe mounted on brackets and a wye to a 6-inch service lead for potential Coca-Cola connection.

## 6. CONCLUSION

With the successful installation of the 10-inch force main, the City of Grand Rapids is now one step closer to becoming a net zero energy city. With all deadlines met and a completed trunk sewer installation, all parties were satisfied with the results. The completion of the forcemain installation was a positive experience and provided alternative methods of pipe installation outside of open cut which would have proven very disruptive to the City. This project was largely successful due to the detailed planning by HRC, close coordination with the City, and the ability of Diversco and Harper Industrial to provide a quality product. This project showcases how even a crowded street with many obstacles and factors to consider can be navigated with careful planning, an arsenal of installation methods, and creativity; and may serve to be an example for future projects with crowded underground utilities and geographical challenges.

In particular, the creative trunk sewer installation demonstrates the advantages of being receptive to new ideas and designs. The City could have justified the traditional open cut method over the trunk sewer by citing lack of standard procedures and experience but saw an opportunity to utilize existing underground infrastructure. As a result, the project was completed on time, traffic impact was minimized, and the budget was managed efficiently.

## 7. REFERENCES

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