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Difficult Situations Require Ext-REAM Measures: How Pipe Reaming Was Selected to Rehabilitate Easement Sewer Mains

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ABSTRACT: The City of Burlingame (City) has been continuously upgrading its wastewater collection system for the past 17 years. The Easton Addition, Ray Park and Neighborhood Sewer Rehabilitation Project is the most recent undertaking by the City in its efforts to reduce infiltration/inflows, reduce the number of sanitary sewer overflows, and ensure a more reliable collection system. Phase 2 of this project focuses primarily on the Easton Addition neighborhood, which has a significant number of sewer mains located in easements running along the back and sides of many of the homes.

The easements in the Easton Addition are overgrown with vegetation and have been built out and encroached on over the years by residents. They are also occupied by other utilities, including gas mains and overhead wires, near the sewer mains. Access is limited in most cases and the soils in these areas are dense, further complicating the selection of a construction method.

After careful consideration, pipe reaming and open cut construction methods were specified as the replacement method options, with the winning contractor electing to use pipe reaming for the majority of the easement sewers. This paper will discuss the challenges and considerations faced during the design stage including coordination with other utilities, the pros-and-cons analysis of the various construction methods considered, and how bid documents were finalized.

1. INTRODUCTION

The City of Burlingame (City) has been using pipe bursting for sewer rehabilitation since the mid-1980s. Since that time, pipe bursting has become a very familiar and successful construction method for the City, particularly for sewer mains in the easements located between the backyards of residential properties, where access and work areas are minimal. The Easton Addition area of the City of Burlingame (as shown in Figure 1) is located in the geographic center of the City limits and is primarily a residential area with single family homes. Phase 2 of the Easton Addition, Ray Park and Neighborhood Sewer Rehabilitation Project focused primarily on the sewer mains in the back easements of the homes located farthest west in the Easton Addition.

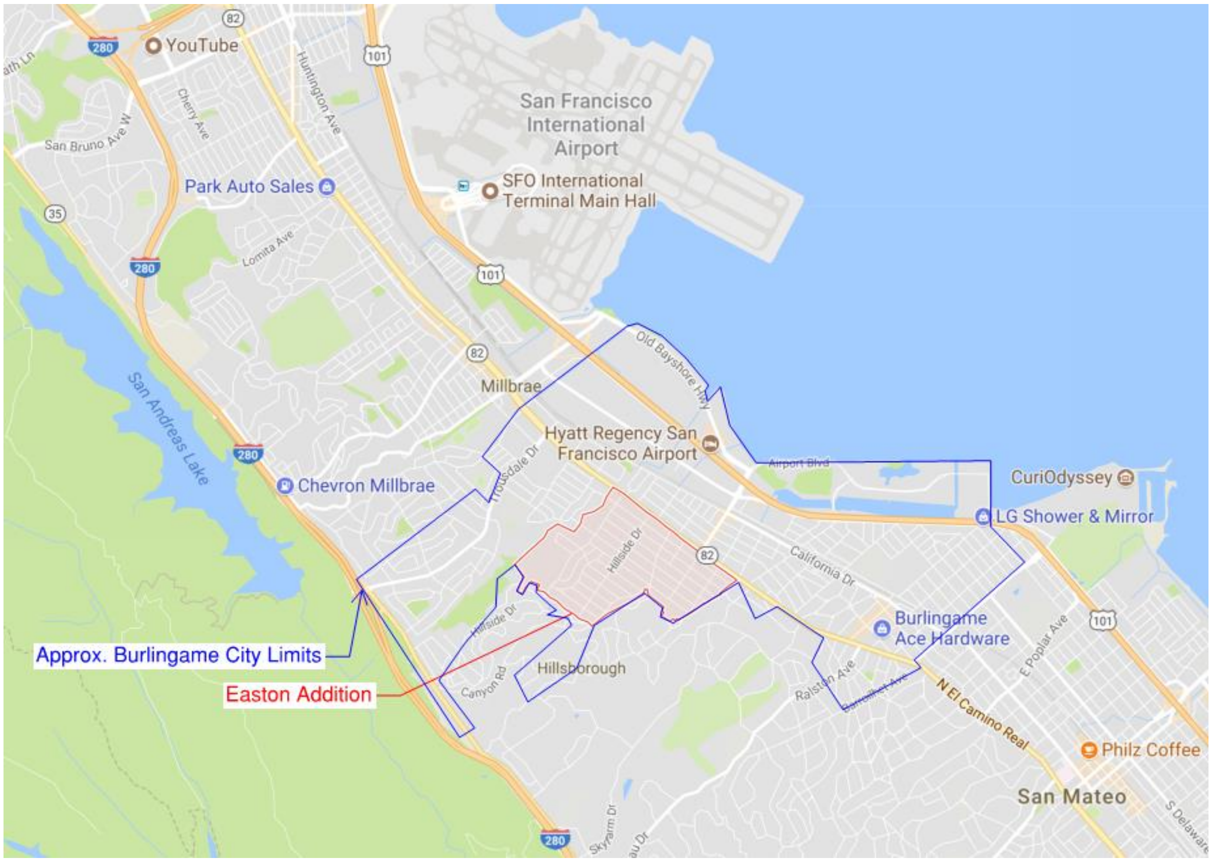

Figure 1. Easton Addition, City of Burlingame, CA

2. EASEMENT CHALLENGES

As mentioned above, the majority of this project is located in easements crisscrossing the neighborhoods. Most of the easements encountered in the City come with their typical challenges. Access and work space are limited due to the typical easements being only 8 to 10 feet wide. This proximity to homes presents a higher likelihood for dust and noise to be a nuisance, and occasionally residents have built out onto the easement. For this project, those issues were found in higher frequency and severity than in past projects.

Gas Mains

The Easton Addition easements are home to most of the area's sewer mains but also share real estate with the majority of the gas mains for the neighborhood. During the design phase, while coordinating with local utility owners, it was discovered that gas mains were located in most of the easements within the project limits. More red flags arose after potholing, when it was discovered that a significant number of gas mains were located within three feet of the sewer mains. Figure 2 depicts a typical easement with the gas main in close proximity to the sewer main.

It is fairly common to discover utilities perpendicularly crossing existing sewer mains during replacement projects utilizing pipe bursting. In those cases, the crossing is typically "air-gapped," or exposed, to eliminate the force of the soil being pushed against surrounding facilities. However, following a thorough review of the gas maps, it was discovered that most of the mains in the easement areas run parallel to, or directly above, the existing sewer mains. A field meeting with representatives of the gas utility owner revealed that pipe bursting in close proximity to existing gas mains was not considered a safe option due to radial forces caused by the bursting process. If the gas mains were located within 5 feet of the sewer mains, it was requested that the gas mains be “daylighted,” or completely exposed, to ensure no damage occurred during the pipe bursting process. The option of pipe bursting within 3 feet was considered, but would require leak testing before and after the sewer main was replaced. To narrow down the viable options for sewer replacement, it was determined the gas mains would need to be accurately located. Extensive potholing took place to locate the gas mains for correlating their locations to the existing sewer mains.

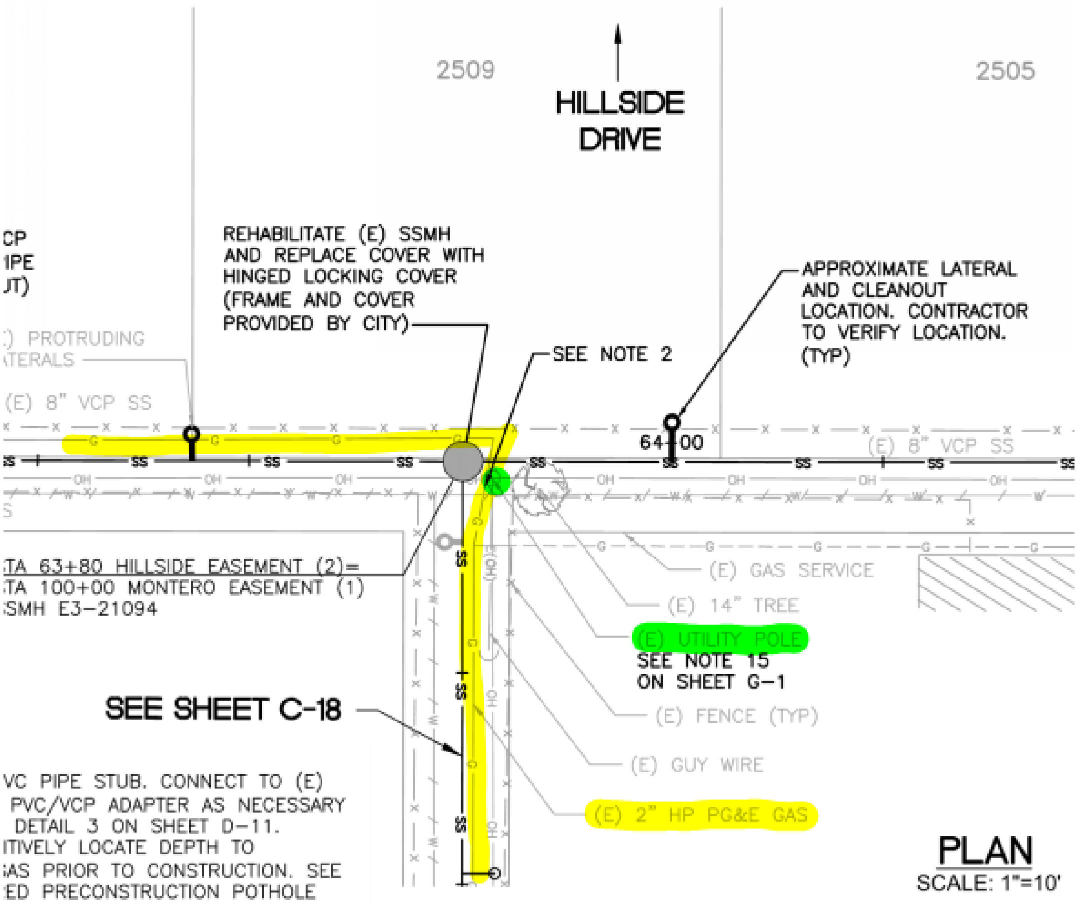

Figure 2. Gas mains in close proximity to sewer mains

<u>Vegetation and Resident Build-out</u>

Many back easements within the City have become overgrown with vegetation, and access is typically limited. These conditions proved to be true in the Easton Addition and was often much worse than in other areas of the City. There were a significant number of trees, ivy and other vegetation that had grown together and intruded into the easements as shown in Figure 3. In a few cases, residents had built gardens in the easement, complete with raised planters and irrigation. Additionally, several homeowners had built extensively onto the easement with permanent features such as brick driveways or landscaped yards, and some even restricted access with locked gates and fences as shown in Figure 4. This proved to be particularly challenging during surveying and field investigations.

Figure 3. Overgrown easements in Easton Addition.

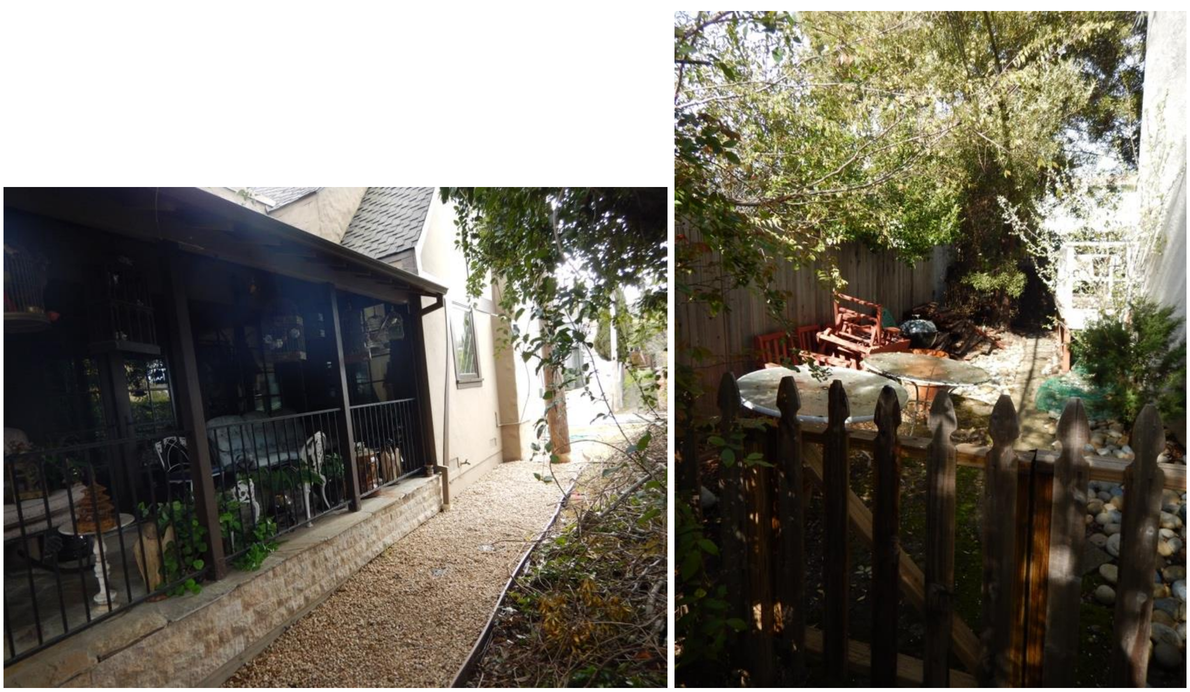

Figure 4. Resident build-out onto the easements.

Soil Conditions

A review of the geotechnical report for the project revealed the soils in these areas were quite dense/hard, as shown in Figure 5. This was of particular concern considering the City's preferred method for easement main replacement is pipe bursting. A review of the geotechnical boring logs from previous projects that had successfully used pipe bursting in Burlingame found the blow counts recorded were significantly higher for the subject project. The borings also showed very dense sands and clays in much of the project area. These soil conditions did not appear to be favorable for bursting (Najafi, 2010 and Bennett, Ariaratnam, and Wallin, 2011).

After discussing our findings and concerns with City staff, the City recalled a past project in the Easton Addition where pipe bursting had been attempted to rehabilitate certain easement sewer mains. The City Project Manager remembered having several issues on that project involving the pipe bursting head getting stuck, the winch cable breaking during bursting operations, and several gas services breaking due to heaving soil.

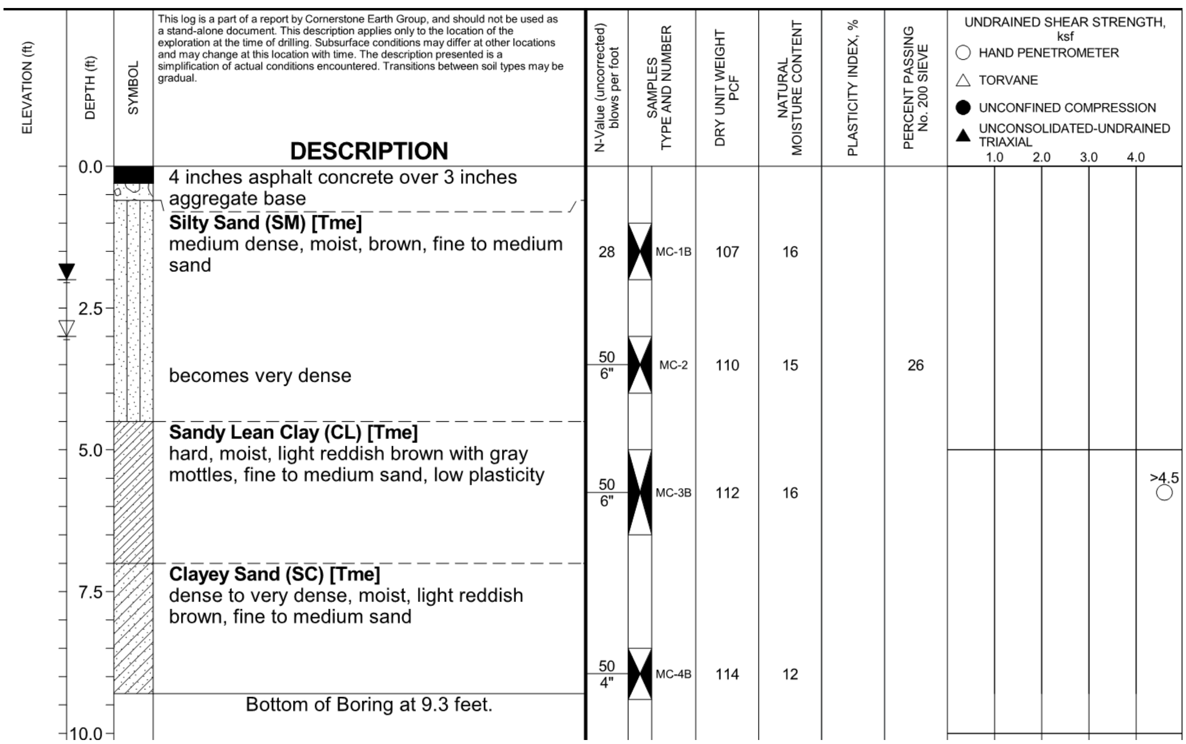

Figure 5. Sample Geotechnical boring log from Easton Addition.

3. PROS VS. CONS

After considering the issues described above, other pipe replacement options were explored. The pros and cons of each construction method determined to be viable are summarized in Table 1 below:

Method	Pros	Cons
Open Cut	• Satisfies PG&E's requirements near gas mains • Familiar method to most local contractors • Trusted and familiar method to the City	• Most costly • Access requirements and crowded easements would limit equipment options
Pipe Bursting	• Familiar method to most local contractors • Trusted and familiar method to the City • Cheaper than open cut	• Dense soils may result in costly issues during construction • Cannot be utilized within 3 feet of gas mains
Pipe Reaming	• Less costly than open cut • Satisfies PG&E's requirements near gas mains • Dense soils not an issue	• Not a familiar method to the City • Limited number of local contractors to perform reaming
Cured-in-Place Pipe (CIPP)	• Cheaper than open cut • Satisfies PG&E's requirements near gas mains • Dense soils not an issue	• Reduction in flow capacity • Unable to upsize

Table 1. Pros vs. cons analysis of construction methods.

CIPP was quickly removed as an option for several reasons; primarily, most of the existing lines were 6-inch vitrified clay pipe (VCP) and the preferred City minimum is 8 inches for sewer mains. The reduction in capacity, as well as some of the conditions in the existing pipes, would not be acceptable for lining.

The combination of soil conditions and restrictions due to the adjacent gas mains all but eliminated most pipe bursting for the project. There were some areas where the conditions allowed and pipe bursting was specified, but those areas were only 83 linear feet out of the total 2,622 linear feet on this project. After research and site visits to further investigate pipe reaming, it was agreed pipe reaming was the best solution for the challenging situation. The primary concern with pipe reaming was the limited number of local contractors who performed the method routinely. The City did not want to discourage contractors from bidding the project, and open cut was also included as an acceptable option. However, the construction costs associated with open cutting were a concern.

After some discussion, it was decided to specify open cut or pipe reaming as the construction methods for the pipe reaches that could not be safely pipe burst. This would allow more contractors to bid on the project and keep bids competitive, while clearly specifying which methods would be acceptable to the City with the given situation. Figure 6 illustrates the lengths of pipe for each rehabilitation method specified for this project.

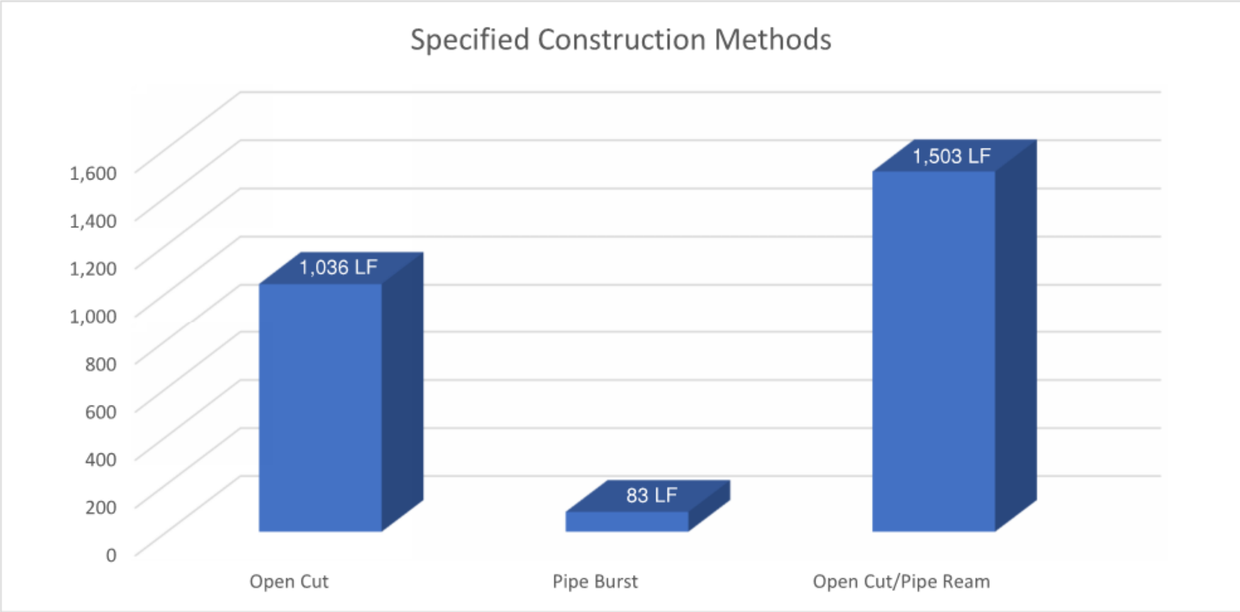

Figure 6. Lengths of pipe for each rehabilitation method specified for this project.

4. PIPE REAMING

Pipe reaming utilizes directional drilling equipment with a modified reaming head to remove the existing pipe and replace with a new pipe in the same alignment. Drill rods are inserted into the existing pipe alignment and attached to the reaming tool at the insertion pit. An example of the reaming tool is shown in Figure 7 below. The reaming head grinds the existing pipe, in combination with the use of drilling fluid, as it is pulled back and the new pipe is installed in its place. The reaming head is also available in a variety of configurations for addressing specific ground conditions or existing pipe materials (PE 100+ Association, Pipe Reaming). The existing pipe that is destroyed and suspended in the drilling fluid is removed with the use of a vacuum truck. High density polyethylene pipe (HDPE) was used for the subject project as this is a typical pipe material for reaming, although other pipe materials may be considered depending on available work area, depth of the existing pipe, and existing ground conditions.

Figure 7. An example of a reaming head. Reaming heads can come in a variety of configurations.
Source: Plastics Pipe Institute

Pipe reaming can be used in a variety of different scenarios including easements with limited accessibility similar to this project and also for routine pipe replacement including upsizing. As discussed in Section 3, pipe reaming may be the preferred method of replacement as it does not create the same radial forces as pipe bursting, which pose a risk to surrounding facilities. Limitations to pipe reaming may include existing groundwater, concrete encasement, and rock (ISTT, 2017). Although not impossible to pipe ream in these conditions, it is critical that thorough investigation takes place prior to pipe installation to confirm pipe reaming is the most appropriate method and to ensure the proper equipment is being used.

The equipment setup and layout for pipe reaming is almost identical to horizontal directional drilling. Similar to pipe bursting, it is necessary for the pipe to be fused prior to pipe installation. Special considerations may be required if the work area space is limited or if work is occurring in a residential area requiring driveways and roadways to remain accessible to local traffic. For this project, most of the sites were within easements with very limited access, requiring strategic set-up locations to maximize efficiency and reduce disturbances to the surrounding neighborhood. Figures 8 and 9 below show an example of one of the trickier areas on the project. As shown in Figure 8, the contractor chose to set up the drill rig in the center of a reach of pipe to be replaced. They reamed one half of the reach (shown in blue), then set up the rig on the opposite side of the same receiving pit and reamed the other half of the reach (shown in green). They joined the two sections together with an electrofusion coupling.

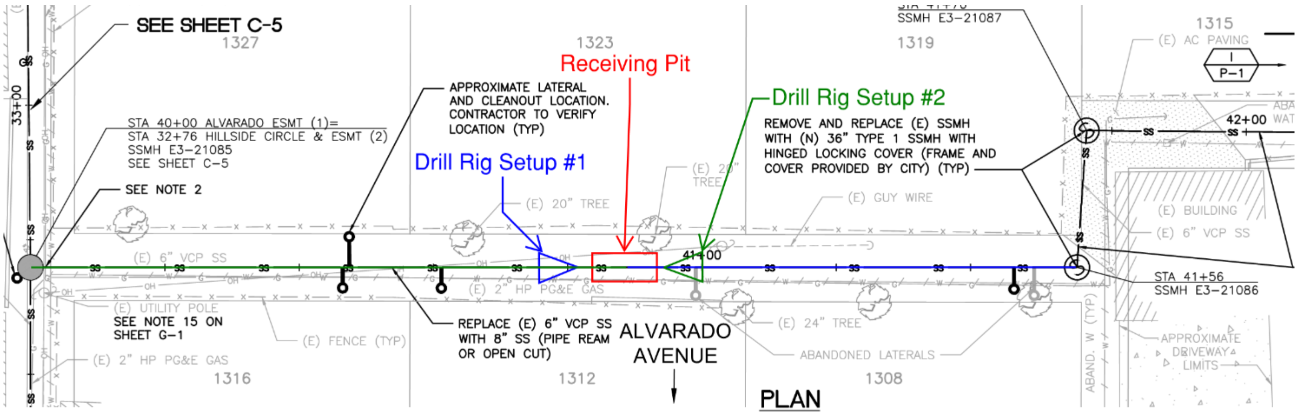

Figure 8. Sample equipment layout of pipe reaming equipment.

In Figure 9, another benefit of pipe reaming is depicted, which proved to be useful in the constricted easement areas. With the permission of the resident, the contractor was able to drill a pilot bore under an adjacent property to cut the corner and allow them to ream a reach of sewer pipe where there was no clearance for setting up the rig. This maneuverability proved to be beneficial on several occasions throughout the project.

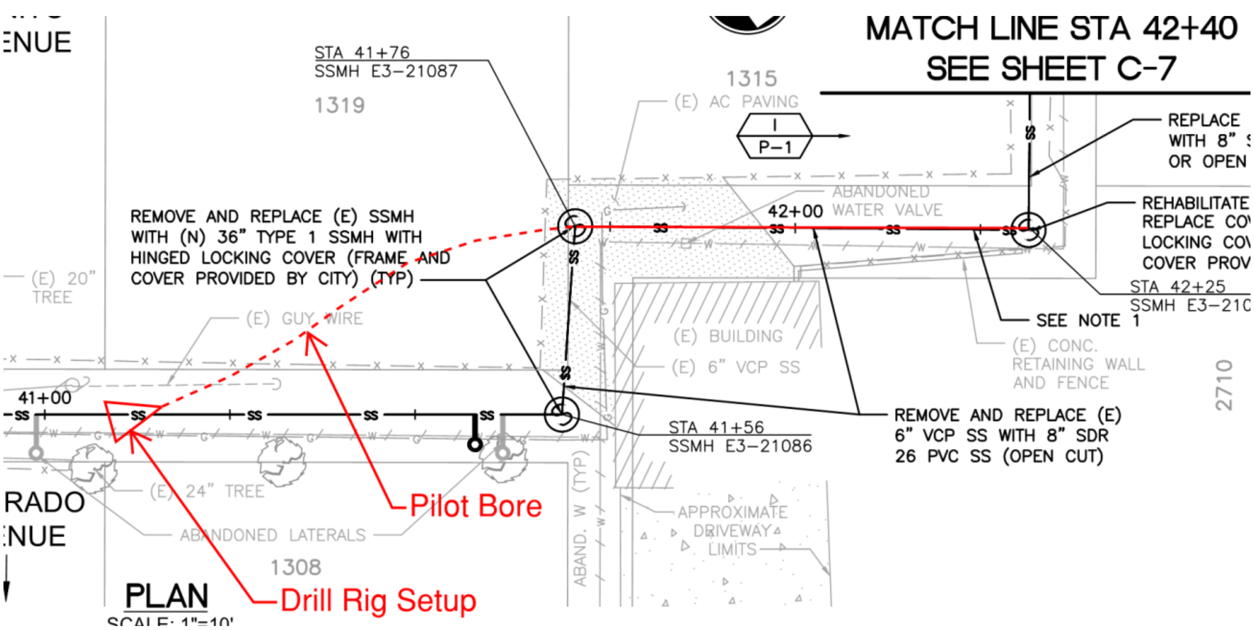

Figure 9. Pipe reaming equipment setup utilizing a pilot bore.

In conclusion, allowing pipe reaming as an option for pipe replacement resulted in a competitive and cost-effective opportunity.

5. REFERENCES

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