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Just Another Bore-ing Water Main Crossing: How Preliminary Exploration Helped Deliver a Successful Project

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ABSTRACT: As part of the City of Mountain View's initiative to increase the accessibility and reliability of its water and sewer system, the Water Main Crossing US 101 from San Rafael Avenue to Macon Avenue Project was constructed to provide redundancy to one of the three aging utility pipelines that provide service to the City's North Bayshore area. Located under a six-lane California state highway with high traffic volumes, the water main project included 570 linear feet of 12-inch fusible PVC (FPVC) pipe installed via jack and bore, and 470 linear feet of 12-inch FPVC pipe installed via open trench methods.

Our project team's approach was to identify and anticipate potential project challenges early and conduct preliminary site exploration to evaluate project conditions, to uncover risks, and to find solutions which enabled the team to keep the project on schedule and budget.

Project challenges included construction within active and abandoned underground utilities, coordination with nearby businesses who were directly impacted by shutdowns/tie-ins of the existing water mains, monitoring and stabilizing the sandy soil conditions to prevent settlement, and dewatering of the site to remove the groundwater due to the project pipeline's sea level elevation. Additionally, because one segment of the water main was installed within a private property that was also under construction, coordination with the property owner representatives during design and construction was necessary.

This paper will discuss how site-specific challenges were identified and addressed, their impacts on the construction and installation methods of the water main, and the positive outcome of providing preliminary exploration during pipeline construction.

1. INTRODUCTION

The Water Main Crossing Highway 101 from San Rafael Avenue to Macon Avenue, Project 16-61, (Project) is located in the North Bayshore neighborhood within the City of Mountain View (City) in Santa Clara County, California. Named for its view of the Santa Cruz Mountains, the City is in the heart of Silicon Valley and home to many high technology and innovation companies. As seen in Figure 1, the surrounding context of this project includes a regional park to the north, Highway U.S. 101 to the south, the City of Palo Alto to the west, and the City of Sunnyvale's Stevens Creek neighborhood to the east.

Because U.S. 101 is a 6-lane highway with high traffic volumes and multiple on and off ramps, it created unique logistical challenges and impacted the construction methods utilized for the installation of the new water main. The Project included 570 linear feet of a 24-inch steel casing installed via jack and bore for a 12-inch FPVC water main, and 470 linear feet of 12-inch FPVC water main pipe installed via open trench methods.

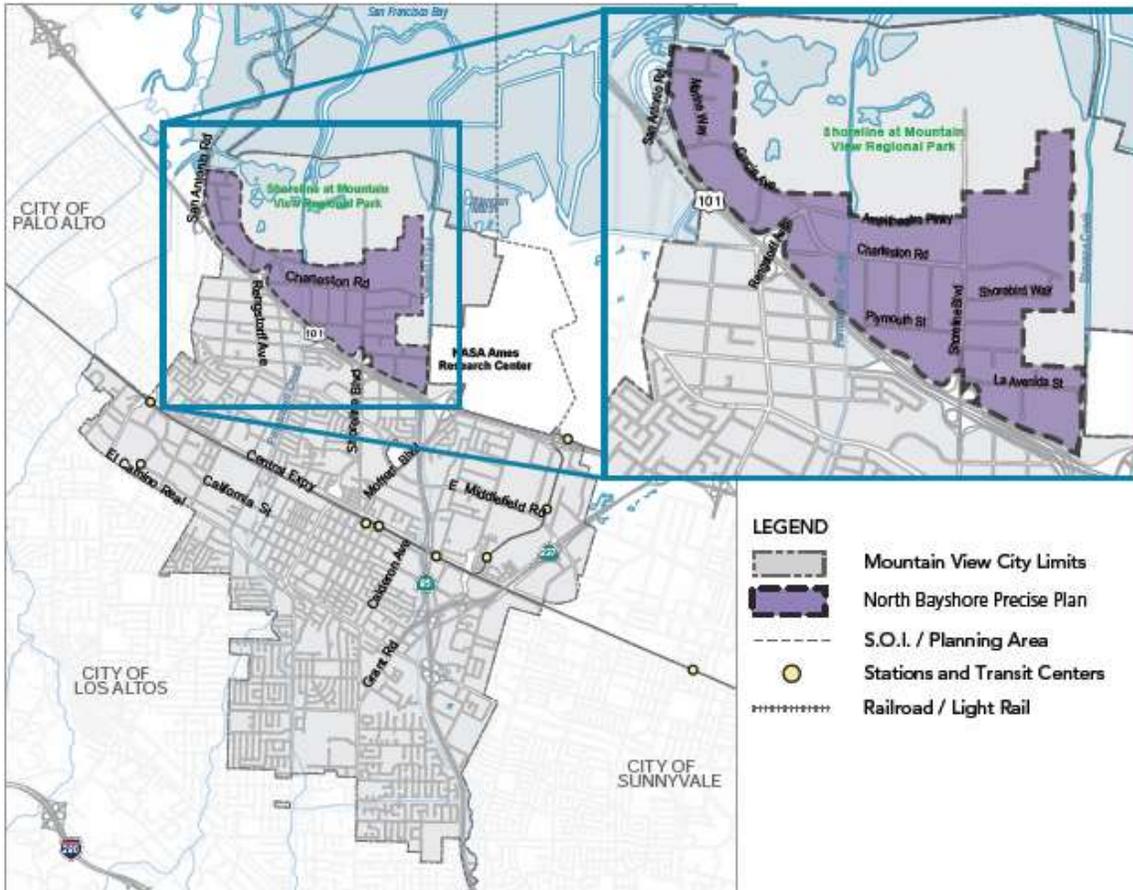


Figure 1. North Bayshore Area - City of Mountain View (2017). Final Draft of North Bayshore Precise Plan Location Map.

Upon completion, this Project provided a redundancy line of service from the southern part of the City to the North Bayshore area in the event another water main is out of service due to maintenance, construction, or a natural disaster. This new water main is an essential asset to the City as the North Bayshore area continues to develop, and allows the future expansion needs of the surrounding companies of Microsoft, Google, Intuit, LinkedIn, and other growing companies to be met with reliable and effective utility services.

2. CONSTRUCTION CHALLENGES & SOLUTIONS

Challenging Location

This Project faced geographically distinct challenges to effectively install the water main utilizing a jack and bore method under Highway U.S. 101. The receiving pit was located on San Rafael Avenue at the end of a business cul-de-sac and the jacking pit was located on Macon Avenue within the Microsoft Campus development area. The construction of these two pits required a permanent and temporary construction easement through the Microsoft Campus at 1075 La Avenida and a temporary construction easement from

the property at 970 Terra Bella Avenue. Additionally, the water main was installed under three (3) mechanically stabilized walls which support the abutment of the vehicular approach to the Route 85 and U.S. 101 Interchange and required Caltrans permits.

Coordination with North Bayshore Neighbors

Timely communication and coordination with the surrounding businesses was key to the project's success. In addition to obtaining the required easement through the Microsoft Campus, it was necessary for the project team to coordinate with the onsite construction that was to occur at the Microsoft Campus during the same timeframe as the water main installation. All stakeholders involved had a vested interest in ensuring that the project was completed on schedule. The City, Tanner Pacific, Inc. (Construction Management firm for the Project), and Microsoft representatives had regularly scheduled meetings to review project progress and coordinate construction activities. As seen in Figure 2 below, the construction deliveries to the Microsoft Campus required close coordination during the cut and cover segment along Macon Avenue because the work area restricted the turn radius of trucks.

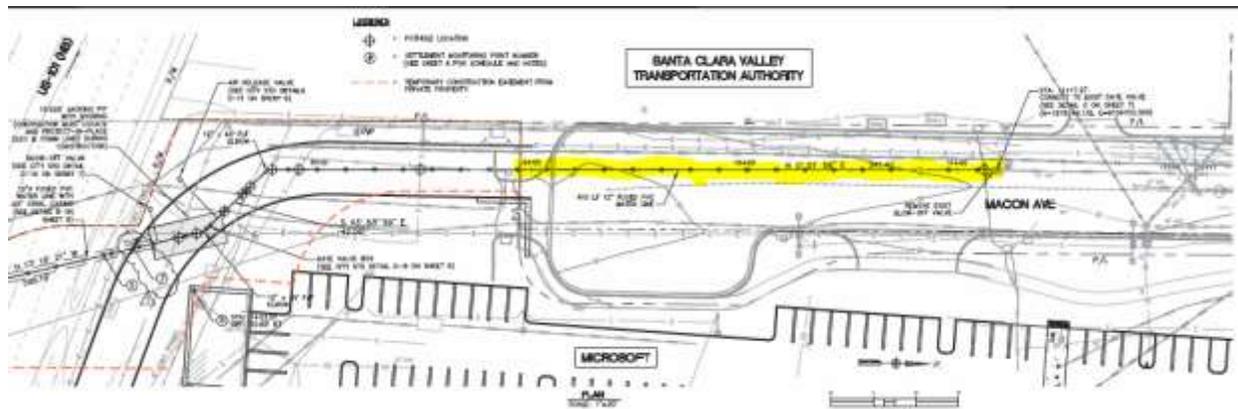


Figure 2. Cut and cover segment of water main segment on Macon Avenue its proximity to the Microsoft Campus.

Additionally, coordination was particularly critical for the water tie-in on Macon Avenue. The water shutdown impacted the Valley Transportation Authority (VTA), Microsoft, and other surrounding businesses. To minimize the impacts of the water shutdown, the Contractor was directed to perform the tie-in on a Saturday. This resulted in a Contract Change Order for the weekend work, but the overall benefit to the project and the community outweighed the cost impacts.

Working Through the Pandemic

The global pandemic has brought many challenges to the construction industry and directly influenced this project. Santa Clara County's initial response to the COVID-19 virus was to issue a "Shelter in Place Order" on March 16, 2020 which stated that all construction sites needed to shut down until deemed safe by the County. When the Order was lifted for Public Works construction projects on May 4, 2020, the project's schedule was already impacted.

The original start date that was planned for March 2020 was delayed until mid-May. This unavoidable schedule change impacted the project's ability to meet Microsoft's hard-set demobilization date of August 2020 (that was based on their upcoming campus site construction schedule needs). To successfully meet the hard-set deadline, the City allowed the Contractor to work extended hours (2 hours extra each day) for the duration of the boring work. This was allowed for several reasons: the boring operation was outside of the residential area thus minimizing the noise and construction impact on residents, ongoing building construction in the North Bayshore area had 7:00 AM – 6:00 PM work hours (the same work hours the Contractor was requesting), and finally, the jacking pit and receiving pit were both in cul-de-sacs and the jacking pit was on private property, thus had no impact on traffic. These extended hours allowed the Contractor to complete the project on schedule and meet the hard-set deadline.

The County also issued a policy for construction sites to cease if a person working onsite had a positive COVID-19 test result. Unfortunately, one individual tested positive, so all workers who were in contact at that time were required to have two negative COVID-19 tests within a specific time before they could return to the site. Additionally, the contractor had to hire a County-certified COVID-19 cleaning company to disinfect the site prior to remobilization. Fortunately, all other persons on this project tested negative for COVID-19, which was attributed to the adherence to the State and County guidelines regarding social distancing, wearing facial masks and proper PPE, washing hands frequently, among other established safety practices.

To address the reduction of in-person meetings and site visits throughout the duration of the project, the City, the Designer, the Contractor, and the Construction Management firm established effective communication strategies. The construction management software Procore was used as a collaborative tool during both the preconstruction and construction phases of the project. It served as the hub of virtual communication for document management, meeting agendas and records of discussion, and keeping track of financials. The application that was most effective during the pandemic was the Daily Log tool. This tool ensured that the Construction Management firm and City were up to date with current notes, photographs, videos, and site observations. Since the Daily Log tool (see Figure 3) was updated by the Construction Manager or Inspector in real time, information was accessible to all team members instantly and resulted in timely decisions. Any project changes, schedule updates, or information related to daily inspections was successfully provided without requiring physical site visits.

Issue?	Location	Comments	Attachments
<input type="checkbox"/>		(CE#001)-0700-contacted Cindy (TPI) for the daily wellness check.	No Attachments
<input type="checkbox"/>	Macon Ave> Jacking Pit	(CE#001)-0730-contractor daily wellness check per the Santa Clara County order for COVID-19.	No Attachments
<input type="checkbox"/>	Macon Ave> Jacking Pit	0740-observed 3 Cratus workers using the excavator and dump trucks to begin excavation of the jacking pit per plan. Water from the dewatering tank is being used for dust control. 1 worker is using a hose for dust control during excavation, and 1 worker is cleaning truck edges and tailgates prior to leaving the site. 6 dump trucks in rotation total. Trucking manifests provided to contractor for soil off-haul and dumping.	Download All D2670277-6EDA-4481-8A... E54CD2CA-18C0-43F9-83... 3C290e32-FC30-45DC-8F...
<input type="checkbox"/>	Macon Ave> Jacking Pit	0800-delivery of steel plates and perforated 10" PVC for the dewatering wells.	No Attachments
<input type="checkbox"/>	Macon Ave> Jacking Pit	0825-excavation halted while trucks are in rotation to the dump site. Observed 3 Cratus workers using the excavator to offload steel plates.	No Attachments
<input type="checkbox"/>	Macon Ave> Jacking Pit	0900-excavation and off haul has commenced. Observed 3 Cratus workers using the excavator and dump trucks to continue excavation of the jacking pit per plan. Water from the dewatering tank is being used for dust control. 1 worker is using a hose for dust control during excavation, and 1 worker is cleaning truck edges and tailgates prior to leaving the site. Currently approximately 8.5' deep.	Download All 14E83808-D43A-489D-A3... 0C9E8D95-D380-4903-9C...

Figure 3. An example of the Daily Log tool in Procore from the Project

An additional project challenge that was faced while working through the pandemic was managing and submitting documents that required the City's signature. For example, each soil manifests required a wet signature from the City Project Manager prior to the soil being sent to the waste facility. This process

required extra coordination between the City Project Manager, Construction Management team, and the Contractor to ensure that all safety protocols were followed.

Site Conditions

At the beginning of the project, the soil type and the groundwater level at the Project location were both identified as site conditions that would need to be addressed during construction. As shown in Figure 4, the geotechnical report for this project revealed the soils at the jacking and receiving pits were both sandy and clayey soils.

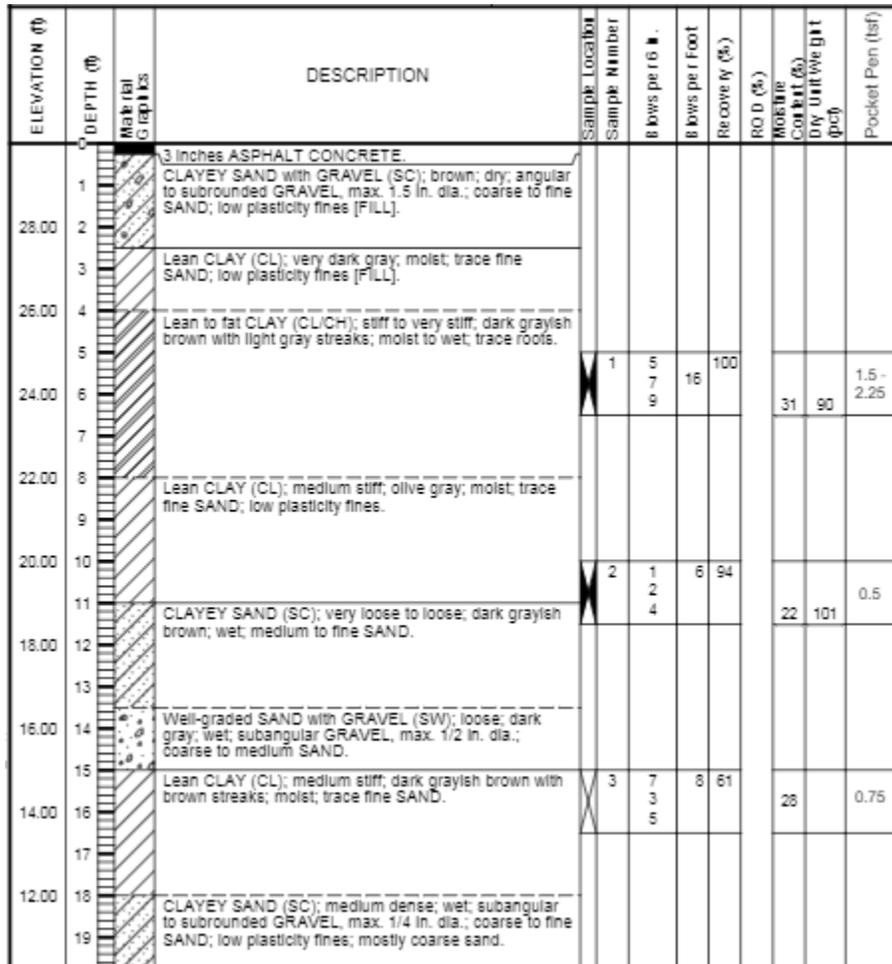


Figure 4. Boring Record for hole ID B-1 from the geotechnical report for this Project.

Even though these soils were identified as susceptible to settlement, the geotechnical report stated, "Archiving would be expected to occur in still soils such as those revealed in project and historic explorations such that voids which might be present around the pipe as a result of overcut would be unlikely to manifest as ground surface settlement. If settlement were to occur, it would be alleviated by the U.S. 101 pavement structural section." Based on this report, surface and subsurface settlement monitoring points were given to the Contractor and they monitored the points per the Designer's recommendation. The monitoring reports showed minor settlement occurred throughout the project, all within the limits set by the Designer.

Additionally, the Contractor installed a 4-inch pilot tube to guide the auger bore. The Contractor utilized Akkerman pilot tube jacking machine and was able to install 575-linear feet of the 4-inch pilot tube within one day without any difficulty. The pilot bore obtained high levels of accuracy in line and grade before proceeding with jacking of steel casing. The contractor also utilized a "reaming head" which allowed the 24-

inch diameter casing to connect to the pilot tubes already installed and decreased the risk of cave-in particularly in the clayey sandy soil lenses.

Another site condition that was encountered was the groundwater present onsite. The jacking and receiving pits were located under sea level, so it was evident that dewatering of the pits would be required. Also, according to the Soil and Groundwater Disposal Report created by the Designer, the water needed to be sampled and tested for two metals: barium and chromium and four VOCs. All water samples came back within the limits set for the Project and no treatment of the water was necessary.

3. LESSONS LEARNED

Addressing Settlement

As discussed above, the soils at the Project location were sandy and clayey. Both soil types required settlement monitoring, which was described in the geotechnical report prepared by the Designer. Because the Designer and the Contractor interpreted the Specification Section on settlement monitoring differently, there was confusion regarding the optimal number of settlement monitoring points and when the points should be monitored. To provide clear direction to the contractor, it is recommended that the Specifications be reviewed during the Constructability Review of the project prior to sending the project out to bid. It is also recommended to require additional project meetings to specifically discuss soil monitoring expectations and ensure the project team members are unified on the approach.

Active and Abandoned Underground Utilities

As expected in the North Bayshore neighborhood of Mountain View, there are many active and abandoned utilities installed underground. A review of the BESS Utility Solutions Potholing Report for the project revealed many utilities at the jacking pit location. During a previous City project, underground utilities were installed in a joint trench located in the same corridor as the water main in this project. The site also contained multiple utility lines that were abandoned in place which led to additional challenges to accurately identify and locate all underground utilities.

When the Contractor mobilized to the site, they did their due diligence and potholed to ensure their jacking and receiving pits and open cut sections would not hit any active or abandoned utilities. During this time of preliminary exploration, one of the utilities that was previously abandoned on the joint trench project was identified as active on the project's as-built drawing set. This issue was resolved by hiring the utility company and UtiliQuest, an underground utility locating service, to visit the site, test the utility, and resolve the conflict. It took six days for both companies to visit site and confirm the conduit was in fact abandoned. Although a six-day delay in the project is small in the scale of the project, more coordination with the utility services and potholes in the design phase and pre-construction phase of the project could have eliminated or minimized this delay.

4. PROJECT CONCLUSION

Our project team's successful outcome was based on identifying and anticipating potential project challenges and then taking action through site exploration to evaluate project conditions, uncover risks, and find solutions to keep the project moving forward. Whether working within a complex urban location, coordinating with existing North Bayshore neighbors, communicating virtually among the project stakeholders during a pandemic, or having challenging soil and groundwater site conditions, being prepared enabled our project team to deliver the project ahead of schedule and under budget to the City.

5. REFERENCES

BESS Utility Solutions (2019). Potholing Report No. BTL 13-8333.

Loebener, B. (2019). Soil and Groundwater Disposal Report, City of Mountain View – Water and Sanitary Sewer Main Replacement Crossing U.S. 101 Design Project 16-61.

Moore, A., and Boddie, P. (2019). Geotechnical Exploration and Engineering Assessment, City of Mountain View – Water and Sanitary Sewer Main Replacement Crossing U.S. 101 Design Project 16-61.

The City of Mountain View (2017). NORTH BAYSHORE PRECISE PLAN.