

FIRST CURVED MICROTUNNEL IN THE MIDWEST!

Successful "Dugway West Interceptor Relief Sewer" Microtunnel Project in Cleveland Completed Ahead of Schedule

By: A2B Publishing Inc.

Microtunneling setup at DWIRS launch shaft. The curved microtunnel eliminated the construction of two shafts, reducing impacts on the local community

Presented an opportunity to embark bravely into the next frontier of microtunneling by designing and completing a curved drive, trenchless contractor Super Excavators, Inc. (SEI) stepped up to the challenge, delivering excellent value to the project owner, while working to minimize surface disruption for residents in a busy east side Cleveland neighborhood.

At its own initiative, SEI submitted a Value Engineering Change Proposal (VECP) for design modifications to the Dugway West Interceptor Relief Sewer (DWIRS) microtunnel project, completed this August. The VECP introduced a 700 LF 72-inch tunnel curve in the alignment, replacing three shorter straight drives, and relocating one structure. Benefits from the design modifications in the VECP included reduced community impacts and maintenance costs from elimination of the construction of two shafts in a residential neighborhood. These changes also accelerated the overall project construction.

Overview

Project Clean Lake is the \$3 billion 25 year Northeast Ohio Regional Sewer District (NEORS D) program with the ultimate goal to ensure 98% of wet weather flows entering the combined sewer system receive treatment, thereby dramatically reducing raw discharges into Lake Erie and adjacent waterways. The NEORS D services over one million customers in all or part of 62 member communities in the greater Cleveland area, treating over 90 billion gallons of wastewater annually.

Under Project Clean Lake, the Dugway West Interceptor Relief Sewer (DWIRS) is a major component of the combined sewer overflow (CSO) control projects in the NEORS D Easterly service area, a system of conveyance and storage facilities under construction to drastically reduce overall CSO discharges. Part of the Euclid Creek and Dugway Storage Tunnel system, the DWIRS provides flow management to decrease the frequency and volume of CSO and flooding in the Dugway Brook West

Branch watershed area, which encompasses the Glenville neighborhood - an older, predominantly residential area east of downtown Cleveland. The projected annual CSO capture for the DWIRS is 110 million gallons.

Essentially a 2 mile long conveyance tunnel, the DWIRS project design included construction of 10,600 LF of main line relief sewer, 4,000 LF of connecting sewers, demolition of 8 buildings and modification reconstruction or abandonment of 39 regulating structures. Due to location in a dense urban area with overhead and buried utilities, a minimum tunnel depth of 25 feet and high water table, the project design specified the use of microtunneling trenchless methods. In many tight urban settings such as east side Cleveland, trenchless construction is often now required because of the negative impacts on local communities from open-cut construction. These impacts can include general inconvenience, safety problems, environmental concerns, along with damage to roads, utilities, and other infrastructure already in place.

DWIRS Microtunnel Project

NEORS D awarded the \$57 million contract for the DWIRS project in October 2013 to Joint Venture partners Walsh Construction and Super Excavators, Inc. (SEI) of Menomonee Falls Wisconsin. Walsh Construction was responsible for all the above ground work including the regulating structures, manholes, junction chambers and all tie in connections to the existing sewer system.

SEI focused on the microtunneling work, which consisted of 7,000 LF of 72-inch RCP relief sewer, mining through shale rock of approximately 915 LF, and trenchless construction of approximately 4,000 LF of 48-inch RCP sewer. In total there were 17 separate drives of varying lengths with the longest being 1079 LF. Depths ranged from 25 – 32 feet with the deepest drive at 42 feet. Nine launch shafts and 11 receiving pits were constructed – one launch shaft and one receiving pit were eliminated from the

original project design through implementation of the VECP design modifications.

Before construction, subsurface conditions were evaluated along the planned DWIRS route, which runs along the gently sloping east side of the Cuyahoga River valley northwards to Lake Erie. Soils consist of fill, alluvium, glacial lacustrine deposits, and glacial till on shale bedrock. Nearly the entire alignment is covered in non-engineered fill consisting of sand with varying amounts of silt, clay and gravel intermixed with random debris. Much of this fill has the appearance of fine sandy dredge spoil from Lake Erie. Alluvial deposits are comprised of channel deposits and flood plain deposits, predominantly silty fine sand. Cobbles and boulders common in glacial tills throughout the Great Lakes region were also found. These ground conditions changed variously and frequently over short distances along the project alignment, reflecting the complex post glacial geology and rich settlement history of the region.

The water table is generally from 10 to 20 feet deep, several feet above the installed pipe. At the upper, southernmost end of the alignment, groundwater follows the elevation of Dugway Brook West Branch, which is almost entirely enclosed in a culvert, now a vital part of the current sewer system used for CSO discharges. The proximity of this culverted stream to the planned DWIRS alignment was an additional consideration in the original selection of microtunneling in the project design. Use of precision trenchless methods instead of open-cut construction greatly reduced risk of damage to the Dugway Brook Culvert.

Because of the project specific soil conditions and elevated water table, two Microtunnel Boring Machines (MTBMs) with capability to continuously pressurize the mining face were used. The first MTBM drive was launched in August 2014 from a 45-foot deep secant pile shaft with an Akkerman SL60 MTBM. The SL60 was used throughout the project for the 48-inch RCP sewer, including a 915 LF run through shale, while an Akkerman SL74 was deployed on all the 72-inch drives including the 700 LF of curved microtunnel. Both MTBMs were equipped with an increase kit so that the final bore diameter would accommodate the outer bore diameter of the jacked pipe. The machines performed very well in the various ground conditions encountered during tunneling operations.



Project Clean Lake plan overview of DWIRS with location of curved microtunnel segment highlighted. Southern end runs close to existing culvert (courtesy NEORS D)

Value Engineering Change Proposal

SEI initiated the VECP to consolidate three very short drives into one longer curved tunnel located at the southernmost upper end of the DWIRS project alignment along Linn Drive. The original NEORS D design used 3 shorter drives in order to work within the easement granted for the project, and to stay far enough away from the existing Dugway Brook Culvert. This initial design approach followed the curve of the culvert with short pieces of straight pipe.

Together, these three relatively short tunnel runs made up about 670 LF. SEI realized these three straight runs could be incorporated into one longer curved drive design which would greatly reduce the costs and time associated with shaft construction, setup/breakdown, and moving equipment and crews around. All of this could be

accomplished through elimination of one jacking shaft and one receiving shaft.

With the curved design approach, future maintenance costs incurred by NEORSRD for these two structures (points of intersection) PM14 and PM15 were completely eliminated. The owner allowed SEI to relocate structure PM13 approximately 30 feet north which helped facilitate a “better fit” curve by making it 30 feet longer, and thus 700 LF in total.

Curved MTBM Drive

Once the idea of introducing a curved tunnel into the alignment was accepted by the owner, Scott Ludlow, S.J. Ludlow Consulting Engineers, Inc., of Indianapolis IN, was retained by SEI to complete the engineering design necessary to obtain final approval. Based on what he saw, Ludlow was optimistic about the prospects for success:

“Considering the project requirements, anticipated ground conditions, SEI’s capability to perform the work, and the NEORSRD’s knowledge of tunneling, the concept of utilizing a curved microtunnel appeared to be viable.”

In order to maintain proper safe distance from the Dugway Brook Culvert the curve in the VECP design mirrored the curve of the existing culvert and roughly followed the path of the original NEORSRD design. The entire alignment was very close to the culvert – never more than 15-20 feet away. To facilitate the curved section, Hanson Pipe of Columbus Ohio provided shorter 8 foot 72-inch RCP segments, which were installed instead of the 10 foot RCP segments used on the rest of the job.

According to Ludlow: *“Design considerations for the tunnel section included: maintaining an alignment within the right-of-way; estimates of jacking forces and ground response; and structural adequacy/joint performance of the pipe.”*

Working 24 hours/day it took 10 days to complete this historic drive, mining north to south, from PM13 to PM16 which at is the southern terminus of the DWIRS under the intersection of Ada Avenue and Linn Drive.

As SEI Project Manager Justin Kolster observed: *“The response of SEI to approach this section of the DWIRS with the curved*



First MTBM launch August 15 2014 from a 45 foot deep secant pile shaft using an Akkerman with an MT860K jacking frame



design was strictly a matter of practicality in terms of schedule, neighborhood impact, cost, and overall project goals, all of which

were successfully met and delivered by implementing the curve design.”

CURVED MICROTUNNELS: DIRECT BENEFITS

Over the last few years, curved micro-tunnel alignments have been successfully completed on only a limited number of projects in North America. The majority of curved projects were bid as straight drive microtunnels, and later became curved drives through value engineering proposals from contractors.

Project owners have recently appreciated that incorporating curves into microtunnel alignments can lead to net savings both in terms of cost and schedule after risks have been addressed. As the infrastructure inevitably becomes denser, being able to reduce the number of shafts, reduce shaft depths, provide flexibility along the right of way or the alignment, and avoid obstacles, sensitive zones or utility crossings will lead to more significant direct and indirect cost savings.

Contractors are now more willing to bring forward change proposals on their own that incorporate curves and offer savings in terms of the impact to the public or in terms of saving time and money. The majority of curves have come from the contractors who have had to present proposals in a way to the owners that made sense in terms of the benefits. This has been a huge step for the industry - soon we will get to a point where owners are willing to have curved drives on their actual bid sets.

Now that they are seeing projects completed successfully in North America, owners are engaged in the discussion and eager to learn more. They are more receptive to seeing if it makes sense to do a curve. Recently there has been a major step forward in the projects contractors and owners are willing to do. However, this is just the beginning of where we will go.

In the future, the North American industry will see longer drives, sharper curves, curves in rock, and alignments with more spatial curves. This will be accomplished with more successful projects providing direct benefits to owners where risks are appropriately allocated to the party best able to manage them.



Rory Ball is a graduate of the University of Illinois and a Senior Project Manager with Hatch Mott MacDonald based in Cleveland

OH. He has over twelve years of work experience in the tunneling industry on a wide variety of tunneling projects in four countries and over a dozen states. Rory is passionate about pressurized face tunneling and fostering advancements within the North America industry.



Guidance System

A crucial element in the successful completion of any microtunneling project is the guidance system used, and this was absolutely critical to the success of the curved tunnel segment.

Once design was approved for curve approach, SEI purchased a VMT navigation system to assist with the MTBM guidance. VMT was a big contributor to the success of the curved microtunnel, as they provided onsite survey support for the duration of construction. Said Kolster: "VMT was critical in making this successful."



Break out at PM 16 receiving pit celebrated by SEI crew after completion of curved tunnel drive with an Akkerman SL74 MTBM



Tunnel has curve radius of 915 feet. 8 Foot segments of 72-inch RCP were jacked in the curved section

Major Accomplishment

Joining an elite group of North American microtunneling contractors who have accomplished this feat, SEI completed the approximate 700 LF of 72-inch curved MTBM drive this summer. It is the first curved microtunnel completed in the Midwest region, and the 4th such milestone using conventional microtunneling equipment completed to date in the US. 100% the brainchild of SEI, the VECP further reduced community impacts from DWIRS construction in a densely populated Cleveland neighborhood, while reducing long term maintenance costs for project owner NEORS D.

The DWIRS project demonstrates how close ongoing cooperation between owner and contractor can deliver success. SEI worked together with NEORS D to ensure the most accurate, up-to-date information on the project was dispersed to local residents. The microtunnel curve facilitated an accelerated schedule as did the fact NEORS D allowed work to proceed on a 24 hour basis for much of the job. Microtunnel construction completed in August 2015, 60 days ahead of schedule.

As Kolster summed up: "It doesn't get any better than this. It went perfect, and just as planned. SEI's team, S.J. Ludlow Consulting Engineers, Inc., the NEORS D, Hanson Pipe, VMT, and onsite crews all did a great job working together, and the results show." 🏆

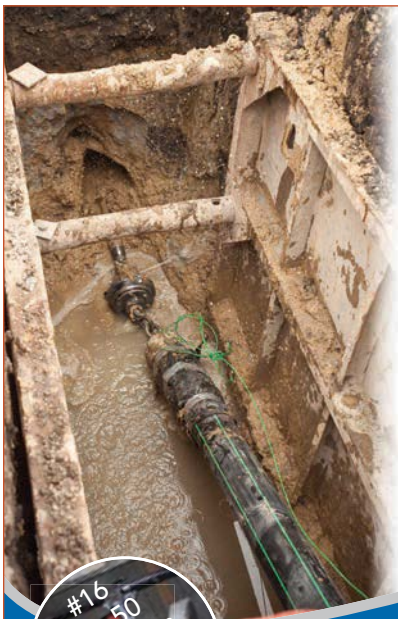
Key Project Personnel:

SEI Team: Justin Kolster, Project Manager;

Brian Strane, Superintendent; Nate Weidmeyer,

Superintendent; Craig Smet, Foreman. NEORS D Team:

Kellie Rotunno, Chief Operating Officer; Robert Auber, Construction Manager



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