Pilot Tube Method Maintains Line and Grade and Confidence

A Midwest contractor completed a demanding deep shaft sanitary sewer upgrade using three-pass guided boring for the City of Fort Dodge, Iowa, to resolve infrastructure overloads, which led to a record no-dig installation.

By Laura Anderson

FOR YEARS

City of Fort Dodge, Iowa, residents experienced the undesirable effects of an overloaded sanitary system during peak wastewater events.

Preparation to embark on a solution to address the situation began in February of 2011, following a comprehensive evaluation. City of Fort Dodge city council entered into a contract with McClure Engineering Company of Clive, Iowa. The study identified three areas most in need of immediate replacement. The first project was the 20th Avenue North Sanitary Sewer Gravity Bypass, located in a residential area, developed in the 1960s just east of the Fort Dodge Nature Trail.

Austyn Wolfe, project engineer with McClure described the circumstance: "The project was designed to replace the City's Northgate Lift Station and provide overflow relief to other portions of the sanitary sewer in the surrounding region. The lift station was undersized and did not have backup power. It also discharged into a shallow gravity sewer

which became overloaded during storm events causing basement backups and the need for bypass pumping."

From the beginning, the owner preferred a pilot tube guided boring installation to minimize impacts to residents and ensure line and grade accuracy of the sewer. Because of the installation depth, the selected method also presented project savings. Wolfe explains, "The new 12-in. gravity relief trunk was installed at depths from 15 to 30 ft. Open-cut construction would have required a trench that would have taken most of the right-of-way, and led to replacement of all the sidewalks, paving, curb and gutter, and possibly other existing utilities such as water main and storm sewers. Removing the road entirely would have left a significant number of residents without access to their homes as well as limiting access to emergency services."

The city council secured two sources of funding in 2012, and 2014 and sought bids for construction of the new sanitary sewer. In August 2014, Minger Construction Inc. of Jordan, Minnesota, was the low bidder, however, the bid exceeded available funds by $300,000 and was $500,000 over the design estimate.

To reduce expenditures, McClure went back to the drawing board to value engineer the original design package. He explained, "The initial design contained approximately 250-lf of roadway reconstruction at the intersection of 20th Avenue North and North 27th Street. It included water and storm utility replacement as well as 200 lf of open-cut sanitary sewer at 17-ft depths. Following the first bid, Minger Construction Inc. suggested that costs could be significantly reduced if we were able to remove this work from the project."

Furthermore, Wolfe stated, "The original design did not have any bores that exceeded 400 lf. During redesign, we consulted with guided boring professionals to verify the maximum bore length at which line and grade could be confidently maintained. Armed with this information, new bore pit locations were identified to limit the amount of traffic control and conflicts with existing utilities."

The project rebid in January of 2016. Minger Construction Inc. was again low bidder with their base bid, and two additional alternative bids to connect five homes which were on private septic systems to the new sewer, bringing the total approved contract amount to $1,570,367. City council accepted the base bid and alternatives, and the project was awarded for construction to begin in summer 2016.

The 20th Avenue North Sanitary Gravity Bypass was installed between 16 to 30-ft, 10 to 20 ft deeper than the existing parallel sewer. Demolition of an existing lift station and utility lines, open-cut installation of sanitary sewer, water main and storm sewer connections, and removal and replacement of manholes were all part of the project scope.

Minger Construction president Luke Minger stated, "From the beginning, the City wanted to minimize the construction impacts for residents by keeping traffic flowing, allowing access to driveways each night and centralizing construction so only small areas were affected at one time rather than full blocks. A pilot tube installation accomplishes all of these goals."

A total of 2,242 lf of new trenchless sanitary sewers were installed in six drives. Drives four through six were

480, 434 and 473 lf, their extended lengths the result of the design's eliminated launch shafts. Minger, confident in his crew's ability, stated, "Not every pilot tube contractor is up to this kind of undertaking, but because of our guided boring experience through all kinds of adversity, I knew that my crew was up to the challenge."

Minger crews mobilized in June 2016. Work for the new gravity bypass sewer took place in the right of way along North 22nd Street and 20th Avenue North.

Minger elected to use its Akkerman GBM 4800 system, which can install up to 48-in. outside diameter pipe. The jacking frame is fully customizable; it can be configured with 30-in. or 40-in. stroke cylinders and combinations of one, two, 10 and 14-ft skid extensions for a variety of shaft designs. The GBM 4800 Series jacking frame, skid extensions, thrust block, pipe, and tooling can fit in a minimum 11-ft shaft when installing one-meter length pipe or a 13-ft shaft using two-meter pipe. Contractors can also add an auger adapter assembly, likened to a master push ring, to direct install steel casing with the jacking frame while the auger adapter assembly facilitates the soil discharge in the launch shaft.

The design allowed Minger crews to construct four 12x20 ft trench box launch shafts ranging from along the design, allowing for 2-m pipe segments and extra space for tooling changes.

The pipe that was supplied for the new sanitary was 12-in. inside diameter NO-DIG Vitrified Clay Jacking Pipe (VCP) with a 15.875-in. outside diameter in two-meter segment lengths. Vitrified Clay Jacking Pipe was selected due to its inherent compressive strength, material durability, service life, and availability in both one and two-meter lengths. These segment lengths allow for smaller jacking shafts, which are more economical for deep applications.

The first three runs consisted of 144, 386 and 325 lf. When each drive was completed, Minger crews installed the connecting manholes, removed the shafts, and then moved them to the next location to be poised for the succeeding drive. Minger reported, "This leap-frog method was very efficient and kept things moving forward."

All six runs were constructed with the three-pass method.

With the three-pass method, the first step is to install pilot tubes using the guidance system. Akkerman pilot tubes are hollow, with a dual inner wall. The center ring provides a target sight path. The narrower outer ring allows for lubrication flow to the steering head ports which is released on the outside of pilot tube string to reduce jacking forces.

A steering head containing the LED target is affixed to the lead pilot tube and advanced as pilot tubes are added to the pilot tube string. As this happens, the steering head rotates and displaces the ground.

Concurrently, the operator views the target on the monitor, mounted to the jacking frame. The operator assesses the target's position and makes steering corrections as necessary to establish an accurate bore path for the pilot tubes. The operator also controls

the hydraulic values on the gearbox for jacking, rotation, and advancement of tooling.

When the steering head reached the reception shaft, the crew began adding 16-in. temporary casing and augers which matched the outside diameter of the final product pipe, representing the second pass. The augers excavated the remaining soil in the annular space and moved it to the launch shaft for removal. As each casing and auger segment was added and advanced, the pilot tubes were removed from the reception shaft.

The third and final step was to install the 12-in. VCP. As the pipe advanced forward, the casing and auger sections were removed from the reception shaft. When the product pipe reached the reception shaft, the drive was complete.

In addition to installation depth, the biggest challenges to minimize construction impacts were equipment and pipe staging. Minger states, "In order to maintain accessibility, material and equipment had to be staged strategically so that we were not blocking driveways or setting equipment or materials on people's lawns. This required good pre planning with suppliers to guarantee that materials arrived when they were needed."

The clay ground conditions were ideal for a pilot tube installation, with relatively low jacking forces. Often additional tooling like a reaming head or bearing swivel are added to the tooling string between the casing and auger and final product pipe, but they were not necessary on this project.

As a safeguard on the last three long runs, crews used BORE-GEL bentonite lubricant, which ported through the steering head during the pilot tube pass. The lubricant kept the jacking forces low and assisted to facilitate the longest drives.

The fourth and longest run of 480 ft is a record for NO-DIG VCP. With the Akkerman GBM guidance system, line and grade can be maintained within a quarter of an inch at distances of approximately 400 lf. Because of the project's ideal ground conditions, a clear target sight path, and operator skill, the distance was accurately achieved with repeated success on the 473-lf. drive.

Minger crews finalized the remaining project construction and moved out on Nov. 3, 2016.

"The residents were pleased with the owner's decision to go with trenchless technology and our attention to minimizing impacts allowed life to go on as normal as possible during the construction of the deep utility" Minger reports.

Wolfe concludes, "The City of Fort Dodge and the residents around 20th Avenue North were very pleased with the outcome of the project," Wolfe says. "Minger Construction Inc. did an exceptional job with staging and management of the project construction which really did minimize the project's impact on citizens."

Since completion, the City has experienced several large rain events and has not needed to deploy bypass pumping equipment in this area.

Laura Anderson is director of marketing and communications at Akkerman, Brownsdale, Minnesota.