The Lauritzen Gardens Project

Preserving a Sensitive Area with a 585-Foot Single Drive at Depths Reaching 50 Feet

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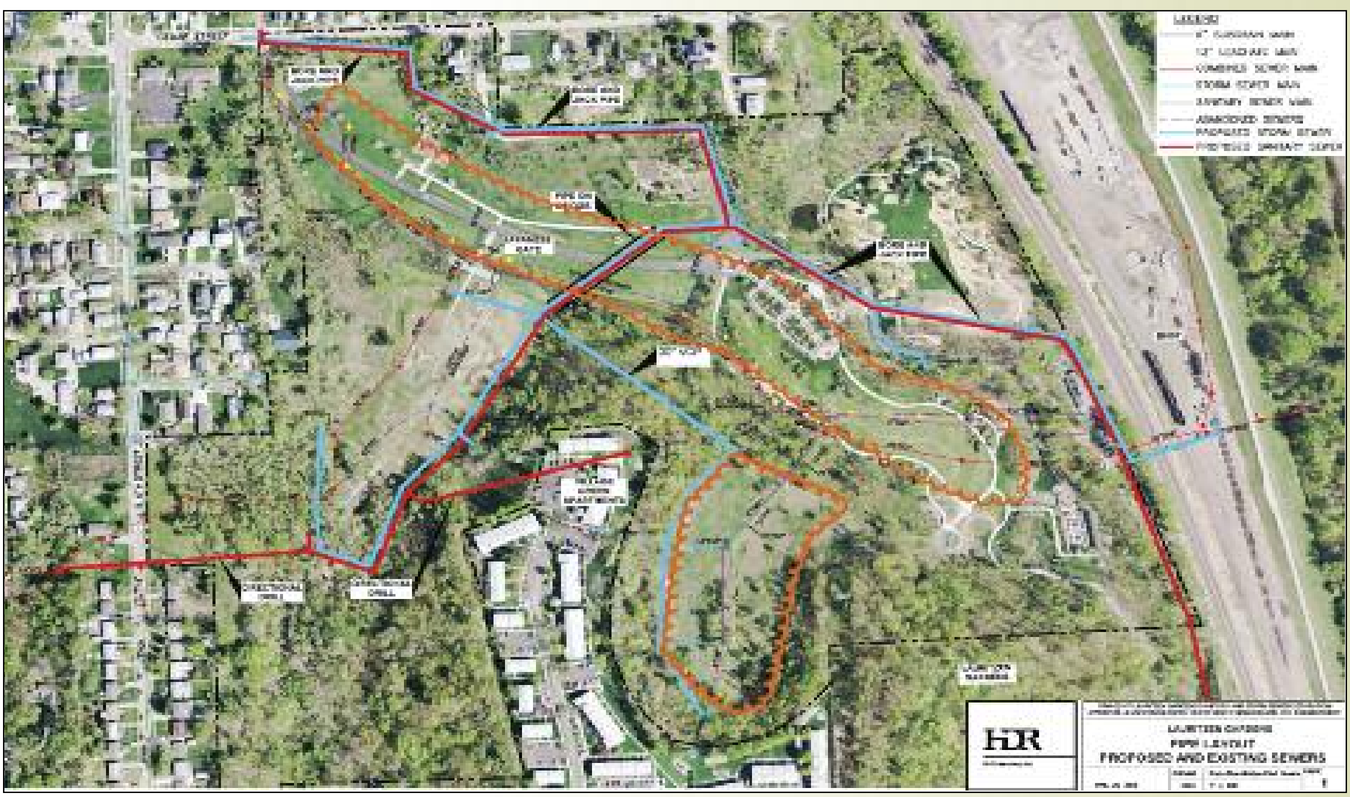
Omaha, Nebraska, stretches along the Missouri River for seven miles and is under a consent order with the Nebraska Department of Environmental Quality to improve water quality in the river. One component of the required work includes separating sanitary and storm sewers in selected areas. One project defined by this program is a sewer separation project which took place in a very sensitive setting: Omaha's Lauritzen Gardens.

A portion of the 100-acre site is referred to as the Balefill because a municipal solid waste landfill was operated on the site until 1982. Solid municipal waste was compacted, bound into bales and placed at the site. Closure of the Balefill was completed in 1983.

The Gardens were established on this site in 1993 and are the result of a public-private partnership. Lauritzen Gardens is a privately funded enterprise with several community leaders on its Board of Directors, making it a politically and environmentally sensitive area.

The Lauritzen Gardens Sanitary and Storm Sewer Separation Project called for a single pilot tube microtunnel drive of 587 feet through a hillside at depths of up to 50 feet to install a 30-inch ID storm sewer. Although typically utilized in sanitary applications for its corrosion resistance, vitrified clay jacking pipe was selected for this storm water installation for its axial compressive strength.

The designer needed to avoid the landfill area on one side and a large apartment complex on the other, or this path would not have been chosen. Soil bores were taken at each end of the crossing near what became the pit locations. Due to the steep hillside, the amount of trees, and the depth of cover in this area, no additional bores were taken along the length of the



Site Condition and Plan

A tree-covered hill obstructed the line of sight.

planned drive. The geotechnical report indicated conditions consisting of Peorian loess of medium stiff to stiff consistency.

The planned first phase of construction involved pushing the pilot tube through the entire length of the drive. When all goes well, the completed pilot tube is upsized by a reaming head attached directly to the pilot tube rod on one end and temporary steel casing on the opposite end. The auger-boring machine increases the bore diameter while removing spoil following the guided path created by the pilot tube. On this project, the plan was to use a 24-inch temporary casing for a distance of 60-80 feet and then upsize to a 38½-inch-OD temporary casing. This intermediate step between the pilot tube and the finished size of the tunnel was planned and necessary because of the hardness of the soil.

At first, the project went according to plan. The jacking frame was set to the desired height, grade and alignment from the established survey control points and for the first 260 feet, the pilot tube progressed on line and grade without difficulty.

Conditions outside those indicated in the geotechnical report were encountered 260 feet into the crossing during the initial pilot tube pass. The initial 260 feet of the drive proceeded as expected, but approximately 280 feet short of the receiving shaft, pilot tube advancement halted. The equipment did not reach its maximum thrust capability, but the jacking pressure applied to the pilot tube was sufficient to cause the pilot tube to flex in a serpentine motion, making it difficult for the operator to maintain the target. The crew from Horizontal Boring & Tunneling Co. made another attempt using a five-inch-OD head and one using a 4½-inch-OD head, including a bullet-shaped head for hard soils. The conditions encountered were later determined to be in excess of 4.5 tons per square foot.

The decision was made to attempt an intersect to complete the pilot tube pass through the entire crossing.

The original plan called for an auger-boring machine to install the temporary casing and product pipe because of its torque and thrust capabilities. The unit selected produces over a million pounds of thrust and up to 199,481 foot-pounds of torque and was selected to turn a long string of 36-inch auger.

The adjusted plan called for the intersect pilot tube drive to start from the downhill jacking site. At approximately 180 feet into this drive, 100 feet from successful intersection, the hard clays were encountered from the opposite direction. In spite of the hard clays, the pilot advancement continued and remained on target, until the point of intersection where the target shifted and the thrust pressure decreased suddenly and dramatically. As the operator continued to push the pilot tube string, it transitioned into the previous path and the target was lost. Despite the inability to see the target, the contractor chose to continue the advance until it exited on the uphill side of the crossing.

The two holes were not perfectly aligned. Because of the imperfect alignment, adjustments to the initial plan were made in an effort to mitigate the kink in the pilot tube bore. Because of the hard clay soil conditions, a 24-inch-diameter auger was attached to the pilot tube via a swivel. The new plan called for pushing 24-inch temporary casings through the entire length.

When the 24-inch temporary casing reached the intersect point in the original pilot tube path, the auger began to bind against the casing, indicating the auger was following the pilot tube through the slight bend, while the casing was continuing in a straight line. In order to alleviate some of the pressure, a bit was inserted to provide greater overcut in an attempt to get the casing to follow the pilot tube alignment. Use of a rock bit did not alleviate the bind, and the swivel between the auger and pilot tube was destroyed.

To get a 24-inch casing through the crossing, the augers were removed from this casing and moved to the other pit (on the downhill side), where a second auger boring machine was set up to drive the remaining length in the opposite direction. The casings didn't meet up as desired, so the 24-inch temporary casing string could not be tied together. The crew began to remove casing from the downhill shaft by pulling it out while the other string of casing was augered and pushed down through from the uphill shaft. Using this push-pull technique, the crew was able to achieve a continuous 24-inch temporary casing through the entire run, although the bend was still present, daylight could be seen through the bore.

Jacking the 30-inch VCP in the final step was the smoothest part of the installation.

The decision was made to push the 38½-inch casing with a 36-inch auger from the uphill shaft downward, while pushing out the 24-inch temporary casing. To connect and center the 38½-inch casing on the 24-inch casing, Horizontal Boring & Tunneling fabricated a tool that would go inside the 24-inch casing and accommodate a swivel that attached to the hex on the rotating 36-inch auger. A rock bit was used and the crew began to push casing. Again, the crew encountered grinding near the point of the intersect and the swivel connection was destroyed. The crew resumed the push-pull technique by pulling the 24-inch temporary casing out from the downhill -side with one boring machine while pushing the 38½-inch casing downhill from the topside. Visual inspection indicated the wider casing was on grade, but deviated from alignment. The result was that the downstream end of the drive was out of alignment by approximately three feet.

With the path established by the 38½-inch temporary casing, VCP was used to jack the casings out of the tunnel. The crew attached a two-inch PVC line on top of the VCP to convey grout, filling the annular space. With an established alignment and hard clay soils, this became the smoothest portion of the project and was completed in just two days.

Important lessons are frequently learned on more challenging projects. In this case, the primary lesson learned is the critical nature of the survey control points. A very small misalignment created a cascading series of challenges that required the expertise of the entire team.

Condensed from a paper presented at NASTT's 2014 No-Dig Show in Orlando, Florida.