Sewer Renovation by Open Cut Excavation

Project included burial depths up to 50 ft deep.

Sometimes the solution to a problem is so ideal that it can be applied repeatedly. This was the case in 1989 when officials of High Point, NC, decided to replace an entire interceptor system instead of just one sanitary sewer. The city wanted a leak-free pipe with a long service life and inherent corrosion resistance.

High Point works hard to maintain its infrastructure and this project, one of the most recent, was named Deep River Outfall Segment 2. Greg Hall was project engineer for the city. Davis-Martin-Powell & Associates, Inc. (DMP) of High Point was the consulting engineer. Thalle Construction Company, Inc. (TC) of Hillsborough, NC, was the contractor.

The many visitors to the city recognize it as a center for diversified industry and commerce, especially furniture, but give little thought to the miles of utility infrastructure. However, to the city, infrastructure is of utmost importance. With a population of about 100,000, the city has more than 70 furniture stores and claims the title of "the Home Furnishings Capital of the World™." It draws participants from 50 states and more than 100 countries for the biannual International Home Furnishings Market, the largest event of its kind in the world.

Ben Palmer of DMP said, "Basically, the line that was replaced was 40 years old. It had reached its life and was undersized and deteriorating. It had several point failures in the line just from degradation. That was really the driving force behind replacing the whole line. And the city was looking for a replacement material that was going to be resistant to the hydrogen sulfide gasses that were present in the line. And, that led them to HOBAS pipe."

The crushed granite used for backfill covered up to 70 percent of the OD on the shallower depths. For the deeper covers of more than 15 ft, crews placed the same material 12 in. over the top of the pipe.

Palmer added, "The city had installed a short segment of 66-inch HOBAS pipe into a new wastewater pumping station that they had built in the early 1990s, which actually was the starting point for this major outfall replacement. They had also used some of the 36-inch pipe for a section of the force main coming out of the station. That was really their first experience with the pipe, they liked what they saw, and that was what led to the use of the pipe for the remainder of the outfall line.

"There were a number of discussions between the city and the pipe manufacturer regarding the depth it was going to have to be installed at and the manufacturer assured us that with proper installation, it could withstand those burial depths. During and after the installation, there was no noticeable deflection of the pipe. So, we felt pretty comfortable based on the information that the manufacturer had provided.

"The segment 2 project is completed and holding up as promised. The main trunk line for segment 3 is nearing completion."

HOBAS was the only pipe named in the specs. The centrifugally cast, fiberglass reinforced polymer mortar (CCFRPM) pipe was the unique product that fit the city's requirements without any add-on coatings or linings. Powell explained, "CCFRPM pipe can be fabricated into a variety of fittings such as elbows, wyes, and tee-base manhole risers, so the city could have the required qualities throughout. The FWC couplings on the main line could

A surveyor's total station is used to direct the location of pipe in the trench during the construction of Deep River Outfall Segment 2 in High Point, NC.

also connect to the fittings maintaining the leak-free quality."

High Point started specifying CCFRPM pipe for a variety of applications in the early 1990's, and has used more than ten miles of this pipe in a variety of applications for corrosive environments including sanitary sewers and foul air. Of the many jobs, Deep River Outfall Segment 2 and Segment 3 are the most recent. Powell said, "When the entire Deep River outfall replacement is complete, including all of the jobs since we started using CCFRPM pipe, more than 40 miles of the pipe will have been used,"

TC installed 13,700 ft of 54- to 66-in. sewer pipe at depths of 35 to 60 ft. The deep sewer construction included more than 200,000 cu yd of pre-cut benching and restoration, 74,000 cu yd of rock excavation, 1,427 ft of 96- and 90-in. diameter tunnels, and the removal of 4,500 ft of the existing aerial sewer crossings.

Deep Burial

The 60-ft burial depth for the outfall is deep for a sewer. Much of it was installed through granite in a rock quarry and required blasting. Ed Kuehnel, project manager for TC, was involved in every aspect. He said, "It was definitely a tough job, up to 60 feet in the ground with an average depth of about 40 feet. We had one 800-foot run that was 60 feet deep from end to end.

"There was a tremendous amount of earthwork involved just to get to the point where you could install the pipe. We had to excavate and build ourselves a bench at 20 feet. We had to get the earth down to a 20-foot cut. The biggest challenges were the depth and the rock. We had to drill and blast to get the mass rock and trench rock out.

"The job turned out really well. We were very pleased with the pipe. It was the first time that I personally had worked with that pipe. It's easy to install. It's lighter so your rigging and equipment can be lighter."

This project was one of many phases that High Point is undertaking to replace the interceptor system on the east side of town. As it neared completion, the city continued its reliance on HOBAS, starting a new job using 54-in. pipe.

The depth of Deep River Outfall Segment 2 called for benching in the excavation. This began with a scraper used to remove layers of dirt, in this case up to 20-ft wide for the first excavation. The crew then dug down ten to 20 ft for this first part of the excavation.

As is typical with benched excavation technique, the crew then dug the excavation deeper but narrower, the width equal to the diameter of the pipe plus two feet of clearance on each side for the crew to work. The trench box was located in this lower sub-trench.

Bedding was six to 12 in. deep, depending on the depth of the excavation, using crushed granite 3/4-in. in diameter. After the installation crew put the bedding down, they laid the pipe on the bedding and adjusted the final line and grade. The same material was used for backfill. On the shallower depths, it covered up to 70 percent of the OD. For the deeper covers of more than 15 ft, they placed the same material 12 in. over the top of the pipe.

The bedding material was available from the rock quarry that the pipeline traverses. The cover was completed with "select native material," which is material obtained from project excavations cleaned of objectionable materials and used as backfill.

When pipeline construction goes this deep, the engineers usually consider tunneling, typically the first choice for deep installations. In High Point, the mixed face conditions and hilly terrain made tunneling difficult. The wide-open area of the project allowed for the deep direct bury with the benched construction and only a minimum of tunneling. Powell said, "The CCFRPM pipe was ideal. It was easy to handle for direct bury and worked just as well in the tunnels."

The extreme depth extending to about 60 ft in much of the line eliminated the need for several lift stations that would have been needed in a shallower installation. Lift stations must function in harsh and corrosive environments and their pumps and valves can become a maintenance problem. Choosing a deeper installation and a pipe system with an extended, maintenance free life, High Point demonstrated that it recognizes the long-term benefits of investing in infrastructure.

The depth creates an enormous overburden on the pipe. The engineers specified pipe stiffness of 72 psi for all of the installation and had full confidence in the structural characteristics of the CCFRPM pipe, so there was no question about its strength.

Commenting on the city's acceptance of the new line, Greg Hall said, "We air test each joint independently. On pipes of 30-inches and larger, a test pressure of 3.5 psi would apply. We've had less than six joints fail and every one of those would be classified as an installation problem. Minimal effort was required to correct all six prior to job completion. The precautions in handling the pipe are no greater than with any other material. I've seen little damage if any from handling the pipe."

The sections that were replaced had some significant infiltration problems. Hall said, "It's hard for us to put a figure on infiltration because that segment is only phase four out of six, so it's hard to get a number until the whole project is built. I can't give any numbers but I know that infiltration has definitely decreased. The same can be said for exfiltration." GE