Shoal Creek
Wastewater Improvements

Planetary Subsurface Utility Successful On Three Unusual HDD Bores

By Liz Moucka

For utility contractor Planetary Subsurface Utility of Dallas, taking care of Garland Power and Light's high-voltage electrical distribution system is their bread and butter. Then there are the jobs that allow the contractor to sink their teeth into something a bit tougher.

"Garland Power and Light is one of the best customers I've ever worked for," says Brian Sauer CEO of Planetary. "You couldn't find a better client. We're happy to stay home and work here," says Sauer, "but some of the projects are so interesting and challenging, it is hard to turn them down."

Last year, Planetary traveled to Austin for three challenging directional drilling installations as part of the Shoal Creek Wastewater Improvements. The city's $200-million Austin Clean Water Program (ACWP) includes removing wastewater collection lines from several creeks and relieving other lines by constructing parallel lines outside creek boundaries.

Planetary was subcontracted by W.L. Hailey of Nashville, Tenn., to install three 24-inch casings for new laterals to a 100-inch tunnel buried between 60 and 70 feet deep from 29th to 34th Street. The laterals serving the large tunnel required installation at severe grades:

- 288 feet at a 13.5-percent grade,
- 50 feet at a 47-percent grade,
- 75 feet at a 125-percent grade.

According to Sauer, the city planners, engineers and the general contractor were familiar with the benefits of horizontal directional drilling (HDD), but not for use in the way it could be employed on the Shoal Creek project.

All three bores to the Shoal Creek tunnel were made with a compact Ditch Witch JT2720 All Terrain directional drilling unit.

"The big tunnel had been installed by micro tunneling, so micro tunneling was considered the preferred method for installing the laterals," Sauer explained. "But micro tunneling equipment would experience severe difficulty with the harsh inclines, and there would be safety hazards associated with spoil removal."

Micro tunneling would require starting the laterals 60 to 70 feet below ground within the tunnel and working upward. The grade of the laterals was critical, with permitted deviations of less than 1 percent.

Inquiries were made with several contractors about using directional drilling, but all felt that it would be impossible to make such an installation. A W.L. Hailey representative discussed the issue with one of Planetary's project managers, Russell Prater, who urged Sauer to consider the project.

"With our extensive experience drilling on grade by HDD, we were able to design a profile to go from a surface entry and exit in the tunnel wall," says Sauer.

All three installations were made with a compact Ditch Witch JT2720 All Terrain directional drilling unit. The Ditch Witch JT2720 All Terrain model generates 27,000 pounds of pullback, has a maximum spindle torque of 3,200 foot-pounds, and utilizes a dual-pipe drilling drive: an inner rod to drive a rock bit and an outer pipe for steering the downhole tool during drilling. The outer pipe also provides rotary torque

for the hole opener during backreaming. The system operates on low volumes of drilling fluid, can drill through a variety of soils, and can drill through many types of rock without the need to use a mud motor.

The pilot holes were drilled with a 53/4-inch rock bit through a Del Rio formation, a blue-gray rock that drilled like blue shale. The Planetary crew engineered special setups for the drill rig to handle the steep grades.

"Preparing for the 125-percent grade shot was probably one of the most unrealistic setups I have ever attempted," Sauer says, "because 125 percent is not but a handful of points away from perpendicular, or straight up and down. If the head needs to be at 125 percent at entry you can imagine what your machine set up looks like. The drill rig was set up at probably about a 90 percent and hanging over a 20-foot-deep entry pit. The entry pit was shored with some heavy-duty trench safety that stunt-doubled as support plates to hold the rig in that awkward position. This, along with an elephant chain and some dead man anchors, gave us confidence the rig was not going to move. Professional rig operator, Wade Parker, commented several times throughout the bore, jokingly, that this felt more like a Six Flags ride."

The next bore, only 50 feet at 47-percent grade, presented a whole new set of challenges, according to Sauer. Due to natural terrain, this bore pit was dug into the side of a small mountain, prohibiting a running start or a creative setup. The solution was to pick up the entire rig with a crane and set it down in the bottom of the 20-foot bore pit.

"Drillers, don't try this at home," said Sauer. "Some damage to the rig did occur; however, the sacrifice was for the greater good of the project. Once the drill was in place, we were able to jack the rig into a 47-percent grade."

"The linchpin to a successful grade shot performed is all in the preparation," Sauer explained, "with elevation stakes every 10 feet, and choosing adequate locating equipment. I suggest an Eclipse.

"The formula behind the offsets is extremely important. Each bore is going to be different. It is up to the experience of the driller in that particular geographical area to decide what kind of displacement and fall will occur during every reaming pass."

For each installation, personnel had to climb down 70 feet into the main tunnel. Reamers and tools were lowered into the tunnel in a basket by a huge crane, and then had to be loaded onto cars of a small mine train to be carried to the spot where the bit had entered the tunnel.

"When you are placing a bore on grade, your ultimate target is the flow line, which means your pilot must be placed with precision so that every reaming pass of the hole you are opening is actually opening it into position, Sauer continued. "It's not uncommon on larger products for your pilot bore to be greater than 18 inches above target flow line. So at the end of the day, when the casing is placed in the bore hole and the spacers are put on the carrier pipe and when the carrier pipe is populated into the casing, all the gears line up, so to speak, and the flow line is right where she is supposed to be."

Because of the depth and location of the bore, Planetary incorporated a variety of tracking methods while drilling pilot holes.

"We started with a walk-over system, and then switched to a wireline system as the drill head moved towards its target," Sauer says. "As we got closer to the main tunnel, some 70 to 80 feet underground, the steel rings that structurally reinforced the tunnel created an unsurpassable interference. In order to overcome the interference, we went to a wireline system. After exhausting an AC current faced with some of the same problems, we found our formula by using a DC current."

The same complications made the crew's two-way radios inoperable. The only way to talk to personnel on the surface was via mine phones positioned at intervals along the 5,500-foot-long tunnel.

"When tunnel workers needed to communicate with the drill," says Sauer, "one would have to go to the nearest mine phone and talk to a crew member on the surface, who would relay information to and from drill personnel by radio."

Communication played only one challenge during the back reaming stage.

"For each installation, personnel had to climb down 70 feet into the main tunnel," explains Sauer. "Reamers and tools were lowered into the tunnel in a basket by a huge crane. They then had to be loaded onto cars of a small train like those used in mines, then carried to the spot where the bit had entered the tunnel. Everything had to be done by manual labor, and lifting the reamers into position was very

Just about anything that can go wrong with Planetary's equipment can be repaired on the job site with what they have stocked in this custom trailer.

difficult since some of the tools weighed 500 and 600 pounds."

"I had to design lifting pulleys and swivels inside the tunnel wall. I specifically remember being down in the tunnel by myself waiting for over an hour for something as simple as a communication reply. However, it forced me to appreciate history as I sat with plenty of time to think, listening to the drip of the water as it came through the tunnel walls, and watching the flickering of an already very dim mine light. I thought about how it all began, using manual skills and ingenuity from Egyptian tombs to excavating coal mines."

Back in the present, the Planetary crew enlarged the pilot holes to accept the 24-inch casing by making three back reaming passes for each installation using reamers designed and built by Planetary employees in their own shop. During reaming, spoil and drilling fluid entered the main tunnel, and disposal was labor intensive and time-consuming.

The fluid and spoil mixture were deposited into a train, or lokey, of muck carts, with each cart carrying about 10 yards of drill fluid. Full carts were driven to the main entrance of the tunnel shaft, where each one was raised to the surface by a crane, dumped and replaced into the mine.

"The shocking thing was the time it would take to fill up all the carts," Sauer exclaimed. "The rock was hard, and the product was big. I can remember sometimes only getting three or four feet and then getting the call to stop while the carts were emptied. This was very time-consuming."

The traditional way of pulling product into place was also not available. Instead, the Planetary crew used a track loader to push the pipe down into the bore holes. A bullet nose cone fitted onto the front of the first pipe facilitated its journey into the shaft. Each 20-foot length of pipe was welded to the end of the previous length of pipe after each push.

After Planetary installed the 24-inch casing, the general contractor installed 12-inch carrier pipe with spacers keeping the smaller pipe at the correct grade.

"Pilot bores took two days each; reaming and pipe placement were time-consuming because of access in and out of the tunnel," says Sauer.

Installation of the three laterals took about 30 days. The City of Austin reported that its ACWP program was well ahead of schedule.

Time is money, and Planetary's Ditch Witch operator, Wade Parker, credits their customized utility trailer, designed and built by Sauer, with keeping the equipment running and meeting deadlines. It is a repair shop and break room on wheels. Sauer says he learned the value of organization with a mobile facility through his years of expert motocross racing.

"Just about anything that can go wrong out here can be repaired on the job site with what we have in this trailer," said Sauer. "We stock four or five extras for any parts that may wear out, break or just go bad. I can even make hydraulic hoses on-site. That way we never have to wait for repairs. We're like the NASCAR Pit Team of the directional drilling world," jokes Sauer.

In other stages of the Austin Clean Water Program, a new wastewater line at the Crosstown Tunnel Inlet at West 29th Street was also installed by tunneling methods. In addition to the three laterals installed by Planetary, others were placed by open cut and jack-and-bore, and one was rehabilitated by cured-in-place pipe lining. Existing wastewater interceptors will be abandoned in place with exposed portions to be removed. ■

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