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READING SEWER MAIN UPGRADE UNDER WAY

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Pit boss John A. "Jack" Jones could barely be heard over the noise of the yellow rig drilling dozens of two-foot-wide holes 49 feet into the ground at the city's Sixth and Canal streets sewage pumping station.

The holes, arranged around the perimeter of a 30-foot circle, were being filled with concrete to form buried columns, or piles, Jones said.

In a process that will take several more weeks to finish, Jones' crews are digging a pit 30 feet wide and 40 feet deep, well below the floor of the adjacent Schuylkill River.

And that's just to get ready for the real job: boring a five-foot-wide tunnel under the Schuylkill, a 400-foot-long hole through which the city's new 42-inch sewer main will run, on its way from the pumping station to the treatment plant on Fritz's Island.

The $9.8 million project, including the tunnel and the new main, is part of the 2004 consent decree with which state and federal agencies are forcing the city to upgrade the plant and its pipes.

And it's none too soon for sewer plant manager Ralph Johnson, who's had to fix a recent rash of breaks in the existing 60-year-old main.

The crews hope to finish by late summer.

But first, they've got to bore the tunnel. And before that, they've got to finish the pit.

Jones, general superintendent of Maryland-based Bradshaw Construction Corp., which is overseeing the tunnel, said when the concrete cures in the first 21 holes, crews will drill a second round of two-foot holes in the less-than-two-foot spaces between the columns.

That means the drill will bore slightly into those existing columns, but when the new holes also are filled with concrete, the result will be an interlocking circular wall, very strong and very tight, that will withstand anything, he said.

Then the crews will dig out the ground inside the wall to form the pit, more properly called a secant pile shaft, that's 49 feet deep.

Although its bottom will fill up with several feet of river water, crews will pour a concrete plug nine feet thick at the bottom. Jones said when it cures under the water, the crews will pump out the pit.

At that point, the pit is done. Bring in the tunnelers.

It will take several weeks to set up for the actual drill, called a microtunnel boring machine that's 60 inches in diameter and 16 feet long.

First, it needs a target. That will be the center of a nine-foot-wide shaft to be drilled on the other side of the river.

Using a new technology laser and old-technology plumb bobs, the target's direction will be transferred to the robotic boring machine and to its operator, sitting in a control center at pit's edge.

The top of the tunnel will be five feet under the river bottom, going through bedrock and soil mixes.

"We did a lot of borings across the river, so they have a good idea of what's under there," Johnson said.

When boring begins, the machine will be propelled by 500-ton jacks behind it, which brace against the tunnel walls and push it forward.

Every so often, the jacks will pull back, push a new section of casing into the new portion of the hole, then go back to pushing the machine.

Jones said that if the machine was just going through dirt and gravel, the crews could hit within an inch of the far pit's center.

Rock is different, and makes it harder to steer. And transitioning between soil and rock makes steering even harder, he said. The operator will have to be careful.

"It's a nine-foot hole," Jones said of the far pit. "We can't be off much."

The cutting head uses roller disks made of high-strength steel, a bit like those used in glass cutters but far larger.

The machine will crush the tailings to an inch or less, add a flood of water, and pump out that slurry to a separation plant brought on-site.

In softer soil the machine could bore through 80 to 100 feet on a shift. But in really hard rock, it may do only a foot a shift, and be taken apart often to replace the rollers.

So when will the tunnel be complete?

"The rock will be what dictates how long it will be," Jones said.

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