

## MICROTUNNELLING

### Laura Anderson reports on two small-diameter bores in Milwaukee

**T**HE Wisconsin Department of Transportation was presented with a serious quandary when designing the IH 43/894 segment of the I-94 North-South Freeway project. It realised that construction in one area would remove half of the ground cover on one sanitary sewer line going under the freeway, while the proposed, finished grade of the highway would be only 1.5m below another nearby sewer crossing.

After further study, the city of Milwaukee and the Wisconsin Department of Transportation (WDT) worked together to unite the two sewer lines to create the second direct-jacked, uncased, vitrified clay pipeline in the city, and Milwaukee's third pilot-tube microtunnelling (PTMT) project.

The Airport Freeway Sanitary Sewer project called for the PTMT of 487m of 400mm- and 450mm-diameter, 1m-long, vitrified clay pipe for its gravity sewer network. An additional 87m length of 450mm outside-diameter pipe was installed with the open-cut method. These new



*Bore Master workers install a section of vitrified clay pipe during one of five drives*

## Going under cover

sanitary sewer pipelines replaced the original sewer mains, built in 1964, and increased capacity. These pipelines service mostly residential areas alongside the IH 43/894 highway and discharge into the Milwaukee Metro Sewer District's interceptor sewer about 1.6km away.

The IH 43/894 is the bypass route around the south and west areas of Milwaukee. This portion of the highway is part of the larger, 56km I-94 North-South Freeway Project of southeast Wisconsin, which began in 2009 and will continue through 2016.

Richard Blauvelt of Norris and Associates notes that designers had looked initially at the possibility of simply replacing the existing 400mm-diameter pipeline so that it could be lowered to clear a new freeway ramp.

Mr Blauvelt notes: "The necessary depth of the proposed crossing would have required replacing an additional 488m of downstream sewer (about six blocks) through a residential neighbourhood at depths of up to 9m, and the reconnection of about 24 house laterals, most with risers."

The existing 250mm pipeline at the western end of the project did not directly conflict with the freeway construction. However, Mr Blauvelt noted that "the city was concerned about possible damage to the pipe because of reduced cover and considered CIPP lining instead".

Ultimately, the decision to combine the two pipelines and use the PTMT technique allowed the designers to reduce linear footage, and avoid residential disturbance.

The city was the project owner with authority for design approval, and the project was administered by the WDT since the construction zone was under its jurisdiction.

Norris and Associates was the design sub-consultant to Milwaukee Transportation Partners, a joint-venture between infrastructure firm HNTB and C2MH Hill. Project costs totalled US\$1.25 million.

WDT sought bids for the PTMT pipe installation method. The Airport Freeway sewer marks the

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**"Using PTMT allowed the designers to reduce linear footage, and avoid residential disturbance"**

# MICROTUNNELLING



*Crew members install the PCH on the GBM jacking frame after the casings and augers are installed*



*The final pipe string, installed accurately on line and grade, meets the concrete manhole where the rest of the shaft will be filled in and sealed off*

third PTMT project, with the previous two having been well received.

The first PTMT project took place in spring 2009, when a 105m drive of 200mm-diameter, 1m-long pipe was installed adjacent to the

I-94 North-South Freeway by Bore Master of Pewaukee, Wisconsin.

In order to continue work on the I-94 project, contractors had to tunnel and extend the sanitary sewer line from West Grange Avenue to

West Mallory Avenue. The tunnel allowed the project contractors working in a constricted area to avoid disruptions from residential landscaping and sound-wall construction.

This first PTMT installation marked the first phase for the second PTMT project in the city. This was completed by Super Excavators of Menomonee Falls, Wisconsin, in spring 2010. Operators installed 95m of 250mm-diameter pipe between two manholes at an average depth of 6m.

Submitting the lowest of three bids for the Airport Freeway sanitary sewer project and performing all facets of open-cut construction was the general contractor, Globe Contractors of Pewaukee, Wisconsin. Its sister company, Bore Master, carried out the trenchless installations.

Bore Master leased Akkerman's guided-boring machine (GBM) equipment, using an Akkerman 240A jacking frame, P100Q power pack, and a powered cutterhead (PCH) 20 upsizing tool to match the final product pipe. The PCH was fitted with an 'increase kit' to accommodate both pipe sizes.

Work on the Airport Freeway project began in July 2010. The total 487m length of pipe was installed in five drives in clay and cobble-laden soil. There was one 87m drive with 400mm clay →



*Above the jacking shaft, 1m segments of 400mm clay pipe are lined up and ready to be lowered*

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→ pipe, and four 92-107m drives with 450mm No-Dig clay pipe. The six shafts ranged in depth from 6-11m. There were two launch shafts and four reception shafts; one launch shaft initiated three drives and the other initiated two. Using the same jacking shaft for multiple drives saves crew members moving and equipment set-up time.

Each of the five drives was completed in three steps using PTMT. The first step is to install the pilot tubes accurately to negotiate the desired grade and any existing utilities. Next, the casings and augers upsize the bore from (in this case) the 100mm pilot tubes to 280mm. After the last pilot-tube length is pushed to the reception shaft and removed, the PCH is installed to upsize and meet the final product pipe's outside diameter.

With the casings and augers encompassing the full lengths of the drive, the augers are reversed by the PCH's hydraulic drive and spoils are pushed to the reception shaft. The final product pipe is attached to the back end of the PCH with a pipe adapter. As the PCH advances, it lubricates and cuts the bore as casings and auger sections progress to the reception shaft for removal. This movement continues until the final product pipe is in place and the drive is complete. Further explanation and video demonstration on these processes can be

viewed on the Akkerman website.

As many contractors know, no job goes off without at least one glitch. In this case, the glitch was encountered about 21m into the fifth and penultimate drive, during the third GBM step with the PCH. A 600mm x 900mm diameter boulder, previously undetected in the geotechnical reports, missed the pilot tube, augers and casing passes. When the PCH came through, upsizing the bore diameter to match the final product pipe, the boulder's position infringed on the bore just enough to create an impasse.

Although the PCH is equipped to accommodate cobbles of up to 76mm (the capacity of the screw auger), the size of this boulder prevented the possibility of going forward. Luckily, the surface area was clear and accessible, allowing a rescue shaft to be constructed.

The crew shored the shaft in a day, and retrieved the boulder and PCH. The delay only set operators back by about a week in production time. During this same window of downtime, Bore Master brought the PCH back to the Akkerman manufacturing facility for routine maintenance and repaired the wear on

***The 600mm x 900mm boulder encountered***



***One of the two jacking shafts on the Airport Freeway City of Milwaukee Sanitary Sewer project***

the carbide bullet teeth following the encounter with the boulder.

The longest drive completed on this job was 107m and spanned directly under the IH 43/894 highway. Most pilot-tube installation drives were completed within one shift. Crew members averaged the installation of 30-60 casings and auger segments per day. The project concluded in the first week of November 2010.

Department of Public Works representative Brian Kasprzyk reports: "This project was successfully completed on time with no major complications encountered. The sewer and freeway contractors were able to work alongside each other without major conflict."

Darin Fuglestad, project manager for Globe Contractors, is pleased with this technique of pipe installation, stating: "We've had extensive experience with pilot-tube auger boring so PTMT was the next natural progression for us."

Bore Master project foreman Terry Johnson adds: "As with anything, there is a learning curve when using new equipment, but as we became more familiar with it, we got our approach down."

Bore Master subsequently purchased the Akkerman equipment used on this project.

Globe Contractors, established in 1971, has been providing water and sewer utility services for municipalities and subdivisions in Wisconsin for 40 years.

Bore Master was established as its sister company in 1997, to meet the needs of the emerging trenchless market, and it is currently bidding on additional work for Milwaukee.

***All six drives were along the IH 43/894, with the longest drive passing under these two highways for the City of Milwaukee***

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