



Midwest Mole Tunnels Rugged Indiana Sewers

Richmond, IN, is a growing city of 50,000 people along Highway 27, with extensive commercial development planned along the north side. The new development requires an equal growth in infrastructure – including a four-mile long sewer line that will more than double the capacity of the north Richmond system. Contractor Midwest Mole Inc. of Indianapolis is utilizing powerful hard rock technology, including a Robbins Rockhead (SBU-RHSS) and a Small Boring Unit with a full face auger (SBU-A), to tackle four gravity sewer crossings with strict grade requirements underneath a nearby river and the Whitewater Gorge Trail.

The Chester Blvd. Interceptor Sewer – a two-mile stretch of the pipeline – will service a new commercial district as well as the new, 750,000-square-foot campus of Richmond's Reid Hospital.

The new gravity sewer pipeline will increase the efficiency and capacity of the current system and will link up to an existing sewer system originally installed in the 1920s. With the extended capacity, the Richmond Sanitary District aims to eliminate three pump stations that were installed two to three decades ago to accommodate what were then much lower demands. The sewer pipeline will transport wastewater by gravity to a nearby water treatment plant, lowering costs for the entire system.

"We believe that over the long term, this gravity sewer installation will be well worth any initial investments because of its overall savings when compared to the pump stations," said Robert Wiwi, district engineer for the Richmond Sanitary District.

Currently, each pump station requires almost daily monitoring of flow rates, as

well as routine maintenance and repairs.

Wastewater will flow underneath the White Water River and under the Whitewater Gorge Trail via a siphon before transitioning to an above ground pipe set in reinforced concrete piers. The 30-inch outside diameter ductile iron pipe will be on the surface for approximately 20,000 feet in order to maintain the grade of the pipeline (due to the topography of the area).

A \$4.7 million contract for the Chester Blvd. Interceptor sewer was awarded to general contractors Brackney Inc. of Brookville, IN, in December 2006. The contract calls for the entire pipeline to be finished by March 2008. Midwest Mole was subcontracted to bore a series of four hard rock crossings – two underneath White Water River and two at locations along the Whitewater Gorge Trail. The crossings were requested by the city in order to avoid disturbance to the 1.5-mile paved trail, which was converted from an original railroad line built in 1834. A fifth crossing in soft ground will be excavated by cut and cover across a roadway.

Crossings

Midwest Mole chose a 54-inch diameter Rockhead machine, a type of small tunnel

Top: The operator can steer the Robbins Rockhead to a strict grade requirement of .25% using a console inside the machine's rear shield. Middle: Contractor Midwest Mole Inc. is using a 54-inch diameter Rockhead to bore two 400-foot crossings in Indiana. Bottom: The Rockhead Single Shield is using a machine belt conveyor for disposal of muck.



Small TBM And Microtunneling Machines

The Robbins Rockhead, a type of small-diameter tunnel boring machine (TBM), allows for longer crossings (over 325 feet) in hard rock from 4,000 to more than 25,000 psi UCS. The machines are available in diameters from 54 - 84 inches, and can be used in conjunction with steel casing, reinforced concrete pipe, ring beam and board or four flange liner plate.

A Rockhead generates torque from a drive unit mounted at the cutterhead thrust bearing assembly. The machine operates in the same fashion as larger diameter Single Shield TBMs, and uses a belt conveyor for spoils transfer through the machine to a small, battery-operated muck car on track. The Rockhead advances using cutterhead thrust transferred to the cutting face by hydraulic thrust cylinders mounted inside the machine. Once the boring stroke is complete, large forward shield stabilizers extend and hold the cutterhead in place as the telescopic shield is advanced by a pit-mounted pipe-jacking station.

To steer the Rockhead, an articulation system is used and the machine is guided by either a simple pipeline laser or a more advanced laser pipe jacking system with data logging printout. An operator's console is located inside the rear shield for control of all machine functions.

Microtunneling machines (MTBMs) are often the first-choice for longer bore lengths; however, most MTBMs use tungsten carbide drag bits on the cutting head, which are highly inefficient in hard rock. The drag bits break off in rock above 75 to 100 MPa, requiring expensive replacements, slowing progress, and increasing man-hours. Even if the MTBM were to use disc cutters, there is typically no man access to change the discs in the 54-inch machine size range.

In dry or near dry conditions, when an auger is used in conjunction with the MTBM for spoils removal, the method is more expensive than a simple belt conveyor to muck car system. Using an auger in this fashion requires that all rock chipped from the face be further crushed for removal, resulting in slower excavation rates. Rockheads and other SBU systems, in contrast, use interchangeable single disc cutters to size the rock chips at the face.



boring machine (TBM), for the two longest crossings, each 400-feet long, underneath the walking trails. They used a machine already in their fleet, which had bored over 4,000 feet through hard rock on six previous projects since its first use in 2005. Midwest Mole only recently sent the machine to the Robbins manufacturing facility for its first refurbishment and change of cutters after extensive use. The contractor is again using 6.5-inch diameter single disc cutters for this project in order to bore through shale and limestone of up to 10,000 psi. The Rockhead was welded to 54-inch steel casing and was launched from the bore pit using a hydraulic ram in March 2007.

"We haven't found anything better than this machine for boring in competent rock," said Jason Miller, vice president of Midwest Mole. "We're averaging 20 to 25 feet per day with the Rockhead."

The Rockhead's pipe-jacked or self-propelled arrangement allows it to operate on longer crossings without relying on an auger boring machine (ABM) for torque and thrust, which is the case for SBU-As. The crossings, on a 0.25 percent grade, can be steered to strict requirements for both line and grade using the machine's articulation system. The operator steers the Rockhead from a console within the machine's rear shield by articulating the cutterhead and controlling the pressure of each thrust cylinder. By monitoring this thrust, the operator can optimize cutter loading, which increases cutter life and reduces replacement costs. If the cutters do wear out, then they can be replaced without removing the machine from the bore.

The first trail crossing is scheduled for completion in 35 working days, while the first river crossings will begin in June 2007. The crossings will utilize 27 to 30 inch PVC pipe once the casing is installed. The White

Water River crossings are shorter (175 feet each) and will use a 48-inch Robbins SBU-A with a 60 - 72 inch Barbcro auger boring machine. The SBU-A will be welded to 48-inch steel casing, similar to any jack and bore setup, and will use single disc cutters to fracture the rock face, consisting of shale and limestone, into chips. The ABM will supply the torque to turn the cutting head into the face, while the casing will provide forward thrust.

Since these crossings are on a 0.42 percent grade, the alignment of the SBU-A will need to be monitored and its heading will be adjusted using stabilizer pads located in each quadrant of the machine's shield. The stabilizer pads extend out to the tunnel wall to stabilize the machine as it overbores the casing by about two inches in diameter. On a 48-inch SBU-A, the pads are adjusted using a fixed hydraulic cylinder after a wrench has loosened the locking nuts on the stabilizer assembly. Adjusting the height of each stabilizer pad allows for adjustment of the machine's direction, as well as stabilization.

By April 2008 the entire pipeline should be finished, and Midwest Mole hopes to continue using both machines on future projects. While Midwest Mole continues to use technology such as tungsten carbide cutting heads for soft ground, they typically rely on machines using single disc cutters for hard rock applications.

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