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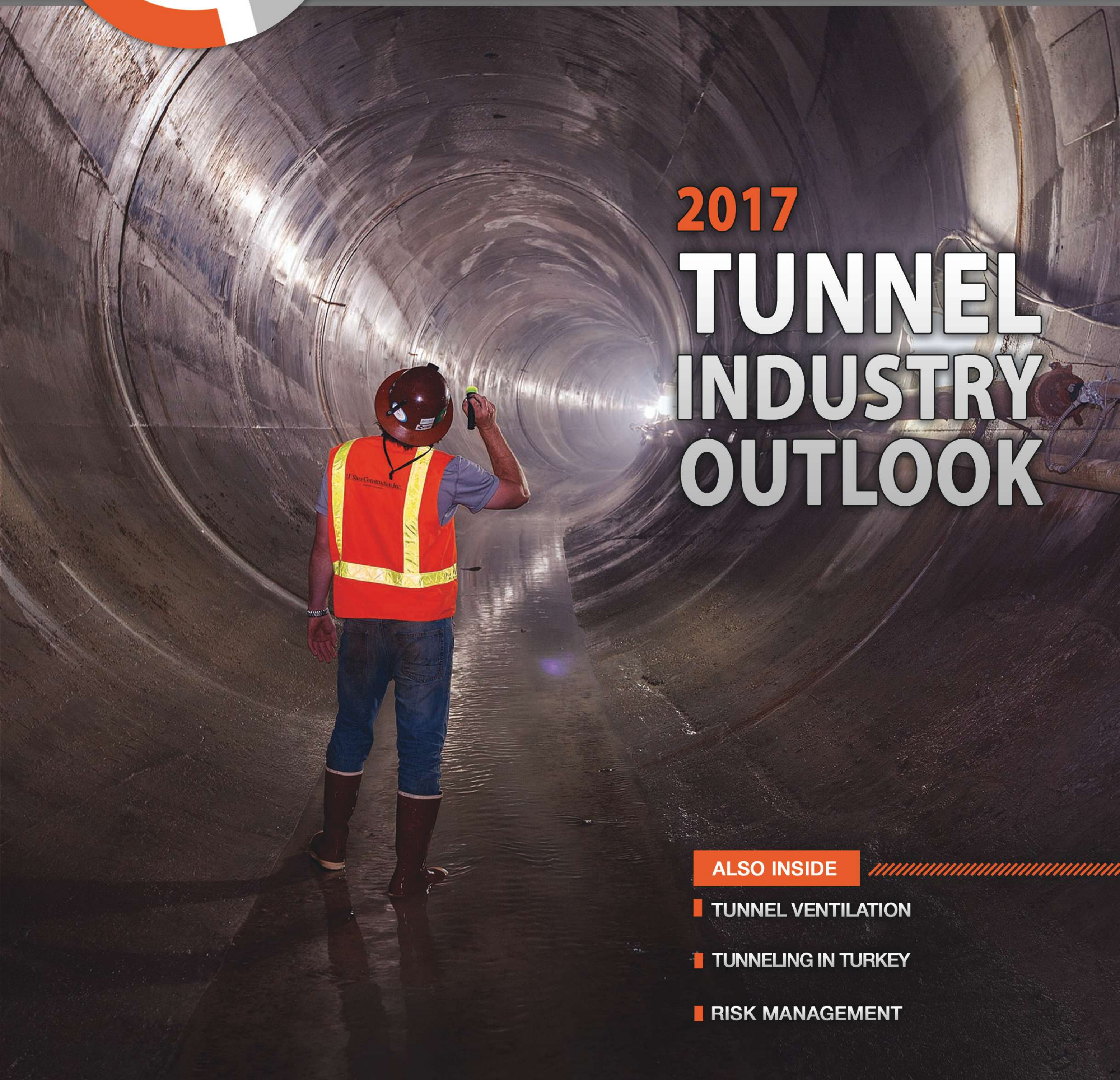

2017 TUNNEL INDUSTRY OUTLOOK

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10050 Brecksville Rd., Brecksville, OH 44141
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The project involved an 830-ft drive of 60-in. casing using a Herrenknecht AVN-1200 with rock cutterwheel.

EXPERIENCE KEY FOR PENNSYLVANIA INTAKE PROJECT

In tunneling, like many other aspects of life and work, experience is the best guide. For Bradshaw Construction, experience was the key in a tricky intake project it completed recently in Pennsylvania.

The project – the Wildcat Point Raw Water Supply for the Old Dominion Electric Cooperative – was completed within sight of another intake project completed by Bradshaw Construction for another energy company a few years earlier. That experience allowed Bradshaw Construction to work with the owner and designer (Burns & McDonnell) to offer a re-engineered solution involving microtunneling.

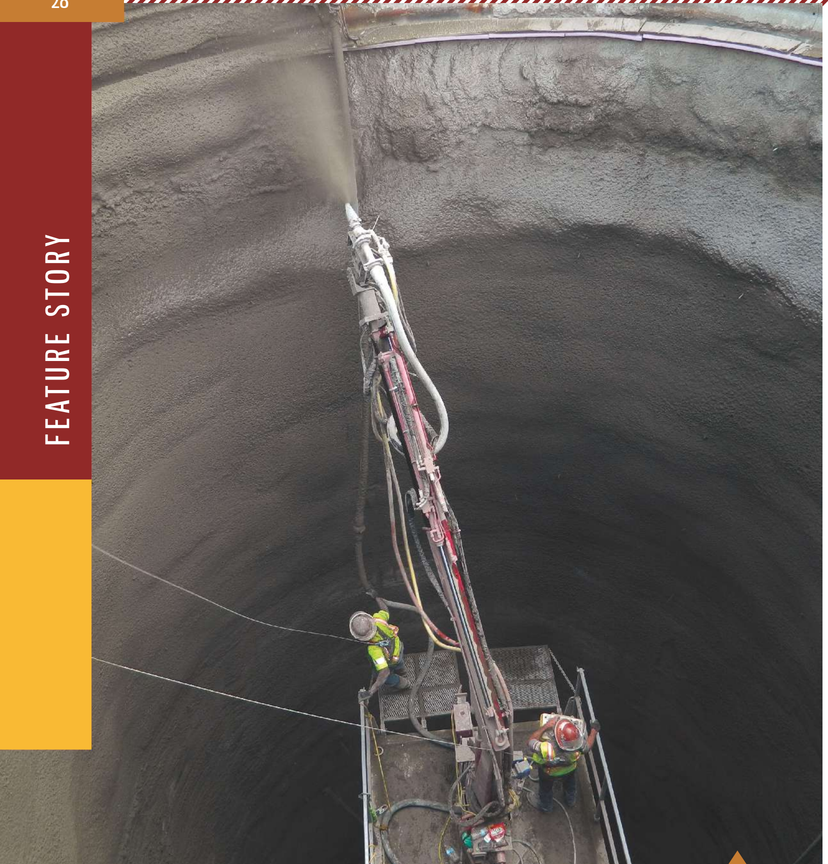
The project, completed in Peach Bottom, Pennsylvania, involved building the intake pipeline into the bottom of the Conowingo Reservoir, which is formed by the Conowingo Dam along the Susquehanna River just south of the Pennsylvania-Maryland border. The biggest challenge associated with the project was the liquefiable nature of the soils of the riverbed, which provided little resistance to the buoyancy of the pipeline.

"Luckily, we had dealt with this situation once before right across the river, so we had a pretty good idea of the right way to build the job," said Todd Brown, project manager for Bradshaw Construction.

Project Background

Old Dominion Electrical Cooperative's Wildcat Point Generation Facility (WPGF) in Cecil County, Maryland, requires the use of raw water drawn from the Conowingo Reservoir in Lancaster County, Pennsylvania. The Wildcat Point Raw Water Supply Project, consisting of a new pump house, wet well intake shaft and conveyance pipeline on the banks of the Susquehanna River, draws water from the reservoir for the WPGF.

Bradshaw Construction completed the



All shotcrete operations were preformed after all tunneling was completed from an elevated platform constructed by the contractor to support a shotcrete robot.

installation of a 54-ft deep wet well shaft, which also served as the launch point for the tunnel, and 830-ft intake tunnel, installing 60-in. steel casing by microtunneling into the reservoir. Bradshaw's experience on a similar project in 2010 located directly across the river offered the company a unique perspective for the design and execution of the tunnel.

Geologic conditions for the wet well shaft consisted of highly to moderately weathered, decomposed schist. Ground conditions for the trenchless installation began in the same moderately weathered schist (160 ft), but after mining through a brief transition zone of cobbles and gravel near the river edge, alluvial river sediments of elastic silt and sandy silt were encountered throughout the remainder of the tunnel, outside of one rock pinnacle that was anticipated and encountered 620 ft into the drive. The unstable, muck-like nature of the river deposits, mining beneath an active railroad, and the presence of reservoir obstructions and the rock pinnacle each offered unique challenges which were successfully navigated.

For shaft operations, final footprint restrictions combined with high hydrostatic load design requirements necessitated dual levels of support: an initial 296-in. NAD, 3 gage liner plate support of excavation was installed, followed by a 10-in. thick final shotcrete lining. Due to the owner's concerns regarding drilling and blasting for rock excavation and cold, early spring temperatures impacting the permanent shotcrete wet well liner, all shotcrete operations were preformed after all tunneling was completed. Since the shaft was 54 ft deep, an elevated platform to support a shotcrete robot was fabricated by Bradshaw to facilitate shotcrete operations at high shaft elevations in a safe and efficient manner.

Like the sister project across the river, the Herrenknecht AVN-1200 with rock cutterwheel was recovered by Walker Diving, which excavated and supported a 16-ft x 48-ft recovery cofferdam 670 ft offshore. The MTBM was driven into the cofferdam and then stripped of utilities and electrical components. After capping the wet well structure, the tunnel was filled to prevent an inrush of debris into the tunnel before the machine was removed.

Due to outstanding microtunneling production, Bradshaw's operations were completed well ahead of an already heavily accelerated schedule.

Collaboration between the various members of the project team was necessary to finalize and execute a design that would accommodate the owner's requirements while fitting within several constraints. The wet well shaft design was limited by an outside diameter of 25 ft, so as not to encroach on the structural load bearing requirements of the pump house to be constructed above. It also required an inside diameter of 23 ft to allow for capacity within the wet well.

This left only 12 in. radially for the construction of both an initial support and a final permanent liner. The project team settled on a 296-in. NAD, 3-gage liner plate shaft, constructed without the use of steel ribs in order to meet wall thickness requirements for the final 276-in. ID shotcrete lined shaft. The use of liner plates on a 25-ft shaft without steel ribs for support was a unique challenge, as was maintaining the shape and integrity of the shaft throughout excavation.

Change of Plans

The original intake design called for three 36-in. steel casing bores to run 160 ft from the wet well shaft into a 40-ft x 40-ft cofferdam directly offshore, with the final 670 ft to be installed by ma-

The MTBM was recovered by Walker Diving from a cofferdam 670 ft offshore.

rine open-cut construction. Spatial constraints within the shaft prohibited the parallel bores, and based on Bradshaw's previous project experience, it proposed one 60-in. steel casing tunnel be installed from the wet well shaft 830 ft to the intake location.

Steel casing that would counter the buoyant forces of the river was required, and in collaboration with the manufacturer (Northwest/Permalok), heavy walled (1.625-in.) casing joints with cast-iron ingots enclosed were utilized beneath the river. The anti-buoyancy casing weighed 2,000 pounds per foot. For the on-shore section of the pipeline, Bradshaw used conventional 0.844-in. thick casing.

Mixed ground conditions, obstructions and rock protrusions into an alignment are always challenging. On this project, Bradshaw encountered all three obstacles. Maintaining grade in the river muck was challenging as the MTBM and pipe string would settle in the loose material when not in operation. 24-hour per day mining was required throughout the drive.

Obstructions, particularly tree stumps and branches, are common in man-made reservoirs, and the MTBM often cannot displace them from the alignment path. These obstructions caused jacking forces to significantly rise toward the end of the drive. Rock protrusions within soft ground can force the MTBM off alignment, particularly if encountered at high speeds. In order to maintain grade, high jacking speed within the river muck was required, but through successful operation, the pinnacle was encountered and line and grade were maintained.

Crews began the project in March 2016 and were able to complete the job in June 2016. "The schedule was very, very critical," Brown said. "The plant needed the water flowing to begin its operations so we were mandated to work 24 hours a day. That required close coordination between all parties – the marine contractor, the blasting subcontractor and the general contractor (Allan Myers). It took a lot of hours and manpower, but we were able to complete the job."