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NORTH AMERICAN MICROTUNNELING

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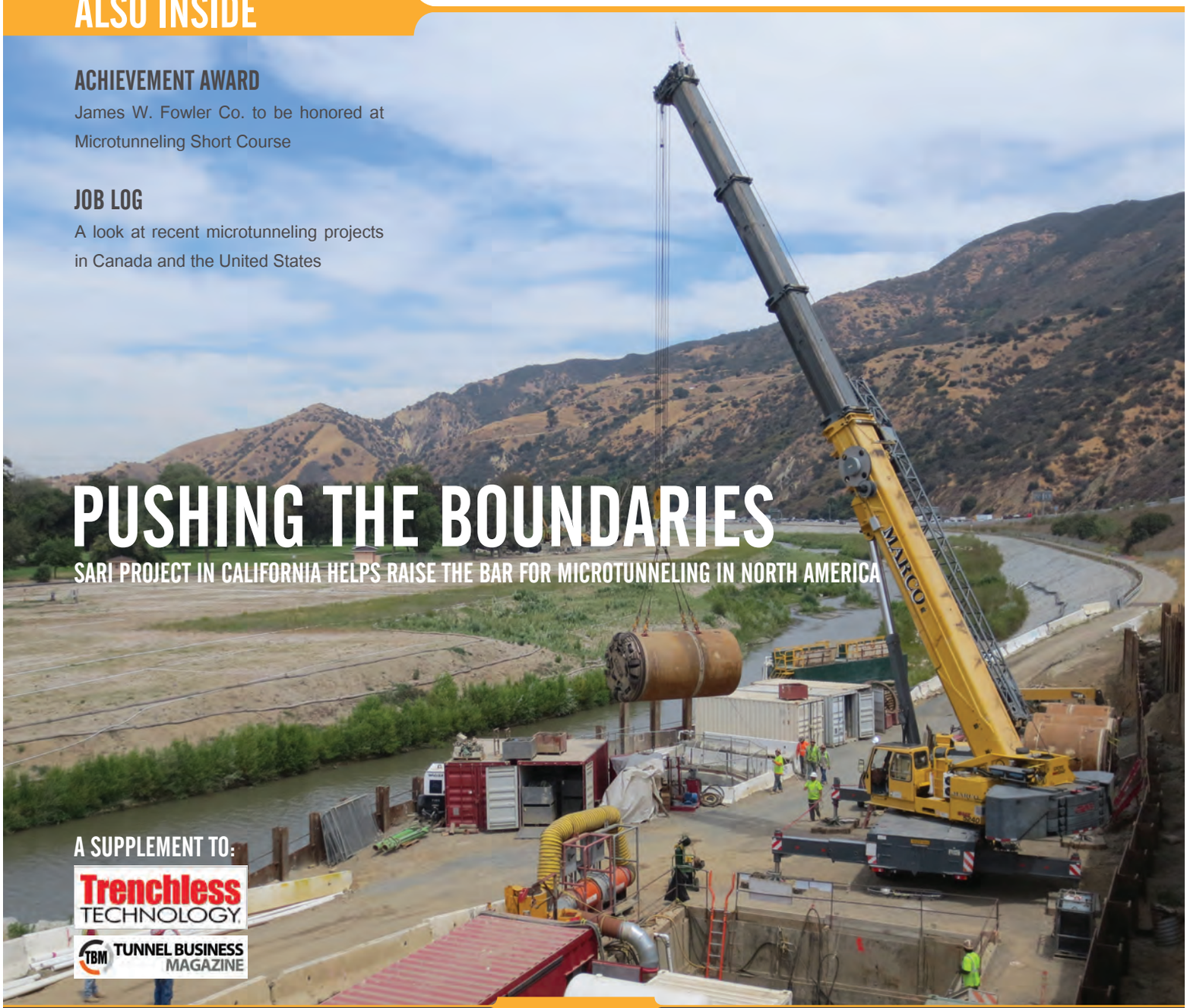

PUSHING THE BOUNDARIES

SARI PROJECT IN CALIFORNIA HELPS RAISE THE BAR FOR MICROTUNNELING IN NORTH AMERICA

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PUSHING THE BOUNDARIES

HISTORIC SANTA ANA RIVER INTERCEPTOR PROJECT COMPLETED IN SOUTHERN CALIFORNIA

PRIOR TO CONSTRUCTION, THE CONSTRUCTION TEAM PROPOSED COMBINING MULTIPLE DRIVES INTO A SINGLE, LONG S-CURVE DRIVE THAT WOULD ELIMINATE ONE SHAFT AND CONVERT ANOTHER TO A PUSH-THROUGH SHAFT.

In the early hours of the morning on May 1, 2013, microtunneling contractor James W. Fowler Co. broke through on the third of four drives for the Santa Ana River Interceptor (SARI) Relocation – SARI Mainline project, completing a difficult and record-setting drive that marked the longest S-curve completed in the United States to date.

The record-setting drive was an S-curve 1,567 ft in length. In fall 2012, Frank Coluccio Construction Co. had completed a 1,250-ft S-curve drive in Hawaii, marking the first double curve in the United States as well as the longest U.S. curved drive. Just this fall, Ward and Burke completed the longest curved drive in North America with the completion of a 740-m (2,427-ft) drive as part of the Elgin Mills Watermain project in Ontario.

The SARI project initially was designed as a conventional microtunnel project with several straight drives. Prior to construction, the construction team proposed combining multiple drives into a single, long S-curve drive that would eliminate one shaft and convert another to a push-through shaft.

John Fowler, executive vice president of James W. Fowler Co. said, "We recognize that this innovation would not have been possible without the partnership of the Orange County Public Works (OCPW) and its consultants, HDR, TetraTech, MWH Constructors and Hatch Mott MacDonald. OCPW showed great innovation by placing their trust in our team for this challenging project. The project truly has the ability to revolutionize the North American tunneling industry by allowing greater design flexibility in microtunnel drive alignments."

PROJECT BACKGROUND

Constructed in the mid-1970s, the Santa Ana Regional Interceptor in Yorba Linda, Calif., was originally constructed with approximately 20 ft of cover within the floodway of the Santa Ana River between Weir Canyon Road and the Orange/Riverside county boundary. In some locations, the low-flow of the Santa Ana River has meandered toward the existing SARI Line and the bed of the Santa Ana River has degraded, leaving the SARI line virtually exposed to the river at several locations and requiring the placement of temporary rock riprap revetment and grade stabilizers to protect the SARI line nearly every year.

The SARI Relocation Project relocated approximately 4 miles of existing interceptor sewer pipeline out of the Santa Ana River scour zone. Construction of the SARI Relocation Project began in mid-2011 and is expected to be fully completed by 2014. Approximately 4,700 ft of the product pipe was installed by 77- to 101.5-in diameter microtunneling in five segments, including two inverted siphon crossings and two curved drives, one of which is a 1,567-ft, S-shaped alignment. Tunneling was performed between May 2012 and July 2013.

Tunneling was chosen to avoid construction impacts to the community and environmental impacts along the river. Soil conditions on the project include a complex mix of alluvium with abundant cobbles and boulders in a weak sandy matrix. During design, subsurface investigation reports indicated abrasive soils based on Miller testing. Groundwater levels were well above the pipeline elevation during flood season along several of the tunnels. Temporary shaft structures were excavated up to 70 ft deep and included the use of cement deep-soil mixing, secant piles and soldier pile and lagging walls with permeation grouting designed to limit groundwater inflow.

The design team, led by Tetra Tech, with tunnel and shaft design

by Hatch Mott MacDonald, was retained by the Orange County Flood Control District (OCFCD) to complete the preliminary and final design to relocate the existing SARI, as part of the U.S. Army Corps of Engineers Santa Ana River Mainstem project. The project consisted of the following two contract packages:

1. SARI Yorba Linda Spur (YLS) Contract – It consisted of 4,685 ft of 15-in. gravity sewer, including 794 ft of siphon pipes inside a 77-in. outside diameter (OD) casing pipe installed via microtunneling under the Santa Ana River for the construction of a twin barrel 12-in. siphon with a 16-in. overflow, and odor control facilities. The project was awarded to LA Engineering for $7.2 million; Vadnais performed the microtunneling.
2. SARI Mainline and Metering Station (Mainline) Contract – Consisted of approximately 20,700 ft of 54-in. diameter gravity sewer, with several reaches of 101.5-in. OD casing installed via microtunneling. Work included installation of gravity sewer and casing behind an existing tie-back wall; open-trench construction; crossing a documented wildlife corridor; and four tunneling segments including two planned curved microtunnels, one that is the longest S-curved microtunnel in the United States. The project was awarded to W.A. Rasic Construction for $41.85 million; Fowler performed the microtunneling.

RAISING THE BAR

The planning, design and construction of the SARI Relocation Project required significant coordination with almost two dozen stakeholders. The project included five microtunnel drives driven through extremely abrasive soil conditions in environmentally sensitive areas with state-of-the-art Herrenknecht microtunnel boring machines (MTBMs). The specified minimum microtunneling equipment requirements with face access and compressed air lock was, in part, due to the anticipated abrasiveness of the ground and the possibility of encountering large boulders. However, all four drives were completed without the need for interventions.

The Mainline Contractor, WA Rasic, and its microtunneling subcontractor, Fowler, proposed a value engineering change in the project alignment to add three curves, thus eliminating a tunnel shaft. In addition to the savings this yielded to the project, one less shaft meant reducing the impact to the environment, as well as saving on the construction schedule. This revised alignment included the longest S-curve microtunnel drive in North America and a second single-curve microtunnel. The design team worked with OCPW and the contractor to evaluate the value engineering change and support the successful completion of the curved drives. The changes yielded a project cost savings of more than $1 million and more than a month of project schedule.

The reason for the curves in the tunnels was due to the narrow right of way along the project alignment. To one side of the available right of way is land owned by the State of California's Department of State Parks. The land is dedicated open space and provides a path used by various animals such as cougars, bears and deer to reach the Santa Ana River from the adjacent hillsides. The other side is owned by the California Department of Transportation (Caltrans) and is dedicated for the 91 Freeway.

VMT provided the theodolite guidance systems, which helped the contractor negotiate the curves and long distances. A tunnel-mounted system, such as VMT, is necessary as microtunnel drives become longer and incorporate curves because standard shaft-mounted lasers will not suffice.

For the first time in North America, this project utilized the Jackcontrol AG joint system to help protect and monitor the pipe joints during the tunnel drive. This unique system incorporates a hydraulic packer at each joint that distributes thrust loads during pipe jacking to prevent damage to the pipes. Fluid within the hydraulic packer allows the joint to compress on the inner side of the curve and expand on the outer side of the curve to create uniform loading of the pipe joint. The Jackcontrol system allows for real-time monitoring of pressure within packers and also monitors rotation of pipe joints. This information is fed to the operator who sees the system's recommendations for lowering jacking pressures in certain zones if packer pressure or joint rotations become excessive.

"We were able to liaise with Jackcontrol's offices in Switzerland as they monitored the joint and pipe performance and they supported us throughout the entire project," according to Fowler project superintendent Phil Hollingsworth.

Fowler project manager Jeff Anderson said, "James W. Fowler Co. appreciates the partnership of Jackcontrol and VMT in completing the [longest S-curved] drive using the Jackcontrol hydraulic gasketed joint and the VMT navigations system. We made a great team."

Both the Jackcontrol and VMT systems will be utilized more in North America as the number of curved tunnel drives increases in the industry to save time and money, and reduce disruption.

THIS ARTICLE WAS COMPILED BY *TRENCHLESS TECHNOLOGY* STAFF BASED ON INFORMATION SUPPLIED BY RORY BALL OF HATCH MOTT MACDONALD, AND SONDRA JAMESON OF JAMES W. FOWLER CO.