After a dramatic lift to the surface this spring, repairs began for Bertha, the world's largest tunnel boring machine (TBM) imported to drill Seattle's SR99.

PHOTO: CONSTRUCTIONIMAGES.COM

Underground II

Tunneling Forward

Innovation and mastery of techniques continue to drive all types of underground construction

By Karin Tetlow

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Projects to Watch

PHOTO: NICHOLSON

Norris Cut Tunneling Project

Miami, Fla.

Owner: Miami-Dade Water and Sewer Dept. (MDWASD)

Estimated Completion: 2016

Design-build contractor Nicholson Construction Company has mobilized teams on both Virginia Key and Fisher Island in Miami Beach, Fla., to construct a 1-mile-long and 10-ft-wide precast concrete segment tunnel under the ocean. They are replacing an existing 54-in. force main with a new 60-in. replacement that will extend from the Virginia Key Center District Wastewater Treatment Plant under Norris Cut to Fisher Island. The TBM, christened "Dorsey" by a local elementary school, was lowered into the launch shaft recently and will begin working through the difficult layers of coral rock and sand in the Fort Thompson Limestone.

PHOTO: WWW.PHOTOGRAPHYBYGNARON.COM

Van Ness Campus Hospital and Tunnel

San Francisco, Calif.

Owner: Sutter Health

Estimated Completion: 2020

The joint venture of HerreroBOLDT has broken ground on the new 730,000-sq-ft, 12-story Van Ness Geary Campus Hospital, and Pankow Builders will break ground later this year on the adjacent 9-story Medical Center. Malcolm, the foundation contractor for the campus project, began construction on the hospital foundation and underground pedestrian corridor in April 2015. The massive health center straddles Van Ness Avenue, a major downtown San Francisco thoroughfare. Construction coordination involves two three-day closures of Van Ness Avenue, allowing for the installation of shoring and decking elements with another closure occurring later to repair the roadway.

Lake Mead Intake No. 3 and Low Lake Level Pumping Station

Las Vegas, Nev.

Owner: Southern Nevada Water Authority

Completion: 2015/2020

The new $817-million Lake Mead Intake No. 3 tunnel reached a milestone hole-through to the intake structure on December 10, 2014. Since then, crews have been disassembling the tunnel boring machine and making preparations to flood the tunnel in summer 2015. In the meantime, the Southern Nevada Water Authority has sent an RFP for qualified construction manager at risk services for the new Low Lake Level Pumping Station. This next component—with nearly 50% of the work underground—is expected to begin construction summer 2015 with full completion in 2020. Estimated costs are $650 million.

Permanent Canal Closures and Pumps (PCCP)

New Orleans, La.

Owner: U.S. Army Corps of Engineers

Estimated Completion: 2017

In 2012, the U.S. Army Corps of Engineers awarded the PCCP Constructors the $650-million contract to build three permanent canal closure and pump station structures to block hurricane storm surges at the Lake Pontchartrain mouths of the 17th Street, Orleans Avenue and London Avenue drainage canals in New Orleans. The PCCP will provide permanent and more sustainable measures for reducing the risk of a 100-year level storm surge entering the three canals. The area is currently being protected by interim closure structures.

Projects to Watch, continued

Sweeny Midstream Spread D

Texas

Customer: Phillips 66

Completion: Summer 2015

Starting at Gulf Coast Fractionators in Mont Belvieu, Texas, and running southeast toward Friendswood, Texas, Sweeny Midstream Spread D is approximately 30 miles of 18-in. pipeline for Phillips 66. Michels Corporation is using direct pipe technology to install a 36-in. container pipeline through one of the most crowded utility corridors in the Houston area. The 1,000-ft crossing is one of two employing direct pipe technology. Michels worked with Phillips and general contractor Troy Construction, LLC, to determine that direct pipe was the safest and most effective method for completing installations under highways and rail tracks.

PHOTO: LOCKWOOD, ANDREWS & NEWNAM, INC. (LAN)

Integrated Pipeline (IPL) Project

Texas

Owner: Tarrant Regional Water District and the City of Dallas Water Utilities

Completion: Section 15-1 August 2015; final phase 2030

The owners are partnering to design, build and operate a massive raw water infrastructure that will deliver approximately 350 million gallons a day of water by connecting a network of reservoirs southeast of the growing Dallas/Fort Worth metroplex. The $2.3-billion five-phase IPL project will consist of 150 miles of pipeline with a series of pump stations and balancing reservoirs. The first phase consists of Section 15-1, Section 15-2 and Sections 12, 13 and 14. Lockwood, Andrews & Newnam, Inc. (LAN) is the prime designer for Section 15-1, the first section currently under construction.

PHOTO: CONSTRUCTIONIMAGES.COM

SR99 Tunnel

Seattle, Wash.

Owner: WSDOT & Agency Partners

Completion: TBD

Beginning in the summer of 2013, 57-ft-wide Bertha, the world's largest tunneling machine, began digging a 2-mile tunnel beneath downtown Seattle. At 1,000 ft, she was stopped by contracting team Seattle Tunnel Partners (STP) after damage to the seal system caused overheating. Then began the world's largest industrial rescue operation. Malcolm installed a 120-ft-deep rescue shaft with the largest ever secant piles. In March 2015, Bertha broke through into the shaft and her 2,000-ton front end assembly was raised for repairs. Visit www.wsdot.wa.gov/Projects/Viaduct/ for videos of raising Bertha and STP's repair plan.

Kaneohe/Kailua Sewer Tunnel

Oahu, Hawai'i

Owner: City and County of Honolulu

Completion: Early 2017

In April 2015, the TBM named Pohakulani ("rock girl from the heavens") was launched at the Kailua Regional Wastewater Treatment Plant. It will bore through approximately 3 miles of basalt bedrock. Southland/Mole JV is performing tunnel boring for this 13-ft-dia gravity sewer, which also includes the 77-ft-deep, 87-ft-dia Kailua TIPS Shaft and the 40-ft-deep, 30-ft-dia Kaneohe Shaft. Brierley Associates is serving as Southland/Mole's construction engineer for the tunnel, shafts and soil stabilization. Subcontractor Layne Christensen is performing slurry wall and jet grouting. Preparations included a blessing ceremony for Pohakulani.

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Specialty contractor Malcolm installs innovative foundation system for 270 Brannan Street, San Francisco.

PHOTO: WWW.PHOTOGRAPHYBYGNARON.COM

The Liquefaction Battle in Variable Ground Conditions

San Francisco's South of Market (SOMA) district has very complex underground conditions consisting of sand dunes, bedrock hills, cliffs, mud flats and marshes—flattened and filled when the city was built and covered by rubble and debris after the 1906 earthquake and fire. When constructing a new building in the SOMA area, the combination of natural geology and historical interventions can produce challenging subsurface conditions that require not only addressing the structure's settlement concern, but also the mitigation of liquefaction and lateral spreading hazards.

Deep Soil Mixing (DSM) in combination with micropiles creates an ideal ground improvement and foundation system, which is the most cost-effective solution for such variable ground conditions. The DSM panels act both as a liquefaction mitigation mechanism and a foundation support system, where the resistance to seismic overturning is provided by uplift-resisting micropiles. 270 Brannan Street, a multistory "Class A" office building, was the most recent example where such a high-level seismic performance system was implemented by a technically sophisticated owner through a process that included constructive collaborations between the various design engineers, the general contractor and the specialty contractor. ■

Blue Plains Tunnel Construction Nearing Completion

Construction of the Blue Plains Tunnel, a 24,000-ft-long, 26-ft-dia combined sewer overflow tunnel under and adjacent to the Potomac and Anacostia Rivers in D.C., is moving steadily along. Currently at 85% completion, the Traylor Bros., Inc.-led joint venture team has recently met or will soon meet several major milestones along the alignment.

Lady Bird receives cutterhead maintenance at the Poplar Point, D.C. junction/drop shaft in early April.

Of the four shafts, two are now complete, the first being the 55-ft-dia main pumping station shaft. The surge chamber, shaft CIP and drop pipe, shaft cover, and retaining wall at the 55-ft-dia junction/drop shaft at Poplar Point Pumping Station are also complete. At the 132-ft-dia dewatering shaft, excavation, waterproofing, base slab and walls are complete; the bulkhead between the dewatering shaft and the adjacent 75-ft-dia screening shaft has been installed; and the site has been demobilized. At the 50-ft-dia drop/overflow shaft at Joint Base Anacostia Bolling, the cast-in-place (CIP) liner construction is complete; excavations for the overflow and approach channel are complete, with the concrete work ongoing; and the drop pipe/vortex installation is nearing completion, with all work to be completed by early May.

Tunneling is moving along at a rapid pace. Lady Bird recently broke through at Poplar Point and will rest there for approximately two weeks for maintenance of the cutterhead tools and tail brushes. Prior to entering the shaft, several cutterhead interventions were performed, both in free air and under pressure. Once back underground, Lady Bird will need to mine only approximately 4,250 ft more of the 24,000 ft, with hole-through scheduled for early July. ■

Rehabilitating a Cast Iron Sewer Line

Michels Pipe Services successfully rehabilitated a sewer line in Milwaukee County without causing as much as a ripple in the river that passed above it.

For a sewer line rehabilitation, Michels installed a pre-liner through a manhole in a residential area.

Michels installed a 404-ft cured-in-place pipe (CIPP) liner into a 12-in. sanitary sewer line under the Menomonee River in Wauwatosa, Wis. The project took months of preparation and planning and less than a day of execution. It will extend the life of the cast iron pipe by about 50 years.

CIPP rehabilitation is a trenchless technology, ideally suited for projects in environmentally sensitive areas and residential neighborhoods, both of which were part of this project. Michels used a water column for installation of the liner and heated the water to cure it. The project management team used its significant experience to select the right combination of methods to achieve the project's goal.

The five-person crew conducted work from two manholes, one on a residential street on the west side of the river and another in the parkway on the east side. All heavy equipment was kept on the roadways to minimize the project's footprint. ■

Michels Pipe Services is a division of Michels Corporation, headquartered in Brownsville, Wis.

Outfield Bleacher Expansion At Wrigley Field in Chicago

During the winter of 2014, Case Foundation Company completed the installation of 69 caissons supporting the historic Wrigley Field outfield bleachers. The company utilized two IMT 220 drill rigs and a BG39 drill rig.

Case Foundation installed 69 belled caissons to support new outfield bleachers at historic Wrigley Field.

A total of 63 belled caissons were installed with shafts ranging from 3 ft to 6 ft dia and bells ranging from 6 ft to 15 ft. Belled caissons were founded on hardpan approximately 45 to 50 ft below grade. Six belled caissons were installed as top of rock caissons due to water bearing ground conditions at the original bearing elevation approximately 70 ft below grade. Each top of rock caisson was founded on the surface of the limestone bedrock approximately 90 ft below grade and utilizing 50TSF bearing capacity.

Once the redesigned top of rock caissons were placed, Case installed the remaining 63 belled caissons in two weeks. Pepper Construction was the client. ■

PHOTOS (CLOCKWISE FROM TOP): TRAYLOR; CASE FOUNDATION; MICHELS

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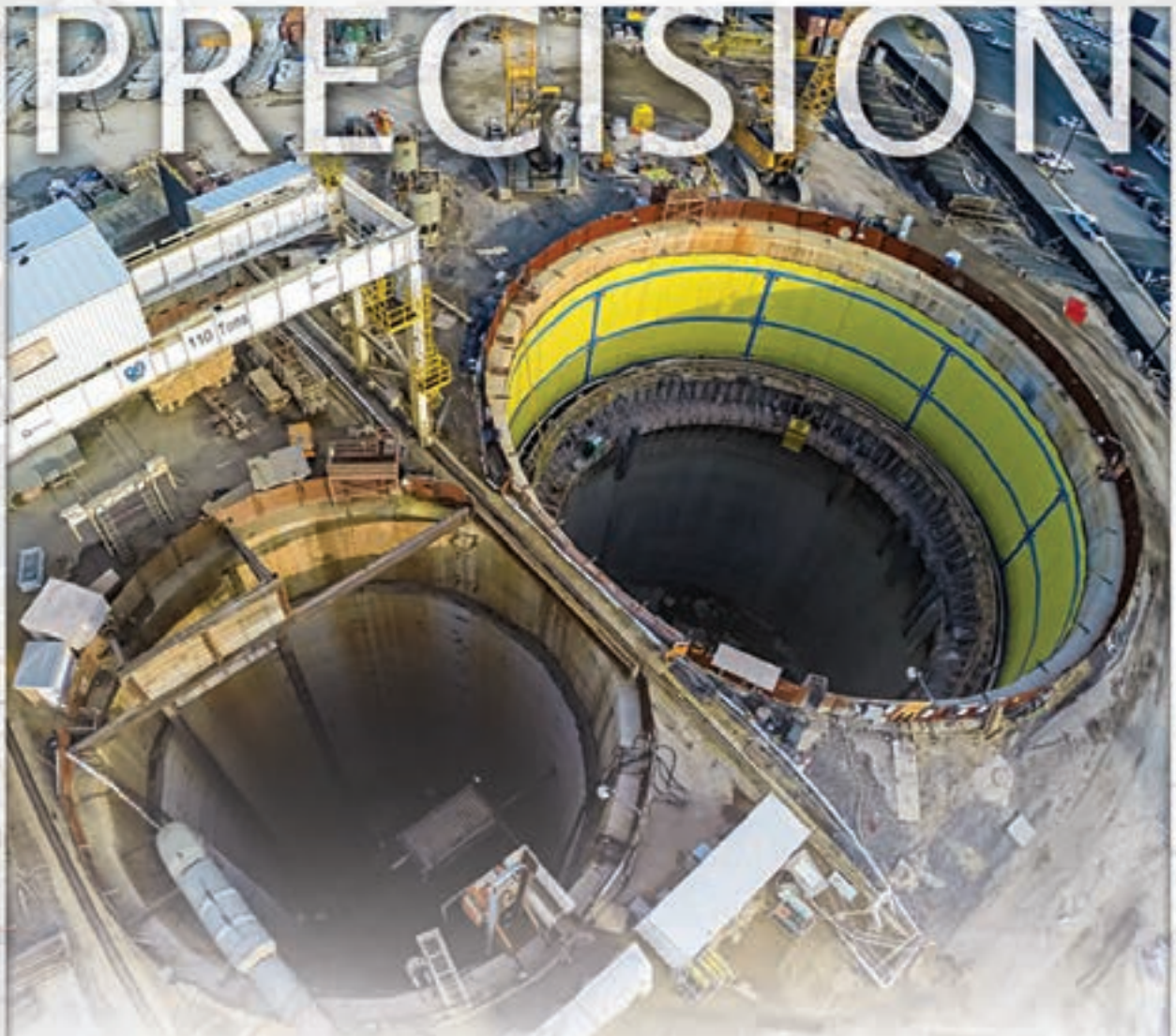

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Waterproofing Pile Caps for The New NBA Sacramento Kings

Pile caps and rebars for the Sacramento Kings new arena were coated and cured with Xypex in one day.

After nearly 20 years of discussions, the NBA Sacramento Kings arena was finally under construction in downtown Sacramento, Calif. Early this year after the initial pour of 300-plus foundation piles, it was discovered that half of them had filled with 4 in. of groundwater due to extreme hydrostatic pressure resulting partially from the nearby convergence of the Sacramento and the American Rivers. Needing to seal the pile caps, whose size ranged from 5 ft x 8 ft to 15 ft x 20 ft, waterproofing contractor F.D. Thomas sought waterproofing material that could be applied and cured quickly, in order to keep to the schedule and because a storm was coming.

After a site inspection, Colter Jones, technical sales representative for Xypex, confirmed that an application of Xypex Concentrate applied at 2.0 lb/sq yd followed by a heavy spray of Xypex Gamma Cure within four hours would serve as the stand-alone waterproofing mechanism for the pile caps at this critical juncture for water intrusion. After construction manager and general contractor Turner Construction approved the use of Xypex, all the pile caps and the rebars were coated and cured the same day. A non-toxic, chemical treatment for the waterproofing and protection of concrete, Xypex's primary feature is its unique ability to generate a non-soluble crystalline formation deep within the pores and capillary tracts of the concrete—thus providing a permanent seal against the penetration of water and other liquids.

The very existence of the arena, which has sparked revitalization of downtown Sacramento, is due mostly to the efforts of two determined players. They are the Kings' chairman Vivek Ranadive, who led the investment group that prevented the team's proposed move to Seattle and Sacramento Mayor Kevin Johnson, who successfully pushed for a $255-million city subsidy. The $477-million LEED® NBA Sacramento Kings Sports & Entertainment Arena should be completed by the 2016-2017 basketball season. The Kings will fund the remaining$222 million. ■

PHOTO: XYPEX

Delivering Water the Alternative Way


The Lake Mead Intake No. 3 meets the demands of today's tunneling world.

PHOTO: MWH

The current demands on today's tunnels require an alternative delivery method for design and construction. The industry is demanding methods such as design-build or construction-management-at-risk (CMAR)—tasks many firms currently find challenging. More and more owners, on the other hand, are seeing the benefits of these new methods, which typically include cost and schedule control.

MWH Global, a Colorado-based engineering firm, uses its management, engineering and construction operations to deliver on these critical issues.

The industry has MWH implementing these methods on such projects as Atlanta's Raw Water Supply Program in which MWH is serving as program manager and Austin's Water Treatment Plant No. 4 with nearly 9 miles of tunnels where MWH served as the CMAR.

MWH's focus on detailed engineering results in a strong understanding of multiple methods. The firm is well versed in designing while in close connection with the construction contractor. Examples include the Panama Canal Third set of locks, where MWH served as the lead designer to the contractor and the Lake Mead Intake No. 3 project where MWH has been a joint venture partner on the owner's engineer team.

Whether it is for drinking, irrigating, treatment, discharge, power or transportation, MWH has the means to deliver the demanding requirements of the many types of tunneling systems. From management through detailed design and construction, the MWH team has the in-house skills to successfully deliver water the alternative way. ■

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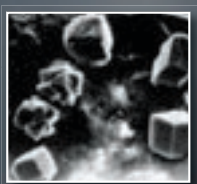

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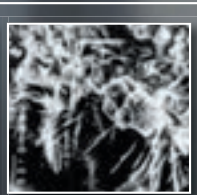

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Guide Frame System Protects Excavations

Selecting a steel sheeting guide frame system for unstable soils that also protects crossing utility lines was key to this project's success.

PHOTO: NATIONAL TRENCH SAFETY

A familiar challenge for contractors repairing or replacing utility lines is selecting a system that both protects an excavation in unstable soil and accommodates other utility lines that cross that excavation. A typical example is repairing a sanitary sewer line repair within a wastewater treatment plant in type C-60 sandy mixture soil where a 48-in. line crosses through the excavated area. In this case, the repair required a 16-ft linear run, with a width of 20 ft and an excavation depth of 11 ft.

After reviewing a few protective options, the contractor selected a steel sheeting guide frame system for the project—a system composed of steel panels threaded along corner rails in much the same manner as slide rail systems are configured. The steel sheeting guide frame system introduces open channel panels that allow steel sheets to be inserted through the channels and pushed to the excavation depth. The steel sheet is pushed below the excavation depth a few feet according to manufacturer's tabulated data and provides soil support to the full depth of the excavation. The system is installed in what is commonly known as a "dig and push" method to maintain soil stability.

The system's utilization of steel sheets also helps to accommodate crossing utilities, such as the 48-in. line. Sheets can be pushed around the utility according to the product's tabulated data to achieve the necessary soil protection while also addressing the presence of the utility. The steel sheeting guide frame system is a relatively new system that provides contractors with one additional tool to meet the trench safety needs on their projects. The contractor was very satisfied with the system, its ease of use and quick installation process. ■


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Insuring the Unique Risks of the Construction Industry

Houston International Insurance Group (HIIG) specializes in offering coverage for the unique risks of the construction industry. Through its subsidiary, HIIG Construction, the company has experience and expertise in successfully underwriting a full spectrum of coverages specific to the needs of the construction industry.

HIIG Construction has particularly focused on heavy mechanized operations and infrastructure. Examples of coverage for heavy mechanized operations include: site preparation, land clearing, grading, excavation, earth retention, stone crushing, steel erection and fabrication. Examples of coverage for infrastructure include: underground utility, oil and gas pipeline, bridge and concrete, street and road paving.

HIIG offered coverages include: commercial general liability, commercial automobile, inland marine, property, excess liability, workers' compensation and employer's liability.

HIIG has assets of more than $1 billion and shareholders' equity of more than $250 million. Its underwriting divisions focus on Construction, Energy, Professional Liability, Transactional Property and other Specialty business.

HIIG's insurance company subsidiaries consist of Houston Specialty Insurance Company, Imperium Insurance Company, Great Midwest Insurance Company and Oklahoma Specialty Insurance Company. These insurance companies are rated A/A- (Excellent) by A.M. Best Company.

Houston International Insurance Group, the insurance holding company is based in Houston, Texas, with offices in Atlanta, Ga.; Birmingham, Ala.; Chicago, Ill.; Dallas, Texas; Morristown, N.J.; Oklahoma City, Okla.; and a representative office in London, England. ■

For inquiries, please contact: Jon Oppenheim, Joppenheim@hiig.com, (770) 701-2586

Doubling the Rigs Cuts the Time in Half

Terra Sonic International (TSI) recently performed a large environmental site assessment project for Ecotech Environmental Services (Pompano Beach, Fla.). The project involved the installation of 25 monitoring wells covering five properties in Pensacola, Fla. These well depths ranged from 45 ft to 80 ft below grade, and a total of 1,345 linear ft of monitoring wells were installed over the seven-day project. Ecotech requested TSI provide two compact crawlers, which allowed the project to be completed in half the usual time with one seven-day mobilization. Terra Sonic is known for its ability to provide multiple rigs for a single project.

TSI recently formed a strategic alliance with Earth Tech Drilling to provide sonic drilling services to Earth Tech's south Florida clients and the two firms partnered on the Pensacola project. Tim Dehen, president of Ecotech, states he is pleased that TSI has formed an alliance with Earth Tech and looks forward to expanded service capabilities and additional sonic drilling at the Pensacola site and others. "Working with TSI and Earth Tech Drilling on this project exceeded our performance expectations with regard to troubleshooting and the project duration. Sonic drilling was the perfect technology for the well depths required, and the complicated geology/hydrogeology found at this site. These drillers really showed their in-depth experience with this technology," he says. ■


Terra Sonic installed 1,345 linear ft of monitoring wells in Pensacola, Fla., in seven days.

PHOTOS: HIIG (TOP); TERRA SONIC (BOTTOM)

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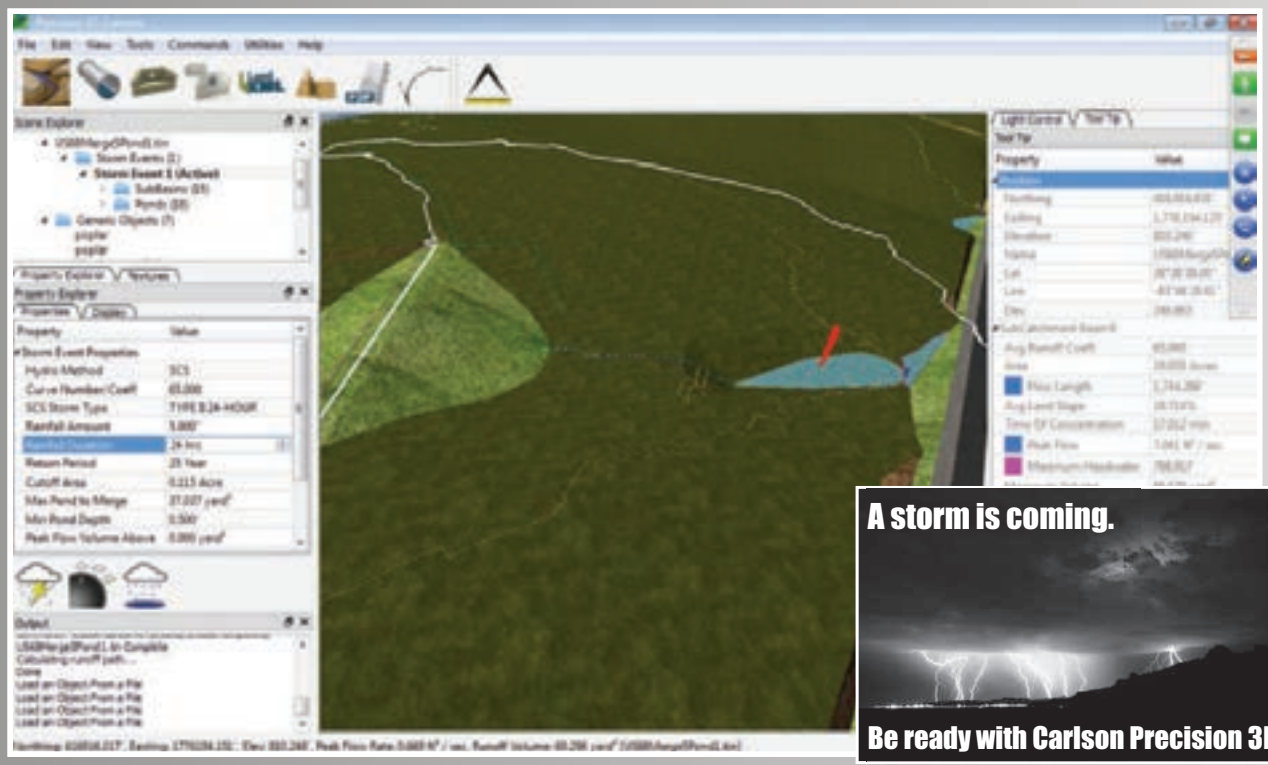

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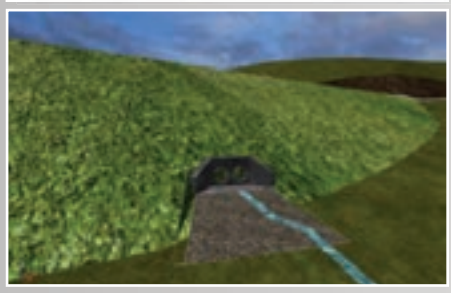

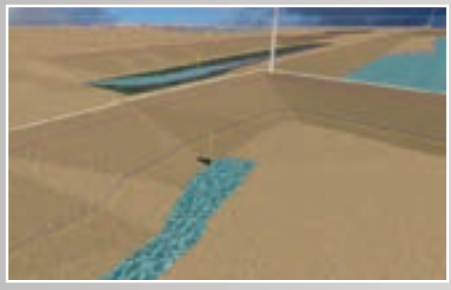

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Solving Geotechnical Challenges With Rammed Aggregate Pier Systems

Geopier ground improvement solutions support a 12-story office building and parking garage in New Haven, Conn.

PHOTO: © HELICAL DRILLING, INC.

The first phase of the New Haven Downtown Crossing/Route 34 East featured a 12-story office building and parking garage. Column footing loads exceeded 4,000 kips and wall footing loads surpassed 60 kips per linear ft. The project team faced a variety of geotechnical challenges including the presence of fill, soft organic soils, loose sand/silt and high groundwater table that would have led to excessive settlement with a shallow foundation system.

The design team evaluated several deep foundation support solutions including augercast piles and structural slabs and ground improvement methods. Ultimately, a ground improvement solution consisting of Geopier GeoConcrete® Columns (GCCs) and Rammed Aggregate Pier® (RAP) systems was selected as a substantial cost savings option.

Helical Drilling, Inc. installed over 900 Geopier GCCs to support footings and 100 RAPs to support the structure. The solution allowed for traditional spread footing support construction and did not require dewatering or spoil offhaul.

Geopier GCCs were designed with a structural fill pad beneath the footings to transfer footing stresses to the GeoConcrete Columns and surrounding matric soil. A full-scale modulus test was conducted on a group of GCCs and individual elements to 150% of the element design stress. The total and differential post-construction footing settlement was limited to less than 1-½ in. and 1 in. respectively within the improved zone, providing a maximum allowable bearing pressure of 9.5 kss. ■