Across the U.S., municipalities must come to terms with the impact of climate change on underground infrastructure.

The Challenge of Climate Change to Underground Infrastructure

State, regional and local organizations have set aside billions of dollars to initiate major underground infrastructure rehab, modernization and expansion projects to meet population growth, regulatory requirements and, likely, climate change in 2013 and beyond. President Obama's Climate Action Plan specifically points to the need to boost the resiliency of buildings and infrastructure to prepare the U.S. for the adverse effects of climate change.

A National Association of Clean Water Agencies (NACWA) report estimated that U.S. water and sewer agencies would have to spend between $448 billion and $944 billion from 2010 through 2050 in infrastructure, operations and maintenance to prepare for climate change. Besides the need for new water sources and improved conservation of existing sources, the investment must include increased storage and conveyance methods to accommodate bigger storms and more precipitation in a shorter amount of time.

Failure to provide a plan for climate-change adaptation has serious consequences, according to NACWA, that range from higher emergency relief and response costs to long-term loss of water and sanitation services in communities.

Leading regulators clearly agree. EPA's Clean Water and Safe Drinking Water Infrastructure Sustainability Policy [EPA, 2010c] encourages water sector owners to incorporate climate-change considerations into their planning and operations, and supports the work of the Climate Ready Water Utilities (CRWU) initiative. Similarly, the National Water Program (NWP) is looking at a "long-term, transformative approach to deal strategically with the challenges that climate change will present to the nation's water resources and utilities." There is an increasing number of risk assessment tools developed by governments and non-profits available to help agencies prioritize climate risks, and capital improvement plans will most certainly need to consider the likelihood of multiple extreme events.

In the wake of recent extreme weather events in the northeast, the city of Cambridge, Mass., has already taken steps to understand how it must prepare its infrastructure and its community for possible changes in sea level rise, storm events, flooding, increasing temperatures and other related climate-change impacts. The city is undertaking a climate-change vulnerability assessment, which will run to the end of 2014 and serve as the foundation for a climate-change resilience and adaptation plan. By adequately capturing the complexity of climate-change impacts, the city will be able to proactively identify and prioritize critical at-risk infrastructure, services and operations. A consultant team led by Kleinfelder, a Cambridge-based architecture, engineering and sustainability services firm, will work with city staff to develop a holistic, comprehensive model that links the built and natural water systems. The model will provide a high-level review of existing vulnerabilities including best- and worst-case scenarios for water and energy infrastructure and the identification of priority planning areas.

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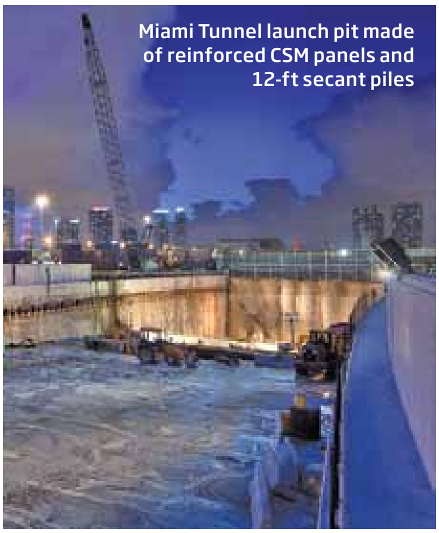
Anthony Zuena, P.E., water market manager for Kleinfelder, says, "The resulting assessments will be incorporated into a meaningful, implementable adaptation/resiliency plan, complete with short- and long-term actions to address climate-change impacts for the most at-risk elements. Using the plan, the city will be able to identify and prioritize actions across its assets and systems to make the best use of the limited available funding and protect infrastructure."

Cambridge is one of many municipalities and other organizations that must assess climate-change impacts to underground infrastructure and will look to industry professionals for answers in the near term. ■

PHOTO COURTESY OF MALCOLM DRILLING

Cutter Soil Mixing Proves Ideal in Miami Limestone

The twin 42-ft-dia, 4,000-ft-long tunnel bores recently completed as part of the Port of Miami Tunnel (POMT) project passed through native silty sands and into the multi-layered sands, cemented sands and highly porous limestone that have formed beneath Watson Island and Dodge Island. To support the tunnels, the Watson Island and Dodge Island excavation support systems are the deepest and largest excavations performed to-date in South Florida.



Miami Tunnel launch pit made of reinforced CSM panels and 12-ft secant piles

As the foundation subcontractor, Malcolm installed the walls of the excavation support using a cutter-soil-mix (CSM) system reinforced with W-beam soldier piles in combination with strand anchors to provide the lateral structural excavation support and groundwater cut-off. More than 200 CSM panels were constructed for the walls to an average depth of approximately 50 ft.

CSM is typically used in coarse- and fine-grained soils with limited penetration into rock. In the case of the POMT project, the team implemented changes in the CSM sampling and mix design protocols and pretreated the soils to overcome the challenging conditions. A dual-phase technique using a bentonite slurry during the penetration phase and cement slurry during the extraction phase was required due to the relatively long time required to cut through the rock.

Charles W. Bartlett, P.E., with Malcolm, explains, “The bentonite slurry used during the penetration phase effectively filled the voids in the limestone thus keeping the cement slurry from escaping. Most of the CSM panels for the deeper section of the excavation support walls had bottom elevations over 10 ft into the underlying hard Fort Thompson limestone formation. These panels exhibited great performance with high strength and very low permeability, without requiring any additional measures aside from the predrilling and dual-phase grouting method described above.”

“Cutter-soil-mixing produces a product of exceptional quality,” says Bartlett. “Due mainly to the quality of the product, engineers can consider the application of this technique in an endless array of ground improvement, cut-off wall and excavation support applications.” ■

PHOTO COURTESY OF MALCOLM DRILLING