



NASTT's *Trenchless Today*

Educate - Train - Research - Publish



FALL 2016 | VOLUME 6 | ISSUE NO. 3

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FEATURES

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By Andrew Farr

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For this month's In the Trenches, *NASTT's Trenchless Today* profiles Adam McKnight of the Upper Trinity Regional Water District in Texas, and Tara Lamoureux of the City of Casselberry, Florida, to hear about the trenchless projects they have completed and the work they are doing within NASTT to help spread the trenchless word.

18 NASTT's 2016 Membership Directory

Compiled by NTT staff

NASTT strives to be the essential resource for professionals working in the underground construction field, and the Society takes on this mission with pride and passion. With NASTT's annual membership directory, trenchless professionals can connect with contractors, manufacturers, professional service providers and municipal representatives who are NASTT members. When planning your next trenchless project, you may need it!



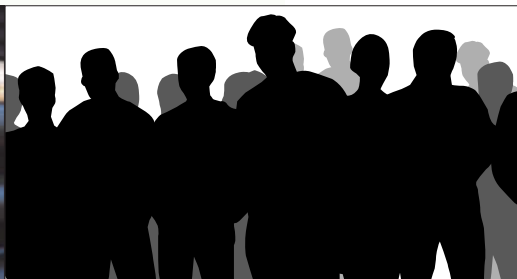
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NASTT Staff

Executive Director

Michael J. Willmets — mwillmets@nastt.org

Program Director

Michelle Hill — mhill@nastt.org

Marketing Manager

Jenna O. Hale — jhale@nastt.org

Membership Coordinator

Molly Margosian — mmargosian@nastt.org

Benjamin Media Publishing Team**Publisher**

Bernard P. Krzys

Editor

James W. Rush

Associate Editor

Andrew Farr

Graphic Designer

Deborah R. McManus

Brand Sales Manager

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Editorial and Advertising Offices

BENJAMIN
MEDIA.

10050 Brecksville Rd.
Brecksville, OH 44141 USA
(330) 467-7588, Fax: (330) 468-2289

www.benjaminmedia.com

e-mail: info@benjaminmedia.com

Editorial: afarr@benjaminmedia.com

Advertising: bcline@benjaminmedia.com

Reprints
Wright's Media
Ph: (877) 652-5295
Fax: (281) 419-5712

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A Society Built on Membership Commitment



Mike Willmets
NASTT Executive
Director

We're well over halfway through 2016 and it continues to be an exciting time to be involved in the trenchless industry. NASTT has been working hard to improve our membership services and benefits to keep up with the growth we're seeing. We've implemented new tools and resources throughout this year that we're always trying to improve your experience while preparing for the future growth of the society.

For the majority of the year, we have been working on the development of a new membership database and portal. This portal was designed to enhance our members' experience when managing their memberships and accessing trenchless information and resources on our website. The portal is a robust system that uses the latest technology allowing for an efficient and user-friendly experience. Along with the member portal, we also completely revamped the NASTT website. The new site is device-responsive, meaning that no matter what type of device you use to access it, the experience will be optimized. With a simple navigation system combined with an attractive look and modern feel, we're really proud of the new website and we hope that our members and trenchless friends will find it even more valuable than ever before. Be sure to check it out and your feedback is always welcomed!

Trenchless education is the backbone of NASTT. It is the leadership of our members

and volunteers that makes our educational programs so successful. We have many volunteer committees that work behind the scenes to bring our courses and events to life. NASTT's 2017 No-Dig Show Program Committee recently met in Washington, D.C. to plan the technical program for the annual show. The committee is led by the 2017 Program Chair, Jennifer Glynn of RMC Water & Environment and Vice Chair, Don Del Nero of Stantec. With this leadership, the committee of over 100 volunteers and industry experts, peer reviews every single abstract that is submitted and uses their knowledge to formulate the best technical program available at any trenchless conference.

Another committee that works tirelessly and devotes many hours of service is NASTT's Educational Fund Auction Committee. The 2017 Auction Committee Chair is Tim Peterie of Insituform and the Vice Chair is Gregg Leslie of Xylem. This committee works throughout the year to plan the annual auction event held at NASTT's No-Dig Show, which raises funds for our educational initiatives. To date, we've raised more than \$930,000 thanks to the dedication of this committee and our generous members and attendees. If you'd like to join this committee and help raise funds dedicated to education while having a blast, please contact NASTT's Marketing Manager, Jenna Hale, at jhale@nastt.org. We'd love to have you join us.

I'd also like to thank our member volun-

teers that donate their time to serve on our Student Education Committee, Awards Committees, Networking Committees and Technical Committees. There is truly something for everyone at NASTT and we're always looking for new ideas and input. If you would like to join one of our committees or would like more information on getting involved, please contact NASTT's Membership Coordinator, Molly Margosian, at mmargosian@nastt.org.

I can't talk about our committees, volunteers and our educational program without mentioning our dedicated expert instructors! These fine individuals use their own time to travel all over North America to teach NASTT's Good Practices Courses to hundreds of trenchless professionals every year. NASTT offers eight Good Practices Courses along with various discussion panels and webinars every year. If you'd like to learn more about our expert instructors, please visit our website at nastt.org/instructors. If you'd like to learn more about becoming an instructor, please contact NASTT's Program Director, Michelle Hill, at mhill@nastt.org.

We're gearing up for another groundbreaking conference in 2017 in Washington, D.C., April 9-13. We hope that you will join us for top notch education, valuable networking and of course, a really good time!

Michael J. Willmets
NASTT Executive Director



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Your Society, Your Industry Strategic Plan Positions NASTT for Continued Engagement, Future Success



Dr. Kimberlie Staheli, P.E.
NASTT Chair

It's been a year of many great things for NASTT and the trenchless industry as a whole. Our members and volunteers continue to amaze us with their commitment and innovation, and we dedicate this issue to them.

Three years ago we set out to create a Strategic Plan by asking our members for their feedback. With your guidance, we embarked on a journey to improve and enhance the benefits offered to our members. One of our top initiatives is to continue to increase our member value. NASTT is your Society, and it is important to us that we meet your needs.

During NASTT's 2016 No-Dig Show, we introduced several new initiatives including the addition of six roundtable discussions added to the technical program schedule. Each roundtable was moderated by either 2016 Program Chair Jeff Maier or Vice Chair Jennifer Glynn. The roundtables consisted of a panel of industry experts on various trenchless subjects including microtunneling, HDD, water main rehabilitation, manhole rehabilitation, stormwater condition assessment and alternative project delivery methods. Audience participation was encouraged and the panels proved to be a lively and valuable addition to NASTT's No-Dig Show offerings.

We are proud and pleased to continue offering our free webinar series for the fifth year! Our fall webinar series kicks

off in October with alternative project delivery. In November, we tackle water main rehabilitation and wrap up the series in December with small diameter tunneling. As always, our webinars are led and moderated by recognized industry experts and are free of commercial content. To register for our complimentary webinars, visit nastt.org/webinars. You can also watch any of our archived webinars from the past five years, instantly! NASTT is dedicated to bringing you the latest information on our industry, and our webinars are a great way to stay current on technology and innovations, as well as to learn about case studies and real-world solutions, right from your desk.

As always, and with our Strategic Plan as our guide, NASTT is working to foster and leverage strategic partnerships to further extend our networking efforts for the benefit of reaching new audiences and advancing trenchless technology. We have participated throughout the year at various trade shows and conferences. Earlier this year, we exhibited at the UCT (Underground Construction Technology) conference where we also hosted a trenchless panel discussion, "Trenchless Trends in Atlanta." As solutions for aging infrastructure continue to trend towards proven trenchless options for rehabilitation, an expert panel consisting of Mikita K. Browning with the City

of Atlanta, Don Del Nero of Stantec, Jeff Maier of C&L Water Solutions, Inc., and Eddie Ward of TT Technologies, discussed the options.

In August we exhibited at the American Public Works Association's (APWA) PWX in Minneapolis, Minn., and hosted a forum titled "Trenchless Trends in the Midwest." This forum was led by local trenchless champion, Paul Pasko of SEH, Inc., along with panel members Craig Vandaele of Michels Tunneling, Jason Holden of Akkerman, Jeff Oliver with the City of Golden Valley, Minn., and Red Pederson of Quam Construction. The panel covered topics such as exploring use of trenchless technology for a future project, developing a trenchless technology program for your department and exceeding expectations for future projects by saving time and money using trenchless technology. These panel discussions have proven to be a popular format for trenchless education and discussion.

NASTT strives to be the premier resource for trenchless education and networking for all of our members. For more information on member benefits, visit our website at nastt.org and please feel free to contact us at info@nastt.org.

Dr. Kimberlie Staheli, P.E.
NASTT Chair & International Representative



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Register. Watch. Succeed. Repeat.



Michelle Hill
NASTT Program
Director

We all know that education is crucial for our professional growth and success. The challenge for most is getting that time away from the office or the jobsite to get the education they not only need, but deserve.

We here at NASTT know it's sometimes tough to carve out the time to attend a conference, so back in 2012 we started our webinar program. Not only are these webinars free to attend during the live broadcast, but we archive them on our website so members and non-members can access them 24 hours a day without paying a penny.

We currently have 13 webinars archived online at nastt.org/webinars, and we are planning three more for this fall. The Alternative Project Delivery (Oct. 4) and Water Main

Rehabilitation (Nov. 8) webinars were inspired by our panel discussions at NASTT's 2016 No-Dig Show, and our Small Diameter Tunneling webinar on Dec. 6 was created based on feedback from our membership.

We are very proud of this outreach program, and we can't thank our expert volunteers enough for creating this valuable content for our industry. Our volunteers not only bring success to NASTT, but to your organization as well.

So make sure you register at nastt.org/webinars, watch some or all of our webinars and keep us posted on all of your success!

Michelle Hill
NASTT Program Director



Upcoming Webinars:

Alternative Project Delivery – Oct. 4, 2016

Water Main Rehab – Nov. 8, 2016

Small Diameter Tunneling – Dec. 6, 2016

Archived Webinars:

Trenchless Rehabilitation Part 1 – Cured in Place Pipe (CIPP) Lining, Spray-on Systems, Tight Fit Lining Systems, Lateral Lining

Trenchless Rehabilitation Part 2 – Pipe Bursting, Spot Repairs, Sliplining, Grout in Place Lining Systems, Spiral Liners, Manhole Rehabilitation

Trenchless New Installation Part 1 – Horizontal Directional Drilling (HDD), Microtunneling, Open Shield Pipe Jacking

Trenchless New Installation Part 2 – Auger Boring, Pilot Tube, Pipe Ramming, Guided Boring, Moling/Piercing

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Sliplining

Sewer Laterals

NASTT's Carbon Calculator

Cured-in-Place-Pipe (CIPP)

Condition Assessment for Water Mains

Build Your Trenchless Toolbox

NASTT's Manhole Rehabilitation Webinar

NASTT's Pipe Ramming Webinar

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A Conversation with Ed Saxon

NASTT Board Member and Beaufort Jasper Water & Sewer Authority General Manager



Ed Saxon

When you were younger, what first interested you in construction?

For some reason, I always have been good at math and science and I had several teachers encourage me to pursue the engineering profession. My first job was with DuPont operating nuclear reactors at the Savannah River Site and I was exposed to some pretty neat construction projects. As my career progressed, I had the opportunity to work on various petrochemical plant projects and spent time with Conoco providing support to the drilling industry. I eventually ended up in the water and sewer industry and have overseen about \$500 million of capital investment during my 27 years here at the Beaufort Jasper Water & Sewer Authority (BJWSA).

When were you first introduced to trenchless technology?

It wasn't until I joined BJWSA in 1989 that I was introduced to trenchless technology. I observed the Charleston Water System use horizontal directional drilling (HDD) to install several large diameter water mains under the Charleston Harbor to provide service to a barrier island – really neat stuff. The whole process of welding the steel casing, fusing the HDPE pipe, and operating the HDD rig and handling the drill pipe fascinated me. I was also impressed by the talent and professionalism of the HDD crew.

Tell us about your work as general manager of BJWSA. What kinds of trenchless projects have you taken on in recent years? What percentage of your work is trenchless?

We provide water and sewer services to a population of about 170,000 in a two-county area of the southeast coast of South Carolina. We are a military, resort/tourist and retirement driven community; Hilton Head Island is one of our water customers. In recent years, we have

installed more than 15,000 ft of various size pipe using HDD, including a record setting 6,400-ft HDD using 16-in. fusible PVC pipe. Additionally, we have used pipe bursting and CIPP to rehab several large sewer basins, one of which was located on the famous Marine Corps Recruit Depot (MCRD), Parris Island. Approximately 25 percent of our capital program has a trenchless component.

What are the biggest infrastructure challenges in your region?

Beaufort County is 40 percent water and salt-water marsh and has more islands than any county on the East Coast. We have many magnificent live oaks and the community is very protective of its trees and outstanding water environment. Providing water and wastewater services without damaging the environment is a challenge and we are able to support development in these sensitive areas by utilizing trenchless technologies. Additionally, like all water/wastewater utilities, we have an aging infrastructure that requires significant reinvestment in order to maintain the service levels our customers demand.

What do you see as the big needs in the trenchless industry right now? More education? Growing owner acceptance?

From a public utility perspective, the trenchless industry needs an education initiative focused on the public sector. Acceptance of alternative project delivery methods (Design-Build, CMAR, etc.) by utilities is growing and the uniqueness of trenchless construction fits well in these types of projects. The education initiative could supply the public owners a toolbox of innovative trenchless solutions to provide cost effective rehab of aging infrastructure and the extension of services. The trenchless industry should identify types of projects where risk sharing by owners could reduce cost and schedule, and pro-

vide a template showing how this risk sharing can be incorporated into construction contracts.

How did you first become involved with NASTT? How has serving on the Board of Directors helped expand your knowledge of the industry?

I had attended several NASTT conferences in the past, and at NASTT's 2011 No-Dig Show, participated in a presentation on our record-setting MCRD-Parris Island 6,400-ft HDD using 16-in. fusible PVC pipe with representatives from Mears and Underground Solutions. I have always found the conference technical sessions and exhibit hall very informative and encouraged many of my public sector colleagues to attend. While serving on the Board, I've had the opportunity to "peak behind the curtain" to observe the tremendous effort both the NASTT staff and volunteers give to plan and coordinate these great No-Dig Shows. We have many talented trenchless experts on the Board and I learn something new every time we get together.

What are you looking to accomplish during the remainder of your term on the Board?

I would like to see a bigger public utility presence at the No-Dig Shows and increased public utility membership in NASTT. I promote the value of NASTT membership and trenchless technology every chance I get at the numerous water/wastewater conferences I attend. The NASTT trenchless Good Practice's Guidelines books are a valuable asset that every public utility should have and use. The Municipal and Public Utility Scholarship Program which provides free No-Dig Show registration, and in some cases, includes hotel accommodations, is a tremendous opportunity for public systems to cost effectively learn about trenchless technology and establish valuable contacts in the industry.

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In the Trenches

By Andrew Farr



Despite all the innovation taking place in equipment manufacturing and construction methods, municipal engineers and representatives are, in many ways, the backbone of the trenchless industry and NASTT. After all, they are the ones pushing the benefits of trenchless technology on the municipal side – the area where education and awareness is most essential. For this month's In the Trenches feature, *NTT* is pleased to profile Tara Lamoureux and Adam McKnight, two trenchless professionals and NASTT members who have been involved in leading the trenchless discussion – and projects – for their respective utilities.



Tara Lamoureux

Water Resources Engineer, City of Casselberry, Florida


Innovative and successful construction projects, no matter how difficult, costly or labor-intensive, are generally remarkable feats of planning, design, building and coordination of all parties involved.

As an engineer, Tara Lamoureux says getting to the finished product and being able to watch her projects brought to life through the construction process is what inspired her career, and still does.

After receiving her Bachelor of Science in environmental engineering from the University of Central Florida, Lamou-

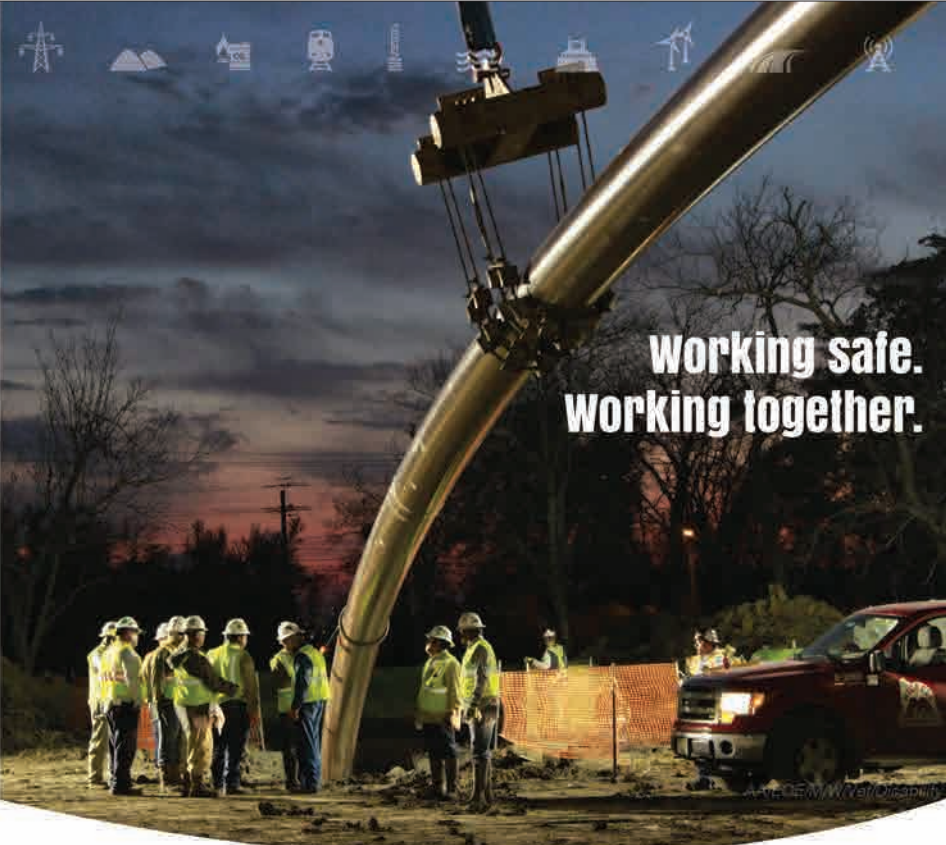
reux was interning with the City of Sanford, Fla. While working there, she conducted her thesis research for her Masters on a pilot study that consisted of ozone and granular activated carbon treatment for sulfide and disinfectant by-product control.

“I was then hired on full time by the city and got to watch




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my pilot study be built into a full scale plant,” she says. “Still one of my favorite parts about working for a utility is being able to watch my ideas become a reality during construction.”

During her time with the City of Sanford, Lamoureux was introduced to pipe bursting – primarily asbestos cement pipe. More recently, while working for the City of Casselberry she says she has gained most of the knowledge she has about trenchless technology.

“Both of my supervisors at Sanford and at Casselberry taught me about the benefits of pipe bursting,” she says. “Since both cities consist mostly of residential areas this method has allowed for limited restoration and disturbance to neighborhoods and the people who reside within them.”

As water resources engineer for the City of Casselberry,

Lamoureux manages the utility’s water production, water reclamation, lift stations and the distribution, collection and reclaimed systems.

“I would say that 75 percent of our rehabilitation work uses trenchless technologies,” she says. “I have gotten the opportunity to work with pipe bursting, directional drilling, CIPP and manhole lining. “All of these trenchless methods have allowed the city to save money while only minimally impacting our community and residents.”

But Lamoureux says rehabilitation work in Casselberry, despite the benefits trenchless methods offer, is not without its challenges.

“In my opinion the biggest infrastructure challenge in my region is the large amount of aging infrastructure and obtaining enough funding to replace it at a sustainable rate,”

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she says. “For a lot of utilities, infrastructure was installed in large phases as their areas grew overtime. Now, the infrastructure is reaching its life expectancy at the same time. The areas in which this infrastructure was originally placed are also now built out making replacement more difficult, time consuming and expensive.”

Lamoureux says she believes the acceptable of trenchless methods is growing on the municipal side, and that the lack of exposure to projects or information has been one hindrance to that growth over the years. Lamoureux says that seems to be changing.

“I believe that trenchless technology is becoming a more popular option for owners,” she says. “I do think that some owners, particularly public ones, do not always get the opportunities to travel to different conferences in order to see

and learn about the different methods being used. As a utility employee myself, it is easier for me to get on board with a new technology if other utilities are using it. The more education that is available to utility personnel, such as through webinars, the more trenchless technology will be used.”

Lamoureux attended her first NASTT’s No-Dig Show in 2016 as part of NASTT’s municipal scholarship program and says she plans to attend again in 2017.

“I think NASTT gives the opportunity for owners, contractors and manufacturers to all get together and share ways of effectively replacing the infrastructure throughout the United States. Before I got involved with NASTT, I was not aware of all of the different trenchless options that were available for evaluating the condition and rehabilitating distribution and collection systems.”

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Adam McKnight

Professional Engineer, Upper Trinity Regional Water District -- Lewisville, Texas

There are many trenchless professionals who have their family ties to the construction business in some way, and Adam McKnight, professional engineer with the Upper Trinity Regional Water District (UTRWD) in Lewisville, Texas, is no exception.

“My father was an iron worker,” he says. “Construction of buildings, bridges and dams always fascinated me.”

McKnight’s introduction to the trenchless industry came about 10 years ago when he led a project to rehabilitate a pipeline going underneath the utility’s main aqueduct. There was no open cut solution and McKnight led a PVC lining project to rehabilitate the line.

“That was my first trenchless project, and then after that, I was pretty much the trenchless guy who did all the boring, sliplining and other trenchless projects going forward,” he says. “Once we had somebody who had completed a project and had enough knowledge to be able to manage these trenchless projects that were a bit out of the norm, that’s when we started doing more of it.”

McKnight says a large percentage of UTRWD’s work is to accommodate the growing population of the region, primarily through expanding and enlarging capacity of the water system. Recently, UTRWD has been working with Txdot to redesign and relocate a pipeline along Interstate 35, a project that incorporates multiple large diameter tunneling, boring and drilling methods used to install casing across the interstate.

“It seems like every year trenchless projects are becoming more and more common,” McKnight says. “Boring, drilling or tunneling seems to be included in every project. The

biggest challenge for us is building and maintaining the infrastructure needed to support a booming population. North Texas is one of the fast growing areas in the United States. Trenchless solutions are going to continue to be a great tool to support our growing community.”

McKnight says the growth of the trenchless industry has been substantial in the time he’s been involved in leading those type of projects for the UTRWD, shifting from a specialty niche method that was once done only when it was needed to something that’s now general practice, especially in urban areas.

“I think education is the key,” he says. “This industry is constantly changing and introducing new products and techniques. Owners need to be continually educated to keep pace with innovation and to understand the specifications that are available to ensure a quality project, and also helping contractors understand what owners’ requirements are.

“It’s also a bit of marketing and getting all the products together so that people can compare them and know what the right solutions are. It’s hard to know what distinguishes one from the other. NASTT is really where all that comes out, and I think that is the most important function they provide.”

Andrew Farr is the associate editor of
NASTT’s Trenchless Today.

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NASTT's 2016 Membership Directory

The North American Society for Trenchless Technology has one goal – to be the essential resource for education and information for professionals working in the underground construction field. At NASTT, working toward this vision is our passion.

Veterans of the trenchless industry will tell you that if there's one thing that will continue to grow the industry, it's more education. Facilitating this education requires effective outreach and communication amongst various industry segments to make sure NASTT members have access to valuable industry tools. With this annual directory, we want to provide a resource for you to connect with engineers, contractors, manufacturers, professional service providers and municipal representatives who are NASTT members. Make sure to keep it close by, as it will prove to be a great resource when planning your next trenchless project. For more, also visit nastt.org to access real-time directory information day or night.

This directory is current as of Aug. 5, 2016, so if your information has changed, please contact NASTT's Membership Coordinator Molly Margosian at mmargosian@nastt.org. You can also log on to nastt.org/directory to update your information.

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636-530-8000
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770-632-7530
integrityfusion.com



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Allen Shewey, Ed Barnhurst, Greg
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Julie Keith-Slusarski, Larry Kiest, Rick
Gage, Greg Norgaard, Amana Arayan,
Mike Czipar
1779 Chessie Ln.
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815-433-1275
lmktechnologies.com

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613-836-2184
mcintoshperry.com


McLaughlin

Dave Gasmovic, Cody Mecham, Philip Heath, Jeff Wage
2006 Perimeter Rd.
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McMillen Jacobs Associates

Glenn Boyce, Mark Havekost, Joe Schrank, Rick Smith, Asif Dunga, Luke Erickson
1350 Treat Blvd., Suite 100
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925-705-4114
mcmjac.com

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Neil Smith, Ronald Gilchrist, Mark Kwilinski, Jim Nelson, Jim Williams, Ron Halderman, Gregory Bosch
5051 Westheimer Rd., Suite 1650
Houston TX 77056 USA
281-448-2488
mears.net

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Eric Melsheimer, Peter Melsheimer, Dick Melsheimer
2712 Airpark Dr.
Santa Maria CA 93455-0118 USA
805-739-0118
melfredborzall.com


Michael Byrne Manufacturing

Jim Weist, Dave Miller
1855 Earth Boring Rd.
PO Box 444
Mansfield OH 44901 USA
419-525-1214
byrnegroup.com


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Michelle Trapp, Patrick O'Donoghue, Craig Vandaelle, Robert Westphal, Tim McGuire, Phillip Michels, Joe Hockberger, Pat Herzog, Greg Goral
817 W. Main St.
PO Box 128
Brownsville WI 53006 USA
920-583-1448
michels.us


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Daniel Liotti, Steve Abernathy, David Howell, Brian Liotti, Gary Gagliardi, Brian Brown, Alex Sharpe, Brent Hofer, Jason Miller, Liviu Ciocan
6814 W. 350 N.
Greenfield IN 46140 USA
317-545-1335
midwestmole.com


Miller Pipeline Corp.

Chris Schuler, Ralph Miller, Kevin Miller, Butch Lanaville, Jeff Newman
8850 Crawfordville Rd.
PO Box 34141
Indianapolis IN 46234-1559 USA
317-293-0278
millerpipeline.com

Milliken Infrastructure Solutions

John Hepfinger, Scott Naiva, Joe Royer, Kevin Weir, Dave Keaffaber, Jaclyn Deter
1300 Brownwood Ave.
LaGrange GA 30240 USA
706-880-5054
infrastructure.milliken.com

Mi-Tech Services Inc.

David Buckner, Lucas Specketer, Stephanie Finamore, Jon Gruber
5707 Schofield Ave.
Weston WI 54476 USA
715-575-9104
mi-tech.us

Mladen Buntich Construction

Lee Roesner, Mladen Buntich, Corey Gurley, Taka Sakai
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Upland CA 91786 USA
909-920-9977
buntich.com

Mott MacDonald

Colin Lawrence, Glenn Duyvestyn, Michael Vitale, Rory Ball, Craig Camp, Sarah Crouse, Lee Abramson, Rodney Fredericks
1400 Broadway, 30th Floor
New York NY 10018 USA
212-532-4111
mottmac.com

Mud Technology International Inc.

John Miller
2610 State Hwy 31 W
Athens TX 75751 USA
903-675-3240
mud-tech.com


National Liner

Scott Roth
375 Williamstowne, Suite 102
Delafield WI 53018 USA
800-547-1235
nationalliner.com

Neptune Coring

Ben Campbell, Mitchell Campbell, Lars-Erik Larsen
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Edmonton AB T5S 2T8 Canada
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Wylie TX 75098 USA
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Nomad Pipeline Services

Jim Lagios
1351 Broadway St.
Rockville MN 56369 USA
320-249-8410
nomadpls.com

North American Pipe Corp.

Robert Eads, Mark Dasilva, Steven Gross
2801 Post Oak Blvd.
Suite 600
Houston TX 77056 USA
484-253-4523
northamericanpipe.com

Northeast Remsco Construction Inc.

Richard Palmer, Rolando Acosta, Alberto Solana, Giovanni Scotto, Peter Sudkamp, Robert Ross, George Gutierrez
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Farmingdale NJ 07727 USA
732-557-6100
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Northwest Pipe Co.

Henry Goff, Shane Zeeman, Trevor Gonterman, Eric Stokes, Brent Keil, Rich Mielke
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NPL Construction Co.

Dennis Redmond, Steve Dockendorf, Mark Wambach, Dylan Hradek, Todd Wallin, Brandon Miller
2355 W Utopia Rd.
Phoenix AZ 85027 USA
623-582-1235
gonpl.com

Olin Blue Cube Operations LLC

Brad Ehle
1586 North William Wells Cir.
Bluffton IN 46714 USA
440-715-3065
olin.com

Oxford Plastics

David Sardinha
101 Dexter Rd.
East Providence RI 02914 USA
401-497-0821
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PEER Consultants PC

Lilia Abron, Kofi Arthur
888 17th St. NW.
Suite 850
Washington DC 20006 USA
202-478-2060
peerpc.com

Penguin Automated Systems Inc.

Greg Baiden
1755 Regional Road 55
Naughton ON POM 2M0 Canada
705-692-8748
penguinasi.com


Perma-Liner Industries

Morgan Trouard, Travis Bohm, Rob Larsen, Dave Groth, John Yergey, Jerry D'Hullster
13000 Automobile Blvd., Suite 300
Clearwater FL 33762 USA
727-235-2496
perma-liner.com


PICA Corp.

Dave Russell, Chris Garrett, Ed Brain, Ad Shatat
4909 75 Ave.
Edmonton AB T6B 2S3 Canada
780-468-6800
picacorp.com

Picote Solutions Inc.

Katja Lindy-Wilkinson
20810 SE. 18th Pl
Sammamish WA 98075 USA
425-505-0646
picotesolutions.com

PipeFlo Contracting Corp.

Julia Noble
111 Frid St.
Hamilton ON L8P 4M3 Canada
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David Wickersham, Mario Carbone, Christopher Hein, Tony Hranicka, Shaun Albert, Tom Nestoras
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James Rentz
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PO Box 48
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919-481-1977
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Blair Seeley, Malcolm Catto, Doug Woo, Paul Gioacchini, Phil Sheridan
30 Centurian Dr., Suite 100
Markham ON L3R 8B8 Canada
905-475-1900
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4125 Welcome All Rd., Suite 100
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801-403-8080
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Kimberlie Staheli, Matthew Olson, Brad Moore, Joel Staheli, Dylan Davidson, Melissa Staheli, Rick Hyatt
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717-255-4357
ugi.com

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Gregory Penza, Robert Kodadek, Nathan King
55 Corbin Ave.
Bay Shore NY 11733 USA
631-667-9200
ulcrobotics.com

Underground Infrastructure Technologies

Jeff Rumer, Donna Hale
1208 Quail St.
Lakewood CO 80215 USA
303-665-2704
theuitco.com

**Underground Solutions Inc.**

Richard (Bo) Botteicher, Tom Marti, Bob Walker, Frank Firsching, Marty Scanlan, Sarah Johnson, Ray Dudley, Rachel Maupin
13135 Danielson St., Suite 201
Poway CA 92064 USA
858-218-3777
undergroundolutions.com

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Shane Cooper
1900 Brookside Blvd.
Box 2 Group 200 RR2
Winnipeg MB R3C 2E6 Canada
204-633-4879
uni-jetindustrialpipe.ca

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Jacob Scissons, Keith Fransson, Jeremy Nutma, Wade Turner, Jan Korinek, Scott Shepherd, Jared Halter, Peter Mandzuik, Mohammed Elenany
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Authority
Nancy Musinski, John Gabaldon, Anthony Montoya
PO Box 568
Albuquerque NM 87103 USA
505-289-3404
abcwua.org

Alderwood Water & Wastewater District

David MacDonald, Brigitte McCarty, Chris Schumacher, Paul Richart
3626 156th St. SW.
Lynnwood WA 98087 USA
425-743-4605
alderwoodwater.com

Allegheny County Department of Public Works

Mark Yoder, James Taylor
701 Kelly Rd., Suite 300
Cumberland MD 21502 USA
301-777-5942
gov.allconet.org

Anchorage Water & Wastewater Utility

Stephen Nuss, Jennifer Satterfield, Mark Queen, James Armstrong
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Anchorage AK 99503 USA
907-564-2763
awwu.biz

Ann Arbor Township

Rick Judkins
3792 Pontiac Trail
Ann Arbor MI 48105 USA
734-663-3418
aatwp.org

Beaufort Jasper Water & Sewer Authority

Ed Saxon, Jim Baker, Brian Chemsak, Joe Devito
6 Snake Rd.
Okatie SC 29907 USA
843-987-9249
bjwsa.org

Boston Water & Sewer Commission

Irene McSweeney, John Sullivan, Peter Salvatore, Patrick Brown
980 Harrison Ave.
Roxbury MA 2119 USA
617-989-7447
bwsc.org

Carmel Area Wastewater District

Drew Lander, Daryl Lauer
PO Box 221428
Carmel CA 93922 USA
831-624-1248
cawd.org

Castro Valley Sanitary District

Landon Lochrie
21040 Marshall St.
Castro Valley CA 94546 USA
510-537-0757
cvsan.org

Central Contra Costa Sanitary District

Alexandr Mestetsky, Nancy Molina, Mark Wenslawski, Will Grant
5019 Imhoff Place
Martinez CA 94553 USA
925-228-9500
centralsan.org

Charlotte Water

Keith Shirley, Ethan Brown, Chris Allen, Mike Wirth
5730 General Commerce Dr.
Charlotte NC 28213 USA
704-432-2954
charneck.org

City and County of Denver

Charles Hart, Lisa Ferreira, Rand Peterson, David Shaw
2000 West Third Ave., 3rd Floor
Denver CO 80223 USA
303-446-3642
denvergov.org

City of Abbotsford

Greg Densmore, Rhys Francis, Tyagu Mathialagan, Tony Seibert
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City of Aurora Water Department

Ray Serrano, Swirvine Nyirenda, Joseph Kleiner, Adam Sharman, Steven Fiori
15151 E. Alameda Pkwy., Suite 4400
Aurora CO 80012 USA
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auroragov.org

City of Bend

Jason Suhr, Reese Moody, Chris Mosher, Kelly Ristoff, Brice Blackwelder
710 NW Wall St.
Bend OR 97701 USA
541-317-3053
bend.or.us

City of Bismarck

Daren Malard, Kevin Schmidt
221 N 5th St.
Bismarck ND 58506 USA
701-355-1505
bismarcknd.gov

City of Burnaby

Bill Lowrie, Ron Weismiller, Tony Kovacevic, Tony Chapman
5780 Laurel St.
Burnaby BC V5G 1N3 Canada
604-294-7073
burnaby.ca

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403-268-1233
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City of Carlsbad

Terry Smith, Lindsey Stephenson, Mark Biskup, Shadi Sami
5950 El Camino Real
Carlsbad CA 92008 USA
760-603-7354
carlsbadca.gov

City of Casper

David Hill
200 N David St.
Casper WY 82601 USA
307-235-8213
casperwy.gov

City of Casselberry

Mark Gisclar, Tara Lamoureux, Matt Baker, James Demasi
95 Triple Lake Dr.
Casselberry FL 32707 USA
407-262-7725
casselberry.org

City of Columbus

Harold Richard, Michael McCloud
910 Dublin Rd., 3rd Floor
Columbus OH 43215 USA
614-645-7490
columbus.gov

City of Edmonton

Albert Kwan, Gary Fei, Siri Fernando, Jagdish Tailor, Arbind Mainali, Eduardo Jaramillo, Bernie Canlas, Eric Magtoto, Emila Rojas, Diana Lu, Xu Xu, Michael Wong, Mahendra Weeratunga, Antonio Stavale, Thang Ho, Sara Kang, Nikita Arora, Aniano Fornales, Fayi Zhou
Coronation Yard
14323-115 Ave.
Edmonton AB T5M 3B8 Canada
780-496-6852
edmonton.ca

City of Edmonton

John Cairns, Todd Yuzda, Frank Policicchio, Clement Yong, Darwin Smith, Michael Kan, Minnan Liu, Frank Fechner, Ray Davies, Binod Rajbhandari, Jonathon Medurecan, Raf Tenderenda, Xiaojian Mao, Arjun Aryal, Shiva Shankar, Anthony Nardi
14323 115th Ave.
Edmonton AB T5M 3B8 Canada
780-496-7902
edmonton.ca

City of Eugene

Patrick Cox, David Starns, Robert Hallett, Matthew Rodrigues
99 E. Broadway, Suite 400
Eugene OR 97401 USA
541-682-5291
eugene-or.gov

City of Everett

Souheil Nasr, Brian Doolan, Grant Moen, Jennifer Bailey
3200 Cedar St.
Everett WA 98201 USA
425-257-8800
everettwa.gov

City of Fort Collins Utilities

Owen Randall, Matt Fater, Linsey Chalfant, Andrew Gingerich
700 Wood St.
PO Box 580
Fort Collins CO 80522 USA
970-221-6809
fcgov.com

City of Fort Saskatchewan

Grant Schaffer, Mark Procyk, Joey Farebrother, Phil Ma
10005 102 St.
Fort Saskatchewan AB T8L 2C5 Canada
780-992-6237
fortsask.ca

City of Gresham

Jeremy Provenzola, Andrew Thorne, Jeff Lofin, James Montgomery
1333 NW Eastman Pkwy.
Gresham OR 97030 USA
503-618-2629
greshamoregon.gov

City of Hamilton

Erika Waite, Michael Zantingh, Gary Moore, Harry Krinas
77 James St. N., Suite 320
Hamilton ON L8R 2K3 Canada
905-546-2424
hamilton.ca

City of Kitchener

Greg McTaggart
200 King St. W.
PO Box 1118
Kitchener ON N2G 4G7 Canada
519-741-2200
kitchener.ca

City of Leduc

Ryan Graham, Shawn Tooth, Kyle Van Steenoven, Shawn Olson
1 Alexandra Park
Leduc AB T9E 4C4 Canada
780-980-7164
leduc.ca

City of Lethbridge

Douglas Kaupp, Darcy Fritz, Adam Campbell, Leanne Lammertsen, Randy Bobinec, Neal Povey
910 Fourth Ave. S.
Lethbridge AB T1J 0P6 Canada
403-320-3078
lethbridge.ca

City of London

John Braam, Dave Chromczak, George Negas, Ashley Rammeloo
663 Bathurst
London ON N5Z 1P8 Canada
519-661-2500
london.ca

City of Los Angeles

Edward Arrington, Brad Jenson, Hortensia Alonso
1149 S. Broadway, Suite 630
Wastewater Conveyance Engineering
Los Angeles CA 90015 USA
213-485-1694
lacity.org

City of Loveland

Roger Berg, Tanner Randall, Craig Weinland
200 North Wilson Ave.
Loveland CO 80537 USA
970-962-3000
ci.loveland.co.us

City of Lynchburg

Timothy Mitchell, Keith Carpenter
525 Taylor St.
Lynchburg VA 24501 USA
434-485-8317
lynchburgva.gov

City of Markham

Ernie Ting, Alex Chiu
101 Town Centre Blvd.
Markham ON L3R 9W3 Canada
905-477-7000
markham.ca

City of Medicine Hat

Jamie McLeod, Evan Laturnas, Brian Graham, Allen Pribyl, Glenn Kessler, James King, Kelly Lawson, Dayna Livingston
2190 Brier Park Place NW.
Medicine Hat AB T1C 1S6 Canada
403-502-8596
medicinehat.ca

City of New York Department of Design + Construction

Yun (Dino) Ng, Mohsen Zargarelahi, Gurdip Saini, Eric MacFarlane
30-30 Thomson Ave.
Long Island City NY 11101 USA
718-391-2043
ddc.nyc.gov

City of Niagara Falls

Geoff Holman
4310 Queen St.
PO Box 1023
Niagara Falls ON L2E 6X5 Canada
905-356-7521
niagarafalls.ca

City of Ottawa

John Mitchell, Peter McKay, Andrea Feilders, Adrian Munteanu
65 Vesta St.
Ottawa ON K2J 3Z1 Canada
613-324-7777
ottawa.ca

City of Port Coquitlam

Gary Goff, Roy Savage, Clarissa Brennan, Carden Ma
1737 Broadway St.
Port Coquitlam BC V3C 2M9 Canada
604-880-3771
portcoquitlam.ca

City of Regina

Eden Jukes, Jay Overend, Doug Booth, Kregg Froh
1430 McIntyre St.
Regina SK S4P 3C8 Canada
306-527-3670
regina.ca

City of Reno

Dustin Waters, Mike Stram, Jonathan Simpson, David Kershaw
1 East 1st St., Suite 800
Reno NV 89501 USA
775-321-8352
reno.gov

**City of Richmond**

Roger Keating, Eric Sparolin, Elena Paller,
Milton Chan, Jamie Villaluz
6911 No. 3 Rd.
Richmond BC V6Y 2C1 Canada
604-276-4014
richmond.ca

City of Santa Barbara

Lisa Arroyo
PO Box 1990
Santa Barbara CA 93102 USA
805-564-5412
santabarbaraca.gov

**City of Sarasota Utilities
Department**

Steve Topovski, Mitt Tidwell, Michael
Crumpton, Richard Meier, Alejandro
Hernandez, Wesley Woodard
1750 12th St.
Sarasota FL 34236 USA
941-329-6184
sarasota.us

City of Saskatoon

Dan Willems, Stephen Wood, Tom Dehod,
W.C. Sexsmith
222-3rd Ave. N.
Saskatoon SK S7K 0J5 Canada
306-975-2466
saskatoon.ca

City of St. Albert

Kate Polkovsky
5 St. Anne St.
St. Albert AB T8N 3Z9 Canada
780-459-1689
stalbert.ca

City of Surrey

Parwinder Athwal, Bill Hargie
6645 148 St.
Surrey BC V3S 3C8 Canada
604-592-7015
surrey.ca

City of Vancouver

Eric Schadler, Sheryl Hale, Frank Dick,
Jessie Uribe
PO Box 1995
Vancouver WA 98668-1995 USA
360-487-7777
cityofvancouver.us

City of Vaughan

Paul Jankowski, John Paterson, Jennifer
Rose, Jack Graziosi, Vince Musacchio,
Paolo Masaro
2141 Major Mackenzie Dr.
Vaughan ON L6A 1T1 Canada
905-832-8585
vaughan.ca

City of Vernon

John Box, Mark Dowhaniuk, Chris
Thompson, Barry Baker
3400 - 30 St.
Vernon BC V1T 5E6 Canada
250-550-3549
vernon.ca

City of Vista

Tony White, Alfred Pedroza, Elmer Alex
200 Civic Center Dr.
Vista CA 92084 USA
760-643-5413
cityofvista.com

City of Windsor

Ian Day, Fahd Mikhael, Jane He, Chris
Manzon
2545 Pillette Rd.
Windsor ON N8T 1P9 Canada
519-818-8461
windsor.ca

Clean Water Services

Andrew Braun, Gabe Sohler, Joe Amerson,
Brad Crement
2550 SW Hillsboro Highway
Hillsboro OR 97123 USA
503-681-3615
cleanwaterservices.org

Colorado Springs Utilities

Holly Link, Dan Derksen, Susan Funchion,
Justin Fecteau
1521 Hancock Expressway
Mailcode 1821
Colorado Springs CO 80947 USA
719-668-4733
csu.org

Con Edison

Richard Trieste, Phil Fowles
4 Irving Place, Rm 2215-S
New York NY 10003 USA
347-203-3817
coned.com

**First Utility District of Knox
County**

Patrick Spangler
122 Durwood Rd.
Knoxville Tennessee 37931 USA
865-966-9741
fudknox.org

Halifax Water

Sushel Arora, Jamie Hannam, Cedric
Williams, Sheldon Parsons, Ken
Macdonald, Danny Patey, Thoren Pelley,
Shawn Rowe, Dino Amaral, Chris Weeks
PO Box 8388
RPO CSC
Halifax NS B3K 5M1 Canada
902-490-6254
halifaxwater.ca

**Hamilton Township Municipal
Authority**

Sharon Purnell, Joshua Eyer
1270 Crottlestown Rd.
Chambersburg PA 17202 USA
717-264-8959

**Joint Meeting of Essex & Union
Counties**

James Paluch, Robert Surman, Marcelo
Kofman
500 S First St.
Elizabeth NJ 7202 USA
908-353-1313
jmeuc.com

Long Beach Water Department

Robert Verceles, Edward Mendoza, Richard
Robillard, Jinny Huang
1800 E Wardlow Rd.
Engineering Bureau
Long Beach CA 90807 USA
562-570-2329
lbwater.org

**Los Angeles County Department
of Public Works**

Robert Swartz, Martin Moreno, Fernando
Villaluna, Eric Liu
900 S. Fremont Ave.
Alhambra CA 91803 USA
626-300-3379
dpw.lacounty.gov

Louisiana Tech University

Tom Iseley, Jadranka Simicevic, Shaurav
Alam, Sandeep Perla
PO Box 10348
Ruston LA 71272 USA
318-257-4072
latech.edu

**Metropolitan Water Reclamation
District (MWRD)**

Kevin Fitzpatrick, Joanna Jacobs, Frederick
Wu, Carmen Sealise
111 E. Erie
Chicago IL 60611 USA
312-751-3163
mwrld.org

Mohawk Valley Water Authority

Richard Goodney, Christopher Carmody,
Joseph Gazzal, James Bednarczyk
1 Kennedy Plaza, 3rd Floor
Utica NY 13502 USA
315-792-0320
mwva.us

Mount Pleasant Waterworks

David Niesse, Wayne Lee, Gary Poretto,
Micah Miley
1619 Rifle Range Rd.
Mount Pleasant SC 29464 USA
843-884-9626
mountpleasantwaterworks.com

Niagara Region

Kyle Moate, Glenn Fulton, Greg Epp,
Michelle Moore, Joseph Tonellato
3501 Schmon Pkwy.
PO Box 1042
Thorold ON L2V 4T7 Canada
905-685-4225
niagararegion.ca

Northshore Utility District

Stephen Dennehy
6830 NE. 185th St.
PO Box 82489
Kenmore WA 98028 USA
425-398-4405
nud.net

**Orange County Sanitation
District (OCS D)**

Raul Cuellar, Yvonne Dake, Martin Dix,
Steve Speakman
10844 Ellis Ave.
Fountain Valley CA 92708 USA
714-593-7828
ocsd.com

**Pinellas County Department of
Environment & Infrastructure**

Dennis Simpson, Dinesh Kamath, Jeremy
Waugh
14 South Fort Harrison Ave., 6th Floor
Clearwater FL 33756 USA
727-464-4223
pinellascounty.org

Region of Halton

John Duong, Nick Rewa, Mark Bajor,
Brenda Kingsmill, Rick Ranalli, Chris
Ewen, Martin Larkin, Kiyoshi Oka, Chris
Gainham, Natalie Ribic, Jason McCauley
1151 Bronte Rd.
Oakville ON L6M 3L1 Canada
866-442-5866
halton.ca

Region of Peel

Darrin Dodds, Anthony Parente, Bill
Turner, Maad Abid Al Hadi, Mark
Crawford, Dan Labrecque, Mark Schiller
10 Peel Centre Dr., Suite B, Floor 4
Brampton ON L6T 4B9 Canada
905-791-7800
peelregion.ca

Ross Valley Sanitary District

Katherine Hayden, Stephen Miksis,
Manuel Vigil
2960 Kerner Blvd.
San Rafael CA 94901 USA
415-259-2949
rvsd.org

Salt Lake City Public Utilities

Michael Velarde, Jason Brown, Ryan
Broadhead, Alex Christensen
1530 W. North Temple
Salt Lake City UT 84115 USA
801-483-6810
slcgov.com

Sanitation District No. 1

Christopher Novak, Rich McGillis, Kyle
Boyle, Robert Wilson
1045 Eaton Dr.
Ft. Wright KY 41017 USA
859-578-6885
sd1.org

**Santa Cruz County Sanitation
District**

Kent Edler, Beatriz Barranco, Rene
Hernandez, Marcella Bailey
701 Ocean St., Room 410
Santa Cruz CA 95060 USA
831-454-2160
dpw.co.santa-cruz.ca.us

**Southwest Suburban Sewer
District**

Bill Tracy, Ronald Hall
431 SW Ambaum Blvd.
Burien WA 98166 USA
206-244-9575
swssd.com

Spartanburg Water

Ronald Champion, Angie Price, Brian
Smith, Wesley Arrowood
301 South Ave.
Spartanburg SC 29306 USA
864-598-7204
spartanburgwater.org

Town of Cary

Lynn Brilz, Robert Hirt, Dave Hallgren,
Jonathan Lane
PO Box 8005
Cary NC 27511 USA
919-460-1047
townofcary.org

Town of Flower Mound

Clayton Riggs, Tiffany Bruce, Brian
Waltenburg
2121 Cross Timbers Rd.
Flower Mound TX 75028 USA
972-874-6302
flower-mound.com

Town of Grand Falls-Windsor

Jeffrey Saunders, Nelson Chatman, Roger
Waugh, Derrick Hounsell
5 High St.
PO Box 439
Grand Falls-Windsor NL A2A 2J8 Canada
708-489-0427
grandfallswindsor.com

Town of Olds

Scott Chant
4512 46th St.
Olds AB T4H 1R5 Canada
403-556-6981
olds.ca

Town of Richmond Hill

Edison Evangelista
1200 Elgin Mills Rd. E.
Richmond Hill ON L4S 1M4 Canada
905-780-2962
town.richmond-hill.on.ca

Union Sanitary District

Sami Ghossain, Rollie Arbolante, Raymond
Chau, Chris Elliott
5072 Benson Rd.
Union City CA 94587 USA
510-477-7601
unionsanitary.com

**Waterford Township Department
of Public Works**

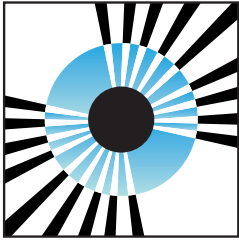
William Fritz, Scott McGrady, Russ
Williams
5240 Civic Center Dr.
Waterford MI 48329 USA
248-618-7456
waterfordmi.gov

West Valley Sanitation District

Edward Oyama, Alan Kam, Jorge Picado,
Jason Cumbo
100 E Sunnyoaks Ave.
Campbell CA 95008 USA
408-385-3011
westvalleysan.org

York County

Michael Elam, Brian Woodward, Mark
Swilley, Kevin Campbell
PO Box 532
Environmental & Development Services
Yorktown VA 23690 USA
757-890-3763
yorkcounty.gov



NASTT'S EYE ON THE INDUSTRY

OUR MEMBERS IN ACTION

ASTM Committee Votes to Renew ASTM F2561



In April, the ASTM International committee F17, Plastic Piping Systems and subcommittee F17.67, Trenchless Plastic Pipeline Technology, voted to renew the ASTM F2561 standard of practice an additional five years. ASTM F2561 was first published in 2006, first renewed in 2011 and now again in 2016. ASTM F2561-16 is the standard practice for rehabilitation of a sewer service lateral and its connection to the main using a one piece main and lateral cured-in-place liner.

The practice covers the requirements and test methods for the reconstruction without excavation. The lateral pipe is accessed remotely from the main pipe and from a lateral cleanout, if available. A resin impregnated one-piece main and lateral CIPP lining is installed by the use of air and inversion. The CIPP liner is pressed against the host pipe by pressurizing a bladder and is held in place until the thermoset resin has cured. The result is a verifiable non-leaking structural continuous, one piece, tight fitting, corrosion resistant connection lining and seal that extends over an 18-in. section of the mainline and into the lateral for a predetermined length.

GSSI Releases New GPR System

GSSI, the world's leading manufacturer of ground penetrating radar (GPR) equipment has announced the release of the UtilityScan Pro, the latest addition to the company's popular UtilityScan GPR product line.



UtilityScan systems are the industry standard for efficiently identifying and marking the location and depth of subsurface utilities, including gas, sewer, and communication lines. Featuring the SIR 4000 control unit, the UtilityScan Pro delivers the configurability and flexibility to address a wide range of utility applications.

This advanced GPR system is ideal for locating gas, communications, sewer lines and other metallic and nonmetallic targets, including underground storage tanks and PVC pipes. The UtilityScan Pro also allows for real-time data collection, with a back-up cursor and cross-hair cursor that allow the user to accurately locate targets. Additionally, the new GPR system allows users to utilize multiple different techniques to calculate the depth of targets, for added flexibility. It effortlessly integrates with GPS and has the ability to store and replay data easily.

Ditch Witch Launches Power Pipe HD Guarantee

Ditch Witch, a Charles Machine Works Co., recently announced the launch of its industry-first replacement program for Ditch Witch Power Pipe HD.

Featuring improved bend radius with the strongest, most wear-resistant tool joints in the industry, Power Pipe HD is a superior pipe designed specifically for Ditch Witch drills. The Power Pipe HD Guarantee offers replacements for pipe that are broken during use. In addition to replacing drill pipe and as part of the program, Ditch Witch dealerships will work with the operators to provide additional guidance to support proper drilling techniques on horizontal directional drilling (HDD) job sites.



The free, one-for-one, Power Pipe HD Guarantee helps ensure operators are armed with reliable products and the knowledge, service and support they need to get the job done right.

"We pride ourselves in giving customers the best products and support to conquer any HDD job," said Jeff Davis, Ditch Witch product manager, HDD tooling. "With our guarantee, customers can feel confident they are buying the best pipe while also knowing their operators are receiving the superior customer support needed to avoid improper usage of drill pipe in the future."

The guarantee covers Ditch Witch Power Pipe HD Fluid Miser II and Power Pipe HD Unlined products one year from the date of purchase, including pipe purchased with a drill or as an after-market addition. To learn more, visit ditchwitch.com/drillpipe or contact your local Ditch Witch dealer.

Hydra-Flex Named Finalist in Manufacturing Awards



In July, Hydra-Flex, Inc., manufacturer of innovative fluid handling equipment, was named a finalist for Best In Class (Small Company, 1-50 employees) in the 2016 Minnesota Manufacturing Awards. Each year, *Minnesota Business* magazine acknowledges exceptional manufacturing companies based upon their new capabilities, products, processes, and services.

Hydra-Flex was nominated for revolutionizing the vehicle wash industry by “finding a better way” to manufacture innovative and reliable fluid handling products. The company’s 45 percent average annual growth over the past seven years can be attributed to the measurable results they provide their customers—specifically an average savings of 27 percent in chemical and water costs.

“I am earnestly grateful for the recognition that Hydra-Flex is receiving from *Minnesota Business*,” says Jaime Harris, president and co-founder of Hydra-Flex, Inc. “The manufacturing industry in Minnesota continues to drive our state to the forefront of innovation, and I am humbled to have Hydra-Flex listed as a finalist amongst other industry leaders.”

Hydra-Flex and other MN Manufacturing Awards finalists will be celebrated at an awards event in Minneapolis on September 29, 2016 and will be honored in the feature story of an all-manufacturing issue of *Minnesota Business* magazine.

Olson Named CEO of The Toro Company



The Toro Co. announced in July that its board of directors has elected Richard M. Olson to the position of president and CEO, effective Nov. 1. Olson, a 30-year veteran of the company, has served as Toro’s president and COO since September 2015 and was elected to the company’s board of directors in January 2016.

Toro’s current chairman and CEO, Michael J. Hoffman, will continue to serve as chairman of the board.

Olson joined Toro in 1986 as a manufacturing process engineer. He has held various positions in operations and engineering including manager of advanced manufacturing, commercial engineering program manager, director of Shakopee plant operations and managing director of northern manufacturing operations. In 2010, he was named general manager of Exmark and was appointed vice president, Exmark in 2012. The following year Olson was named vice president, international business before being elected group vice president, international business, micro-irrigation business and distributor development in June 2014.

“I am honored to have the opportunity to continue the storied legacy of our great company that Mike and leaders before him like Ken Melrose and David Lilly helped build through the decades, making Toro all that it is today,” said Olson. “Like my predecessors, I will rely on the dedication and hard work of the entire Toro family. I look forward to working closely with our talented employees and channel partners to keep our company growing by delivering superior innovation and superior customer care.”

Notz Joins RapidView’s Sales Team



In July, RapidView announced appointment of Richie Notz as the new Southern U.S. and U.S. Caribbean Islands sales manager. Notz brings years of pipeline inspection and training experience to the team. He previously led the training of new customers on how to operate IBAK equipment, the installation of IBAK equipment into trucks and vans, and prior to that was a field supervisor for a pipeline inspection company where he used IBAK equipment.

Robbins Achieves Breakthrough in Bangalore



In June, one of two 6.4-m (21 ft) diameter mixed-face EPB machines broke through at Namma Metro in Bangalore, Karnataka, India. After being launched in March 2015, the TBM named Kaveri made its way through its difficult 750-m (2,460 ft) drive from Chickpet to Majestic. Sister machine Krishna, launched in December 2015 is not far behind, and is expected to break through in approximately two months.

In February 2015, Robbins, with its operating company Robbins India, was asked by Bangalore Metro Rail Corp. to take over the operation and maintenance of two competitor-owned EPBMs. The machines were stalled due to low performance and financial issues from the operating contractor and lack of support by the original machine supplier. As the North-South Bangalore Phase 1 Metro tunnels were on the critical path, the BMRC looked to Robbins to step in and take over the troubled project. A Robbins/Robbins India team of 70 field service personnel refurbished and modified the existing equipment, both while in the tunnel and before relaunching the machines in Chikpet station. In addition, the on-site Robbins/Robbins India Team supervised all aspects of TBM excavation, segmental lining, mucking and grout plant operations since the relaunch of the machines for both drives.

This portion of the Phase One Metro tunnels runs from Chickpet to Majestic at Namma Metro. Once Krishna breaks through, the North and South runs of Bengaluru will be connected, allowing service to an average of 40,000 passengers daily. It is being completed under a tripartite agreement between Robbins India, Coastal Projects Limited, the lead contractor, and project owner, Bangalore Metro Rail Corp. It is anticipated Phase One will be open in its entirety by November 2016.



NASTT

CHAPTER NEWS

British Columbia



Trenchless technologies are still strong as ever in beautiful British Columbia. Our chapter (NASTT-BC) has been continuing its efforts to advance the science and practice of trenchless technologies and we were delighted to have Dr. Alan Atalah of Bowling Green State University and Dr. David Bennett of Bennett Trenchless Engineers as instructors for our pipe bursting courses held earlier in the year in Victoria and Vernon, which were very well received.

Looking forward, the British Columbia Chapter is proud to be hosting the *Trenchless Technology Roadshow* again in 2017 (the event in 2015 was such a success, we couldn't have said no to hosting it again!). This is another joint collaboration between the Centre for Advancement of Trenchless Technologies (CATT), Benjamin Media Inc. and NASTT-BC. The roadshow will consist of one day of courses followed by two days of technical presentations on topics relevant to the needs of British Columbia. The call for abstracts is currently open and will be closing in November, so please get yours in while you have the chance! With the return of the roadshow comes the return of the exhibit hall, only this time it's going to be bigger! You can expect to see the latest and greatest from the world of trenchless technology. You can find more information at roadshow2014.cattevents.ca.

Great Lakes, St. Lawrence & Atlantic



The Great Lakes, St. Lawrence & Atlantic Chapter (GLSLA) will once again be promoting trenchless technology at the ACWWA to be held Sept. 18-21 in Moncton, New Brunswick. The conference will provide an opportunity to learn about and discuss water and wastewater industry

issues with peers in both a technical and social atmosphere.

GLSLA is planning a few upcoming events, including NASTT training courses to be held in the Greater Golden Horse Shoe area and a trenchless conference in Atlantic Canada. The GLSLA website will be updated with details as these events are finalized. Please visit glsla.ca.

Mid Atlantic



The Mid Atlantic Chapter (MASTT) is planning to host a "Trenchless Technology, SSES and Buried Asset Management" seminar in Newark, N.J., Sept. 14-15. MASTT had its annual 2016 Membership and Board of Directors meeting at the NASTT's 2016 No-Dig Show in March in Grapevine, Texas, and MASTT elected its 2016 Board of Directors and Officers at the meeting. Please visit mastt.org or contact Leonard Ingram, executive director, to find out how you can learn more about chapter events, at leonard@engconco.com.

Midwest



The Midwest Chapter (MSTT) is planning a "Trenchless Technology, SSES and Buried Asset Management" seminar in St. Louis, Dec. 7-8. Please plan to support and attend the seminars to enjoy the networking and learning. MSTT had also planned to publish its *Midwest Journal of Trenchless Technology 2016* in early September. Contact Leonard Ingram, executive director, to learn more at leonard@engconco.com.

MSTT also had its annual 2016 Membership and Board of Directors meeting at the NASTT's 2016 No-Dig Show in March in Grapevine, Texas. MSTT elected its 2016 Board of Directors and Officers at the meeting. Please visit mstt.org to find more information on chapter events.

Northeast



The Northeast Chapter is moving forward with planning for our first annual conference Nov. 17, 2016 at the UMass-Lowell Inn & Conference Center. The lunch keynote speaker will be Frederick Laskey, executive director of the Massachusetts Water Resources Authority (MWRA). Interest in the conference continues to grow and the Northeast Chapter's collaboration with UMass-Lowell grows even stronger as the chapter has worked with the Department of Civil & Environmental Engineering to establish an NASTT student chapter. Finally, our *Journal of Trenchless Practices*, published annually, will be published soon with our first edition being 56 pages.

Northwest



This year, the 2016 NW-NASTT Trenchless Conference will be held in Edmonton, Alberta, Canada, Nov. 9-10, and planning is currently underway. Technical lunches in both Edmonton and Calgary will continue, as well. Please check our website at nastt-nw.com for further information on these events.

Pacific Northwest



The Pacific Northwest Chapter (PNW) is actively planning the 2017 Symposium in Seattle, Wash., Jan. 11-12. We will be offering a one-day short course on New Installation Methods, and Day 2 of the event will be filled with papers and case studies highlighting projects in the Pacific Northwest. We have recently finalized the papers for our annual publication. In the next month or so, we will begin advertising for the show, seeking vendors for the tradeshow portion of the event and sending out the request for abstracts for the



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case studies and trenchless technology project highlights. Please visit pnwnastt.org for more information on chapter events and activities.

Rocky Mountain



The Rocky Mountain Chapter is gearing up for two events this fall. The first is our annual conference, "Trenchless Elevated," to be held in Salt Lake City, Utah, Oct. 5-6. The conference will include a full day of technical sessions and a full day of NASTT educational courses. The chapter will also host its annual general meeting at the same time. The second is our first sporting clays networking event, to be held at Kiowa Creek, Colo., Oct. 28. Details can be found at rmnastt.org. We look forward to seeing you there!

Southeast



The Southeast Chapter (SESTT) is planning a "Trenchless Technol-

ogy, SSES and Buried Asset Management" seminar in Miami, Fla., Oct. 12-13, 2016. Please plan to support and attend the seminars to enjoy the networking and learning. Visit sestt.org for more information on chapter events or contact Leonard Ingram, executive director, to find out how you can learn more, at leonard@engconco.com.

South Central



The South Central Chapter was planning to host its first event at the University of Texas at Arlington (UTA) in August, featuring presentations on trenchless technology. More details to come about the turnout of the event, as well as upcoming events. The chapter looks forward to helping students, municipalities and consulting engineers learn about the trenchless market and what NASTT has to offer both locally and nationally.

Western



This year's 12th annual mini No-Dig conference will be held at the South Point Hotel in Las Vegas, Nev., Oct. 17-18, 2016. Please see visit www.westt.org/no-dig-conference.html for more info. The two-day event will include outstanding technical presentations and papers selected from NASTT's 2016 No-Dig Show held in Grapevine, Texas, and two of NASTT's Good Practices Courses – New Installation Methods and Pipe Bursting. These are very comprehensive courses and should be attended by those involved in planning, design, engineering, inspection and construction. This is a great opportunity to learn and exchange ideas and real world experiences with top experts in these fields. We welcome all regional members to attend our conference and ask that regional members help their co-workers and other associates to think about attending the conference. See you in Las Vegas!



NASTT'S 2016

Webinar Series

Alternative Project Delivery

Date: Tuesday, Oct. 4
Time: 2:00 P.M. EDT

Presented by:

Robin Dornfest - Lithos Engineering
Jeff Moore – Garney Construction
Owen Randall – City of Ft. Collins

Moderated by:

Jeff Maier – C&L Water Solutions

Water Main Rehabilitation

Date: Tuesday, Nov. 8
Time: 2:00 P.M. EDT

Presented by:

Ben Cote – Sanexen Environmental Services Inc.
Tara Lamoureux – City of Casselberry
George Mallakis – TT Technologies

Moderated by:

Jennifer Glynn – RMC Water and Environment

Small Diameter Tunneling

Date: Tuesday, Dec. 6
Time: 2:00 P.M. EST

Presented by:

Don Del Nero – Stantec
Craig Vandaelle – Michels Corp.

Moderated by:

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British Columbia

The British Columbia (NASTT-BC) Chapter was established in 2005 by members in the province of British Columbia, Canada.

<p>Chapter Contact Kieran Field, Chair Phone: (604) 990-4800 E-mail: kieran.field@opusdaytonknight.com Website: nastt-bc.org</p>	<p>Elected Officers Chair - Kieran Field Treasurer - Preston Creelman</p>
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Great Lakes, St. Lawrence & Atlantic

The Great Lakes, St. Lawrence & Atlantic (GLSLA) Chapter was established in 1995 and represents the Eastern Canadian perspective of the trenchless technology marketplace. GLSLA members are from Ontario, Quebec and the four Atlantic provinces.

<p>Chapter Contact Kevin Bainbridge, Chair Phone: (905) 304-0080 E-mail: kbainbridge@rcii.com Website: glsla.ca</p>	<p>Elected Officers Chair - Kevin Bainbridge Vice Chair - Anna Polito Secretary - Gerald Bauer Treasurer - Derek Potvin</p>
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Mid Atlantic

The Mid Atlantic (MASTT) Chapter was established in 2004 by members from the states of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia and the District of Columbia.

<p>Chapter Contact Richard Thomasson, Chair Phone: (703) 842-5621 E-mail: rthomasson@pirnie.com Website: mastt.org</p>	<p>Elected Officers Chair - Richard Thomasson Vice Chair - Michael Delzangaro Secretary - Dennis Walsh Treasurer - Tom Wyatt</p>
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Midwest

The Midwest (MSTT) Chapter was established in 1998 to promote trenchless technology education and development for public benefit in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

<p>Chapter Contact Jeff Boschert, Chair Phone: (314) 229-3789 E-mail: jeffboschert@yahoo.com Website: mstt.org</p>	<p>Elected Officers President - Jeff Boschert Vice President - Chris Schuler Secretary - John Milligan Treasurer - Gary Smolinski</p>
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Northeast

The Northeast Chapter was established in 2015 by members in the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

<p>Chapter Contact Dennis Doherty, Chair Phone: (603) 320-6331 E-mail: ddoherty@haleyaldrich.com Website: nastt-ne.org</p>	<p>Elected Officers Chair - Dennis Doherty Vice Chair - Ian Mead Secretary - Walter Fromm Treasurer - Babs Marquis</p>
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Northwest

The Northwest Chapter was established in 1995 by members in the provinces of Alberta and British Columbia, Canada, and in Washington state. In 2005, the members in BC established the NASTT-BC Chapter. In 2009, members in Washington state established the Pacific Northwest Chapter and the Northwest Chapter adjusted the geographic area to include members in the provinces of Manitoba and Saskatchewan.

<p>Chapter Contact Craig Vandaele, Chair E-mail: cvandael@nastt-nw.com Website: nastt-nw.com</p>	<p>Elected Officers Chair - Craig Vandaele Secretary - Greg Tippet Treasurer - Keith Moggach</p>
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Pacific Northwest

The Pacific Northwest Chapter was established in 2009 by members in the states of Alaska, Idaho, Oregon and Washington.

<p>Chapter Contact Chris Sivesind, Chair Phone: (507) 567-2261 x155 E-mail: csivesind@akerman.com Website: pnwnastt.org</p>	<p>Elected Officers Chair - Chris Sivesind Vice Chair - Brendan O'Sullivan Secretary - Brandon Simonds Treasurer - Matt Pease</p>
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Rocky Mountain

The Rocky Mountain Chapter was established in 2009 by members in the states of Colorado, Utah and Wyoming.

<p>Chapter Contact Bo Botteicher, Chair Phone: (303) 521-2618 E-mail: bbotteicher@undergroundolutions.com Website: rmnastt.org</p>	<p>Elected Officers Chair - Bo Botteicher Vice Chair - Ken Matthews Secretary - Chris Larson Treasurer - Joe Lane</p>
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South Central

The South Central Chapter was established in 2015 to serve the members of NASTT from Texas and the south central area of the United States.

<p>Chapter Contact Larry Johnson, Chair Phone: (800) 856-7473 E-mail: ljohnson@hobaspipe.com Website coming soon!</p>	<p>Elected Officers Chair - Larry Johnson Vice Chair - Alan Goodman Secretary - Luis Cuellar Treasurer - Josh Kercho, P.E.</p>
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Southeast

The Southeast (SESTT) Chapter was established in 2001 to serve the members of NASTT from Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Puerto Rico.

<p>Chapter Contact Jerry Trevino, Chair Phone: (877) 462-6465 E-mail: jerry@mechanicaljobbers.com Website sestt.org</p>	<p>Elected Officers Chair - Jerry Trevino Vice Chair - Ed Paradis Secretary - J. Chris Ford Treasurer - Kelly Derr</p>
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Western

The Western (WESTT) Chapter was established in 2003 by members from the states of Arizona, California, New Mexico, Nevada and Hawaii.

<p>Chapter Contact Cindy Preuss Phone: (925) 332-5221 Email: cpreuss@hydroscience.com Website westt.org</p>	<p>Elected Officers Chair - Cindy Preuss Vice Chair - Brian Avon Secretary - Lisa Arroyo Treasurer - Matt Wallin</p>
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NASTT Student chapters are involved in a number of activities throughout the academic year including field trips, seminars and fundraisers. Members of student chapters also attend and participate in NASTT's No-Dig Show where they present trenchless research posters, participate in competitions and provide event support monitoring the technical paper sessions. There are many benefits for students who belong to a NASTT student chapter – scholarships, networking opportunities, education and career opportunities to name a few. To learn more about NASTT's student chapters, visit www.nastt.org/student_chapters.



Arizona State University
 Tempe, Arizona
 Advisor: Dr. Samuel T. Ariaratnam
 E-mail: samuel.ariaratnam@asu.edu



McGill University
 Montreal, Quebec
 Advisor: Dr. Mohamad A. Meguid
 E-mail: mohamed.meguid@mcgill.ca



Bowling Green State University
 Bowling Green, Ohio
 Advisor: Dr. Alan Atalah
 E-mail: aatalah@bgnnet.bgsu.edu



Queen's University
 Kingston, Ontario
 Advisor: Dr. Ian D. Moore
 E-mail: moore@civil.queensu.ca



California State Polytechnic University, Pomona
 Pomona, California
 Advisor: Dr. Jinsung Cho
 E-mail: jinsungcho@cpp.edu



Rutgers University
 New Brunswick, New Jersey
 Advisor: Dr. Nenad Gucunski
 Email: gucunski@rci.rutgers.edu



Clemson University
 Clemson, South Carolina
 Advisor: Dr. Kalyan Piratla
 E-mail: kpiratl@clemson.edu



UIRE/University of Texas at Arlington
 Arlington, Texas
 Advisor: Dr. Mo Najafi
 E-mail: najafi@uta.edu



Concordia University
 Montreal, Quebec
 Advisor: Dr. Tarek Zayed
 E-mail: zayed@bcee.concordia.ca



Vanderbilt University
 Nashville, Tennessee
 Advisor: Dr. Sanjiv Gokhale
 E-mail: s.gokhale@vanderbilt.edu



Indiana University - Purdue University Indianapolis
 Indianapolis, Indiana
 Advisor: Dr. Dae-Hyun (Dan) Koo, P.E.
 E-mail: dankoo@iupui.edu



Virginia Tech University
 Blacksburg, Virginia
 Advisor: Dr. Sunil Sinha
 E-mail: ssinha@vt.edu



Laval University
 Quebec City, Quebec
 Advisor: Dr. Geneviève Pelletier, ing.
 E-mail: Genevieve.Pelletier@gci.ulaval.ca



University of Alberta
 Edmonton, Alberta
 Advisor: Dr. Alieza Bayat
 E-mail: abayat@ualberta.ca



Trenchless Technology Center/Louisiana Tech University
 Ruston, Louisiana
 Advisor: Dr. Shaurav Alam
 E-mail: shaurav@latech.edu



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Reducing Risk and Visitor Impacts: Trenchless Solutions for Liberty Island

Paul J. Mourt, P.E.
Mott MacDonald, Philadelphia, Pa.

Liberty Island, the location of the Statue of Liberty, is an island within New York Harbor, located in Upper New York Bay near the mouth of the Hudson River. The Statue of Liberty is a universal symbol of freedom and democracy, and also a World Heritage Site. Adequate water and wastewater service is necessary to protect the cultural and historic landmarks on Liberty Island, and to serve over 4 million visitors per year. The Island would need to be closed to visitation should reliable water and wastewater service not be available. Liberty State Park is a green oasis in northern New Jersey, offering spectacular views of the Statue of Liberty and the Manhattan skyline, and drawing over four million visitors each year.

Minimizing impacts to visitors of both Liberty Island and Liberty State Park was a key consideration during the planning, design and construction of the new water and wastewater pipelines serving Liberty Island. The use of trenchless installation techniques is a typical way to minimize construction impacts, and horizontal directional drilling, pipe ramming, pipe bursting and sliplining were all used to install the new pipelines. However, while the use of these trenchless techniques did reduce impacts to visitors, each of these techniques has risk factors that need to be identified and addressed. For this project, perceived risk varied amongst stakeholders, particularly from the perspectives of the design engineer and contractor. The Jersey City MUA constructed the improvements for the

National Park Service, and will own and maintain the completed pipelines. Hatch Mott MacDonald served as the JCMUA's design and construction engineer, and Carson Corporation completed the pipeline construction under contract to the JCMUA.

PROJECT PLANNING

Liberty Island is owned by the federal government and the National Park Service (NPS) oversees all aspects of its maintenance and operation. The Jersey City Municipal Utilities Authority (NPS) provides water and wastewater service for Liberty Island.

Service for Liberty Island is currently provided via a 3-in. diameter high density polyethylene (HDPE) water supply pipe and a 2.5-in. diameter HDPE wastewater force main extending from the JCMUA's service area in Jersey City, New Jersey, through Liberty State Park (a New Jersey state park), across New York Harbor to Liberty Island. The water and wastewater lines across the harbor are encased in a single 8-inch HDPE pipe which rests on the harbor bottom. When installed in 1992 to replace leaking cast iron mains under the harbor, the 3-in. and 2.5-in. diameter lines were envisioned as a short-term temporary measure. In 2003, the 8-in. HDPE casing pipe was damaged by a boat anchor and temporarily patched. The current location

of the water and wastewater lines on the sea floor of the harbor leaves the lines vulnerable to damage, and as such presents a significant risk to visitor operations at the Statue of Liberty.

The water supply system on Liberty Island is a combined domestic and fire protection system. Two 15,000-gallon buried storage tanks are located on the Island, which serve as a reservoir for domestic and fire service pumps. All wastewater collection piping on the island leads to a Wet Well/Pump Station located on the western part of the Island, from which point a sewer force main carries flow across New York Harbor and through Liberty State Park to the JCMUA's sewer system. The existing potable water and wastewater pipelines are in violation of the code for proper separation of water and sewer pipelines, do not provide sufficient fire flows to Liberty Island, were installed as a temporary measure in 1992, and present a significant risk to visitor operations at the Statue of Liberty.

During the planning stage of the project, the National Park Service looked at a number of construction alternatives for the replacement of the water and wastewater lines, including open cut construction, pipe bursting, dredging, microtunneling and horizontal directional drilling. The NPS uses a process known as Value Analysis / Choosing by Advantages (VA/CBA). Through this process, a variety of factors were considered, including: impact to natural resources; protection of public, employee and contractor health, safety and welfare; preservation of recreational opportunities and minimization of negative impacts (visual, noise, access); and ease of future maintenance. Each identified alternative is numerically ranked based on input from stakeholders. The results of the Decision Making Phase of the CBA process indicated that pipe bursting of the lines through Liberty State Park and an alternative involving a single directional bore containing the replacement water and wastewater lines across New York Harbor had the highest Total Importance of Advantages and were identified as the Preferred Alternative.



Figure 1: Location Plan and Installation Techniques

The CBA process includes a Reconsideration Phase where the preferred alternative selected by the analysis is tested and whether a hybrid alternative should be considered. Based on the CBA analysis, there was less than a 2 percent difference in the total importance of the advantages between a single bore containing both the water and sewer lines and separate bores for each line. Each alternative was found to be virtually equal in advantages and cost, and as such either option could be selected as the design process progressed. Figure 1 illustrates the relationship between Liberty Island and Liberty State Park, and the portions of the alignment targeted for pipe bursting, open cut installation and horizontal directional drilling.

GEOTECHNICAL CONDITIONS

Regional Geologic Setting

The project site for the HDD crossings is located in Hudson County, New Jersey, in the City of Jersey City, which can be generally described as an urban/industrial area. The project area is located within the Piedmont physiographic province of New Jersey. New York harbor in the vicinity of the project area is underlain by the Manhattan schist which is of lower Cambrian to late Proterozoic age.

The islands within NY Harbor share the same bedrock geology as the southern tip of Manhattan. The surface of the bedrock is below sea level in this area, and is overlain by unconsolidated glacial and marine deposits. The bedrock in the region was scoured by glaciation roughly 20,000 years ago during the Wisconsin glaciation. The New York Harbor islands (Ellis, Liberty, and the former Black Tom Island), and Long Island, are the remains of the terminal glacial moraine left behind as the glacier advanced, melted and receded. Terminal moraines are usually made up of undifferentiated layers of clay, silt, sand and gravel.

Geotechnical Investigation

A subsurface exploration program was performed in February and March 2013 to determine the geotechnical conditions along the intended HDD alignments. Eight borings were advanced as follows:

- a. Two borings advanced on land within Liberty Island, to a depth of 75 ft below grade.
- b. Five borings within the harbor (subaqueous), advanced to a depth of 50 ft below the channel bottom, performed from a jack-up barge.
- c. One boring advanced on land within Liberty State Park (New Jersey mainland), to a depth of 75 ft below grade.

Standard penetration testing and sampling of the soil overburden was performed. All borings were typically advanced 30 ft into competent bedrock and NX rock core was collected for examination and testing. Laboratory testing included a determination of moisture content; liquid and plastic limits; sieve analysis; amount finer than #200 sieve; and unconfined compression strength of intact rock cores.

General Boring Results

Conditions across the harbor were found to consist of varying depths of silt and sand sediment over bedrock, with the boring results showing fairly consistent geologic conditions. The land borings show man-made fill near the surface with glacial till and marine sediments to depths of approximately 50 to 70 ft below sea level. Beneath the till and sediment layers is schist, sometimes with a soft layer of decomposed schist at the top.

The schist breaks easily, mostly because of its “schistosity” which is a planar, parallel foliation that penetrates the rocks. Rock foliation, and hence the fractures, was fairly low angle: on the order of 10-20 degrees from horizontal. The foliation, or jointing, is pervasive and the individual planes are sometimes well developed enough to fracture the core samples. Nevertheless, RQD values mostly range from 60 to 100, and improve slightly with depth below the top of bedrock. Average RQD value from the land boring cores is 75.2, while the average RQD value from the water boring cores is 80.2. Unconfined compressive strength of the rock cores varies across the HDD alignment from a low of 3,480 psi to a high of 25,070 psi.

HDD DESIGN CONSIDERATIONS

Installation of the pipelines across New York Harbor involved the most risk, in terms of potential for environmental damage, drilling difficulty, and visitor disruption. The following sections provide a brief description of the basic components considered during the development of the design plan and profile for the Liberty Island water and sewer crossings.

Design and Minimum Allowable Bend Radii

Calculations were performed to determine the minimum allowable bending radius under construction and operating conditions. The intent was to configure the HDD alignments with a design radius sufficiently greater than the minimum allowable bending radius of the drill rod and product pipelines in order to provide a tolerance for steering corrections to be made by the Contractor without compromising or increasing the installation risks. With the selection of high density polyethylene (HDPE) pipe for the water and sewer lines, the governing minimum allowable bending radius is a function of the downhole drilling equipment, as the HDPE pipe is much more flexible than the steel drill pipe and downhole drilling assemblies used to drill through the anticipated geotechnical materials. For the proposed HDD installations, the design bending radius installations were established at 1,800 feet for both the water and sewer crossings, based on the need to use bedrock drilling assemblies and an assumption that the drill rod would have a minimum diameter of 6-inches.

Entry and Exit Angles

For the proposed installations, the entry and exit angles were set at 13 and 12 degrees, respectively, both relative to the horizontal plane. The entry angle was selected to attain greater depth of cover over the initial portion of the bore. The exit angle was selected to provide the maximum amount of cover beneath the Hudson River while maintaining the proposed exit location.

Installation Depth of Cover

The depth of cover for a given HDD installation is dependent on several factors. These include the anticipated geotechnical materials, presence of preferential flow pathways, design bending radius, presence of existing utilities and/or structures, installation length, and whether drill and intersect drilling methods are anticipated/required. The most important factor in determining the appropriate depth of cover for a given HDD installation is the material properties of the overlying geotechnical material and the resistance that it provides against the required installation-induced bore fluid pressures necessary to remove the cut-

tings. Another important factor in establishing the proper installation depth is the ability to maintain borehole stability over the course of the installation. This is accomplished by placing the HDD bore through geotechnical materials that are favorable to HDD operations.

For the proposed HDD installations, the depth of the borehole is governed primarily by the required depth beneath the Hudson River and the chosen entry and exit locations. As discussed in Section 5.7, a hydraulic fracture evaluation was completed to confirm the resulting depths of cover along the design alignment provided sufficient resistance to frac-outs.

Starter/Conductor Casing

Starter/conductor casings were included in the design to help support soft or loose materials on each side of the installation. In addition to preventing collapse of fill materials near the ground surface, they were included to help maintain drilling fluid circulation through these soils and minimize frac-out potential. The conductor casings were sized to allow passage of the largest anticipated reamer through the bore.

Drill and Intersect Methodology

The achievable installation length of a HDD installation has significantly increased in the past few years with the development of the “Drill and Intersect” drilling method. This method consists of drilling the pilot bore from both ends of the alignment and meeting in a target location established between the ends of the HDD bore. A large, primary drill rig is typically setup on one side of the bore with a smaller, secondary drill rig setup on the opposite side. Both rigs drill towards a pre-determined point located closer to the smaller drill rig side.

For this project, the use of the drill and intersect approach was necessary due to the requirement for steel starter/conductor casings at each end of the HDD installations. An added benefit of using the intersect method for this project was that, by drilling from both sides, the fluid pressures within the bore are much lower than for a single drill rig installation. These lower fluid pressures result in a much lower hydrofracture potential during the pilot bore stage of the installation process.

Horizontal and Vertical Bends

Vertical curvature is inherent to HDD installations. While horizontal curvature is feasible, the scope of design and construction greatly increases in complexity when horizontal curves are required. The addition of tighter radii in horizontal curvature also increases installation loads and stresses, and therefore the risk to the product pipe.

The preliminary HDD alignments developed during the project’s planning stage included parallel horizontal curves for both the water and sewer pipelines. These curves were included based on a design constraint that the proposed pipelines not be located directly beneath one-story buildings used to house National Park Service (NPS) staff. The intended horizontal curvature required spatial separation between the bores on the order of 50 to 75 ft. In addition, the desire to utilize the drill and intersect method for the proposed installations required a long straight section within the middle portion of the bore to provide sufficient area for the intersection of the two drill rigs. Inclusion of horizontal curves in the alignments reduced the available length of the intersect zone. However, as a result of damage to the buildings on Liberty Island from the impacts of Superstorm Sandy in October 2012, NPS determined that the buildings would no longer be utilized and may

eventually be demolished. Removal of this design restriction enabled the proposed horizontal curvature to be eliminated, thereby reducing the HDD installation risks and complexity.

Hydraulic Fracture Evaluation

A hydraulic fracture evaluation for both the water and sewer HDD crossings was completed in general accordance with the Delft Geotechnics Method outlined in Appendix B of the Army Corps of Engineers 1998 Report CPAR-GL-98 (Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling) by Staheli, et. al (1998). This hydraulic fracture evaluation method was developed for soil installations. Currently, no accepted methods are available to model/estimate the maximum allowable drilling fluid pressure within bedrock materials. While bedrock tensile strength and unconfined compressive strength evaluations have been used to estimate the allowable drilling fluid pressure, these methods tend to provide results that are not considered conservative and greatly over predict the true maximum allowable drilling fluid pressures.

The results of the hydraulic fracture evaluation are provided in Figures 2 and 3 for a single drill rig and drill and intersect approaches, respectively, for the pilot bore phase of the installation process. Calculations were performed every 50 feet along the alignment assuming a single drill rig was located on the west (Liberty State Park) side of the crossing and also assuming that drill and intersect methodology was used.

It should be noted that the single rig option is only shown for comparison purposes, as the drill and intersect method was specified for this installation. As the pilot bore progresses the required drilling fluid pressure increases. Thus the potential for hydraulic fracture increases as the drill is advanced from the entry location to the exit location. For the proposed HDD profile depicted in Figure 2, there is a significant increased risk of a hydraulic fracture between HDD Station 50+80 and the proposed HDD exit location at HDD Station 55+81 where the required drilling fluid pressure approaches the estimated allowable pressure afforded by the overlying soils/geotechnical materials.

For the specified drill and intersect approach for this project (Figure 3), the required drilling fluid pressure increases, similar to what is observed for the single drill rig alternative. However, because there are two drill rigs drilling towards each other, the magnitude of the required drilling fluid pressure is significantly reduced. As a result, the risk of a hydraulic fracture is greatly reduced.

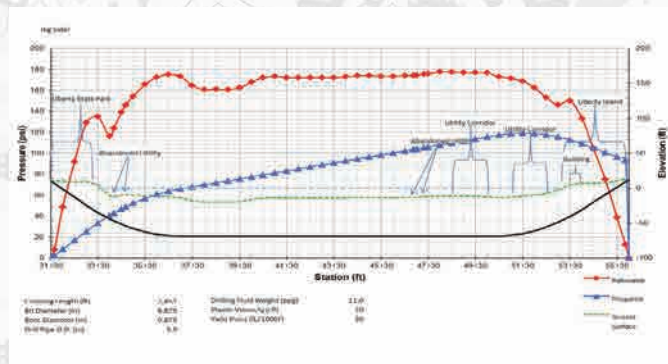


Figure 2: Hydraulic Fracture Evaluation – Single drill rig approach (not recommended).

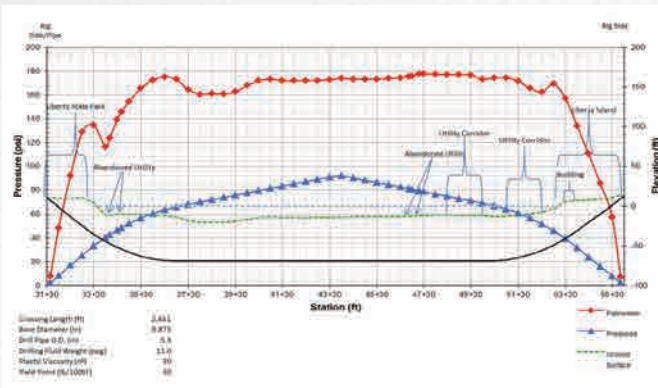


Figure 3: Hydraulic Fracture Evaluation – Recommended drill and intersect approach.

OTHER DESIGN & CONTRACTING CONSIDERATIONS

Liberty Island is divided into a public side, where visitors are permitted to explore the Statue of Liberty and various displays, and a private side, used by NPS maintenance and operations personnel. In keeping with the requirement to minimize visitor disruption, the HDD alignment was situated within the private side of the Island. The alignment for the proposed water and sewer lines, and more specifically the area available for HDD equipment, was severely constrained by existing buildings, active and abandoned utilities, and a number of historic seawalls. In order to provide working room for the drill rig and ancillary equipment, while keeping the drill entry angle and bending radius conservatively within industry guidelines, the design documents called for the existing underground water storage tanks and pumps on the Island to be removed and replaced by a temporary system of above grade tanks and pumps located away from the drill alignment.

Hydraulic modeling determined that 10-in. diameter DR13.5 HDPE would satisfy the fire flow demands of Liberty Island, and that 4-in. diameter DR13.5 HDPE would maximize the capacity of the existing wastewater pumps. However, analysis determined that DR9 and DR7.3 pipe was needed for the water and wastewater lines, respectively, installed by HDD to address installation loads. As such, the increased wall thickness available in 12-in. and 6-in. HDPE pipe was used to address pullback loads while satisfying the minimum diameter needed for hydraulic capacity.

CONSTRUCTION

The design documents called for the existing water storage tanks and pumps on Liberty Island to be removed and replaced with a temporary system, to both provide room for the drill rig and to minimize entry angle and bending radius of the HDD installation. The contractor viewed the risks associated with operating a temporary water system as greater than the risks of an increased entry angle and bending radius. To enable the directional drills to be performed without removal the water storage tanks and pumps, the contractor moved the location of the conductor casing on Liberty Island, such that the drill entry was revised from 12 to 15 degrees, and the bending radius reduced from 1,800 feet to 1,200 ft.

Some difficulty was encountered installing the conductor casings within Liberty State Park through fill materials, necessitating open cut removal of obstructions before the casings could be rammed to their desired

depth. During drilling, rock strength was found to be generally consistent with the borings performed during design. The water line directional drill and pullback was completed as planned and without frac-outs. Although a conductor casing was installed to a similar depth, a frac-out did occur during the sewer line drill when the drill stem was approximately halfway across the harbor (i.e., near the predicted point of maximum drilling pressure per Figure 3). The frac-out manifested itself on the Liberty State Park side of the bore, between the end of the conductor casing and the bedrock layer. The instability created in the fill materials was mitigated by pumping low-strength grout (100 psi) into the bore hole and allowing the grout to flow to the surface along the frac-out path.

Pipe bursting was envisioned to be the installation technique that would cause the least disruption to Liberty State Park. The intent was to upsize the existing 8-in. water line to 10-in., and remove the existing 2.5-in. wastewater line from its 6-in. casing pipe and replace it with 4-in. pipe. In practice, pipe bursting of the existing water line was found to be difficult to implement and necessitated changes in construction procedures. Limited documentation was available during the planning and design phases regarding the actual depth and alignment of the water and wastewater pipelines. The lines were believed to be buried with approximately 4 ft of cover, without bends and with no repair clamps. The existing water line was found to have variable depth of cover, with some portions being located under 9-ft of fill. The orientation of pipe bells was not consistent along the alignment, and several repair clamps were found. The contractor had anticipated the water pipe bursting to proceed at a rate of approximately 300 ft per hour using a static bursting machine with a capacity of 200,000 lbs; in practice, the rate achieved was only 100 to 160 ft per hour. After completing approximately 2,000 feet of the planned 3,000 ft of water pipe bursting, a bend was discovered that prevented the installation of the remaining 1,000 ft. After examining the costs and risks associated with pipe bursting, open cut and HDD, the final 1,000 ft of 10-in. water main was installed by HDD.

The existing sewer line was found to be located at a similar depth of cover as the existing water line but without bends. Installation of the proposed 4-in. HDPE (DIPS) into the existing 6-in. pipe did not require bursting of the existing line, and could be completed by sliplining. To avoid the disruption associated with multiple access pits, the contractor elected to slipline the entire 3,000 feet of proposed sewer force main through Liberty State Park by inserting 1.66-in. diameter drill rod through the existing pipe and using a HDD rig with 10,000 lbs of pullback capacity.

CONCLUSIONS

Utility construction involves various risks, and the perception of what constitutes greater risk will vary among owners, engineers and contractors. Construction of the replacement utility lines to Liberty Island demonstrated that an intended installation technique may need to be modified based on actual field conditions, and that there is more than one way to meet a project goal. The ultimate goal during the replacement of water and wastewater pipelines to Liberty Island was to preserve the visitor experience. This goal was met by maintaining open dialogue between stakeholders and by utilizing multiple trenchless methods to minimize construction impacts.

This paper was edited for style and space in NASTT's *Trenchless Today*. To view the full version of paper MM-T2-02, please visit nastt.org/technicalpapers.

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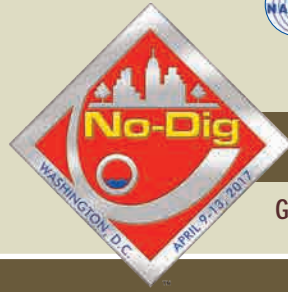
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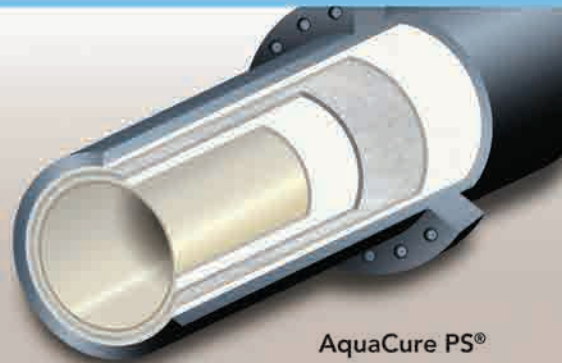


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