NORTHEAST REGIONAL CHAPTER

NORTHEAST JOURNAL
OF TRENCHLESS TECHNOLOGY PRACTICES

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Brooklyn's Gowanus Canal Lining Project
Victory in Vermont: Three Crossings Completed
UMass Lowell NASTT Student Chapter

2020 SPRING EDITION

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MESSAGE FROM NASTT-NE CHAIR

Babs Marquis, CCM, NASTT-NE Chair

Welcome to the Spring/2020 edition of the NASTT Northeast Regional Chapter's *Northeast Journal of Trenchless Technology Practices*. In this edition, we provide follow up coverage from our 4th annual NASTT-NE Trenchless Technology Conference in Syracuse, NY Nov 11-12 and showcase a Complex CIPL Relining of 100+ year old twin 30-inch gas mains under Gowanus Canal in NY. Other articles include: three parallel 60-inch drainage tunnels SBU mined through solid granite and sticky clay at 40-foot depth, as part of Middlebury, VT Rail & Bridge reconstruction project; slip line of East Bay Pipeline 4,300 foot long 24-inch steel main at 170 feet depth, which is the sole conduit supplying potable water to the 50,000 residents served by the Bristol County Water Authority system; report from a UMass Lowell NASTT Student Chapter member, and a progress update on the UMASS Lowell CETTUE, and milestones.

Regretfully, as the final touches and coordination planning for the 2020 NASTT No-Dig Show in Denver, CO were being put into place, and printing of this edition of the Journal being finalized, we received the sad news that due to the Coronavirus (COVID-19) pandemic and public health order canceling events at the Colorado Convention Center. The 2020 No-Dig Show is presently postponed with additional updates to follow. NASTT leadership is working diligently to propose the best way to reschedule or re-imagine the NASTT No-Dig Show. This is the right thing to do in support of our Country's effort to contain, control and prevent continuous spread of the virus – Our safety comes first!

As we plan for our 5th annual Conference in Portland, ME we are monitoring the measures and on-going advisories to combat the COVID-19 pandemic and the likely resulting effects through the fall. For now, our 2020 annual Trenchless Technology Conference is scheduled for Tuesday, November 10th, at the elegant Portland Sheraton at Sable Oaks in Portland Maine, with a Chapter sponsored welcome reception the night before at RiRa. We have been hard at work planning the conference in light of our goal to expand awareness of trenchless technology throughout our region and to increase the Maine representation in our chapter. Please visit our website at www.nastt-ne.org for the latest information, registration and other important details.

Also in the works is the addition of Quinnipiac University – School of Engineering as the newest NASTT Student Chapter from Connecticut. Professor John Greenleaf is the Faculty and Student Advisor for the new student chapter. Naturally, the roll out of this exciting announcement has also been delayed by the recent COVID-19 crisis.

We are continuing to work with our UMass Lowell student chapter to schedule guest lectures and field trips for the year. We solicit input from our regional trenchless practitioners to get involved in continuing with this endeavor as we see it as a forward looking investment in the future of our industry.

Conducting the business of this chapter (especially hosting our annual conference and the publication of this journal) would not be possible without the generous support of our sponsors and vendors. Please reach out to those who have advertised and contributed to the journal, and visit with our vendors at the annual conference. We hope the time you spend reviewing the articles and information in this edition of the Journal will encourage you to get involved in the chapter, perhaps with an article for the next journal or a presentation at the next conference. The Northeast Chapter is a strong voice for trenchless in the region, and we need your support to ensure that the Chapter succeeds and grows.

"PLEASE JOIN US"

The Board of Directors continues to explore ways to maintain the connection with past presidents and founding members of the Northeast Trenchless Association. Thank you to all of our chapter members for participating, reading and sharing the journal, and joining us at our annual conferences. Thanks also to our Past Chair, Executive Committee, and Board of Directors for your time and dedication to the chapter.

Please join us! Our Chapter and its members are known for our ingenuity and resilience. Stay healthy, stay safe! Together, we will overcome this!

Babs Marquis

Babs Marquis, CCM
Chair, NASTT-NE

NASTT-NE SITE

MESSAGE FROM NASTT CHAIR

Craig Vandaelle, NASTT Chair

Hello Northeast Chapter Members. Just before this publication was to go to print, our country, along with the entire globe, began to deal with an unprecedented situation of the COVID-19 pandemic. As shelter-in-place decrees and quarantine measures were enacted throughout the world, the 2020 NASTT No-Dig Show scheduled for April 5-9 in Denver, Colorado, was affected. The conference has been postponed and the staff of NASTT along with the board of directors, are working diligently to re-imagine the show in the best possible way for all our stakeholders in this our 30th year. This a very busy time for all of us here at NASTT as we shift directions and begin to formulate new plans to bring our members, attendees, exhibitors, sponsors, and students the high-quality technical and educational content that you have come to expect from NASTT.

WITH THE TRENCHLESS MARKET GROWING SO FAST NOW IS THE TIME TO GET INVOLVED.

In exciting news, we are thrilled with the incredible success of the inaugural No-Dig North conference held in Calgary this past October. With nearly 600 attendees and 76 exhibitors, I could not be more pleased with the outcome of this show and the volunteer participation and leadership efforts of our Canadian Chapters. We are currently in the planning stages of the next No-Dig North conference to be held in Vancouver, BC, October 19-21,2020 and No-Dig North is heading to Toronto for 2021. If you do business in Canada, you owe it to yourself and your organization to make your way to No-Dig North.

We look forward to growing and learning from these recent challenges and coming back stronger than ever. Thank you for all your support and dedication to NASTT and the trenchless technology industry. We are only as strong as our Regional Chapters. We are always looking for volunteers and new committee members not only locally but nationally. Don't be afraid to get involved! With the trenchless market growing so fast now is the time to get involved.

Craig Vandaelle

Craig Vandaelle,
NASTT Chair

TALK TRENCHLESS

Carolyn Hook, NASTT Membership Outreach & Database Manager

Whether you're on the job site, at the water cooler or at a conference, you'll want to connect with trenchless professionals. The North American Society for Trenchless Technology can help you make those connections every day with Talk Trenchless.

Talk Trenchless is an exclusive, secure, members-only networking tool designed to connect you with verified NASTT members – your peers and trenchless technology experts throughout North America. Participants can download and share ideas, articles, reports and more in the NASTT Members community.

Establish your professional identity.

Create your profile with your photo and areas of expertise, along with your education and position history. Talk Trenchless is a showcase of NASTT's most valuable assets – its members!

Discuss industry-related hot topics with your peers.

Don't wait for the next meeting. Talk about what's happening today and exchange ideas in a professional NASTT setting.

Increase your network.

Build your own contact list or search for colleagues by name, location, company or region in the NASTT online member directory. Meet others in your area online then connect in person at a regional chapter.

Find answers you need.

Looking for a standard practice or for someone to share their experience with a tool or technique? Post your need and access the ideas and stories of more than 2000 NASTT members.

Pay it forward.

Lend your expertise and give back to the profession when you share your knowledge, innovations, resources and experiences with others.

Access the right tools.

Members can post research, projects, solutions, calculators and videos that will be available at your fingertips in the community library.

IT'S TIME TO TALK TRENCHLESS

TALK-TRENCHLESS.NASTT.ORG

How to Get Started

Log in with your nastt.org credentials at talk-trenchless.nastt.org. If you've never accessed the site, you'll be asked to agree to the Community Rules which remind everyone to:

- Stay on topic.
- Don't post commercial messages.
- Be honest, be yourself.
- Submit only your own, original content.
- Keep it clean, keep it friendly.

Next, click your Profile on the top right and add your information. To access the NASTT Members Community, click Communities, My Communities. You'll see the most recent conversations and posts. Join in or start a new one. Send your questions to **membership@nastt.org.**

NASTT-NE BOARD 2020 – 2021

BABS MARQUIS – CHAIR

Babs Marquis is presently the Trenchless Practice lead for the East Coast and Construction Manager with the Burlington, Mass., office of McMillen Jacobs Associates. He previously worked for Jacobs Engineering Group for 10 years and Stone & Webster for 11 years. During his extensive career in the trenchless industry, Babs has been involved in major tunneling and trenchless projects in the Northeast for clients such as the Massachusetts Water Resources Authority, Boston Water & Sewer Commission, the Metropolitan District Commission (Hartford, CT), Narragansett Bay Commission (Providence, RI), NYC Dept. of Design & Construction and NYC Dept. of Environmental Protection.

For the past 19 years, he has focused on underground construction management for tunnels and conveyance including water and wastewater pipeline design and construction projects, with emphasis on trenchless construction methods. He has worked on various pipeline projects utilizing microtunneling, pipe jacking, horizontal auger bore, pipe bursting and pipelines renewal methods. From 2009-2011 Babs was resident engineer on the pivotal Microtunneling, & Pipe Bursting components of the East Boston Branch Sewer Relief Project. His commitment to the trenchless practice includes co-author for revision and update of the ASCE Manual of Practice (MOP 106) for Horizontal Auger Boring Projects and is the chair leading the effort for review and update of ASCE MOP 112 for Pipe Bursting Projects. Babs was instrumental in the development of the Auger Boring School at the Louisiana Technical University where he continues to assist with the annual planning and teaching at the auger boring school.

Babs views the NASTT-NE Regional Chapter as an important vehicle to promoting greater awareness and understanding of trenchless applications at the local level. He sees the level of interest and confidence in trenchless technology growing among owner groups based on the successful completion of many high profile projects across the Northeast. Drawn to the varied unique and innovative aspects of trenchless technology, Babs believes access to ongoing education is key to even greater owner acceptance and NASTT-NE Chapter is a key component towards achieving this acceptance by making information available at the grassroots level as well as attracting student chapters from the region and a robust local participation in the Chapter activities throughout the region.

ERIC SCHULER – VICE CHAIR

Eric Schuler is the City Engineer for an upstate-New York community that is rich in history. As a Department Head, he oversees all of Public Works, Sanitary Sewer, Storm Sewer, Water Distribution, Water Treatment, Wastewater Treatment, Facilities, and Traffic departments. Mr. Schuler has over 8 years of experience as a consulting engineer for nationally-recognized firms prior to switching to the municipal world. He earned his Bachelor of Science in Civil Engineering degree from Clarkson University in Potsdam, NY and has primarily been involved in wastewater, drinking water, civil-site, and stormwater sectors. Eric is a licensed Professional Engineer in New York whose design, project management, and construction-related experiences have helped successfully execute many "trenchless"-focused projects.

Early in his engineering career he gained exposure to various trenchless technologies through utility evaluations and development of utility project design alternatives. He immediately started to envision great opportunities for communities plagued by utility deficiencies and construction constraints to utilize CIPP, HDD, among other trenchless technologies; and for them to be able to benefit from both social and economic perspectives. Eric has also stressed the importance for municipalities to incorporate asset management into utility system evaluations and system rehabilitation designs in order to aid development of capital projects and to determine the most suitable trenchless applications for implementation.

In addition to NASTT-NE, Eric is also a Board Member for the Central New York Branch of the American Public Works Association (APWA), a Director of the Central New York Water Works Conference (CNYWCC), and is active on New York State American Water Works Association Committees (NYAWWA). Eric continues to push for growth of trenchless technologies in upstate-New York and has trained utility owners on the use of hydraulic modeling methods for proper development of utility rehabilitation project design. He is an advocate for educating (designers & installers) of trenchless applications through proper training and increased accessibility of industry standards/ guidelines to ensure successful project design and execution. The successful use and increased awareness of modern-day trenchless technologies that incorporate innovative equipment and materials are what Eric believes will continue to shape and drive the direction of the utility industry for the coming decades.

EXECUTIVE COMMITTEE

PAUL SAVARD – TREASURER

With almost 30 years of career experience in engineering and construction management, Paul is a successful project manager with a proven track record building and leading multifunctional trenchless technology teams. He has worked in both the public sector for a regional water and wastewater provider that serves over 2.5M customers and for private consulting firms on planning, designing, and constructing water and wastewater transmission and conveyance systems. Since the 1990s, he has developed a strong focus on design and construction using trenchless construction methods including microtunneling, pipe jacking, horizontal directional drilling, pipe ramming, auger boring, sliplining, cured-in-place pipe lining, epoxy coatings, carbon fiber reinforced plastic linings, pipe bursting, and manhole rehabilitation. His trenchless projects ranged in construction costs from $1 million up to $90 million.

Paul likes to partner with his clients locally, nationally, and across North America to deliver value for their most complex and critical infrastructure obstacles. Paul recognizes that trenchless technology provides new answers to old questions that provides a better way to update and expand the needed critical infrastructure to move water, sewer, power and communications. Trenchless technology brings the commitment to innovation that provides the greatest value to solving our client's needs.

As NASTT-NE Treasurer, Paul brings a focused energy to grow the trenchless market in the Northeast. He will work hard to expand the Northeast chapter in a financially viable and sustainable way through outreach to our members and their communities. He believes strongly in the NASTT mission to advance trenchless technology and promote its benefits for the public and the natural environment.

JONATHAN KUNAY – SECRETARY

Jonathan Kunay, P.E., PMP is a Principal Engineer and the Northeast Conveyance Market Leader for CDM Smith in Boston, MA. He has over 16 years of experience working as a design engineer and project manager on a variety of trenchless projects including infrastructure assessment with traditional and state-of-the-art investigative techniques, rehabilitation using CIPP, HDD and pipe bursting, facilities planning and master planning, leak detection of water distribution systems, enterprise asset management and risk/criticality studies.

While trenchless technologies have been his primary focus over the past 12 years, he also has worked on civil site design for commercial developments and municipalities, navigated Consent Order driven long-term programs, designed new pumping stations and developed alternatives for sewer separation projects. While Jonathan is based in New England, his diverse project experience has brought him many places to experience unique perspectives in the trenchless marketplace. He has worked on trenchless projects all over the United States including California, Texas, Illinois, Tennessee, Louisiana, South Carolina and Georgia. He has also implemented trenchless projects and programs internationally in the Middle East, China, South America, the Pacific Islands and Europe.

Jonathan was the project manager and design engineer responsible for helping to bring service lateral lining into the New England market in 2008 as part of a comprehensive sewer system rehabilitation program. This comprehensive model has now been adopted across the country as a proven methodology by which infiltration and inflow can be removed in large quantities from the sewer collection system. This comprehensive approach has been presented at conferences to showcase the validity of utilizing a holistic trenchless methodology when large percentages of I/I by volume must be eliminated.

Jonathan has a Bachelor of Civil Engineering and a Minor in Environmental Engineering from the University of Cincinnati, is certified in NASSCO's Pipeline Assessment and Certification Program (PACP), Manhole Assessment and Certification Program (MACP), and Lateral Assessment and Certification Program (LACP), and is the Chair of the Pipeline Rehabilitation Committee in the National Association of Sewer Service Companies (NASSCO).

EXECUTIVE COMMITTEE - CONT'D

IAN MEAD – PAST CHAIR

Ian Mead, P.E., BCEE is a Senior Project Manager with Tighe & Bond in Worcester MA, and has over 20 years of experience working as design engineer, project manager and construction coordinator. His varied experience includes work on drinking water, wastewater, pipeline, site and civil, energy and other municipal infrastructure projects. His more recent focus is on development and delivery of projects for municipal clients across New England.

Born and raised in the construction industry, Ian has spent his entire lifetime on and around heavy equipment on various construction sites. While working for a private engineering company doing survey and site design work, Ian studied civil engineering at the University of Massachusetts Amherst. His first job after graduation was doing site inspection work on pipeline projects throughout MA and RI. He was quickly introduced to trenchless technology as many municipal clients were then expanding sanitary sewer collection systems, and some of this work involved trenchless applications such as HDD, Pipe Bursting, and CIPP. More recently his experience has also included comprehensive pressure pipe condition assessment and rehabilitation, and the incorporation of this information into enterprise asset management programs.

Ian thinks that increasing owner acceptance, and convincing local decision makers that trenchless methods should be part of any utility's asset management plan, are important keys to future growth of the industry. Education and information provided to municipalities and utilities will help spread the word that trenchless is a viable and proven option. Ian feels there is a great opportunity to generate more interest in trenchless technology with mid to smaller sized utilities across the Northeast. Another major goal he has is building general awareness of the NASTT-NE Chapter, and coordinating its resources and activities, such as website, publications and conferences, with the parent NASTT organization and other regional chapters across North America.

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We are proud to be your association through these times as we support each other

MESSAGE FROM NASTT EXECUTIVE DIRECTOR & STAFF

An Update and Information on NASTT Networking & Communication Platforms

By: Matthew Izzard, NASTT Executive Director

It's hard to summarize in a 250 word article the impact COVID-19 pandemic has had on the world and how, in just a few short weeks, we can go from looking forward to a projected record turnout at the world's largest trenchless event - the NASTT No-Dig Show - to making sure our amazing essential services keep operating and that we are protecting each other.

In these times the role of a not-for profit association changes dramatically. From working to promote our industry proactively we've also had to quickly adapt to provide support for our membership during rapidly changing circumstances. Currently we are providing alternative platforms to enable you to communicate and network with trenchless colleagues and friends while we wait out the daily changes in this situation.

The NASTT Board of Directors and Staff are determined, if possible, safe, and appropriate, to deliver an industry leading event in our 30th year. We are working to provide details as soon as a national recovery allows us to announce the information. We anticipate that it will be at the end of April before we have additional news on the direction we need to take.

We are also exploring options with our regional events as well as virtual experiences to provide a wide range of learning and networking opportunities for members.

The NASTT Staff have been able to continue operating as normal as the 'work from home' directive is how we work anyway! It has been great to be in touch with so many of you and hear about the many ways we are dealing with a unique situation.

As we put these events into place please use our social media platforms and visit your Talk Trenchless online community at talk-trenchless.nastt.org where there are various group discussions and forums with networking opportunities to allow you to keep in contact. We have set up a specific COVID-19 Resource Center with links to various supporting organizations giving helpful information and advice. We encourage members to post their recommendations to share experiences and assist others. In addition, we are offering free posting and searching on our Industry Job Board link page.

MAKING SURE OUR AMAZING ESSENTIAL SERVICES KEEP OPERATING.

We continue to share industry stories and news through our weekly e-newsletter and our website, nastt.org, is regularly updated with information. You can also contact us directly at info@nastt.org.

Trenchless technology globally is a special industry to be involved in. We are used to working at the cutting edge and reacting to circumstances outside of our control. We are proud to be your association through these times as we support each other.

Matthew Izzard
NASTT Executive Director

NORTHEAST REGIONAL CHAPTER

PORTLAND, ME
NOV 9-10, 2020

TRENCHLESS CONFERENCE

JOIN US THIS FALL
In Beautiful Portland Maine
for the 5th Annual
Northeast Regional Chapter Trenchless Conference
November 9 - 10, 2020

The NASTT-NE Board of Directors is actively monitoring the public health measures and on-going advisories to combat the COVID-19 pandemic.

Please check www.nastt-ne.org for updates regarding status of the November 10 Conference.

Save the Date!

Visit www.nastt-ne.org for further details on program information

FORMING A "CENTER FOR EXCELLENCE IN TRENCHLESS TECHNOLOGY AND UNDERGROUND ENGINEERING"

The University of Massachusetts Lowell is forming a **Center for Excellence in Trenchless Technology and Underground Engineering (CETTUE)** in collaboration with Purdue and Rutgers. The planned NSF-supported Industry-University Cooperative Research Center (IUCRC) would build long-term collaborative partnerships among industry, academia, and government to address industry-relevant, pre-competitive research needs.

The IUCRC provides significant value to the stakeholders including (1) identify and address real-world challenges through multidisciplinary research, (2) innovate and enhance trenchless methods and underground engineering practices, (3) access to intellectual property and pre-publication research, (4) serve as training partner for practice firms and public agencies, (5) develop a skilled workforce and prepare work-ready engineers, (6) investment leveraging, and networking. Potential interests of the Center include trenchless installations, material science, rehabilitation and repair methods, subsurface investigations, inspections, underground engineering practices, and securing critical underground infrastructure.

The proposed Center is actively seeking partners from industry and government agencies. If interested in learning more about this initiative, please contact Prof. Pradeep Kurup (Pradeep_Kurup@uml.edu) or Prof. Raj Gondle (RajKumar_Gondle@uml.edu) at UMass Lowell, or Prof. Dulcy Abraham (dulcy@purdue.edu) at Purdue University, or Prof. Nenad Gucunski (gucunski@soe.rutgers.edu) at Rutgers University.

BRISTOL COUNTY WATER AUTHORITY 2019 PVC SLIPLINING OF THE EAST BAY PIPELINE

By: Paul Smith, P.E., BETA Group, Inc.
Michael Crawford, P.E., Bristol County Water Authority

The Bristol County Water Authority (BCWA) provides water to approximately 50,000 customers in the Towns of Bristol, Barrington and Warren Rhode Island. The BCWA is a wholesale customer of the Providence Water Supply Board (PWSB). As such, BCWA receives 100 per cent of its supply from the PWSB through a conduit called the East Bay Pipeline. The East Bay pipeline was constructed between 1995-1998 through a series of contracts to address water quality and supply issues within the BCWA system. The East Bay Pipeline was constructed with two portions of the pipeline installed by means of horizontal directional drilling (HDD). The project addressed herein is associated with the longer of the HDD installations, a critical 4,300-foot crossing under the Providence River. This section of the transmission main was originally installed in 1998 by HDD though bedrock using a 24-inch welded steel main to a depth of approximately 170 feet below the river. At the time, it was the longest HDD to be attempted.

Critical 4,300-foot 24-inch welded steel main crossing under the Providence River originally installed in 1998 by HDD to a depth of approximately 170 feet in bedrock

In April of 2019, an alert was triggered resulting from a differential in two BCWA venturi meters located on either side of the Providence River. The differential in flow readings indicated that the East Bay Pipeline sprung a major leak, leaking approximately 400,000 gallons per day. Initial investigation efforts

THE EAST BAY PIPELINE IS THE SOLE CONDUIT SUPPLYING POTABLE WATER TO APPROXIMATELY 50,000 PEOPLE IN THE BCWA SYSTEM.

identified the leak to be on the west side of the Providence River in the Port of Providence parking lot, approximately 1,000 feet west of the Providence River shoreline. The leak arising within the Port of Providence offered a few challenges. The first being that the pipeline was the sole conduit which supplied potable water to approximately 50,000 people in the BCWA system. This meant the pipeline could not be easy isolated to accommodate the excavation work. However, even though the pipeline was leaking it was still functioning as the transmission main to the BCWA system. Another challenge was the location. The Port of Providence is a secure site with multiple documented environmental conditions, which a response would have to be take into consideration. This response would require coordination with multiple State regulatory agencies and the ongoing operations and security of the Port themselves. Given all of these conditions, BCWA reached out to Engineering Consultant BETA Group, Inc (BETA) as a partner to coordinate this effort and ultimately facilitate the repair of this critical water transmission main.

Based on the location of the active leak, it was believed that the pipe had likely sprung a leak at a failed welded joint beneath the parking lot. Since this main is the sole source of water supply for BCWA, repair efforts were going to have to be completed while keeping the main under pressure, actively leaking. To compound the repair efforts, the leak appeared to be where the existing transmission main had been installed by directional drilling methods. This meant that the main had to be located and excavated, to find the leak, all while the main was diving deep, at a 13 per cent slope at depths in excess of 10 feet. At this location, the main was within the water table, beneath mean sea level and subject to tidal fluctuations. The location is also a Rhode Island Department of Environmental Management (RIDEM) regulated site as it is a capped former municipal landfill. Due to this, construction efforts were going to require significant efforts to handle and control groundwater, tidally influenced groundwater and the actively leaking water main. This was not insignificant as all of this water had to be treated and discharged in accordance with applicable DEM discharge effluent limitations.

Two holes were found in the 24-inch steel pipe in bedrock approximately 170 feet beneath the surface of the Providence River

CCTV inspection of the main was critical to identifying the location and nature of the leak

Shortly after identifying the leak, BCWA coordinated with BETA to develop a Scope of Services with which to engage a Contractor. Ultimately, BCWA contracted with C.B. Utility Inc., to complete the emergency repair of the water main. Excavation work commenced in late April,

90- foot "Prover Piece" revealed an unanticipated issue as shreds of the host pipe's epoxy coating were sheared off during the pull and debris sucked into the PVC pipe

Pull head needed to be watertight so a concrete plug was fused onto the first section of pulled PVC pipe

in the parking lot to identify and repair the water main. Four deep sump wells were installed to facilitate dewatering and groundwater control before the main was excavated in an attempt to locate and repair the leak. Groundwater control and treatment proved difficult as each high tide would kick up significant amounts of sediment which silted up the groundwater treatment system. The main was ultimately located at a depth of 14 feet deep. However, the main was observed to have no apparent defects and active significant flow was still entering the trench from the eastern limit of the excavation. As such, additional excavation work, progressing eastward and deeper, was completed in an attempt to locate the defect.

At this time, BCWA received word that there was a possible sink hole within a golf course on the other side of the Providence River. The sink hole was 4,300 feet away at an elevation of 60 feet higher than the Port of Providence side. Following subsequent testing of the water within the sink hole, it was determined that the water was consistent with potable water and directly related to the active leak. The leak was not in the Port of Providence parking lot, but rather somewhere beneath the Providence River at a significant depth, with potable water conveyed through the rock tunnel to both ends of the tunnel. A televised inspection of the main was critical to identifying the location and nature of the leak. This information would also be critical in evaluating possible repair options. Shortly thereafter, a 2-inch corporation stop was installed on the main in Port of Providence and the main inspected using Pure Technologies Sahara camera which allows for CCTV inspection of active water mains. The camera utilizes a parachute that pulls the camera and camera cable down the pipeline using the existing water system hydraulics to suspend the parachute and drag the apparatus through the pipeline. Inspection revealed two small holes on welds approximately 1,800 feet into the pipeline or roughly in the middle of the river crossing itself. The larger of the two holes is believed to be approximately 1-inch in diameter. At this location, the main is in bedrock approximately 170 feet beneath the surface of the Providence River. The plan was to complete an inspection of the entire crossing, approximately 5,000 feet, in an attempt to document all defects that could impact rehabilitation or repair efforts. Unfortunately, as the camera came up on the second hole, the parachute got propelled with the flow of water into the hole, lodged and ultimately damaged upon removal from the hole, thus preventing any additional inspection of the pipeline. Therefore, approximately 2,500 feet would go uninspected.

Once the break was pinpointed BCWA contracted with BETA to design the repair of the pipeline. With the leak holding a steady flow, the BCWA decided that the repair efforts would best be completed in the fall months when system demand would be lower and emergency interconnections could support the shutdown of the transmission main. The BCWA had installed a 16-inch emergency interconnection with the City of East Providence in 2016. This interconnection is not large enough to provide sufficient water supply to BCWA during peak flow during the summer months but would support work in a lower demand period. This seasonal constraint provided BETA approximately 1 month to complete

Fusing of PVC pipe segments was done at the golf course on the East Providence side of the river

the design of the repair and prepare construction documents.

BETA evaluated numerous pipeline rehabilitation options; multiple sliplining technologies and materials were evaluated based on their installation requirements, hydraulic capacity and overall costs. BETA ultimately recommended sliplining the existing water main with an 18-inch DR 18 Fusible PVC Pipe. The Fusible PVC pipe solution provided for the best possible water system hydraulics and met the significant pressure requirements due to the depth of the existing water main beneath the river. Due to the unknown condition of the remainder of the water main, the project was bid to include CCTV inspection of the entire main and the pulling of a 90-foot "prover" piece. The purpose of the "prover" piece was to evaluate the condition of the PVC pipe once pulled through the existing host pipe. This information would be used to evaluate if the pull resulted in any significant defects to the pipe, and if any adjustments would be required during the final pull. The job was designed and bid over the months of July and August in order to allow for construction to be completed in the fall. The pipe was pre-ordered by the Owner in order to avoid any lead time issues which would have prevented the pipe from being installed in the scheduled timeline.

The project was bid in August and awarded to Biszko Contracting Corp. of Fall River, MA. In September, after the peak summer months, the 16-inch diameter interconnection between BCWA and the City of East Providence was opened to provide BCWA water during the repair. The existing 24-inch steel water main was shut down and the repair commenced. Prior to completing the sliplining, the entirety of the pipeline was CCTV inspected to ensure that there were no other issues that would be prohibitive to the sliplining itself. The inspection revealed no obstructions or additional holes beyond the two previously identified and the repair moved forward.

Pipe staging and fusing of the PVC pipe segments occurred at the golf course on the East Providence side of the Providence River. The PVC was fused into 450-foot lengths, 10 sections of pipe, and air pressure tested to 5 psi to confirm that there were no issues with the fused

PVC pipe was pulled from the golf course side of the river to the Port of Providence side. Sliplining pull completed in 3 days

joints. Biszko's horizontal directional drilling (HDD) subcontractor, Hemlock Directional Boring Inc., setup their HDD rig within the Port of Providence. Once the driller had extended his steel drill rods 4,300 LF to the other side of the river, the 90-foot "Prover Piece" consisting of two 45-foot lengths of PVC pipe fused to together was pulled through the host pipe towards the Providence side of the river. The prover revealed only superficial scratches to the pipe exterior. However, the prover did reveal an unanticipated issue. Once the drill head was removed it was discovered that a significant amount of debris consisting of pulverized pieces of the existing steel pipe's epoxy liner had been ground off the pipe, kicked into suspension and sucked into the PVC pipe during the pull. A solution to this issue was required before completing the final pull, as this material would significantly complicate disinfection of the new water main should this happen during the sliplining operation.

In order to complete a pull of this length, the PVC pipe needed to be ballasted to reduce the overall pulling forces required to trip the PVC through the steel host pipe. Initially, the plan was to pull the PVC pipe with an open-faced drill head. This would have allowed for the PVC pipe to fill itself during the pull, essentially ballasting itself during the trip. Unfortunately, the epoxy observed within the prover piece after the pullback eliminated this as a possibility. Ballasting from the tail was the only alternative, but the pull head now had to be made watertight. Numerous options were quickly evaluated to determine what could provide this watertight connection while minimizing the risks of migration due to the significant pressures anticipated during the pull. There was concern with using an inflatable plug, as the anticipated pressures could deform

PVC was fused into 450-foot lengths, 10 sections of pipe in total

the plug, causing the plug to migrate away from the head, lodging itself within the pipe in an irretrievable location. Ultimately, BETA and BCWA decided to install a concrete plug behind the drill head. To install the concrete plug, a section of PVC pipe was inserted into the drill head and locked in with the drill head pins. The head was then placed vertically, and the PVC was filled with a 8-foot concrete plug, with the pins locking the concrete in. The drill head with concrete plug was then fused onto the first section of PVC pipe to be pulled.

The sliplining pull was completed over the course of 3 days. The pullback process consisted of pulling of each 450-foot length, then filling the installed length from the tail to ballast the PVC section within steel host pipe. Once the entire pipe was installed, it was successfully pressure tested to ensure continuity following the pullback and intermediate fused joints that were not subject to the initial test. Grouting of the annular space was completed on each side to stabilize the PVC and seal off the ends which was particularly important on the Port of Providence side as the location was within the tidal fluctuation zone. The PVC pipe was then transitioned to ductile iron and permanent connections to the existing steel main were completed. The main was then flushed, disinfected, sampled and returned to service. The project was completed on time and on budget.

The investigation, repair, and rehabilitation of the Providence River Crossing of the East Bay Pipeline offered some unique challenges for the BCWA, BETA and Contractors to overcome. From the environmental conditions, the length, the location and the many stakeholders, these challenges required careful planning and coordination to ensure the timeframe could be met and the project as a whole could be a success. Many hours were spent by all involved supporting this effort. The rehabilitation of this section of pipeline will serve the BCWA system for many years to provide a reliable source of supply to the BCWA system.

ABOUT THE AUTHORS:

Paul Smith, P.E. *is Senior Project Manager at BETA Group, Inc. He has 17 years of experience in the water and wastewater Engineering fields. Paul specializes in the design of water distribution systems, wastewater collection systems, sewer separation projects, projects requiring trenchless technology, environmental permitting, and construction administration.*

Michael Crawford, P.E. *is the Deputy Operations Manager of the Bristol County Water Authority. Mike has over 15 years of experience in engineering and utility management industry. Spanning that time Mike has extensive experience in matters related to utility construction, water system management, planning, operation and maintenance.*

COMPLEX LINING PROJECT UNDER BROOKLYN'S GOWANUS CANAL IS A WINDOW TO HISTORY

By: Mario Carbone, Progressive Pipeline Management

Gas main infrastructure is extremely expensive to replace and in some cases near impossible. Since 2002, Progressive Pipeline Management has been installing the Starline® Cured In Place Lining trenchless technology for natural gas main renewal. The nature of lining and pipeline rehabilitation is that most of the time the pipeline is buried in the ground. After the job is done, we drive the roads over the lined pipes. Rarely would we stop to appreciate the painstaking complexity of the job. Gowanus was different in every way.

The rehabilitation project for National Grid was to line two 30-inch cast iron natural gas mains installed in the 1890s underneath Brooklyn's Gowanus canal. It was complex, nerve-wracking, fulfilling, historical, and in the end, fun. With a series of complex engineering challenges at every step, the entire project has taken more than three years.

We were dealing with a pipeline that starts 20 feet above ground, makes a sharp turn down into a shaft with a 30 foot vertical drop. The pipe has multiple bends and a bastard fitting inside a tunnel underneath the Gowanus canal. It travels back up the shaft on the other side. One challenge led to another. Lots of trial and error. A big headache was figuring out how to deal with a bastard fitting that was larger than the liner with an abrupt 90-degree angle. We had to reconfigure our equipment to line "upwards" instead of using conventional pits to line underground. Every little nerve-wracking step had to fall into place before we could move forward. Each challenge was faced and overcome one plan, one step, one segment at a time.

Tunnel underneath Gowanus is over 130 years old. Note the detailed brickwork on the walls

AT EVERY MEETING WITH NATIONAL GRID, I WOULD SAY, "I'M WILLING TO TRY IF YOU'RE WILLING TO TRY." AND THEY ALWAYS WERE.

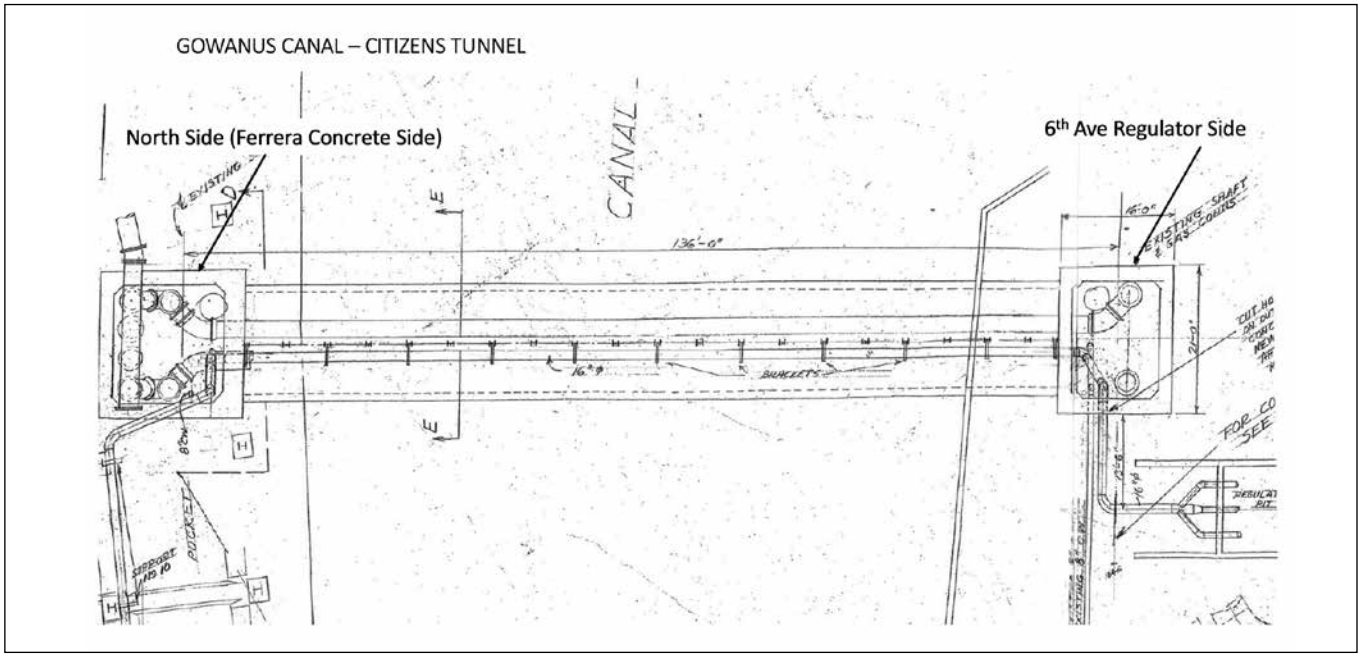
You know what kept me going? The history. Going into the tunnel is like stepping back 130 years. The brickwork in the tunnel is perfect, like a work of art. It's hard to grasp that just after the Civil War a group of men built the canal and then dug a tunnel underneath it. That's before power tools, cherry pickers or jack hammers. Then, in the early 1900s, three cast-iron pipelines were installed in the shafts and tunnel. All done with ropes, horses, wagons and muscle. If we had to build this today, the undertaking would be monumental.

Gowanus Canal is a 1.8-mile-long canal in the New York City borough of Brooklyn. The canal was completed in the late 1860s and became a hub of Brooklyn's maritime and commercial activity. By the 1880s it was a key location for concentrating heavy industry, coal gas, manufacturing plants, oil refineries, machine shops, chemical plants and more. There were also residential communities where workers lived.

More than once I thought, "If our ancestors could build this tunnel and install the pipes, then we should be able to figure out how to line it so they'll last another hundred years."

ENGINEERING & DESIGN

The sketches National Grid handed us were around 100 years old. The detail was perfect, showing the overhead view and tunnel. The



Sketch from National Grid showing both shafts and pipelines are over 100 years old

pipes enter the shaft, make their way down the shaft until we get to the bottom of the tunnel. The two 30-inch pipes and a smaller one are detailed in the sketch. In the tunnel, you can walk from shaft to shaft alongside the two pipes. The north side of the canal has the Ferrara Concrete company and the south side has a regulator station.

A major headache and source for numerous engineering discussions surrounded the bastard fitting with a 36-inch drip on the North side. The bastard fitting was an odd shaped unconventional fitting with two big problems for us. One, the drip is larger in size than the 30-inch liner going in. Drips were designed to catch liquids that are in the gas stream. Today these drips are obsolete because the natural gas process is much dryer.

Back to our history lesson. When this pipeline was built 100 years ago, natural gas was made from coal and refined to extract the gas. That extraction process was wet. Over time, the liquid in the gas would drop out into the pipeline and gather at the bottom. The drip would catch all the liquid and the fitting would connect to a pump and would extract the liquid that was collected in the drip.

As a turnkey project, PPM ran the job from soup to nuts with close observation from National Grid. It began with engineering. National Grid tasked PPM to run the entire project due to the highly complex nature of the project. Our construction and engineering partner was Bancker Construction. They did the digging, acquired the material, equipment and manpower.

The second problem on the bastard fitting was that the 90-degree angle was too abrupt for the lining to adhere and cure. It took a great deal of time to come up with the best scenario to approach it. Upon investigation, we realized that removing the fitting wasn't an option. At the right end of the fitting are two flanges bent in towards each other at 22 ½ degrees. They depend on each other for thrust blocking. The pressure in the pipe is pushing on the other flange in the other direction. If we had removed a flange, it would hinder the other's ability to support itself.

The solution was to remove the two 15-foot vertical segments of pipe to give us access to the bastard fitting. They were then lined separately above ground. The segments were to be reinstalled at the end, after lining the pipe. We needed to get our equipment in to start working on the solution for lining the horizontal drip.

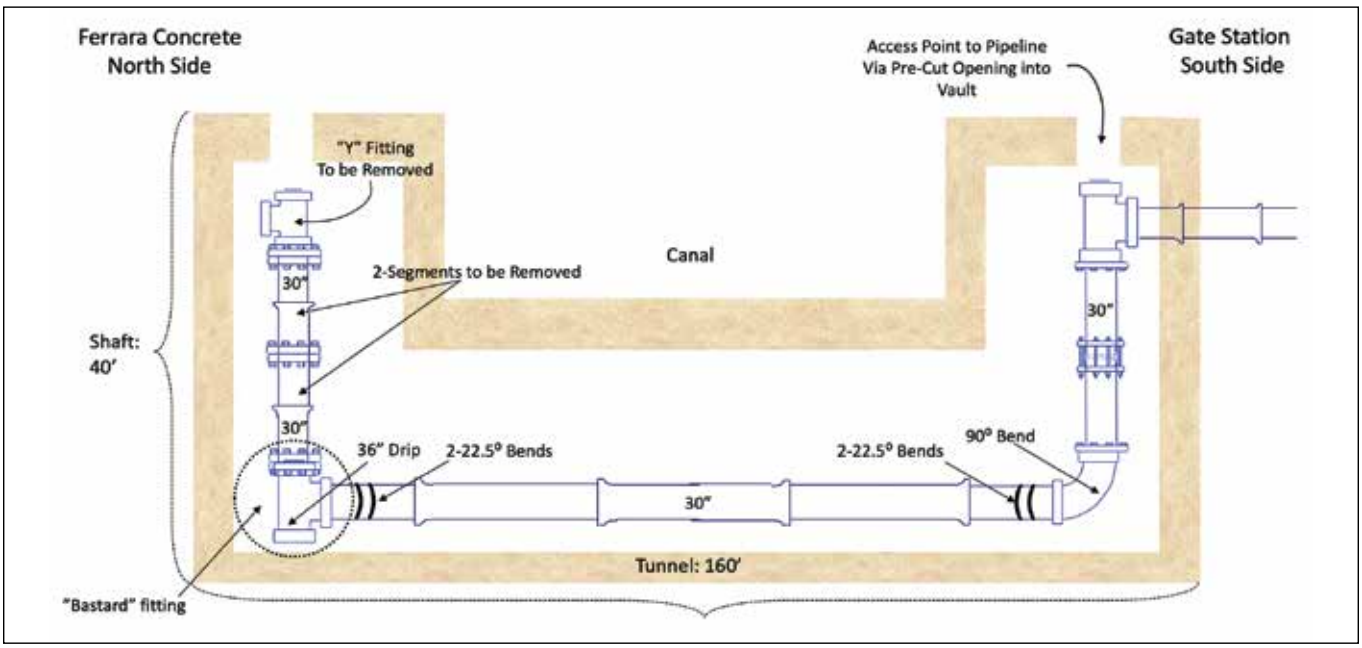
AGGRAVATION OVER CONDENSATION

The pre-cleaning CCTV inspection revealed that the pipeline was oily. EPA rules and regulations dictate how we dealt with it. We used an environmental company to wash and decontaminate the pipes. All liquids and the oils had to be disposed of in an environmentally safe way.

The next problem was drying the pipeline. Usually, drying was no big deal. We dry the pipe by pulling in fresh air from one side to the other with a giant vacuum truck. After a day or so, it would dry.

It was summer of 2017 with the outside temperature in the 80s. Inside the tunnel was in the low 40s. As we brought warm air into the tunnel, it started to rain inside the pipe. We were bringing warm outside air into a cold environment. The amount of condensation that we were creating was counterproductive. The issues of temperature change from outside to inside the tunnel caused a nightmare.

After a day or so of pulling the hair out of my head, I decided to turn it around and pull the cold air from the tunnel into the pipe and out into the atmosphere. We hired Montauk Services who introduced a system using a compressor to draw the moisture out of the pipe. It helped, but so much time had lapsed that we decided to come back in the winter when the temperature outside and inside would be closer. There was so much condensation, we had to repump, dispose of the liquids and dry all over.



Schematic shows a side view of pipeline segments to be removed with the shafts, bastard fitting, and tunnel under the Gowanus canal

CARBON FIBER REINFORCEMENT

One further large problem had to be addressed. On the south side of the canal, at the access point, the opening on the horizontal and vertical portion, was a 30-inch "T." There was a gap in the pipe inside the 30-inch pipe. When lining, without reinforcement, part of the liner would be exposed. To solve that problem we installed a carbon fiber reinforcement, one of the strongest products that PPM has developed. It's stronger than steel and very durable. We made the sleeve, then we installed a bladder, that acts like a balloon inside it. The balloon squeezes the carbon fiber tightly to the pipe and is inflated so the carbon is tightly fit. After it dries, it is deflated and removed. This "bridge" was installed so that the liner would not burst during installation.

BUILDING A 90-DEGREE FITTING

The final step in preparation for lining was to build a 30-inch, 90-degree bend fitting. We had to build it with "feet" so the 90 could rest on the top flange without damaging it. The liner would protrude out from and across that gap. When it was lined, we needed to cut the liner physically and remove the 90. Without "feet" there would have not been a way to separate the 90 and the top T section. We lined through the 90, across this gap and into the section that had the carbon fiber. The feet rested on a wooden gasket made out of plywood. It was a cheap solution that gave a buffer for the feet to rest on so they would not damage the cast-iron gasket beneath.

LINING UPWARDS TOWARDS THE PIPELINE

The 90-degree bend had to be anchored to two traffic plates. As the liner goes into the 90 degree bend fitting, it would push forward. The liner could not turn easily or make the bend. The thrust would have broken the feet and possibly broken the flange, which would have done a world of damage. We needed to support and overtake the thrust power of the inversion, which led to another innovation. Traffic plates and straps were mounted and calculated to be greater than the thrust power.

Final preparations were in place to line upwards to the 90 degree bend, instead of the conventional down, towards the pipe. The

Liner is being inverted as transfer hose is held up by a cherry picker towards the pipeline

drum is 12 feet tall. The liner with adhesive inside is connected to the drum. There are stainless steel rollers in the drum. We had to hold the transfer hose up at the same time with the backhoe just to get it in position.

To hold the hose with the liner, a cherry picker had to be rigged to hold the inversion head onto the 90 while the liner was inverting. Bancker provided the cherry picker to lower and lift the equipment in and out of the tunnel. The moment we pressurized the hose, it wanted to go forward. We had to go back and forth with minor adjustments to the pressure and change the speed of the inversion process. After all the prep, it only took a day to line about 200 feet, down the shaft, across the tunnel and back up the vertical on the other side of the canal.

Vertical segment with carbon fiber sleeve that inflates, pushing the liner against the wall of the flange liner to cure and adhere to the pipe wall

INNOVATING TO DEAL WITH FLANGES

One of the final steps was to install the two vertical segments in front of the bastard fitting that had been lined separately. Once again, there was a problem that needed custom design and engineering. The vertical segments had flanges on each end. When the sections were installed, the flanges would touch and the liner couldn't adhere properly to the wall of the pipe. The solution was to add extra inches of liner protruding to cover up the other flange. When we brought the pipe down to meet the other pipe, the extra liner would encompass it and seal. The inflatable bladder was used again to push against the wall of the flange.

Nothing about this job was typical. Almost daily, we were designing and creating solutions and retrofits. It was nerve-wracking, as we were never completely certain our solution would work. We would decide on a particular approach and explain to them 'this is what we think will solve the problem.' At every meeting with National Grid, we made sure they understood that we were trying things for the very first time. I would say, "I'm willing to try if you're willing to try." And they always were.

AFTER ALL THE PREP, IT ONLY TOOK A DAY TO LINE ABOUT 200 FEET

Bill Howe, the National Grid Project Manager said it the best: "Citizen's Tunnel Lining was one of the most complex projects our department faced. It started with identifying the existing conditions of the cast iron pipe, installed back in the 1920's. The lining process involved a challenging inversion through the vertical section in the access shaft, and complex custom fittings to align to the existing pipe. Teamwork and PPM's engineering and product expertise were invaluable to the success of this job."

What made it fulfilling was overcoming the challenges. Perhaps that's the way our forefathers built the tunnel and laid the cast iron pipe 130 years ago. They faced each challenge, designed a solution and forged ahead one brick at a time.

ABOUT THE AUTHOR:

Mario Carbone's *ingenuity and perseverance define his leadership. His decades of experience enable PPM to design, develop and test new technologies and robotics while complying with required industry standards. He spent thirty two years in design, maintenance and construction with Brooklyn Union Gas/KeySpan Energy and ten years as the senior manager for gas research and development with KeySpan Energy. Mario is versed in current regulations for corrosion and pipeline environmental procedures. His inventiveness to overcome challenges led PPM to win the Trenchless Technology Project of the Year.*

VICTORY IN VERMONT:

Three Hard Rock Crossings Completed On Line, On Grade, and On Time

By: Desiree Willis, The Robbins Company

SBU-M launched from a 40-foot deep shaft right in the middle of town

Vermont's Middlebury Rail and Bridge Project is no small task – requiring bridge demolition and construction of a new rail tunnel, a new drainage system, and roads for temporary access. And to top it off, construction is being done in the heart of downtown Middlebury, a historic New England college town of 8,700 people.

To compress the project schedule, multiple contract packages are being let out over three years. Local contractor Engineers Construction, Inc. (ECI) was subcontracted to bore three drainage tunnels as part of the Early Work Package 3 (EWP3), a contract that included the drainage system. These tunnels, excavated below the downtown historical district in solid rock, were successfully bored under strict line and grade requirements using a motorized small boring machine, known as an SBU-M.

RE-ESTABLISHING THE RAIL CORRIDOR

Middlebury, on the western side of Vermont, is a historic mill town home to Otter Creek (a 628-sq-mi. drainage area), the convergence of three major state highways, and Vermont's western rail corridor, all within the downtown area. The new project is arguably one of the biggest projects owner VTrans (Vermont Agency of Transportation) has undertaken because of its scope: rail, drainage tunnels, and two bridges, all through a downtown area that is on the National Register of Historic Places. But the benefits of the project outweigh its impacts: "In the 1840s it was desirable to build the rail through the center of town. 175 years later, this project will allow riders to get on a train in downtown Middlebury and ride all the way down to New York City's Penn Station on Amtrak's Ethan Allen service," said Jim Gish, Community Liaison for the Town of Middlebury. In addition to the state-of-the-art rail tunnel and rebuilt downtown rail corridor, Middlebury will benefit from new infrastructure for water, sewer, and stormwater drainage lines.

The three-year project, set to finish in 2021, evolved from a specific set of circumstances. In the center of town, there are two roadways that cross over the rail corridor using two bridges originally built in the 1920s. "It is the State of Vermont's responsibility to maintain all crossings of the western corridor rail line. The bridges were shown to be deteriorating, so these were then demolished and temporary bridges were put in place in 2017. Because the two bridges cross the rail line, federal regulations about the required height between top of the rail and the bridge came into play. "We realized the tracks had to be lowered to accommodate these federal standards, and so the project grew to include replacement of the downtown rail corridor as well," said Gish. The Town of Middlebury and VTrans discussed the options, ultimately deciding on a precast concrete tunnel, constructed by cut & cover methods, that would replace the two bridges. A 3500-ft-long section of the rail line downtown would also be rebuilt, and lowered by about four feet total, thereby significantly increasing the drainage requirements. Over the top of the construction area, a newly landscaped park would then be constructed between the locations of the former bridges.

Early Work packages for the project included demolition of the existing bridges and construction of temporary bridges (EWP2) as well as the drainage system construction (EWP3). In 2018, general

contractor Kubricky subcontracted ECI for the series of three drainage tunnels. The tunnels would be bored upgrade north and south along the rail corridor while a third tunnel would be bored downgrade and terminate at nearby Otter Creek as an outlet.

CHOOSING THE TUNNELING MACHINE: THE MOTORIZED SMALL BORING UNIT (SBU-M)

ECI, a Vermont-based, 54-year-old heavy civil construction contractor, had experience with a variety of trenchless equipment. The line and grade requirements, combined with the predicted geology of 20,000 psi Unconfined Compressive Strength (UCS) marble, necessitated hard rock tunnel boring machines. "We worked with the general contractor to create a budget, which was a three-year process. The state hired an engineering firm and an independent cost estimator, we had a risk registry, it was quite a process," said Tom Loyer, Project Manager & Estimator for ECI's trenchless division.

Specifically, ECI had used Small Boring Units (SBUs) manufactured by The Robbins Company on several projects over the years. The equipment ranges from hard rock boring attachments, that work in conjunction with Auger Boring Machines (ABMs), to self-propelled tunnel boring machines, all of it under 78 inches in diameter. "SBUs were the plan from the beginning. We made some changes during the process – the carrier pipe was originally a 2-pass system using Hobas or Reinforced Concrete pipe, which we later changed to Permalok casing. We went through different casing diameters but we were always planning to use the SBU-M," said Loyer. "Our line and grade requirements, along with a layer of clay that we knew we would encounter on drive three, were also important factors in our decision."

> **"I FIND IF YOU GIVE PEOPLE THE UNVARNISHED TRUTH THEY APPRECIATE THAT"**
>
> **- JIM GISH, COMMUNITY LIAISON, TOWN OF MIDDLEBURY**

The SBU-M, or Motorized Small Boring Unit, is a motorized, manned-entry rock and mixed ground boring attachment meant to bore in geology such as dry alluvium or rock with UCS of 4,000 psi to over 25,000 psi. It is made for use with any Auger Boring Machine from 48-inch to 78-inch, or any standard pipe jacking unit.

The SBU-M uses a hydraulic or electric motor to generate torque while the circular cutterhead, mounted with disc cutters or mixed ground tooling, excavates the ground.

For spoil removal, an invert auger enclosed in steel casing runs beneath the bearing housing and drive motor assemblies. To seal off the cutterhead and protect the motor, a steel bulkhead is added to direct the rock chips into the invert auger.

Made for line and grade sensitive projects, the SBU-M can be steered continuously, either from the bore pit or from an operator's console within the machine's shield. A laser is set up in the back of the bore pit and projected onto a target inside the machine. The operator can then control the machine using stabilizer pads and hydraulic articulation cylinders that pivot the machine on an articulation joint.

A LAUNCH SHAFT IN THE MIDDLE OF TOWN

For the EWP3, the machine was launched from a 40- foot deep shaft in the middle of town, requiring not only a fine-tuned construction operation, but also community buy-in. "VTrans sees the value in having a point person in the community to work between businesses, construction companies, and

No cutter changes were required over the course of the three tunnels

With launch shaft construction next to the rail line, in the heart of downtown Middlebury the project was firmly in the public eye

"WE FINISHED ON LINE, ON GRADE, AND ON TIME. EVERYONE WORKED HARD AND WORKED TOGETHER, IT WAS GREAT."

- TOM LOYER, TRENCHLESS PROJECT MANAGER & ESTIMATOR, ECI

Mining rates were as high as 20 feet in one day and 3 feet in one hour

residents. I publish a weekly blog (www.middleburybridges.org) that brings the community up to date, and keeps everyone apprised of what is happening, meetings, and construction news," said Gish.

With launch shaft construction sitting squarely between the National Bank of Middlebury and the town's post office, and right next to the rail line, the project was firmly in the public eye. Receiving pits on to the north and south also had to be excavated to a depth of 30 feet to allow for the 140- to 150-foot runs below ground. "The community was very interested in the blasting going on down in the bedrock. People actually wanted to see the process, but it was highly controlled blasting, so it was not as eventful as they were hoping. That's why in the blog every week we would give them an update on the blasting and then how far the machine had gone once it launched. It was fun for the community to follow the progress, and it took some of the anxiety out of it. People were worried about their buildings and they realized the guys doing the work were very professional, and were knowledgeable about blasting procedures and impacts. I find if you give people the unvarnished truth they appreciate that," said Gish.

With further measures including reduced boring hours from 7 AM to between 3 and 5 PM daily, and vibrational monitoring, the community got on board with the construction. Controlled blasting required all activity to shut down for 15 minutes before each of 18 blasts in a coordinated effort. Vibrations were ultimately not enough to be of concern, although minor vibrations from the boring machine were reported by people at the National Bank of Middlebury.

SUCCESSFUL TUNNEL EXCAVATION

The 60-inch diameter Robbins SBU-M was launched on August 22, 2018 from the 36 foot deep, 40 foot diameter shaft and took 30 days to bore 140 feet. "We had a Robbins technician on site for the duration of the project, who cross trained our people," said Loyer of the launch and excavation process.

The TBM averaged between 1 and 2 feet an hour cutting through solid rock, and somewhat less when making its way through a seam of mixed dirt and rock. "In drive 1, we hit a small vein of clay that the geotech report did not see, but we worked through it. It got us off grade but we backed up and recut the bottom of the tunnel and we were fine. It wasn't a major challenge," said Loyer.

After being transported back to ECI's shop for inspection, the machine was then launched on a 152 foot long bore that would make the southern leg of the drainage system. The second tunnel was completed in significantly less time than the first stretch of tunnel.

"ECI and Robbins learned from their experience on that first run and it helped that the second run was entirely in bedrock," wrote Gish in a blog entry. "This won't be the case with the third and final run to Receiving Pit 3, where bedrock turns to a mix of rock and clay about 100 feet in."

The final 139 foot long tunnel makes up the northern leg of the new drainage system, and was found to include a section of sticky clay, which was verified during construction of the receiving pit. Contractor Kubricky hit the clay just five feet down from the surface. The clay was again encountered during excavation: "We hit a 20 foot layer of clay. We had one long 18-hour day, where we lost our ability to steer but were able to push through the heavy clay using water injected through the cutterhead for lubrication," explained Loyer.

Despite the challenges, the machine made its final breakout on November 13, 2018, about one month ahead of the overall construction schedule. In the course of 12 weeks, the TBM had drilled its way through 442 feet of bedrock, mixed ground including soil and rock, and a challenging final stretch of sticky clay. Excavation rates averaged 1.5 to 2 feet per hour, and, were as high as 20 feet in one day and 3 feet in one hour.

"We finished on line, on grade, and on time. Everyone worked hard and worked together, it was great. The Robbins personnel were great," said Loyer. The TBM holed through within one inch of line and two inches of grade, and well within the set project limits. Though ECI had extra disc cutters on site, no cutter changes were required over the course of

Middlebury will benefit from new infrastructure for water, sewer, and stormwater drainage lines

the three tunnels. "At the end of each drive we analyzed the cutters and they looked great throughout."

WORK STILL TO BE DONE

With drainage tunneling complete, the main railroad tunnel work is set to begin soon. "The main project starts in summer 2019," explained Gish. "The main contract covers the construction of the rail tunnel and the reconstruction of the 3500 foot long downtown rail line. Before they construct the rail line they also need to put in minipiles, tiebacks, and sheeting, to prevent abutments from collapsing as they dig down. This work will wrap up in late 2019. Then in Summer 2020, our two downtown roadways will be closed for a period of 10 weeks and rail will be rerouted through the eastern side of the state while we are shut down." Vehicle traffic will be rerouted as well around the town center as crews work 24/7 to reconstruct the rail line, remove the temporary bridges, and construct the rail tunnel. Once the construction is done and transportation restored, the focus will turn to the landscaping of new parks in the construction areas and other finishing touches.

For Gish, the project's success is a testament to the good cooperation of all parties involved: "It is essential in a project of this magnitude to have a positive partnership between the local community, the contractor and governmental agencies. That has paid big dividends as we've gone through the project. We have a common understanding of our goals and how they will be achieved."

NOTE: This article originally appeared in the May 2019 issue of Trenchless Technology. It can be viewed at TrenchlessTechnology.com.

ABOUT THE AUTHOR:

***Desiree Willis** is Public Relations Manager at The Robbins Company, a developer and manufacturer of advanced, underground construction machinery. With more than 67 years of innovation and experience, Robbins has supplied equipment to hundreds of tunnel boring projects around the world.*

WELCOMED IN - ONE STUDENT'S STORY ON ENTERING THE TRENCHLESS TECHNOLOGIES FIELD

UMass Lowell NASTT Student Chapter

By: Joseph Pietropaolo and Dr. Raj Kumar Gondle (Faculty Advisor)

Students touring the GLX site

An opportunity was given to a student to conduct an independent study on trenchless technologies. Two professors, Dr. Raj Gondle and Dr. Pradeep Kurup, have overseen a graduate level course, formally known as "Special Topics in Civil Engineering," allowing for an open-ended curriculum best suited for faculty and students committed to certain fields. The NASTT Student Chapter at UMass Lowell encourages students to learn more about trenchless technologies.

Truth be told, when considering the four civil engineering specialties I knew before coming to UMass Lowell (geotechnical, structural, environmental, transportation), geotechnical would have been ranked lowest priority. For some reason, it was hard for me to find resources that explained the discipline in a comprehensive but accessible manner. Nothing remotely close to trenchless technology came up either. But that's because I did not know what to look for. Once I completed the transfer from my local community college and came to UMass Lowell, majoring in civil engineering, there was far more exposure, particularly to geotechnical engineering.

Along with Professor Gondle, who I met during my Fall 2018 semester, there were classmates I met that gave me brief but insightful introductions on the activities of the NASTT Student Chapter. Schedule conflicts prevented me from attending regular meetings of the chapter, so for two semesters, I bided my time, but didn't lose track of two newly formed goals: joining the NASTT Student Chapter and potentially seek a career in trenchless technology. After a year passed, I took the chance to attend a more critical meeting where the student chapter held officer elections, and with great trust from my classmates, I was elected to the secretary position based on my participation and enthusiasm. All officers took an oath to follow the constitution of the student chapter, established by the governance of the UMass Lowell student community.

Pipe bursting demonstration in Syracuse

A CAREER IN TRENCHLESS TECHNOLOGIES MAY OFFER FULFILLMENT FROM INVESTING TIME ON BENEFITTING PEOPLE

The opportunity to see field demonstrations and attend presentations at the NASTT Northeast regional conference in Syracuse, NY was an excellent setup for what has come next. My intent is to take two professional electives in my areas of interest; this will provide prior knowledge before applying for internships or full-time positions.

So how does the "special topics" course help me do that?

My special topics course is run as an independent study where I meet my professors biweekly or as needed with a technical report on a given trenchless topic and a related presentation. This class structure is unique in that it has flexible meeting times, meaning it can fit into my current school schedule with no conflicts. For each trenchless topic, I am

Centrifugally cast concrete lining demonstration in Syracuse

given direction on the focus upcoming report and related literature, including NASTT No-Dig technical papers, regional journals, NASTT Good Practices Guidelines, and other pertinent sources.

The topics covered include in this independent study include but are not limited to: an introduction to trenchless technology, geotechnical considerations, new installations, condition assessment, rehabilitation, risk-based engineering and management, critical underground infrastructure, and new materials/ developing technologies. It has been important to synthesize the information from Good Practices Guidelines and other published information in writing a good technical report. Based on found literature, I was surprised to learn that trenchless technology had its roots in the 1970s with the National Association of Sewer Service Companies (NASSCO), which wanted to increase awareness on pipeline rehabilitation through education, industry partnership, resources and advocacy. I also learned the NASTT is part of a greater society, founded in the UK in 1986 called the International Society for Trenchless Technology (ISTT).

Taking a small detour, my next report covered the trenchless technology market. I included sections on China to show a global perspective; business, research, and developments are some of the ways the world comes together. While the United States still has the largest market for pipe rehabilitation, other countries, mostly in East Asia, are expected to have high growth over the next few years.

Several case studies were reviewed to understand the significance of geotechnical considerations in trenchless projects, including regional geology, related tests, and how they influence project outcomes. Information was found on Delft's Equation, used to determine the maximum stress a soil can withstand before fracturing, brought stress elements and Mohr's circle up to my attention again. Delft's equation also incorporates effective stresses and pore water pressures; I ended up learning

more about these variables in my soil mechanics course days after reading the paper. This reaffirmed the trust I was placing in my education to prepare me for a future career.

My curiosity extended to the challenges faced by contractors and how they succeeded or failed to overcome them. Complications in glacial varves or poorly graded dry soils made me aware how complicated it must be to pair a method with ground conditions. One study involved speaking with contractors and engineers on the risk factors associated with different installation methods such as excessive shaft dewatering, potential over-excavation, and soft ground unfit for steering in. Soil settlement was the most frequent concern I had read about. Before writing this article, or even starting this course, it felt obvious that ground conditions would be a serious consideration in trenchless designs and practices. Fortunately, every paper I reviewed succinctly emphasized the importance of geotechnical reports.

There has also been an opportunity to attend the NASTT No-Dig show and Good Practices courses run by industry leaders. It complements the experiential learning from visiting field sites like the Green Line Extension (GLX) in Boston and presentations held at UMass Lowell featuring members of industry; these resources improve a student's understanding of a future career.

While the focus of trenchless technology appears niche, it has an ever-increasing depth to its testing, means, and methods for addressing an area of society that deserves serious attention. For me, trenchless technology provides a chance to find a career that addresses the issues that made me want to become a civil engineer in the first place. I began hearing more frequently about failing underground infrastructure from sources like the ASCE in the years after high school. From what I knew before, projects on a large scale (for example, the Interstate Highway Act) could provide great social benefit, with positive economic impact coming from bringing everyone together around a common goal. In the long run, a career in trenchless technologies may offer fulfillment from investing time on efforts benefitting people by the thousands or more.

ABOUT THE AUTHORS:

Joseph Pietropaolo *is a senior in the Civil and Environmental Engineering program at the University of Massachusetts Lowell (UMass Lowell). He is the current secretary for UMass Lowell's NASTT Student Chapter. Along with undertaking an independent study in trenchless technology, Joseph is also a research assistant on a project to recalibrate safety performance functions for intersections in the state of Massachusetts.*

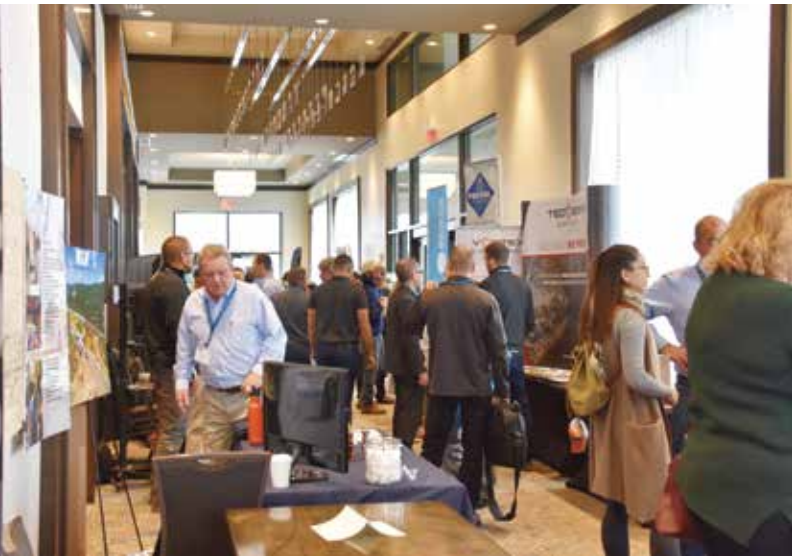
Dr. Raj K. Gondle *is an Assistant Teaching Professor in the Department of Civil and Environmental Engineering at the University of Massachusetts Lowell (UMass Lowell). He serves as a faculty advisor for North American Society for Trenchless Technology (NASTT) Student Chapter.*

FOURTH ANNUAL NASTT-NE NORTHEAST TRENCHLESS CONFERENCE 2019 – ANOTHER GREAT SUCCESS!

Another Year of Record-Setting Attendance!

More than 150 trenchless professionals, municipal attendees, industry exhibitors and students gathered at the Embassy Suites by Hilton Destiny USA in Syracuse New York on November 12 for the fourth annual North American Society for Trenchless Technology Northeast Chapter (NASTT-NE) Trenchless Conference & Municipal Outreach Forum. Attendees were relaxed and in good spirits after a Social Event the night before at the world famous Dinosaur Bar-B-Que in downtown Syracuse.

Ian Mead, outgoing Chapter Chair, moderated the day's proceedings, which started with departing NASTT Executive Director, Michael Willmets, delivering opening remarks about the growth of trenchless technology and development of the NASTT organization during his twelve years at the helm. He praised the



Delegates had easy access to 26 trenchless technology exhibits and numerous industry experts

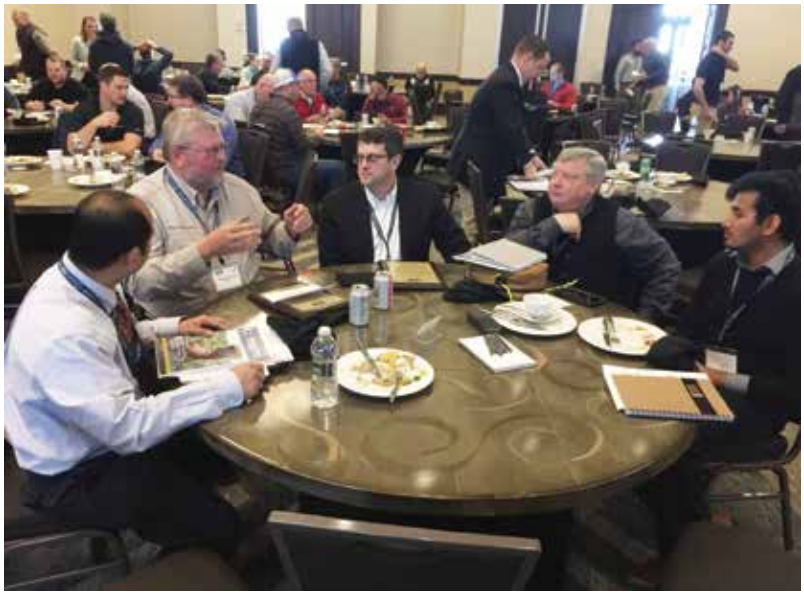
More than 150 delegates gathered for a full day of trenchless technology education and networking

Northeast Chapter membership as one of the most dynamic and forward-looking regional NASTT Chapters showing tremendous growth and focused outreach activity since founding only five years ago. Mike's remarks were followed by a presentation from the UMass Lowell NASTT Student Chapter on their yearly activities including a field site visit to 102-inch aqueduct sliplining project in Providence RI.

Throughout the day, sixteen papers were presented in two concurrent tracks covering a wide range of trenchless technology topics and applications featuring underground infrastructure rehabilitation techniques, new installations, investigative methods, equipment innovations and construction best practices. The afternoon technical sessions concluded with a roundtable discussion on HDD Best Practices, including frack-out planning

Outgoing NASTT Executive Director Mike Willmets commended the NASTT-NE Chapter membership for their efforts

Outgoing NASTT-NE Chair Ian Mead welcomed delegates to the 4th annual conference



Networking and close personal access to industry expertise is an important aspect of the annual NASTT-NE Conference

Roundtable panel discussion on "HDD Best Practices" was a fitting end to a busy day of seminars. From left to right: Mark Kwilinski, George Ragula, Romeo Shiplee, Dennis Doherty, Mike West, Brian Dorwart

and mitigation. All the proceedings are publically available for download from the NASTT-NE chapter website: www.nastt-ne.org.

A highlight of the one day event were the mid-morning live demonstrations bravely carried off between bands of snowfall by area trenchless contractors. A crew from Centerline Trenchless Construction located in Blossvale NY, gave a pipe bursting demo and workers from Arold Construction, based in Kingston NY, demonstrated the application of centrifugally cast concrete on a length of CMP. The NASTT-NE Chapter Board extends appreciation to both these companies for taking time from their busy workdays to mobilize crews to share their technology and

Seminars covered a wide range of trenchless subjects and were intensely followed by conference delegates

UMass Lowell NASTT Student Chapter members Steve Fallon (left) and Liam Henderson (right) describe field visit activities, and the lessons learned

Distinguished Service Award presented to Ian Mead, outgoing NASTT-NE Chair (right) from Babs Marquis, incoming NASTT-NE Chair (left)

expertise with conference attendees. We are grateful for their willingness to step up and support our cause.

Another highlight of the one day event was the lunch time presentation by Shannon L. Harty, PE; Deputy Commissioner at the local Onondaga County Department of Water Environment Protection, Syracuse NY, who outlined their county wide condition assessment program and gave insight into their future water and wastewater capital improvement planning. Following her thorough-going and entertaining speech, she was presented a plaque of appreciation by outgoing NASTT-NE Chair (and incoming Past-Chair!), Ian Mead, Tighe & Bond, and incoming NASTT-NE Vice Chair, Eric Schuler, City of Oneida, who is the former NASTT-NE Treasurer. Many thanks for an excellent lunch hour presentation!

Award for the annual 2019 NASTT-NE Paper of the Year was accepted by co-authors Brian Lakin, McMillen Jacobs Associates,

UMass Lowell Student Chapter members such as Joseph Pietropaolo (left) and Jorge Calmo (right) provide invaluable logistical support for the Conference

Outgoing NASTT Executive Director Mike Willmets (center) support of the NASTT-NE Chapter during its growth phase is warmly appreciated. A token of gratitude was presented by incoming NASTT-NE Chair Babs Marquis (left) and by outgoing Chair Ian Mead (right)

Shannon L. Harty, PE; Deputy Commissioner of the Onondaga County Department of Water Environment Protection, Syracuse NY, (center) receives Plaque of Appreciation from Ian Mead, outgoing NASTT-NE Chair (left) and NASTT-NE Vice Chair Eric Schuler (right)

NASTT-NE 2019 Paper of the Year Award Co-Authors Lawrence Marcik, P.E., South Central Connecticut Regional Water Authority (center right), and Brian Lakin, McMillen Jacobs Associates, (right) receive award plaques from Ian Mead, NASTT-NE Chapter Chair (center left), and Dr. Raj K. Gondle, NASTT-NE Paper of the Year Selection Committee (left), for the paper "Great Hill Tunnel Rehabilitation: A Comparison of ROV and Manned "Inspections of a 1927 Water Tunnel"

Excellent lunch hour presentation by Shannon L. Harty, PE; Deputy Commissioner of the Onondaga County Department of Water Environment Protection was a highlight of the day's proceedings

and Lawrence Marcik, P.E., South Central Connecticut Regional Water Authority, for their 2019 NASTT No-Dig Paper entitled *"Great Hill Tunnel Rehabilitation: A Comparison of ROV and Manned Inspections of a 1927 Water Tunnel"*. (NASTT-NE Journal, Fall, 2019 pp18-28).

At the end of the day, Ian Mead was given the Distinguished Service award for his two years leading the organization as NASTT-NE Chapter Chair. Outgoing NASTT Executive Director Mike Willmets was also presented with an engraved table clock as a token of appreciation for his abiding encouragement and support of the NASTT-NE Chapter. The day ended with a concluding address from incoming NASTT-NE Chapter Chair Babs Marquis

The fourth annual Northeast Trenchless Technology Conference was held at the friendly and spacious Embassy Suites by Hilton Syracuse Destiny USA, adjacent to Destiny USA, destination mall in upper state New York, and largest shopping mall in the state. Conference attendees had up close regular access to 25 industry exhibitors available to converse with attendees, providing up to date technical information and details on the latest trenchless technology innovations.

Crew from Centerline Trenchless braved the weather to give pipe-bursting demonstration

THE NASTT-NE CHAPTER BOARD OF DIRECTORS THANKS EVERYONE FOR THEIR PARTICIPATION IN A VERY SUCCESSFUL FOURTH ANNUAL NASTT-NE NORTHEAST TRENCHLESS CONFERENCE.

In keeping with the NASTT-NE Chapter training and educational goals, Dr. Raj Kumar Gondle, lecturer and faculty advisor for the UMass Lowell Student Chapter, along with Dr.Pradeep Kurup, and student members, met industry professionals at their exhibit booths, participated in the conference as presenters, and also provided logistical support

Live field demos are a regular conference highlight. Arold Construction demonstrates centrifugally spincast lining

BUILDING ON FOUR CONSECUTIVE YEARS OF SUCCESS THE NASTT-NE CHAPTER CONTINUES TO HOLD ANNUAL CONFERENCE EVENTS AT VARIOUS LOCATIONS THROUGHOUT THE VAST AND BEAUTIFUL NORTHEAST REGION.

for the conference, such as staffing the registration table, and other help as required. Drs. Gondle and Kurup also announced the formation of the new **Center for Excellence in Trenchless Technology and Underground Engineering**, an initiative spearheaded by UMass Lowell which includes Purdue and Rutgers Universities.

The NASTT-NE Chapter Board of Directors thanks everyone for their participation in a very successful fourth annual 2019 NASTT-NE Northeast Trenchless Conference. We wish to extend our appreciation to all our presenters, moderators, and attendees for their participation, time and effort. A special note of thanks also goes out to our Premium Sponsors & Exhibitors.

Building on four consecutive years of success the NASTT-NE Chapter continues to hold annual conference events at various locations throughout the vast and beautiful Northeast region. We plan to host seminar, workshops and other outreach events throughout New York and New England in the coming years. The 2020 Fifth Annual Northeast Trenchless Technology Conference is scheduled November 9 - 10 at the Portland Sheraton at Sable Oaks in beautiful Portland, Maine.

For further details and updates please visit:

www.nastt-ne.org

We look forward to seeing everyone again in 2020 in beautiful Portland Maine for the Fifth Annual Northeast Trenchless Technology Conference!!!

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The show will consist of:

- Pre-event Good Practices Courses (Monday, October 19, 2020)
- Two days of technical paper presentations
- Industry exhibits
- Networking opportunities
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Full Agenda Coming Soon

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QUESTIONS? PLEASE CONTACT:

Michelle Hill
Email: mhill@nastt.org
Phone: 888.993.9935

EXHIBITOR OR SPONSORSHIP QUESTIONS? PLEASE CONTACT:

Brittany Cline, Events Manager
Email: bcline@benjaminmedia.com
Phone: 330-467-7588

Call for Abstracts

Submission Deadline: June 30, 2020

March 28 - April 1 2021

Orange County Convention Center
Orlando, FL

The North American Society for Trenchless Technology (NASTT) is now accepting abstracts for its 2021 No-Dig Show in Orlando, Florida at the Orange County Convention Center on March 28-April 1, 2021. Prospective authors are invited to submit a 250-word abstract outlining the scope of their paper and the principal points of benefit to the trenchless industry. The abstracts must be submitted electronically at NASTT's website by June 30, 2020: nastt.org/no-dig-show.

Abstracts from the following subject areas are of interest to the No-Dig Show Program Committee:

Potable Water and Pressure Systems
- Pipeline Inspection, Locating, and Condition Assessment
- Pipe Rehabilitation
- Pipe Bursting
- Emerging Technologies
- Case Studies

Wastewater, Storm water and Non-pressure Systems
- Advanced Pipeline Condition Assessment
- I&I and Leak Detection
- Pipeline and Laterals Rehabilitation
- Pipeline Inspection, Locating, and Condition Assessment
- Cured-in-Place Pipe Lining
- Sliplining
- Pipe Bursting
- Spray Applied Linings
- Grouting
- Manhole Rehabilitation
- Case Studies

Energy Pipeline Systems
- Pipeline Inspection, Locating, and Condition Assessment
- Aging System Rehabilitation
- New Trenchless Installation
- Standards and Regulations

Trenchless Research and Development
- University and Industry Initiatives
- Education and Training

Industry Issues
- Subsurface Utility Engineering
- Submittal Requirements and Quality Assurance/Quality Control
- Project Budgeting and Prioritization
- Funding for "Green" Technologies
- Selection Criteria for Contractors
- Social Costs and Impacts
- Carbon Footprint Reduction
- Sustainable Construction Practices
- Industry Trends, Issues and Concerns
- Differing Site Condition Claims

New Installations – Tunneling, Boring and Pipe Ramming
- New Concepts or Trenchless Equipment, Materials and Methods
- New Applications for Boring Techniques (Auger Boring and Pipe Ramming)
- Pilot Tube Boring (Tunneling)
- Case Studies

Horizontal Directional Drilling (HDD)
- New Concepts and Applications for Horizontal Directional Drilling Equipment, Materials and Methods
- Case Studies

Microtunneling
- New Concepts and Applications for Microtunneling Equipment, Materials and Methods
- Case Studies

Questions? Please contact:

Michelle Hill
NASTT Program Director
E: mhill@nastt.org
P: 888-993-9935

For more information visit

nodigshow.com

The No-Dig Show is owned by the North American Society for Trenchless Technology (NASTT), a not-for-profit educational and technical society established in 1990 to promote trenchless technology for the public benefit. For more information about NASTT, visit our website at nastt.org.

INDEX TO ADVERTISERS

NEW NASTT STUDENT CHAPTER!

The NASTT-NE Board of Directors is delighted to announce the formation of the second NASTT Student Chapter in the Northeast region.

Join us this autumn in welcoming students from the Quinnipiac University School of Engineering to the NASTT Student Chapter with Dr. John Greenleaf as Faculty Advisor.

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