

The Official Magazine of the North American Society for Trenchless Technology



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Educate - Train - Research - Publish



Fall 2020
Volume 10 | Issue No. 3



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2020 Member List Inside

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Compiled by NTT staff

The NASTT Member List is a condensed version of the NASTT Online Membership Directory – a searchable directory with complete contact information. In the listings in this issue, you'll find the names of current individual members and their employers as well as corporate, government and education members. Don't see your name? Contact membership@nastt.org.

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NASTT, Trenchless Community Go the Extra Degree

“Challenging and difficult times,” “unprecedented change” and “new normal” are phrases used and overused every day.

Sam Parker, author of the book “212 Degrees – The Extra Degree,” says, “At 211 degrees, water is hot. At 212 degrees, it boils. And with boiling water comes steam. And with steam you can power a train. Just one extra degree makes all the difference.” There is no doubt, as I speak or email with many of you, that our family and business lives have been changed like never before in recent history. And yet, through all this adversity, we are finding a way through – sometimes I think that’s why we’re in trenchless technology.

One word I’d like to bring to the forefront therefore is “resiliency.” NASTT members, its leadership, staff and the trenchless profession have shown the ability to adapt and evolve in order to continue to operate and grow in an uncertain future. Resiliency has meant careful planning, continual monitoring and flexibility in responding – because it is paramount for us to honor the investment that members have made in NASTT. Resiliency has meant adding our COVID-19 Resource Center, revitalizing our Job Board, stimulating participation in Talk Trenchless, launching a 30 percent off book sale and providing industry insights through our COVID-19 Trenchless Industry Impact Report. Resiliency that has seen an awesomely redesigned online Educational Fund Auction, an online Innovative Products Forum and most impressively of all a

Good Practices Course web series.

Education and the sharing of knowledge in trenchless technology is central to what NASTT is about. We wanted to provide these courses in a format as familiar as possible. With our amazing staff (Michelle, Jenna, Carolyn and Jessie) and an incredible commitment from trainers and many volunteers, we have been able to schedule a full program of virtual courses for this year complete with live training and CEUs. All course paperwork will be sent out ahead of time so attendees can follow the way they would in the classroom, without the need to travel or have additional time away from work. There will also be full Q&A opportunities with presenters. Please pick one or several of the courses to participate in. You’ll learn from the experience and support the commitment made by our volunteers. You are what keeps them coming back!

And so, I want to take this opportunity to bring up two more words (no, not those ones!): THANK YOU.

- Thank you to our **members** for continuing to renew your membership.
- Thank you to so many of our **No-Dig registrants** who donated their registration to the NASTT Education Fund.
- Thank you to our Hall of Fame, Volunteer of the Year, Young Trenchless Achievement, Chair Award for Distinguished Service and Outstanding Paper **award recipients** who didn’t receive their awards in the spotlight this year.

- Thank you to our **No-Dig Show and No-Dig North exhibitors and sponsors** for sticking by us and supporting our 2021 No-Dig endeavors.
- Thank you to **trenchless educators and NASTT student chapters and their advisors** for continuing to inspire students and shaping the profession right now and for the future.
- Thank you to NASTT **committee members, regional chapter boards and volunteers** for exploring new options when plans fell through.
- And **THANK YOU** to all of you in the trenchless industry who continued to meet infrastructure, utility and municipal challenges whether on site or from home in the face of a worldwide pandemic. And thank you to those furloughed or displaced – for your courage and commitment. We’re here for you!

I’d like to leave you with a challenge to go that extra degree for NASTT. Recruit a new member. Talk to a colleague about membership and have him or her email membership@nastt.org. We’ll reach out to them. And when they join, we’ll go the extra degree and send you a book from our bookstore.

I’m excited for NASTT’s next steps and having you take them with us.



Matthew Izzard
NASTT EXECUTIVE
DIRECTOR

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Adjusting to Meet the Needs of Our Industry

For everyone 2020 has been quite a whirlwind year! Like the rest of the world, the staff and volunteers here at NASTT have been pivoting and evolving on a near daily basis to change how we do business due to the COVID-19 situation.

As this unprecedented year continues to unfold, NASTT is working diligently to continue to provide the training and education you need to do business and stay up to date with innovations in our industry. We quickly rolled out virtual events and training opportunities to uphold our mission to be the premier trenchless educational society in North America.

In August, we launched our NASTT Good Practices Courses as virtual events. These courses are a rescheduling of the 2020 No-Dig Show Good Practices Courses and our entire suite of courses are available as live training events throughout the remainder of the year. Our four-hour courses will take place in one day and our eight-hour courses will be split into two-day sections to allow for schedule flexibility for our attendees. All NASTT Good

Practices Courses include Continuing Education Units, a training manual and the accompanying NASTT Good Practices Guidelines book if applicable. Visit nastt.org/training/events for the full schedule and registration details.

Our goal is to represent our industry and provide valuable programs, services and opportunities to grow your career and your business. To do that, we need the involvement and feedback from our members. We are always seeking volunteers for our various committees and programs. If you are interested in more information, please visit our website at nastt.org/membership/volunteer. There, you can view the committees and learn more about the ways you can stay involved with the trenchless community and to have your voice heard. Please consider becoming a volunteer – we would love to tap into your expertise.

We are looking forward to heading to Orlando next March for the NASTT 2021 No-Dig Show. It will be particularly exciting to come together as a group and celebrate the trenchless industry as we

learn and network together again. By all accounts, the NASTT 2019 No-Dig Show in Chicago was a resounding success, hosting a record-breaking 200-plus exhibitors and more than 2,200 attendees. We're going to come roaring back strong and break these records at No-Dig 2021 in Orlando!

We look forward to growing and learning from these recent challenges. Thank you for all your support and dedication to NASTT and the trenchless technology industry. A special thank you to our volunteer members who are leading the profession both locally and nationally. Don't be afraid to get involved. With the trenchless market growing so fast, now is the time to join us!

Thank you for being a part of our organization and for dedicating your careers to the trenchless industry.



Craig Vandaele
NASTT CHAIR

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NASTT has offered a full suite of courses covering the following topics.

August 20 (virtual):
Introduction to Trenchless
Technology – New Installations

August 26 (virtual):
Introduction to Trenchless
Technology – Rehabilitation

September 17 (virtual):
Gas Good Practices

September 30 (virtual):
Laterals Good Practices

October 5-6 (virtual):
CIPP Good Practices

October 21-22 (virtual):
HDD Good Practices

November 5-6 (virtual):
New Installation Methods

November 17 (virtual):
Municipal Sewer Grouting

December 8-9 (virtual):
Pipe Bursting Good Practices

The Power of a Pivot

NASTT's Good Practices Go Virtual

I remember when we got the call back in March that Cole's soccer (or as my boss likes to call it, football) season was going virtual. As expected, my initial reaction wasn't optimistic. How was my 2-year-old going to learn how to play soccer by watching it on a computer screen?

Much to our surprise, Cole loved it! In fact, most days that we played he requested to run the 22-minute video multiple times. We practiced tiny kicks, big kicks and control while learning the step over and the pull back. Ahh the step over and the pull back. What great techniques! They are these little skills that help a player switch direction quickly.

As I practiced these new moves with Cole, I couldn't help but think of all of the pivoting we've been doing here at NASTT this year. Everything we planned for the trenchless industry in 2020, I mean everything, has had to change.

As you know, every detail of the NASTT 2020 No-Dig Show had to be reimaged. Some celebrations like the auction,

awards and our 30th anniversary are being rescheduled for later this year. Other elements like educational presentations and exhibits will be carried over to next year's event. The biggest pull back was our effort to reschedule all of our Good Practices Courses.

I'm thrilled that our team is able offer our training in a virtual format this year. We've rescheduled our entire suite of training courses so all trenchless professionals have access to our education without the cost and health risks of traveling. Virtual courses include everything you've come to expect during NASTT's in-person training events including real time Q&A opportunities with our expert instructors, a course manual to take notes and follow along during the class, a companion Good Practices Guidelines book if applicable and Continuing Education Units (CEUs) provided by the Trenchless Technology Center at Louisiana Tech University.

I know some of you might be feeling the virtual fatigue. Our trenchless experts

promise engaging content and interactive discussions. Never have they been so accessible to help you be successful in this industry. Our volunteer instructors were true players of the match when they raised their hands for this new teaching experience.

You can check out the details of our virtual Good Practices Courses and view sample agendas on our website at nastt.org/training. Click on the 'View the NASTT Training Calendar' link at the top to see more details and register for each course.

Change is hard. Turning and twisting is hard. Step overs and pull backs were hard for Cole at first, but he's been practicing and getting really good at it. The same holds true for us. We need to adjust to this new normal; but, I'm confident our industry will nail it.



Michelle Hill
NASTT PROGRAM
DIRECTOR

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Q&A with **Alan Goodman**



This month we decided to sit down with Alan Goodman, Market Development Manager at HammerHead Trenchless and Vice Chair of NASTT. We chatted with Goodman about the evolution of trenchless construction, current challenges and his work with NASTT's South Central Chapter.

What first piqued your interest in the construction/engineering field?

After graduating with a degree in international business with a minor in Japanese, I was looking for a career that could involve both. I was intrigued to start a career with McLaughlin Manufacturing in September of 2001 due to trenchless construction and partnering with a Japanese company to offer HDD and utility locators. I was amazed to learn that we could control and direct the path of a drill head underground in order to install an infrastructure to support our local communities.

Tell us about your first introduction to the trenchless technology?

It was at the ICUUE show in 2001. The 9/11 attacks had just happened and yet the show was not cancelled or postponed unlike today due to COVID-19. Because there were few people in attendance, I was able to get hands-on experience at the show. I probably drilled and located 50 bores in a 40-ft area during the week at ICUUE – it was a tremendous introduction to trenchless technology.

What are your thoughts on the current state of the industry? What areas do you see evolving? Biggest challenges?

The trenchless industry is strong and will encounter exponential growth over the next five years. Whether related to new construction, replacement, or rehabilitation the construction industry overall is moving to trenchless more every year. One could say that the trenchless industry is taking the construction market share on an annual basis and it will never go back to open cut.

And yes, communication is evolving. In sales one would think whoever gets to the customer has an advantage. However, the days of walking into an office and seeing someone without a meeting are simply coming to an end. These days we have to work smarter not harder. As new technology is introduced, it becomes more challenging to market and promote this technology to the public. People who have avoided computers, smart phones, Zoom and Microsoft meetings will no longer be able to compete. So, the challenge is to share the technology that will result in making contact.

How did you first get involved with NASTT? Briefly summarize some of your activities for us.

I have always viewed NASTT as the mothership of trenchless technology. I started attending the No-Dig Show in 2005, and roughly 10 years ago I got involved in the program committee which helped me learn a tremendous amount about what all goes into a No Dig Show. Many of the NASTT regional chapters were growing, and there was no regional chapter in Texas or Oklahoma. Six years ago, we started the NASTT South Central Chapter and I was able to be both vice chair and chair in 2016-2019. I also joined the board of NASTT and have been vice chair in 2019 and 2020. I am looking forward to the opportunity to chair this great society in 2021 and 2022.

You've been heavily involved in the South Central Regional Chapter. What have been some of your big goals and initiatives there?

It started with just wanting to have a successful show which meant well attended with value to all attendees. It grew into an annual publication called the Texas & Oklahoma Trenchless Report. A small annual scholarship has now turned into \$7,500 in scholarships given annually to the students throughout our region. While I cannot take credit, the NASTT South Central Chapter membership continues to grow every quarter even through these challenging times with COVID-19. The South Central Chapter Conference being held in Sugar Land, Texas in 2021 will be the most highly-attended conference with some of the best technical information and presentations throughout our local region.

What do you enjoy most about working in the trenchless technology field?

Where do I begin since this field has become so rewarding to me as a professional? For me, at the end of the day, it is all about helping to solve problems. But to solve problems we need to educate the public and the engineering community. Many people are simply unaware that technologies exist that can install, replace or rehabilitate everything under the ground. So, it becomes a matter of the public and engineering community knowing what can and cannot be done. We take pride in discovering the needs and then finding trenchless solutions that address the issues and identify the stakeholders.



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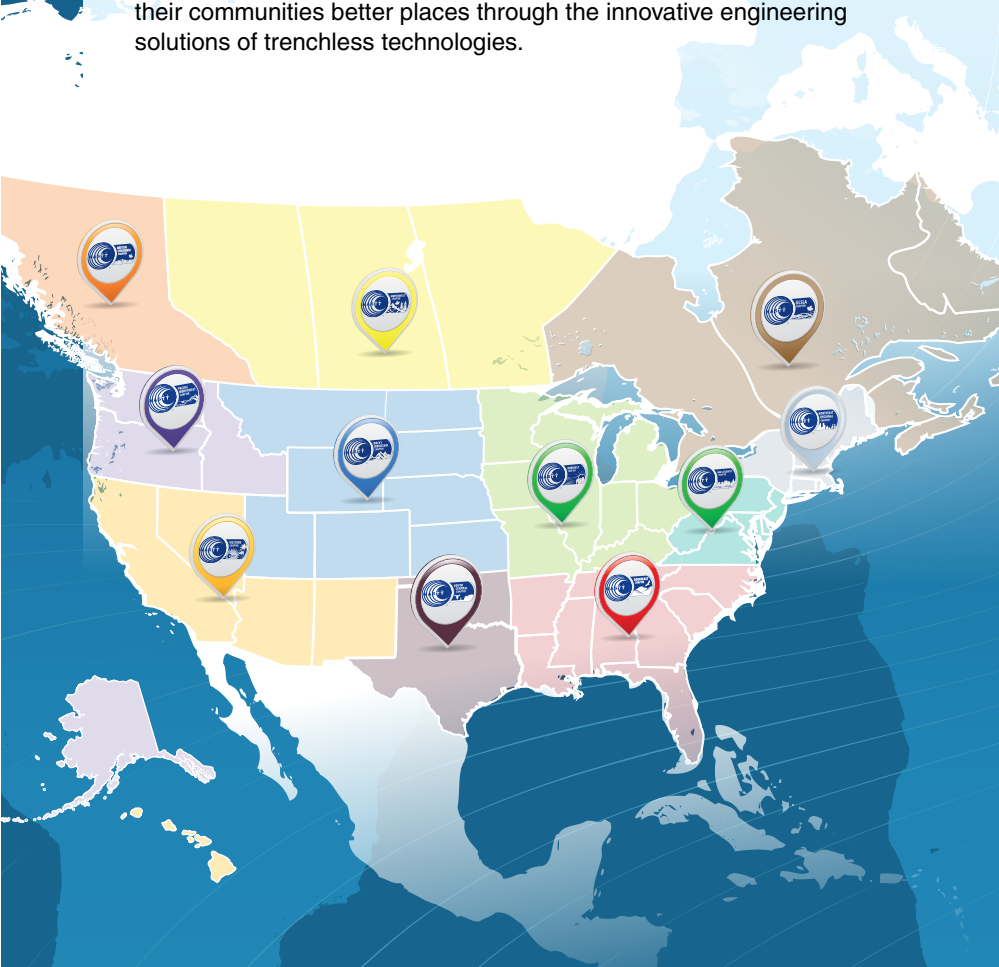
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With your NASTT membership you are automatically enrolled not only in the national and international organization, but also in your regional chapter. So join today and get to know the "local heroes" that are making their communities better places through the innovative engineering solutions of trenchless technologies.



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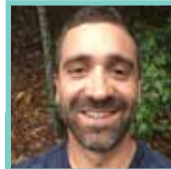
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In the TRENCHES

By Andrew Farr



Sam Brancheau

TERRACON

Sam Brancheau was first introduced to introductory soil mechanics when he took an engineering geology course as part of his geology degree curriculum at Western Washington University. He was hooked immediately and knew geotechnical engineering would be where he would focus his career.

He was also attracted to the construction industry due its broad spectrum in which geotechnical engineering is applicable to almost any segment. “Having the opportunity to contribute to the successful completion of various infrastructure is important to me,” he says.

Brancheau was introduced to the trenchless technology industry from the tunneling side while working at CH2M Hill in Bellevue, Washington. He worked on the preliminary engineering phase for the Sound Transit East Link Light Rail, planned from Seattle to Redmond, which included a tunneled section through downtown Bellevue. He later visited the University Link Tunnel Launch Shaft, which further piqued his interest in the equipment, logistics and complex engineering that goes into a successful tunnel alignment.

After moving to Sacramento, California, he became more involved in the trenchless industry when he was hired by Stantec in 2015. Throughout his time in the industry, Brancheau says he has already seen tremendous advancement in the scope and scale of new installations, with further expansion likely on the horizon.

“I think the industry has a very exciting future,” he says. “We are already seeing increasing diameters and length of direct pipe installations, are breaking records with curved microtunnel installations, and are ever increasing the diameter of cutterheads for road tunnel installations. Technology has seemed to do a very good job of keeping up with the challenging and innovating demands of new installations.”

Brancheau now serves as a project engineer for geotechnical services at Terracon. While his current role is focused on broader geotechnical engineering not necessarily specific to trenchless, he notes one of the biggest industry challenges when it comes to trenchless installations is being

In the TRENCHES

able to accurately predict subsurface conditions along alignments.

If surface conditions are feasible for a comprehensive subsurface exploration plan along the alignment, he explains, selling the owner on those benefits is important, noting Terracon's expertise in this area for tunneling and trenchless new installations. "The more we know about the conditions, the better the baseline report will be, reducing the likelihood of differing site conditions claims," he says.

Brancheau attended his first No-Dig Show in 2013 in Sacramento, but his involvement in NASTT was limited until 2016 when he joined the program committee to assist with

“I THINK THE INDUSTRY HAS A VERY EXCITING FUTURE. WE ARE ALREADY SEEING INCREASING DIAMETERS AND LENGTH OF DIRECT PIPE INSTALLATIONS, AND ARE BREAKING RECORDS WITH CURVED MICROTUNNEL INSTALLATIONS.”

reviewing abstracts. In addition, he now serves as a track leader for the No-Dig Show.

He explains that education in the trenchless and tunneling industries is key, but notes that the geotechnical area specific to trenchless is one niche.

“When I was first introduced to the industry, I became aware of conferences such as No-Dig, RETC and NAT fairly quickly, for which there are collegiate outreach and scholarship opportunities for students to attend and further familiarize themselves with the industry,” he says. “Tunneling and trenchless in comparison to geotechnical engineering as a whole is a bit of a niche



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market. It makes sense that not every university that has a geotechnical engineering program is promoting trenchless engineering as a possible ancillary study option.”

But overall, in regards to promoting the benefits of trenchless, Brancheau says the industry is doing a fine job. “When I was actively involved, there were enough resources readily available which I

could use, for example, to develop reasonable cost-benefit analyses, risk assessments, or preliminary construction cost estimates versus open-cut methods.

In his time working more exclusively on trenchless projects, Brancheau says he valued working under industry experts who helped foster a positive connection with a subject he was already very interested

in. “Surrounding myself, whether purposely or not, with people much smarter than me, was what I enjoyed most,” he says.

“I often recall fondly – and perhaps take for granted – having worked preliminary design on trenchless projects with a multi-million-dollar construction price tag that were technically challenging and innovative,” he adds.



Andrew Costa

AEGION

Andrew Costa didn't start off his career in the construction industry – and before long, he needed a change of scenery.

“I was working for a non-profit organization and was getting pretty burned out. Because of the housing boom, the construction field had a lot of opportunities,” he says.

Costa soon landed at a construction company that he felt valued its employees, was great at what they did and had exceptional leadership. The company was an underground utility contractor that had recently expanded its services to include manhole rehabilitation and protective coatings, utilizing cementitious and spray applied polymers.

“I really value that time, as it gave me a great foundation into various aspects of contracting, underground utilities and the trenchless sector – specifically in Florida,” he says. “I got to work with some amazing people inside the company, in the trenchless contracting field, and with owners and engineers in the municipal space. It really was the ideal jumping off place and set the tone for how I wanted to conduct business, manage employees and contribute in the trenchless sector. I was fortunate to begin my construction career there.”

Costa says since that time he has seen vast improvements across the

**“IN OUR BUSINESS,
IT’S ALL ABOUT
RELATIONSHIPS. OUR
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GREAT THOUGHT
LEADERS, COLORFUL
CHARACTERS AND,
SIMPLY PUT, JUST SOME
DOWNRIGHT GOOD
HUMANS.”**

business of trenchless, beyond just owner acceptance of trenchless options. “For us at Insituform/Aegion, we’re seeing a lot of growth in the pressure market, specifically with potable water,” he says.

He also notes that expansion in areas like materials construction, equipment, robotics and resins has led to more competition in the market. “There are more companies than ever fighting for both the ex-

isting space, as well as to establish themselves,” he says.

Costa currently serves as vice president of sales, east region, for Insituform Technologies, part of Aegion. From his perspective with a leading contractor/manufacturer of pipe rehab, Costa says the biggest challenge in pipeline rehab today is the variability inherent in the projects, specifically in pressure pipe lining. Because each job is unique, he explains, each has its own set of variables, which makes it challenging to find consistency and repeatability.

“Oftentimes owners/engineers ask about general trends or static data points and it’s challenging to offer those, because each job is uniquely different, and our solutions are often custom engineered solutions,” he adds. “It requires us to ask a ton of questions and gather a great deal of information. It can make for a slower sales cycle for sure.”

But even with similarities between jobs, the custom nature of Aegion’s solutions require Costa and his colleagues to gather significant data and consider a wide range of design variables for each application – which differ from project to project. “Because of this, it takes a huge volume of work to pull out the consistencies or trends, and the pressure segment of our business isn’t as mature as the

In the TRENCHES



gravity segment is," he explains.

With Aegion's heavy involvement in NASTT, Costa has been no stranger to volunteering and taking on various initiatives within the Society during his career. He has been a presenter at several NASTT No-Dig Shows and currently serves on the program committee, as a track leader reviewing papers and presentations within the rehabilitation track and assisting in the event's annual planning. In 2021, he is serving as regional ambassador for No-Dig Show in Orlando.

Costa praises the NASTT staff for its management of both the association and production of the No-Dig Show, adding that he would like to continue to get even more involved.

"I think the industry has really grown in the world of trenchless education and training, and the companies and organizations involved in our industry have really worked hard to ramp up those efforts," he says, adding that they industry can't take its foot off the gas in these areas.

"I'm still often surprised at how much guidance owners/engineers need with trenchless applications. As the pressure segment of our industry grows, that need increases even more. I can't stress enough the importance of attending regional and national tradeshow, even if they're virtual, to help further education on the trends and advancements in trenchless technology."

For all the innovation and intuition across the market, Costa's favorite part of working in the industry is actually similar to many others who work in trenchless: the people. He recalls being told early in his career by a trenchless industry colleague, "In our business, it's all about relationships." "That couldn't have been truer," he now agrees. "Our industry has some great thought leaders, colorful characters and simply put – just some downright good humans. Couple that with the innovation that we're striving to provide and it makes for a great experience. Through that journey, I've been extremely fortunate to have formed some amazing relationships over the years."



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Paul Savard

PARSONS

By the time he reached high school, Paul Savard was undecided on a career. While that's not uncommon for a high school student, Savard didn't complicate things in making his decision. "My neighbor was my high school guidance counselor. 'You're good in math and science – how about engineering?'" he recalls her saying. "The rest is history."

Savard decided to pursue to civil engineering, especially after his college roommate was also going in the same direction. "Over time I became interested in hydraulics and understanding how water moves," he says. "I worked a summer for a local building contractor and got an opportunity to understand construction engineering. Looking back, it

seems like a series of chance encounters and unrelated events, but in reality, my interest grew from relationships from those I knew and trusted."

His first job was for a regional water supplier in the late 1980s. He worked on a water main design that had to cross below an active railway. "I didn't know it as trenchless technology back then, but that became my first introduction to pipe jacking," he says. Later when Savard left the public side he went to work in consulting. He says he was fortunate to work for Steve Kramer, now a consultant with COWI North America, who Savard describes as one of the early torchbearers in trenchless. "Together with him and a number of talented trenchless professionals, I was privileged to

work with and learn from them all. That became a watershed for me to engage in trenchless technology in design and construction for both new installation and rehabilitation," he says.

With 30-plus years of experience now in underground construction, Savard believes trenchless has come a long way from the 1990s when he first got involved. But he says the built and natural environments of the world are not getting any less complicated. This is where Savard says trenchless comes in. "The industry does a great job supporting government and private industry for building new and extending the life of existing services every day," he says. "An overall trend is that every trenchless application is finding ways to go longer, complete faster, for less cost in ways that make the technology more competitive with other construction techniques. Following from this trend is that each trenchless installation provides a direct and measurable benefit to the larger communities in which we live."

For all the advancements over the years, successful trenchless technology projects will continue to be depend on the expertise and experience of the people involved, despite the innovation in equipment and methodologies, Savard says.

"They still come as much from the practical experience and lessons learned of those who construct them as much as from being taught how to accurately predict strength based on a material property or understanding the reactions between soil and pipe," he explains. "The physics has not changed. But the people who have built up the knowledge base of the trenchless industry are changing every day. "The challenge is passing on their experiences and lessons to the next generation, so we grow the industry and keep building public confidence in the work we do."

Savard began attending the national NASTT No-Dig Show in the early 1990s. Over the years, his involvement has ebbed and flowed. However, he says, there has been renewed interest in promoting trenchless regionally with the

In the TRENCHES

formation of the Northeast Chapter of NASTT. Savard became involved in the board of directors and is now volunteering as treasurer. The Northeast Chapter had a very successful annual conference with strong support from the national organization. He also credits the chapter's strong student initiative, which actively works with young and enthusiastic engineers eager to take on the challenges of the trenchless industry.

"NASTT is a very practical and informative organization," he says, noting both the national No-Dig Show and other courses offered throughout the year that benefit multiple industry segments. "The good practices courses are very valuable to get experience and learn beyond the basics of each technology," he says. "The suppliers and manufacturers of trenchless equipment and materials

“THE SUPPLIERS AND MANUFACTURERS OF TRENCHLESS EQUIPMENT AND MATERIALS ARE VERY HELPFUL TO THE ENGINEERING COMMUNITY. NASTT DOES A WONDERFUL JOB OF PUTTING THESE OPPORTUNITIES FOR LEARNING AND ENGAGEMENT WITH PEERS TOGETHER.”

are very helpful to the engineering community. NASTT does a wonderful job of putting these opportunities for learning and engagement with peers together.”

At the end of the day, Savard says it's addressing local community challenges through high-quality infrastructure systems that he has enjoyed the most.

“Trenchless technology provides a strong avenue to reduce impacts on the public and on the environment,” he says. “I like applying trenchless technologies in practical and functional ways to solving these challenges.”

Andrew Farr is the managing editor of NASTT's Trenchless Today.



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From small businesses to global enterprises and entry-level, young and future professionals to CEOs and presidents, NASTT equips and empowers its members to thrive in their careers.

Join as an individual or get group savings with a corporate or government/utility membership. For more information and to join online visit nastt.org/membership or contact Carolyn Hook at membership@nastt.org.

ABOUT THE NASTT MEMBER LIST

The NASTT Member List is current as of August 2020. Only NASTT members who have elected to have their names listed are included. Do not use this list for purposes such as advertising, solicitations or mass communications. NASTT members can find contact information for members in the searchable NASTT Online Directory at talk-trenchless.nastt.org/home. Members can also update their profile online at member.nastt.org/profile or send changes to membership@nastt.org.

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“I joined NASTT because of the value of its membership and its dedication to bring trenchless technology to the forefront of every project. This is the only organization that brings such a high caliber of engineers, owners, manufacturers, contractors and students together.”

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 Andy Melton.....RapidView LLC
 Rick Melvin.....TT Technologies Inc.
 Tiffanie Mendez.....Sunbelt Rentals Inc.
 Alex Merletti.....Merletti Construction (1999) Ltd
 Sean Merryman.....Layne, A Granite Company
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 Keith Meyer.....Ditescos
 Steven L. Meyer.....Bowen, Collins & Associates
 Taryn Meyer.....City of Portland Environmental Services Bureau
 Tod Michael.....Vermeer Corp.
 Paul Michalowski.....Con Edison
 Nick Michels.....Mears Group Inc.
 Justin Midgette.....Emerald Coast Utilities Authority
 Eric Mielke.....City of Littleton

Rich Mielke.....Northwest Pipe Company
 Pierre Mikhael.....CUES Inc.
 Stephen Miksis.....Ross Valley Sanitary District
 George Milkowski.....CUES Inc.
 Adam Miller.....Gwinnett County Department of Water Resources
 Brad Miller, PG.....Haley & Aldrich Inc.
 Chad Miller.....MaxLiner
 Dave Miller.....Michael Byrne Manufacturing
 Jason Miller.....Midwest Mole Inc.
 Kevin Miller.....Miller Pipeline Corp.
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 Michael Miller.....Citizens Energy Group
 Ralph Miller.....Miller Pipeline Corp.
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 Kimberly Milligan.....Bestolife Corp.
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 Kenneth Miner.....City of Edmond
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 Neville Missen.....McLaughlin Boring Systems
 Stu Mitchell, P.Eng.....Jacobs Engineering Group - World HQ
 Terence Mitchell.....GOTransit - Metrolinx
 Myles Mix.....EPCOR - North Service Centre
 Maria Modesto.....Huxted Tunneling LLC
 Dorian Modjeski.....Retired
 Leslie Moening.....City of Loveland Water and Power Department
 Kenny Moffat.....Jacobs Engineering Group
 Keith Moggach.....NAPCO Pipe & Fittings
 Adam Monchak.....Kimley Horn
 Pete Monday.....CUES Inc.
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 Dean Monk.....Pro-Pipe
 Clint Montfort.....Acoustical Control LLC
 Michael Mooney.....Colorado School of Mines
 Terri Mooney.....CUES Inc.
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 Brad Moore.....Staheli Trenchless Consultants
 Brent Moore.....Horizontal Boring & Tunneling Co.
 Chance Moore.....Radius HDD Direct LLC
 David Moore.....NAPCO Pipe & Fittings
 Doug Moore.....Subsite Electronics
 Ian D. Moore.....Queen's University
 Mike Moore.....HammerHead Trenchless Equipment
 Steven Moore.....Ross Valley Sanitary District
 Liz Moorhead.....City of Portland Environmental Services Bureau
 Juan Morales.....Stantec
 Brian Moran.....CBCL Limited
 Abel Moreno.....South Adams Co. Water & Sanitation District (SACWSD)
 Claudia Moreno.....Sensors & Software
 Leonardo Moreno.....BGC Engineering Inc.
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 Catherine Morley.....RJN Group Inc.
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 Dustin Muir.....Kinetic Energy Services
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- Ann Peterson Underground Tools Inc.

“NASTT membership allows me to learn about the latest technologies in the industry. Because of NASTT I have a pretty stacked tool belt that helped me bring innovative approaches to addressing infrastructure concerns both as a municipal consultant and in the public sector. And experience with trenchless technologies helped give me a “leg-up” over other candidates for the position I currently hold.”

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Nathan Robertson.....District of Saanich
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“Several NASTT connections provided valuable information which led to numerous project successes! NASTT allowed me to share my experiences with others bringing rewards and learning to the trenchless community at large.”

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kennedyjenks.com

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kobus-inc.com

Kondex Corp.

Diane Riley
kondex.com



Laney Directional Drilling Co.

Jim Nelson
laneydrilling.com



LaValley Industries

Jorge Prince
lavalleyindustries.com

Layne, A Granite Company

Eric Haenlein, PE
graniteconstruction.com

Lithos Engineering

Benny Siljeborg, PE, MBA
lithoseng.com



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loganclaypipe.com

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MarshWagner

Heather Marsh
marshwagner.com

McLaughlin Boring Systems

Dave Gasmovic
mightymole.com

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J.B. Brown
mears.net



Michael Byrne Manufacturing

Jim Weist
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JOE LANE

VICE PRESIDENT, INTERNATIONAL OPERATIONS, INFRASTRUCTURE,
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MINIMIZE DISRUPTION



Maximize Production



Join us at the
NASTT 2021 No-Dig Show
to learn how trenchless technology
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SUBMISSIONS DEADLINE: March 1, 2021

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Abstracts from the following subject areas are of interest:

- Lining/Sliplining/Coating
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- Tunneling
- Microtunneling/Pipe Jacking
- Horizontal Directional Drilling
- Auger/Case Boring
- Inspection/Maintenance Technologies
- Subsurface Utility Engineering

The North American Society for Trenchless Technology Canadian Chapters are now accepting abstracts for its 2021 No-Dig North Show in Vancouver, BC, Canada at the Vancouver Convention Center. Prospective authors are invited to submit a 300-word abstract outlining the scope of their paper and the principal points of benefit to the trenchless industry. Abstracts must be submitted electronically by March 1, 2021: nodignorth.ca/abstracts

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Clean Water Services

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Louisiana Tech University

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mwrdd.org

Ministère des Transports (MTQ)

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transports.gouv.qc.ca/en/Pages/Home.aspx

Mohawk Valley Water Authority

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mvwa.us

Mount Pleasant Waterworks

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mountpleasantwaterworks.com

Murfreesboro Water and Sewer Dept

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Northeast Ohio Regional Sewer District

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peelregion.ca

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rvsd.org

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seattle.gov/utilities

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The City of Calgary

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UGI Utilities Inc.

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UMass Lowell

Raj Kumar Gondle
uml.edu

Upper Trinity Regional Water District

Kurt Staller
utrwd.com



Horizontal directional drilling (HDD) is almost synonymous with Ron Halderman, PE. He, along with other innovators, paved the way for trenchless technology. Halderman died May 29, in Billings, Montana after battling cancer.

With 36 years of design and project management experience in HDD projects, including design build and EPC delivery methods, Halderman never ceased to find a better way to serve his clients in the industry.

A registered professional engineer, he held a degree in Geological Engineering from the Colorado School of Mines and graduate studies from the University of Idaho.

Over the years Halderman published many articles and presented numerous papers. He was involved in many “firsts” in this industry – first mile long drill, first drill under an airport runway, first mile-long drill in rock, and he managed a number of award-winning projects across the globe.

He held two HDD related patents entitled “Apparatus and Method for Recirculating Mud When Drilling under an Obstacle” and “Drilling Fluid Recovery when Drilling under an Obstacle or Water Body.” He was the

co-creator of thixotropic thermal grout (No-Set) for high voltage electrical transmission systems (patent pending).

Halderman was inducted into the North American Society for Trenchless Technology (NASTT) Hall of Fame in 2015 for his contributions to the advancement of both the trenchless technology industry and the NASTT organization.

Halderman served as director of special projects for Mears Group. He was a pillar of integrity and accomplishments, that was well earned over his 36-year career in the industry.

He was also a beloved father, husband, son, and friend to many. His wife, Lynn, always present and supportive of his career, can attest to his quirky humor, but also of his grounded stability, and love for his family.

Mears was privileged to have a person of Halderman's stature in its ranks and is thankful for his innovativeness and passion for his work. He will always remain part of the Mears' family and is an integral part of company's history as a truly remarkable person.

The family will be making a donation

Obituary: HDD Innovator Ron Halderman, PE



to Colorado School of Mines in memory of Halderman. Checks can be made payable to Lynn Halderman. A memorial will be held at a later date at the Halderman's home in Billings.

Bo Botteicher joins Lithos Engineering



Lithos Engineering is thrilled to announce the addition of Richard (Bo) Botteicher, PE to our team. Bo brings over 20 years of experience in the underground infrastructure industry including extensive trenchless new installation and rehabilitation projects for the water, wastewater, reclaimed water, stormwater, industrial and power markets. Botteicher has been involved with multiple historical projects related to horizontal directional drilling (HDD), sliplining, and pipe bursting across the United States.

Robin Dornfest, president of Lithos Engineering said, “Bo is a fantastic addition to the Lithos team and with his experience

in trenchless rehabilitation and new installations, he will allow us to expand to meet the needs of the ever-growing rehabilitation market. We have known Bo for many years and always had great respect for his tireless work in the trenchless world and are extremely excited that he has chosen Lithos as his new home.”

Botteicher is a registered professional engineer and has worked both on the design and commercial sides of the underground construction industry. He started his career designing municipal underground infrastructure and facilities, including new installation and rehabilitation projects. Botteicher spent the last 14 years working for a specialty trenchless pipe supplier, with the last 4 years as the General Manager of that business. Bot-

teicher is very active with the North American Society for Trenchless Technologies (NASTT) and is a member of its Board of Directors.

“I want to thank Lithos for staying true to their growth mindset and entertaining the idea of adding me to their impressive group,” said Bo. “Working directly with the utilities, municipalities, contractors, engineers, and technology firms on the present and future challenges of the underground infrastructure industry is what I enjoy most – and I am looking forward to much more of this with the world-class Lithos Engineering team.”

Lithos Engineering said it is extremely excited about the expanded skill set that Botteicher brings to its team and the ability to better serve its clients now and in the future.

IPC names Carlin vice president as Bothar expands to U.S.



The Bothar Group of companies is pleased to announce the appointment of Dr. Maureen Carlin as vice president of engineering and preconstruction services for the United States division. Carlin's hiring marks Bothar's expansion into the U.S. market through the well-established and highly accomplished IPC brand in North America.

"I cannot express how excited and honored I am to accept this position and join the team," said Carlin. "I feel privileged to be part of an organization built on advanced engineering, cutting edge technology applications and safe and skilled project execution. Bothar as a contracting organization is truly the complete package."

Prior to her involvement with Bothar, Carlin spent six years with Laney Group, Inc., most recently heading up the company's efforts in strategic markets. She has more than 16 years of experience in construction engineering and project management for both vertical commercial construction and trenchless pipeline construction. Carlin's areas of expertise are in advanced project planning and market analysis for trenchless engineering and construction in the oil, gas, water, sewer, power, desalination, sustainable energy and defense sectors. She currently sits on the North American Society for Trenchless Technology (NASTT) Board of Directors.

"We are thrilled to have Maureen as part of our family. Her ability to comprehend the complexity of trenchless projects and the client's needs and combine that with IPC/Bothar's capabilities, will allow our organi-

zation to continue its successful journey. Dr. Carlin is a great addition to our leadership team. Her great personality and solution focused demeanor are in line with the goals we are aiming to achieve," says Mr. Peter Hennig, CEO of IPC.

Bothar's U.S. efforts will focus on trenchless applications for complex projects. The company will also focus on design-build opportunities that offer turn-key solutions to critical crossing applications. Owning one of the largest fleets of Herrenknecht microtunneling machines globally, the group will leverage its ability to swiftly ship and assemble equipment to project sites anywhere across the United States, reducing project lead time. IPC is currently one of the largest and most successful design-build contractors in Canada for trenchless infrastructure construction.

Total Equipment expands Vermeer Industrial representation, rebrands in Caribbean



Total Equipment, Inc., a full-line Vermeer Industrial dealer headquartered in Puerto Rico, announced it has acquired the rights from Vermeer Caribbean to represent the Vermeer Industrial product line in the U.S. Virgin Islands, Haiti and the Dominican Republic.

Under the leadership of Charles de Armas, Total Equipment has represented Vermeer Corporation's sales, service and parts in Puerto Rico since 2014. With this acquisition, the dealership will now operate under the brand of Vermeer Total Equipment. Company headquarters will remain in Puerto Rico, while the dealership offers the full line of Vermeer industrial equipment and full-service operations on the island of Saint Thomas, the

U.S. Virgin Islands and a commercial office in the Dominican Republic.

"As we expand our representation of Vermeer into new territories, we are excited to continue serving the customers who depend on us today in Puerto Rico, while also partnering with the professionals who are doing the critical work to drive progress in the Dominican, USVI and Haiti," said Charles De Armas, Vermeer Total Equipment dealer principal. "This is an exciting chapter for us as we build on our strong legacy in the region and grow our regional footprint under the Vermeer Total Equipment brand."

De Armas has been in the equipment industry for more than 30 years. He began his career by following the steps of his father, Jose de Armas, who founded in 1965 Compresores & Equipos Inc. (C&E), which grew into a well-known rental equipment company in the southern United States and Caribbean. In 2008 Charles assumed leadership of the organization under the Total Equipment name.

As Vermeer Total Equipment expands

its territory, the dealership plans to invest in additional inventory, on-the-road service trucks and customer service representatives to drive growth and better serve its customers in underground infrastructure installation, landscaping, clean-up, construction and other industries. Vermeer Caribbean will continue to represent the Vermeer product line across other key Caribbean islands.

"Vermeer Total Equipment and Vermeer Caribbean have been great partners known for providing dependable support to Vermeer customers across the Caribbean islands for some time," said Herb Waldhuetter, managing director of Vermeer Latin America. "With significant infrastructure and natural resource management investments being made across the region, we are excited for what this new alignment and the investments being made across these two dealerships will do to give our customers an even stronger network of Vermeer equipment, service and support they need to get important work done in smart, efficient ways."



Shah Rahman joins KCI as water practice leader



KCI announced that Shah Rahman has joined the firm as practice leader for the Water Practice in the Dallas office. His responsibilities will include contract negotiation and proposal management, technical project and staff oversight, business development, and quality control as part of the firm's ongoing water market expansion within the state.

Over his 24-year career, Rahman has grown from an applications engineer to a recognized authority in the buried pipe market in the water and wastewater industry. His experience includes the full spectrum of pipe and trenchless work including engineering, product development and management, and construction.

"Shah is a recognized technical and marketing leader in the public works and water/wastewater pipelines industries," said Kathy Berek, PE, ENV SP, regional practice leader. "He will leverage the firm's expertise in large and small diameter water/wastewater pipeline design and construction to grow the firm's capabilities within the Dallas and Fort Worth region."

As senior leader for an array of water contracts, Rahman has established client relationships locally and nationally. He was the first to receive Dallas Water Utilities' and the city of Oklahoma City Water's approval of welded steel pipe for water transmission, as well as the city of Houston's approval of large diameter PVC pressure pipe.

He was directly involved in two of the largest welded steel pipe projects in the US in recent years: the 21-mile Provo Reservoir Canal Enclosure Project of 120-inch diameter polyurethane lined and coated steel pipe in Utah and the 150-mile, 96-in. diameter Integrated Pipe Line (IPL) project at Tarrant Regional Water District in Texas.

Madewell Products launches advisory council

With every intent to grow responsibly, Madewell Products Corp. has initiated an advisory council comprised of five executives of top producing contracting partners among its nationwide network of certified applicators. This proactive and progressive move signals to infrastructure owners, specifying engineers and utility contractors demand for the Mainstay-branded products is on the rise.

For nearly 40 years, Madewell dedicated itself to one thing — researching, developing, and producing a breed of restoration mortars and corrosion resistant epoxy topcoats for structurally enhancing and protecting concrete surfaces. Capitalizing on the unique Mainstay Composite Liner process acquired from US Steel in 1971, much of Madewell's strength and market appeal is derived from its execution arm — Certified Applicators. These independent organizations are equipped, trained, and supported by Madewell Tech Services team.

With the Advisory Council's strategic contribution, decisions will be made as a unified force, with high confidence, and at the speed of business.

Invitations to serve on the Madewell Advisory Council (MAC) were issued on June 1 and without hesitation, all five proudly accepted to give time and energy to the greater good of Madewell:

- Chris Culy, Culy Contracting: IN, TN
- Horacio Franco, H&R Underground: CA
- David Ventresca, Advantage Manhole & Concrete: MD, LA, TX
- David Reaves, Prism Contractors & Engineers: VA
- James Fleming, National Water Main: MA, FL

With excellent geographic disbursement throughout North America, the Madewell Advisory Council will provide a nationwide brain trust, sounding board, and source of strategic input. For more information, visit madewell.net.

Scholarships available for municipal and public utilities for the NASTT 2021 No-Dig Show

NASTT is pleased to announce municipal and public utility scholarship opportunities to attend the NASTT 2021 No-Dig Show, March 28 - April 1 in Orlando, Florida.

In 2013, NASTT established the No-Dig Show Municipal & Public Utility Scholarship Award Program to provide education and training for employees of North American municipalities, government agencies and utility owners who have limited or no training funds due to economic challenges. In past years, over 100 applicants were awarded the scholarship annually.

"The NASTT Municipal & Public Utility Scholarship offers public utilities and owners the unique opportunity to participate in the NASTT No-Dig Show. Since the inception of the scholarship program in 2013, more than 850 applicants have been given awards, and the program continues to grow each year," said Dr. John Matthews, 2021 No-Dig Show Program Chair and Director of the Trenchless Technology Center (TTC). "This scholarship offers utility employees the chance to attend the No-Dig Show, which is dedicated to trenchless technology, at very little cost to them and their agencies."

Selected scholarship winners will be awarded Full Conference and Exhibition registration to the NASTT 2021 No-Dig Show. Also available are one-day conference registrations which include full access to all exhibits and technical paper sessions. Selected applicants will also be eligible to receive complimentary overnight accommodations for three nights at the host hotel. The scholarship applications are reviewed by a committee of NASTT volunteers and awarded based upon the supplied responses.

To apply for the scholarship, complete the application online at nastt.org/no-dig-show/municipal-scholarships on or before Nov. 1, 2020. Applicants are not required to be NASTT members.

NASTT's Municipal & Public Utility Scholarships program is sponsored by Benjamin Media, Inc, award-winning publisher of the leading underground construction magazine, *Trenchless Technology*. For more information about the NASTT No-Dig Show visit nodigshow.com, email conferences@benjaminmedia.com or call 330-467-7588.



NASTT

Chapter News



British Columbia

The British Columbia Chapter (NASTT BC)

was involved in helping organize the 2020 No-Dig North conference along with the GLSLA and Northwest Chapters, which has now been postponed to 2021. NASTT BC is disappointed we were not able to bring this show to fruition due to ongoing concerns about the COVID-19 pandemic. We are now looking ahead to the 2021 No-Dig North show, which will be held at the Vancouver Convention Centre, Nov. 8-10, 2021. For updates on registration, sponsorships, pre-event courses, the technical program and exhibitors, please visit nodignorth.ca.

No-Dig North is the first trenchless conference produced by NASTT to exclusively cover the trenchless construction market in Canada. No-Dig North 2019 was held in Calgary, Alberta, and brought nearly 600 attendees. The show also featured more than 75 exhibiting companies from across the industry.



Great Lakes, St. Lawrence & Atlantic

The GLSLA Chapter is looking forward to spearheading the 2021 No-Dig North conference along with the British Columbia and Northwest Chapters of NASTT. As many events across the industry are being rescheduled due to COVID-19, please stay up to date with chapter information, upcoming events and activities by visiting the chapter's revamped website glsla.ca, where can also view our training schedule.



Mid Atlantic

MASTT had to postpone the Trenchless Technology, SSES and Buried Asset Management seminars planned for Baltimore on May 6, 2020, and for Atlantic City on Sept. 16, 2020 due to coronavirus. Please visit mastt.org to learn more about MASTT and the MASTT seminar program and postponed seminars and publication dates. Or, contact Leonard Ingram, MASTT executive director, at leonard@engconco.com or call (334) 327-7007.

MASTT plans to publish its Mid Atlantic Journal of Trenchless Technology 2020 in September. The journal will have numerous, excellent Mid Atlantic project articles and messages. The publication will be distributed to more than 4,000 water and sewer decision makers in the MASTT area. It and past journals can be seen at mastt.org.



Midwest

The Midwest Chapter (MSTT) had a very successful Trenchless Technology, SSES and Buried Asset Management seminar in Kansas City, Missouri on March 11 just before COVID-19 shut everything down.

MSTT had to postpone another Trenchless Technology, SSES and Buried Asset Management seminar that was planned for Cincinnati, Ohio, on Oct. 28. Please visit mstt.org to learn more about MSTT and the MSTT seminar program and postponed seminar and publication dates. Or, contact Leonard Ingram, MSTT executive director, at

leonard@engconco.com or call (334) 327-7007.

MSTT is publishing its annual *Midwest Journal of Trenchless Technology 2020* in October. The journal will have numerous Midwest trenchless technology project articles and messages. Each publication is distributed to more than 4,000 water and sewer decision makers in the MSTT area. It, along with past journals, can be viewed at mstt.org.



Northeast

The Northeast Chapter in response to the COVID-19 global pandemic has postponed its 5th annual conference, which was scheduled to be held in Portland, Maine. The chapter is looking forward to a Grand 2021 annual conference in the historic West Point Military Academy in New York. In light of the current state of affairs, the Northeast Chapter will host a no-cost NASTT webinar for its members on Nov. 12, 2020 in place of the postponed annual event to keep members in the region engaged. We are also working on our 2020 Fall edition of the Northeast Journal of Trenchless Technology Practices. Please see our website, nastt-ne.org, for updates and more information.



Northwest

The Northwest Chapter is disheartened to announce that, due to COVID-19, the 2020 No-Dig North Confer-

ence in partnership with the Canadian chapters of NASTT has been postponed. The 2021 No-Dig North will take place at the Vancouver Convention Centre on Nov. 8-10, 2021. For updates as they become available on registration, sponsorship, pre-event courses, technical program and exhibitors, please visit the conference's webpage, nodignorth.ca.

The status of the 2020-2021 Technical Lunch Program in both Edmonton and Calgary is not confirmed. However, if you have a specific topic or project that you would like to see us spotlight in the future, please reach out and let us know. For more information, please email gtippett@nastt-nw.com.



Pacific Northwest

The Pacific Northwest Chapter was pleased to announce the recent addition of Oregon State University as a new student chapter of NASTT and the first in the Pacific Northwest region. Please extend a warm welcome to any OSU Students you see at upcoming events. For further updates on chapter meetings, events and activities, please visit our website at pnwnastt.org. You can also check out the recent edition of our chapter publication, the Pacific Northwest Trenchless Review, as well as project updates.



Rocky Mountain

The Rocky Mountain Chapter has been progressing forward despite the continuing COVID pandemic. Like most, we have moved to virtual meetings and social events to stay in touch and conduct important board meetings. The chapter is excited to soon announce our first online webinar which will take the place of this year's show and should involve much needed CEUs for our profession-

als and members who attend. We are currently in limbo with a planned clay shoot for October, but hope to see if we can still make it a go using smaller teams, social distancing and being in the great outdoors!

Stay tuned to our website for more information about our upcoming events at rmnastt.org. Our outreach efforts have been slowed a bit, but as soon as things open up more, we plan to dive into Nebraska and Kansas with some exciting field trip opportunities and potentially a traveling trenchless road show!



South Central

Due to the COVID-19 pandemic, unfortunately the South Central Chapter had to postpone its chapter conference planned for October in Sugar Land, Texas. Our next conference event is now being planned for Sept. 27-28, 2021 at the same originally-planned venue, and we are looking forward to seeing everyone there next year. In lieu of the presentations planned for this October's conference seminars, the planned presenters will be given the opportunity to post their presentations and papers on the South Central Chapter's new official website (talk-trenchless.nastt.org/south-central/home), which goes live this fall and will also contain many other useful resources and information for chapter members and others. Although the conference event where annual student scholarships were to be awarded has been postponed until next year, the chapter is thankful that we were still able to award these scholarships to some very deserving students.

Our chapter is also happy to announce some new additions to our board this year, with Shawn Garcia of Underground Solutions, Cecilia Zavaleta of Akkerman, and Taylor Savoie of Granite Inliner. We look forward to their involvement and contributions while continuing to grow our chapter.



Southeast

The Southeast Chapter (SESTT) had to postpone its Trenchless Technology, SSES and Buried Asset Management seminar planned for Savannah, Georgia, on Aug. 5, 2020. Please visit sestt.org to learn more about SESTT and the SESTT seminar program, postponed seminar dates and postponed publication dates. Or, contact Leonard Ingram, SESTT executive director, at leonard@engconco.com or call (334) 327-7007.

SESTT has a Trenchless Technology, SSES and Buried Asset Management seminar proposed for Miami on Dec. 9, 2020. There is a good chance it will be postponed. Please visit sestt.org for updates.

SESTT is publishing its annual *Southeast Journal of Trenchless Technology 2020* in December. The journal will have numerous, excellent Southeast trenchless technology project articles and messages. Each issue of the publication is distributed to more than 4,000 water and sewer decision makers in the SESTT area. Past Journals can be seen sestt.org.



Western

The Western Chapter (WESTT) had a very successful first webinar on July 30, featuring three presentations on a variety of trenchless topics. Our free webinar series, open to all members and non-members, will continue this fall. Watch for emails from NASTT and be sure to register to be part of this informative and fun series. WESTT is also excited to announce that we have a new website at westt.org. Please visit our site to learn more about our chapter, track upcoming events and find opportunities to get active in the chapter.

Gas: A Natural Place for Trenchless Technology

By George Ragula



Public Service Electric and Gas (PSE&G) is a combined electric and natural gas utility serving 3/4 of the population in the most heavily populated central corridor of New Jersey. The territory encompasses more than 2,200 sq-miles serving a diverse array of rural, urban and suburban communities.

Generally, from a natural gas perspective, most of the new installation HDD work coming from new business is in the southern part of the state, while the northern portion of the service territory is focused on main replacement activity, because of the overall age and condition of those cast iron facilities. However, with all the major storm activity recently there are also a large number of special programs implemented statewide specifically targeting the replacement of aging cast iron and bare steel facilities operating at various pressures. These statewide infrastructure hardening projects are part of a concerted effort to enhance long term safety and reliability of the PSE&G distribution network, with the added benefit of reducing the fugitive methane emissions which contribute to global warming.

Before any type of new or different technology process is adopted, it needs a champion. When I was first exposed to ISTT activities in the mid-1980s, and learned about pipe splitting techniques at Brooklyn Union Gas, my old alma mater, trenchless technology became a natural area of interest to pursue and bring to my new employer, PSE&G, when I joined in the late 1980s. It has been very gratifying for me to have the good fortune throughout my subsequent career at PSE&G to learn more about trenchless applications, become familiar with the advantages, and be an advocate for the greater use of these technologies in the gas industry.

Historically, since the early 1960s, PSE&G had been using modified slip lining for approximately 30 percent of its main replacement work. Using this method, larger diameter facilities operating at low pressure (inches water column) are

replaced with smaller diameter plastic pipe operating at higher pressures (15 psig and higher), which is inserted into the host pipe. Maintaining or increasing pipeline flow capacity is a critical consideration when operating a large gas distribution system that has evolved over many years to keep pace with increased gas loads. Using sliplining, the vast majority of low-pressure service lines can be inserted with smaller diameter plastic also operating at the same low pressure. Maintaining or upsizing flow capacity is a particular niche that trenchless technology fills to a "T."

Another staple trenchless technology application used across the gas industry for many years are jack and bore techniques. Used predominantly for RR crossings, use of jack and bore is decreasing in this area due to the development and growth of lining technology specifically for the gas industry.

In the late 1980s, PSE&G became involved with rod pushing equipment that quickly led to many successful HDD applications for routine distribution work in rural areas to the tune of approximately 60,000 feet per year. Of course, HDD was already routinely being used in various crossing work, however we implemented its use for routine gas main installations, what I commonly refer to as our "bread and butter work."

With limited access to high pressure gas supply sources in largely urban areas, bursting cast iron pipe became a major size-for-size replacement technique in the mid-1990s. This replacement technique was used extensively for low pressure facilities in order to maintain capacity and necessary back feeds. Rod-driven and cable-driven equipment were both utilized.

In the early 1990s, we began at the ground floor with using cured-in-place lining (CIPL) technology for gas pipe rehab projects. CIPL offered many inherent major advantages in terms of actually increasing pipeline capacity through reduced friction and improved laminar flow, and the ability to be installed through multiple bends. Over the



years, we have also seen tremendous cost savings as we have grown this technology on a project-specific basis.

We have completed a number of complex and challenging gas main renewal projects using CIPL, that frankly could not have been done any other way. Today 30 percent of our RR crossings are renewed using this method and approximately 50 percent of our highway crossings (both above ground and below ground). As a utility, PSE&G has played a leading role in spearheading the use of this technology, and I have been proud to be part of this process.

Most recently, we completed an extremely complex and challenging project that set a new world record. It involved the use of CIPL to renew approximately 575 ft of critical high-pressure leaking cast iron gas main installed in the 1950s operating at 15 psig, in close proximity to a State bridge reconstruction project and local hospital, crossing under the Garden State Parkway – the major north-south thoroughfare in central New Jersey.

The critical feed, which had to be renewed within a very tight window during the warmest part of the year from June 1 to Sept. 1, contained seven bends, a drip pot with 48-in. gap in piping located in the shoulder of the roadway requiring the installation of an internal reinforcement sleeve, a short section of steel, and crossed the 8 lane roadway at a point approximately 25 ft below surrounding street surface level, due to the way the parkway was designed and constructed. This project was massive and required years of comprehensive planning efforts, coordination and a carefully engineered approach in order to successfully complete a single flawless liner inversion in just over one hour.

PSE&G continues to stay involved in the trenchless arena. The use of trenchless technology will continue to expand and grow in the gas industry as emphasis on the environment increases, and the cost-savings and ability to upsize or maintain flow capacity are better understood.



George Ragula is distribution technology manager with Public Service Electric and Gas (PSE&G). He has served on the NASTT Board of Directors including as

chair in 2011-12. In 2018 he was inducted into the NASTT Hall of Fame.

NASTT has a network of 11 regional chapters throughout the United States and Canada. With a single NASTT membership, you're automatically enrolled in the national organization, the international organization (ISTT) and also in your regional chapter. Regional chapters offer valuable educational and networking opportunities in your local area. Share your ideas, network with colleagues and find solutions to your everyday challenges.



British Columbia
Website: nastt-bc.org

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

Chapter Contact
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Elected Officers
Chair - Ophir Wainer
Treasurer - Preston Creelman



Great Lakes, St. Lawrence & Atlantic
Website: glsla.ca

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.

Chapter Contact
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Elected Officers
Chair - Kevin Bainbridge
Vice Chair - Anna Polito
Secretary - Gerald Bauer
Treasurer - Derek Potvin



Mid Atlantic
Website: mastt.org

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.

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Elected Officers
Chair - Richard Thomasson
Vice Chair - John Hrabosky
Secretary - Dennis Walsh
Treasurer - Michael Hoffmaster



Midwest
Website: mstt.org

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.

Chapter Contact
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Elected Officers
Chair - Chris Schuler
Vice Chair - Ryan Poertner
Secretary - Robert Martin
Treasurer - Gary Smolinski



Northeast
Website: nastt-ne.org

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

Chapter Contact
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Elected Officers
Chair - Babs Marquis
Vice Chair - Eric Schuler
Secretary - Jonathan Kunay
Treasurer - Paul Savard



Northwest
Website: nastt-nw.com

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.

Chapter Contact
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Elected Officers
Chair - Ben Campbell
Secretary - Jeff Galloway
Treasurer - Keith Moggach



Pacific Northwest
Website: pnwnastt.org

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

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Elected Officers
Chair - Carl Pitzer
Vice Chair - AJ Thorne
Secretary - Glen Wheeler
Treasurer - Heidi Howard



Rocky Mountain
Website: rmnastt.org

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

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Elected Officers
Chair - Chris Larson
Vice Chair - Benny Siljeborg
Secretary - Swirvine Nyirenda
Treasurer - Stephanie Nix



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.

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Elected Officers

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Vice Chair - Justin Taylor
Secretary - Luis Cuellar
Treasurer - Josh Kercho



Western

Website: westt.org

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

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Elected Officers

Chair - Lisa Arroyo
Vice Chair - Kate Wallin
Secretary - Rachel Martin
Treasurer - Tim Taylor



Southeast

Website: sestt.org

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.

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Elected Officers

Chair - Jerry Trevino
Vice Chair - Ed Paradis
Secretary - J. Chris Ford
Treasurer - Ed Diggs



Are you looking to get involved with your regional chapter? Jessie Clevenger, NASTT Regional Chapter Relations Manager, is here to provide enhanced services and support to our Regional and Student Chapters. Contact Jessie at jclevenger@nastt.org to build a powerful network of trenchless professionals and get involved in chapter events in your area!



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NASTT STUDENT CHAPTERS

Members of NASTT's Student Chapters 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 an NASTT Student Chapter – scholarships, networking opportunities, education and career opportunities to name a few. To learn more about NASTT's 17 Student Chapters, visit nastt.org/student-chapters.



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NASTT celebrates 30 years of industry advocacy and education in 2020. We represent more than 2,200 members throughout the United States, Canada and Mexico who all promote better and more responsible ways to manage underground infrastructure.

With education at the forefront of our mission we are offering 30% OFF our trenchless publications in our 30th year!

This sale covers our entire suite of trenchless technology good practices guidelines, including our French and Spanish translations.

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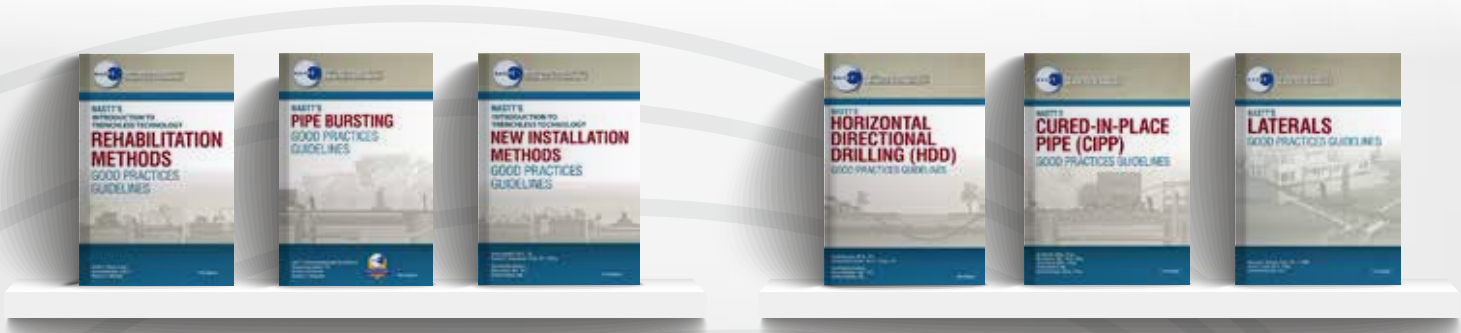
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ENVIRONMENTAL IMPACT EVALUATION OF STEAM-CURED CIPP REHABILITATION

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There have been many questions about the environmental impact of emissions from steam-cured CIPP projects. To address those concerns, a comprehensive project was funded to collect data from multiple projects using various sampling methods to determine the extent of any impacts. This paper will present the findings from that study. The overall objectives of the study were to (1) evaluate air emissions from steam-cured, cured-in-place pipe (CIPP) installations and (2) determine potential impacts on workers and the surrounding community. This was accomplished first by directly measuring worker/public exposure to emissions for locations onsite or immediately offsite. The CIPP installation sites selected represented a range of scenarios typical of CIPP installations. Second, the potential health risks to workers and the community were evaluated based on appropriate health-based action levels using both directly measured and modeled data. The results of the study indicate that the health of workers has the potential to be impacted at two locations, inside the liner truck immediately after opening and areas immediate to the stack (within 10 ft).

INTRODUCTION

As cured-in-place pipe (CIPP) installations have become more common, health officials, utilities and industry representatives have recognized the need to know more about the air-borne chemical emissions created during the CIPP installation process, most specifically in the exhaust produced from steam-cured liners. Recent studies have raised concern about the emissions of styrene and other chemicals on steam-cured CIPP project sites (Ra et al., 2019; Sendesi et al, 2017; Ajdari, 2016). Nineteen TO-15 chemical compounds have been found in CIPP emissions (Najafi et al., 2018). The TO-15 list was created by the US Environmental Protection Agency (EPA) to both identify compounds targeted by the agency for emissions reduction efforts and to define methods for emissions measurements.

With growing concern for understanding health risks posed by CIPP emissions, the National Association of Sewer Service Companies (NASSCO) sponsored a two-phase project to help quantify these risks. The first phase was completed in the spring of 2018 by a team of researchers led by the Center for Underground Infrastructure Research and Education (CUIRE) at the University of Texas at Arlington. Phase I of the project first focused on reviewing CIPP emission study literature and found that of the 21 papers reviewed, previous studies have “defective methodologies” that do not adequately evaluate CIPP emissions (Najafi et al., 2018). The CUIRE team then developed a more robust scope of work for capturing and analyzing CIPP emissions data (Najafi et al., 2018). This scope, which was the target of Phase 2, aimed to determine whether air emissions from steam-cured CIPP installations posed potential health risks for workers and the surrounding community. This paper summarizes in part the results of this study. The objectives of the study were to, first, directly measure worker and public exposure to emissions for locations on-site or immediately off-site and, sec-

Table 1. Site Specific Descriptions

Site #	City	Criteria category		
		Diameter	Pipe Length	Environment
1	Shreveport	6-inch (small)	315-feet (medium)	Residential
2		10-inch (small)	147-feet (short)	Residential
3		8-inch (small)	608-feet (long)	Residential
3a		6-inch (small)	275-feet (medium)	Residential
3b		6-inch (small)	270-feet (medium)	Mixed
4	St. Louis	8-inch (small)	500-feet (long)	Residential
4a		8-inch (small)	270-feet (medium)	Residential
5		24-inch (medium)	535-feet (long)	Commercial
6	Aurora	36-inch (large)	348-feet (medium)	Rural

TABLE 1 – Site Specific Descriptions

ond, evaluate potential health risks to workers and to the community based on appropriate health-based action levels using both directly measured and modeled data.

MEASURING WORKER/PUBLIC EXPOSURE TO CIPP INSTALLATION EMISSIONS

To evaluate the potential health risks associated with steam-cured CIPP installation, first the concentrations of compounds in emissions from pollutant sources were measured. Climate and geography play a significant role in the dispersion of air emissions; therefore, it was important to try to capture sites with a range of climates and elevations. The potential hazards associated with these chemicals depends on the concentration of individual chemical compounds and how chemicals disperse in the environment. To have a more comprehensive understanding of CIPP emissions, the study aimed to capture all the TO-15 compounds present and evaluate the concentration of these chemicals at multiple locations at different points in the CIPP installation process.

SITE SELECTION

Data was collected from a total of nine sites. The sites spanned across three cities: Shreveport, LA; Saint Louis, Missouri; and Aurora, Colorado. Table 1 outlines the sites selected. These sites were selected primarily to capture jobsites in varies climates; however, other limiting factors were considered (e.g. availability of jobsites, project characteristics and site characteristics). The City of Shreveport located in the northwest part of the state of Louisiana (pop. 200,000 approx.), is the third largest city in Louisiana. The climate in Shreveport is typically humid and wet and the city is located at a lower elevation (approximately 150 to 250

feet above sea level). The city of St. Louis, MO is located in the eastern part of the state of Missouri. St. Louis is at a slightly higher elevation than Shreveport (approximately 380 to 615 feet above sea level), is also a humid climate with cooler winters than Shreveport. Aurora is located near Denver in the state of Colorado. Of the three cities, Aurora has the highest elevation (approximately 5,400 feet above sea level) and driest climate. In addition to being selected to provide data collected in varied climates, St. Louis and Aurora were selected since active steam-cured large and medium diameter project were being carried out in these cities, which was not the case in Shreveport.

In addition to climate and elevation variations, ranges of pipe characteristics were also important to evaluate. A range of pipe diameters (small, medium, large) with approximately the same length were targeted. At least three sites were selected representing a range of pipe lengths (short, medium and long), with the same diameter pipe. Site selection also aimed to capture different development characteristics (e.g. residential, commercial/public or mixed development), with at least two sites located near publicly accessible or

vacant buildings accessible for measurement of emission within structures.

EQUIPMENT AND SAMPLING TECHNIQUES USED TO COLLECT EMISSION DATA

Various pieces of equipment were utilized to collect data. The equipment was selected based on the type of data that needed to be collected, the limitations of equipment and expected conditions onsite. A portable HAPSITE Gas chromatography–mass spectrometry (GC-MS) unit was used to collect emission concentrations in a number of locations. Due to the possibility of damage to the equipment during of sampling moist air and the potential for saturating the equipment detector, this equipment was not used to sample directly from the emission stacks. The HAPSITE equipment was primarily used to sample the surrounding areas. Samples were taken for laboratory analysis using both canisters and sorbent tubes. Canisters were primarily used to collect 1) liner truck samples and 2) steam plum exit samples. However, additional canister samples were taken at some of the sites at other locations. Worker and blank sampling were carried out using sorbent tubes. Additional sorbent tubes were also used on Site 3, 5 and 6 to collect air samples in the vicinity of the exit plume. Duplicates of sorbent tubes and canisters were also collected in some cases. All canister and sorbent tube samples were collected by the project team but were analyzed by outside laboratories. Hapsite data was collected and analyzed by the project team.

EVALUATION OF POTENTIAL HEALTH RISKS TO WORKERS AND COMMUNITY

Once these chemical concentrations were measured, the study utilized appropriate

Table 2. Exposure Guidelines for Styrene

Guideline	Exposure Duration					
	5 min	10 min	30 min	1 hour	4 hours	8 hours
AEGL-1 (EPA, 2008)		20 ppm	20 ppm	20 ppm	20 ppm	20 ppm
AEGL-2 (EPA, 2008)		230 ppm	160 ppm	130 ppm	130 ppm	130 ppm
AEGL-3 (EPA, 2008)		1900 ppm	1900 ppm	1100 ppm	340 ppm	340 ppm
IDLH (NIOSH, 2019)			700 ppm*			
REL- TWA (NIOSH, 2019)						50 ppm [10 hr]
STEL-TWA (NIOSH, 2019)		100 ppm [15 min]				
PEL-C (OSHA, 2019)	200 ppm	200 ppm	200 ppm	200 ppm	200 ppm	200 ppm
PEL-TWA (OSHA, 2019)						100 ppm
Acceptable Peak (OSHA, 2019)	600 ppm					

TABLE 2 – Exposure Guidelines for Styrene

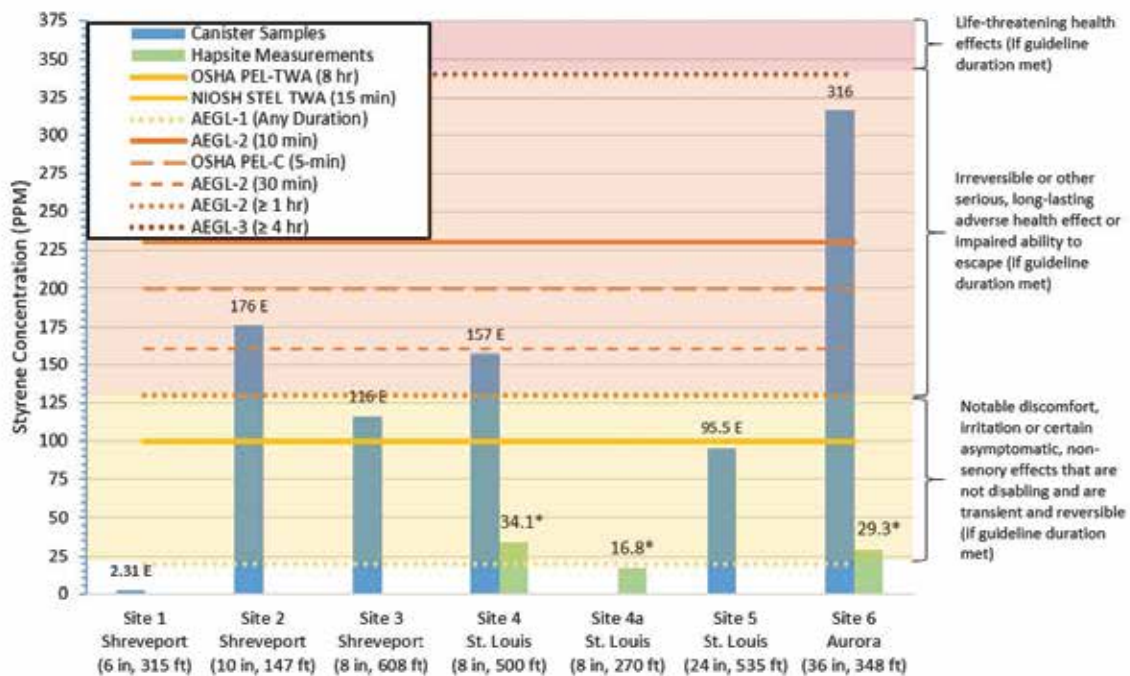


FIGURE 1 – Styrene Concentrations at the Opening of the Liner Transport Truck. *Equipment detector saturated. These values represent minimum concentrations.

health-based action levels published by the Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) to evaluate health risks to workers and the community. Human exposure limit guidelines for the TO-15 chemicals have been published by the United States Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). The guidelines provide exposure boundaries for several scenarios and play a vital role in the analysis of the data collected in this study. It is important to remember that while NIOSH and EPA exposure guidelines are recommendations based on most recent medical research, OSHA exposure guidelines are regulatory and should be enforced. In some instances, the NIOSH, EPA and OSHA guidelines differ. The OSHA limit is enforceable, but, in some cases, the NIOSH and EPA guidelines may offer more stringent recommendations for best practices. OSHA recommends that more stringent guidelines are used if they exist since many of the OSHA limits have not been updated since they were

originally established (OSHA, 2019).

The EPA's Acute Exposure Guideline Limits (AEGL) define thresholds for human health effects from rare or one-time exposure to airborne chemicals. NIOSH Recommended Exposure Limits (REL) define a Short-Term Exposure Limit (STEL) for exposures usually defined as a 15 minute time weighted average (TWA) and a 10-hr TWA. They also define a regulatory guideline level that is Immediately Dangerous to Life and Health (IDLH). OSHA defines a Permitted Exposure Limit (PEL) with a TWA for exposures averaged over 8 hours. OSHA's PEL-C defines a ceiling limit, the exposure level that may not be exceeded for any length of time, except for very short time periods (5 minutes or less) and only up to an acceptable peak limit (NIOSH, 2019). In this study, evaluations of potential health risks were based on these published guidelines.

While all TO-15 chemicals are being quantified in this study, styrene was selected for the evaluation of potential health risks to workers and the community. Of all the compounds measured on the sites, styrene was the only one measured with concentration levels high enough to pose health risks. Styrene, one of the TO-15 chemicals found in some CIPP

liner resins, is found in CIPP emissions at concentrations much higher than the other compounds and is, therefore, of particular interest as an air-borne toxin. Styrene, C8H8 has an odor threshold that according to some literature can vary from 0.16 – 0.64 ppm (EPA, 2008; Amoores & Hautala, 1983). The presence of a styrene odor is not, necessarily, indicative of dangerous styrene levels. Styrene produces a noticeable smell at levels far below the most cautious and conservative regulatory limits. The exposure guidelines for styrene are shown in Table 2. Short-term exposure to styrene can result in mucus membrane and eye irritation as well as gastrointestinal irritation. Long-term exposure to styrene can result in central nervous system [CNS] problems such as headaches, fatigue, muscle weakness, depression, hearing loss, peripheral neuropathy (damage to nerves outside of the brain and spinal cord). Exposure to very high concentrations can lead to death [HHS, 2010; EPA, 2008]. The National Toxicology Program (NTP) under the U.S. Department of Health and Human Services has also declared styrene to be a “reasonably anticipated human carcinogen” (NTP, 2011).

EPA's AEGL thresholds are defined at

three levels each with a defined set of human health impacts. AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure. AEGL - 2 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape. AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death (EPA, 2008).

RESULTS

The health risk analysis only focused on styrene, since of all the TO-15 chemicals measured across all sites it was the only VOC to exceed regulatory thresholds. Emissions and health risk analysis results for common locations or exposure group across all sites are presented in the following sections. Those values reported with an “E” following the concentration value were designated by the outside laboratory as estimated values.

LINER TRUCK DOOR AT INITIAL OPENING

Data collected in or very near the liner transport truck cargo door is summarized for all six sites in Figure 1. All Canister and Hapsite measurement are included with the exception of one duplicate canister from Site 6, which came back from the lab with a concentration of 1,820 E ppm. This result on Site 6 does not agree with the duplicate result of 316 ppm (shown in Figure 1). Liner truck results for previous sites have concentrations ranging from 95 E ppm to 176 E ppm. Considering this range and the discrepancy between the duplicates (1820 E ppm and 316 ppm), there is possibly some error in the sample analysis or estimation of the concentration in the laboratory. For this reason, the 1,820 E ppm measurement did not factor into any recommendations provided at the end of this study. The lower concentration for Site 1 should also be questioned, since the liner truck had been

open for several minutes before that sample was taken. If the 1,820 E ppm value is eliminated, only one of the eight cargo truck measurements exceeded the OSHA PEL-C of 200 ppm. Five of eight measurements exceeded the NIOSH STEL of 50 ppm. One measurement exceeded the AEGL-2 level of 230 ppm.

EXHAUST STACK AND/OR TERMINATION MANHOLE

The results for the air samples collected from the emissions released from the exhaust stack are shown in Figure 2. The max concentrations during curing that were measured from areas nearby (within 25 ft) of the termination manhole/exhaust stack are shown in Figure 3. One of the styrene measurements taken at an exhaust stack was 293 ppm, which exceeds the OSHA PEL-C limit of 200 ppm but is less than the acceptable peak of 600 ppm. The OSHA permitted exposure limit ceiling is more than a recommendation. That limit is the enforceable exposure limit for styrene exposure lasting for a period longer than 5 minutes within a 3-hour window in the construction setting. Provided a worker is exposed to this concentration for 5 minutes or less within any 3-hour window during an 8-hour shift, the exposure falls within OSHA limits. However, it should be noted that OSHA recommends the use of more stringent guidelines (OSHA, 2019) and at one time proposed adopting styrene limits similar NIOSH’s 8-hr TWA (50 ppm) and 15-min STEL (100 ppm) (CDC, 2020).

The 293-ppm measurement exceeds the 15-min STEL. This concentration also exceeds the 10-min and 30-min AEGL-2 guideline at which point long-lasting health effects could occur. Four measurements exceed the AEGL-1 guideline for any duration. The styrene level at any given point over the curing process will likely vary under the influence of environmental factors and degree of cure. However, it is reasonable to conclude that styrene levels within the plume on the CIPP installation site could reach levels that exceed regulatory limits if the exposure durations are met. This identifies the exhaust stack at a CIPP installation site as one the locations where there is reasonable concern for both worker and public exposure to styrene emissions.

In areas immediately surrounding the manhole and stack (within 10 ft), concentrations are at levels not high enough to be im-

mediately dangerous or inescapable or cause long-lasting health effects (Figure 3). The levels are significantly less than the OSHA PEL-C of 200 ppm. Four concentration measurements within ten feet exceed AEGL-1. This data indicates that any worker or member of the public entering and exiting an area with styrene concentrations at the levels recorded in this study should not experience any negative health effects provided the total exposure time is less than 5 minutes and they avoid entering the exhaust plume. No measurements outside of 10-ft exceed AEGL-1. This indicates a decreasing styrene concentration even at relatively short distances from the emission source.

CONCLUSIONS

Future studies of CIPP emissions should focus on:

- **Determining the time it takes the liner truck emissions to dissipate;**
- **Collecting and evaluating task-oriented worker exposure data to identify specific tasks within the typical 8-hour shift window that could pose potential health risks;**
- **Investigating factors such as the size and number of liners on the truck as well the duration each liner is on the truck; and**
- **Capturing and evaluating rogue emission concentrations to evaluate health risks associated with these emissions.**

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9
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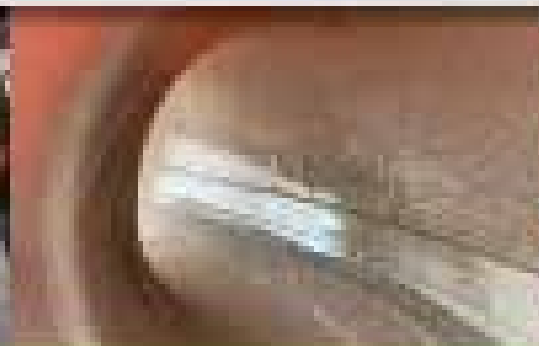


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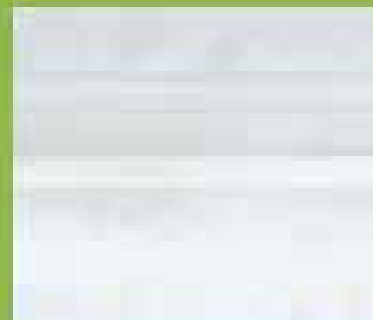


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