NASTT's Trenchless Today

Educate - Train - Research - Publish

WINTER 2011 ISSUE No. 1

Inside Our Inaugural Issue:

Meet the Board

Pipe Bursting and Sliplining in California

2011 No-Dig Show Preview

THE OFFICIAL MAGAZINE OF THE NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY

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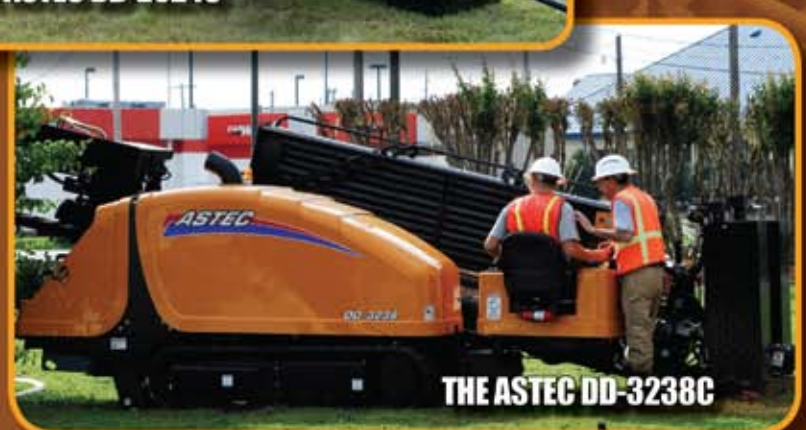

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Message from the Executive Director

NASTT's Trenchless Today

A New Magazine Brings a New Energy to NASTT

Ideas are often hatched over a cup of coffee with friends or casual conversations with colleagues, and this new publication is no different. What was expressed was that NASTT needed a new way to showcase our industry champions and to tell the story of the volunteers who make our society so successful. So here it is: Welcome to our inaugural issue of *NASTT's Trenchless Today*!

Three times a year, we'll deliver the latest news and articles about and for our NASTT membership. These are the trenchless industry innovators who are setting the progressive trends and evolving North America's infrastructure engineering. These are the people who make us more responsible and aware of construction's social impacts, environmental concerns and the fiscal benefits of innovative solutions to municipal servicing. What better way to promote trenchless technology and share its significant benefits?

As our engineering society reaches the young adult age of 21, *NASTT's Trenchless Today* will feature articles on our respected pioneers, our seasoned veterans and the rising young stars of NASTT. Each issue will update and inform you on current NASTT activities, like our annual No-Dig Show, and feature the people "in the trenches" of trenchless technology.

As NASTT continues to grow and take on new challenges, it is important for our not-for-profit society to serve and support our diverse industry partners. Often referred to as the NASTT family, we proudly represent: municipalities and public utilities; consultants and engineers; manufacturers and suppliers; trenchless contractors; as well as academia. With nine regional chapters and 12 student chapters, it is a rather big family. We will attempt to reach out to all of these groups and share with the reader the latest news and accomplishments of the NASTT membership. We'll also keep you informed about our technical programs, continuing education opportunities, the No-Dig Show, forums and the latest NASTT technical publications.

We wish to extend our sincere thanks to the many sponsors of this new publication. Without your generosity and belief in the mission of NASTT, none of our activities would be possible. Your support is highly valued and greatly appreciated.

We hope you enjoy the first issue of *NASTT's Trenchless Today* and we look forward to bringing you many more. Feedback is always welcomed and involvement is invited.

Welcome and enjoy,

Michael Willmets
NASTT Executive Director

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Chairman's Message

Looking Ahead

The New Year Brings Plenty of New Opportunities for NASTT

Happy New Year! First off, I would like to introduce myself as the new chairman of NASTT. I look forward to serving you over the next year and leading NASTT into some new and exciting ventures. I would also like to welcome the new incoming board members and the new Executive Group for 2011. Our new board members include: Frank Firsching, Underground Solutions; Jason Lueke, Ph.D., P.Eng., Arizona State University; and Jim Rankin II, Vermeer Corp.

Our Executive Group is comprised of well-seasoned and experienced trenchless professionals including: Bob Westphal, vice chairman; Benoît Côté, secretary; and Kaleel Rahaim, treasurer. If you happen to cross paths with any of these members, please take the opportunity to welcome them into their new leadership roles.

As I settle into my new role as chairman, there are many ambitions I have for NASTT for the upcoming year. One important goal is to increase membership growth with a special emphasis on owners who benefit the most from trenchless (municipalities and utilities, in particular). Another goal is to strengthen our mission by increasing the number of chapters we have — both regional and student — and expanding our presence. There's strength in numbers, and together we can get a lot accomplished.

I hope that we can increase public sector visibility and interest level through identifying the benefits of trenchless methods. Whether it's environmental or cost-cutting concerns, we need to show owners that there's a bright future based on what we have to offer. I personally think that having this year's No-Dig Show in Washington, D.C., will be ideal for that purpose.

Speaking of No-Dig, I'm beyond excited for this year's show. Not only is it in a great location, but it's the 20th anniversary for the event. Under the leadership of Jack Burnham, we're certainly in for a treat and can expect a great show. The quality of the session tracks and technical papers certainly emphasize our commitment to education and training.

Every year, the No-Dig Show helps to promote NASTT as a premier organization and offers its exhibitors and attendees the opportunity to network and stay current in technology, materials and methods. NASTT and the No-Dig Show definitely have a lot to offer, especially in these hard economic times. I would also like to point out the revamped auction program under the leadership of Joanne Hughes. The auction is for a great cause and Joanne has worked hard to make the event even more enjoyable this year.

Another topic to talk about is the training opportunities NASTT offers to its members. Currently, we have four training courses covering HDD, CIPP, pipe bursting and laterals. And there are opportunities beyond being a student, as we're always looking for instructors. Not only is it a great chance to increase your membership involvement, but you'll also benefit your fellow trenchless colleagues. We're looking at the potential of adding new training courses as well and I'll be sure to keep you updated as the year goes on.

As an organization, we continue to highlight the importance of updating and increasing the quality of our publications. For 2011, there's a new *Pipe Bursting Good Practices* (2nd edition) and a third edition of the *HDD Good Practices* publication. On top of that, we've scheduled a CIPP publication update. To broaden the credibility of our publications, NASTT plans to work closely with ISTT and increase awareness of all NASTT trenchless educational products through International No-Dig Shows and other training events outside of North America.

As we move forward into 2011, I want to remind all of you the importance of making your membership more valuable. There are many opportunities available — such as becoming a committee member, course instructor, exhibitor — for you to dive even further into NASTT. Don't forget, you get out of NASTT what you put into it. Be proactive and get involved!

See you at No-Dig,

George Ragula
NASTT Chairman

Outgoing Chairman's Message

In Retrospect

Taking a Look Back at NASTT's Growth Over the Past Two Years

Looking back on my tenure as NASTT chairman, my first thoughts go to the people who make up the organization. I always knew from being a member of the association that it was run by a good group of people, but until I became chairman and began working closely with them, I did not realize that these folks are not just good people — they are great! An organization is only as good as the people who run it and in this case, NASTT could not be in better hands.

I have thoroughly enjoyed working with all of the people within the association, all of the board members and all of the various committee leaders and members; it is truly an outstanding organization. They all care about NASTT and believe in doing the best for the markets.

Reflecting further, I think we're coming off of some of the best shows we've ever had in the history of the organization. The No-Dig Show two years ago in Toronto, which featured the ISTT show as well, was really a tremendous event. People left that show fired up and motivated. That energy and excitement continued through the Chicago show in 2010.

That is significant for our industry. Having engaged and motivated members means we can continue to work hard for the trenchless industry and help our customers get the dollars they need to pursue trenchless projects. That's where NASTT comes in. That is why we produce the educational tools the industry needs to grow. The good practices books, module updates and educational materials continue to be the best and well intended in the industry.

In addition, over the past two years we've been able to really make strides in building a solid financial foundation for the organization, and we've been able to expand into new geographical areas. For example, the Rocky Mountain Chapter was established over the last two years. The importance of the regional chapters cannot be overstated. They are the grassroots, the front lines. They continue those educational programs all year long. They are the face of the organization, so adding new chapters is significant.

Our students are important too. We have as many, if not more, students than ever before. And we've been able to dramatically increase our scholarships for students. That's something we are all very proud of.

Looking ahead, I am going to miss "the action," but George Ragula will be a fine chairman and continue to carry the trenchless torch for our industry. I am extremely confident that he will do a terrific job and will continue to move the organization in the right direction. I predict that we will have a great No-Dig Show in Washington, D.C., with George and Jack Burnam leading the charge. And I also want to welcome Bob Westphal, senior vice president of construction operations for Michels Corp., as our new vice chairman.

Finally, I would like to say thank you to everyone who made my tenure as NASTT chairman memorable and so productive. I am so proud to have had the opportunity to serve this great organization.

Here's to continuing success,

Chris Brahler
Outgoing NASTT Chairman

Working Together

John Hemphill, Executive Director of ISTT, Discusses the Organization's Relationship with NASTT

Congratulations to the North American Society for Trenchless Technology on the launch of *NASTT's Trenchless Today*! The magazine should prove to be an excellent vehicle for readers to keep abreast of the many positive activities of NASTT, one of the largest and most active of the trenchless societies.

NASTT is fortunate to have members who are dedicated to the industry and willing to pitch in to advance the educational mission of the society. Many NASTT members volunteer their time to serve on technical committees, session chairs and present technical papers at trenchless conferences. Some write articles or teach classes and some serve on the NASTT board. Such involvement is a lot of work, but it has its rewards. This magazine provides an opportunity for the society to recognize more fully the good works of so many of its members.

It also gives the International Society for Trenchless Technology (ISTT), the umbrella trenchless organization, this opportunity to describe more fully who we are, what we do and how we relate to NASTT.

ISTT has been around since 1990. It was founded in the United Kingdom, and during the early years, most of its members were from the U.K. In the mid-1990s, ISTT became truly international when it entered into affiliation agreements with existing trenchless societies in Europe, North America and Asia to work cooperatively to advance the industry worldwide. NASTT was one of the earliest societies to affiliate with ISTT. Today, there are 26 trenchless societies around the world that are members of the ISTT family, from Scandinavia to Singapore.

ISTT has benefited from NASTT leadership over the years. Ray Sterling, former NASTT chairman and longtime NASTT board member, also served on the ISTT board and was chairman of ISTT from 2002 to 2005. Today, ISTT is fortunate to have former NASTT board member, Samuel Ariaratnam, as its current chairman.

The mission of ISTT, and all affiliated societies, is to advance trenchless technology through education and training. ISTT membership is the collective membership of the 26 affiliated societies. If you are a member of NASTT, you are a member of ISTT. ISTT supports the training activities of affiliated societies by participating in and promoting society events. ISTT has a website (*www.istt.com)*, which it uses to publicize affiliated society functions, and to post and distribute technical reports and papers and other information of interest to the industry. Annually, ISTT recognizes trenchless achievements in the industry and academia, and co-sponsors the annual conference of the Trenchless Research Colloquium. ISTT also sponsors *Trenchless International* magazine.

Perhaps ISTT's most visible service to the trenchless community is the International No-Dig Conference and Exhibition. First held in London in 1986, we will be holding our 29th No-Dig this year in Berlin. These international No-Digs are generally hosted by an affiliated society. NASTT has hosted four International No-Digs, most recently a very successful conference and exhibition in 2009 in Toronto.

This year, the German Society for Trenchless Technology (GSTT) is hosting the event, which will take place in Berlin, May 2-5. This International No-Dig, like all our conferences, promises to be informative and educational. Berlin is an exciting city with lots to see. ISTT chairman Sam Ariaratnam and I look forward to seeing many NASTT members there.

John Hemphill
Executive Director of ISTT
Former Executive Director of NASTT (2000-2008)

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Meet the Board

NASTT Officers

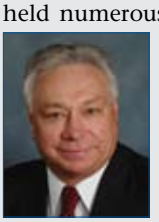
George Ragula, P.E. – Chairman

George Ragula is responsible for evaluating cutting-edge technologies that increase efficiency and effectiveness of operations for Public Service Electric & Gas (PSE&G). Responsibilities include planning, coordinating, managing and implementing procedural and equipment technology transfer with a particular emphasis on increased use of various trenchless technologies. He has spent the last 18 years committed to the ever-growing technologies in trenchless construction.

He is a member of the American Gas Association, American Society of Mechanical Engineers (ASME), NASTT, Society of Gas Operators and the New Jersey Society of Asphalt Technologists. He serves as treasurer of the Northeast Gas Distribution Council and is actively involved as a project advisor for the Gas Technology Institute Operations Technology Development Program and Sustaining Membership Program. In addition,he serves as chairman of the NYSEARCH — Northeast Gas Association R&D Committee. He received his bachelor's degree in mechanical engineering from Polytechnic Institute of Brooklyn in New York.

Robert H. Westphal – Vice Chairman

Robert H. (Bob) Westphal's career with Michels Corp. began in 1965. Since then he has earned himself a distinguished reputation as a hard worker with determination, strong convictions, great work ethic and a "get it done" attitude. Westphal held numerous positions while working his way up through the ranks, which include laborer, operator, foreman, project superintendent, project manager and general superintendent. He currently is senior vice president of construction operations for Michels, a position he has held since 2009.



Westphal has evolved with the underground construction industry through the years and has helped transform what is now Michels Corp. into a worldwide leader in underground construction. Westphal served as president of the Pipe Line Contractors Association (PLCA) in 2005 and currently sits on its Board of Directors. He also serves on the PLCA's Labor Committee and the Pipe Line Industry Advancement Fund (PLIAF). Additionally, he is a trustee on the Laborers National Pension Fund.

Benoît Côté, M.Sc. – Secretary

Benoît Côté has been with Sanexen Environmental Services since 1995. In 1998, he was involved in the development and marketing of the Aqua-Pipe technology for water main rehabilitation. For the past 10 years, he has managed the development and growth of the water main rehab branch at Sanexen.

Since 2001, Côté has held the director of Aqua-Pipe position at Sanexen working to market and license the technology in North America. He has comprehensive expertise in water main rehab and NSF certification protocols. He is also active with the American Water Works Association (AWWA). Côté is a Master of Science graduate from the University of Sherbrooke.

Kaleel Rahaim – Treasurer

Kaleel Rahaim is a chemical engineering graduate from Mississippi State University. He has experience in many different aspects of engineering such as project and process engineering. He has been involved in the thermoset polymer industry for almost 30 years. His current position is business manager, Pipeline Remediation Polymers for the Thermoset Resins Division of Interplastic Corp. Aside from being on the Board of Directors for NASTT, Rahaim is also involved in other trade organizations for the trenchless remediation industry. He served as the program chair of the 2008 No-Dig Show in Dallas. Rahaim resides in Houston with his wife, Peggy.

Chris Brahler – Immediate Past Chairman

Chris Brahler has been active in the development and growth of the underground construction industry for 30 years. He received a bachelor's degree in business administration in 1974 and began his career in the cable installation equipment market that same year. Brahler soon developed an interest in trenchless technology. In 1991, Brahler started TT Technologies, Aurora, Ill., a manufacturer of a wide range of trenchless tools and equipment. As president and CEO of TT Technologies, Brahler works with many different underground construction applications including boring systems, pipe ramming, HDD and pipe bursting.

Brahler has been very involved in promoting the growth of the trenchless technology market. He has been a featured presenter at conventions and conferences around the country including, UCT, the Power and Communication Contractors Association (PCCA), the Distribution Contractors Association (DCA) and the National Utility Contractors Association (NUCA). Brahler has served on the No-Dig Trenchless Committee, DCA Board of Directors and the NUCA Trenchless Committee.

2011 Board of Directors

Alan Atalah, Ph.D., P.E.

Alan Atalah is an associate professor working for Bowling Green State University where he teaches construction management. Atalah earned a Doctor of Engineering, Master of Science in civil engineering and Master of Business Administration degrees from Louisiana Tech University in Ruston, La. He graduated with a diploma in construction management and a bachelor's degree in civil engineering from Ain Shams University, Cairo, Egypt. He has more than 24 years of construction experience in water and wastewater projects, 15 years of which were in trenchless technology construction. He has delivered hundreds of trenchless technology and construction management presentations in many national conferences and educational seminars.

George Cowan, P.E.

George Cowan graduated from the Polytechnic Institute of Brooklyn in 1973, earning his Bachelor of Science in civil engineering and Registered Professional Engineer in the state

of New York since 1977. Cowan is also a member of the American Society of Civil Engineers (ASCE), member of the Buried Asset Management Institute (BAMI) and a part of the Industry Advisory Board at Louisiana Tech's TTC.

Cowan is a project engineer for Carp-Seca Construction. Previously, he worked at the New York City Department of Environmental Protection from 1973 through 1996 and was involved in the design and construction of sewers. Upon New York City's formation of the Department of Design and Construction in 1996, he was appointed the assistant commissioner for the Division of Infrastructure/Design, where he was responsible for overseeing the design of the city's infrastructure including sewers, water mains and roadways.

Frank Firsching

As the vice president of sales for UGSI, Frank Firsching oversees regional sales managers and coordinates all domestic and international sales activities. He has extensive engineering, sales and management experience. He received a Master of

Business Administration at the Wharton School of Business and a bachelor's in mechanical engineering from the University of Virginia. Before joining UGSI, Firsching worked for USFilter as president of the Water and Wastewater Systems Group, with responsibility for USFilter's global process equipment and technology divisions. He also held the positions of executive vice president of Process Water Group, West Regional and general manager at USFilter. In addition, Firsching has worked for Deloitte & Touche Management Consulting and GE.

Jennifer Glynn, P.E.

Jennifer Glynn is a project manager for RMC Water and Environment in its Walnut Creek, Calif., office. She earned her Bachelor of Science in civil engineering from the University of New Hampshire and then headed west to California. Glynn has

15 years of experience in municipal infrastructure planning, permitting, design and construction management with an emphasis on pipeline design and the use of trenchless technology. She has published and presented papers on projects she designed using trenchless technology at conferences all over the United States.

Glynn has been a member of the No-Dig Show Program Committee for the past seven years and is one of the founding members of Western Chapter (WESTT). She currently serves as chair of WESTT and is a volunteer NASTT Pipe Bursting Good Practices Course instructor. Glynn is also a member of the AWWA Water Pipeline Rehabilitation Committee and a past vice president of the Northern California Pipe User's Group (PUG).

Mark Hallett

Mark Hallett has been in the construction business the majority of his working career, specializing in the rehabilitation of underground infrastructures. He is the vice president of SAERTEX multiCom LP, a manufacturer and supplier of resin impregnated glass fiber liner designed to cure under UV light. Previously, he was employed by Miller Pipeline Corp., a full service underground utility contractor, where he served as vice president of the Utility Division. Hallett has been active in a number of trade associations and

was the president of NASSCO's International Pipe Bursting Association (IPBA) and is now serving on the Board of Directors of NASTT. He was the program chair for the 2010 No-Dig Show in Chicago.

Jamie Hannam, MBA, P.Eng.

Jamie Hannam is the manager of engineering and information services for Halifax Water, a position he obtained in 2007. Prior to this, he was the chief engineer with the Halifax Regional Water Commission from 1994 to 2007. A graduate of Acadia University (B.Sc. 1983), Technical University of Nova Scotia (B.Eng. 1985) and Dalhousie (MBA 1990), he spent the earlier years of his career in municipal government in both Halifax and Dartmouth working on a variety of engineering tasks. In his current role with Halifax Water, he is responsible for water and wastewater infrastructure master planning, asset management and capital project delivery with an annual capital budget of $30 million.

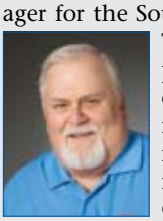
Halifax Water, the first regulated water, wastewater and stormwater utility in Canada and the largest utility in Atlantic Canada, serving 350,000, with pipes as old as 1856, has utilized trenchless technologies and NASTT resources as key components of its system rehabilitation program for the past 15 years.

Tom Hayes

Tom Hayes is the president of Haywood Associates LLC. Previously, he was vice president of the North American Rehabilitation Division for Insituform Technologies, where he worked for 24 years. Hayes has over 30 years experience in underground pipeline infrastructure. Before joining Insituform, he was a partner at Utility Surveys Inc., a utility construction firm. Prior to that, he worked for McCullough Environmental, a firm specializing in sewer system evaluation surveys (SSES) for municipal and federal utility systems. An Atlanta resident, Hayes holds a Bachelor of Arts degree in psychology from the University of South Carolina and a Master of Business Administration degree from Jacksonville University. Hayes is a member of the American Public Works Association (APWA) and the AWWA.

Jim Hoggatt

Jim Hoggatt is currently the Engineering Department manager for the South Tahoe Public Utility District in South Lake Tahoe, Calif. Hoggatt has over 30 years of experience in planning, permitting, design and construction management in the field of municipal engineering. He has been the project manager on the design and construction of many trenchless projects including sliplining, CIPP, pipe bursting, HDD and auger boring. Hoggatt earned a Bachelor of Science in civil engineering from New Mexico State University and has been active in NASTT for the past 15 years.



Dave Krywiak, P.Eng.

Dave Krywiak is a senior project manager with Stantec Consulting Ltd. in its Edmonton Alberta office. He obtained a Bachelor of Science degree in civil engineering from the University of Alberta in 1977 and has been employed in the consulting industry since that time. Many of the projects that Krywiak has been involved with have included significant trenchless technology components, such as conventional and microtunneling, HDD and CIPP relining. He is one of the founding members of the Northwest Chapter of NASTT and has served on the Chapter Board for a number of terms, including a term as the chapter chair.

Jason Lueke, Ph.D., P. Eng.

In January 2009, Jason Lueke became an assistant professor with the Del E. Webb School of Construction at Arizona State University. He has published more than 40 journal and conference papers in the field of trenchless technology and was the inaugural president of the University of Alberta Student Chapter of NASTT.

A strong promoter of the trenchless industry, Lueke has been actively involved with NASTT for 11 years. He is a volunteer instructor for the NASTT HDD and Lateral Rehabilitation Good Practices courses, currently the WESTT Chapter secretary, and a No-Dig Technical Program Committee member and session leader since 2006. He was the chair for two and a member of seven organizing committees of the Alberta Trenchless Symposiums and was the Edmonton section chair of the Northwest Chapter of NASTT. Lueke has authored two award-winning papers and was the recipient of the 2010 Trent Ralston Young Trenchless Achievement Award.

Derek Potvin, P.Eng.

Derek Potvin is the vice president of the multi-disciplinary engineering firm, Robinson Consultants Inc. He obtained his bachelor's of applied sciences with a minor in business administration from the University of Ottawa. Potvin has been providing trenchless rehabilitation solutions to his clients for over 20 years, including a trenchless technology project that won a Canadian Consulting Engineering Award. He is actively involved with the NASTT No-Dig Conference, where he has authored many papers including a paper that won an "Outstanding Paper Award." And for several years, he has been an instructor for the introduction to sewer and watermain trenchless rehabilitation course. Potvin is the treasurer for the Great Lakes, St. Lawrence and Atlantic Chapter (GLSLA) of NASTT. Potvin, along with two other GLSLA members, was recently invited to Cairo, Egypt, to provide a course on municipal infrastructure management, including trenchless technologies, to attendees from Egypt, the Middle East and North African countries.

Cindy Preuss, P.E.

Cindy Preuss graduated with a Bachelor of Science degree in civil and environmental engineering from the University of California at Berkeley and is a licensed professional civil engineer in the state of California. She is an associate and project manager with Harris & Associates and works out of its corporate headquarters located in Concord, Calif. In her 10 years with Harris & Associates, Cindy's engineering expertise includes designing new and rehabilitated pipeline systems and other infrastructure facilities.

Her pipeline design projects include such trenchless technologies as HDD, jack and auger boring, sliplining, cast-in-place plastic lining and pipe bursting. Prior to Harris & Associates, Preuss worked at the Regional Water Quality Control Board, monitoring and enforcing cleanup orders for soil- and groundwater-contaminated sites in the San Francisco Bay. Preuss is currently serving her sixth year on the Board of Directors for the Northern California PUG.

Jim Rankin II

Jim Rankin has been with Vermeer Corp. for more than 33 years and has amassed a vast array of knowledge of industrial equipment and trenchless technology applications. For the

past 23 years, his focus has been on Vermeer horizontal directional drills. Rankin was the project leader for the team that developed the first drill commercially marketed by Vermeer. Prior to working with HDD equipment, he was involved with the development for Vermeer's Utility Products (formerly Rubber Tire) and track equipment. Rankin has demonstrated his innovative abilities and technical skills by earning 14 industrial patents.

Rankin delivers the Vermeer vision, "Taking Care Of Customers Worldwide With Better Solutions," through extensive domestic and international travel and by meeting the business needs of the Vermeer customers and dealers. He is a long-term member of the No-Dig Technical Program Committee, as well as a dedicated member of the NASTT Annual Educational Fund Auction Committee.

Kimberlie Staheli, Ph.D., P.E.

Kimberlie Staheli is the president and founder of Staheli Trenchless Consultants in Seattle, a trenchless engineering consulting firm specializing in the design and construction management of all types of high risk trenchless projects for over 18 years. Staheli has a bachelor's in mechanical engineering from Rensselaer Polytechnic Institute, a master's in civil engineering from Mississippi State University and a Ph.D. in geotechnical engineering from Georgia Institute of Technology. She is a Registered Professional Engineer in Washington, Oregon and California.

Staheli has specialized in trenchless design and construction working for contractors, performing trenchless research and working as a consultant. She is particularly interested in minimizing the risks of installation techniques including microtunneling, directional drilling, pipe ramming, auger boring and large-diameter tunneling. Staheli has focused on risk reduction through the development of geotechnical baseline reports as well as pro-active construction risk management. She has vast experience in trenchless forensics and post construction claims analysis and provides expert testimony.

Isabel Tardif, B.Eng., LL.B., M.P.M.

Isabel Tardif holds a bachelor's degree in civil engineering from McGill University and a law degree from the University du Quebec in Montreal. She also earned a master's in project management from the University du Quebec en Outaouais.

Tardif is a technologies director pertaining to underground infrastructures for the Centre for Expertise and Research on Infrastructure in Urban Areas (CERIU). Prior to CERIU, she has held the position of operations manager — Potable Water and Sewer Networks for the City of Aylmer, as well as coordinator — Potable Water and Sewer Rehabilitation for the Engineering Department for the City of Gatineau.

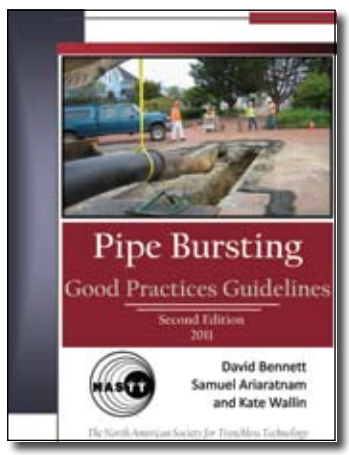
She has been involved in several INFRAGuide Committees; NASTT and with the CERIU for many years in regards potable water and sewer underground infrastructures. Tardif had moderated and has given conferences in Africa and in North America on different topics pertaining to potable water, sewer and trenchless technologies. She currently gives courses and lectures on trenchless technologies to engineers, technicians, as well as university and college students.

NEW RELEASE ANNOUNCEMENT

Pipe Bursting Guidelines

With a worldwide increase in urban growth, more and more municipal governments are facing enormous challenges with aging water and wastewater systems. Potable water distribution piping is often below operational requirements plus, sanitary and storm collection piping is often at peak capacity or even beyond. These utility owners are faced with the onerous task of replacing or rehabilitation their infrastructure while under ever increasing financial and environmental restrictions.

Pipe bursting is defined as the replacement of the host, or original, pipe by fragmenting the existing conduit and installing the product or new pipe in its place. This construction technique is recognized as the only method of trenchless rehabilitation that can replace an existing line with a completely new pipe, providing a total pipe replacement. Additionally, pipe bursting allows for the replacement of existing pipe with a new line of equal or larger diameter, to maintain or increase flow capabilities.



The First Edition of the *Pipe Bursting Good Practices Guidelines* was published in 2005 as a supplement to the Pipe Bursting Training Course developed by the North American Society for Trenchless Technology (NASTT). The Second Edition of the *Pipe Bursting Good Practices* has expanded to reflect the current state of the industry. The Second Edition also has a new section on design calculations and a newly revamped Trouble Shooting section including remediation and preventative measures. The Second Edition *Guidelines* were authored by Dr. David Bennett, Dr. Samuel Ariaratnam, and Kate Wallin in conjunction with TT Technologies, Inc., Earth Tool Company and Albuquerque Underground, Inc.

Topics covered in the book include:

- Pipe Bursting Techniques
- Design Considerations
- Elements of Construction
- Trouble Shooting and Remedial Actions

The intent of this North American Society for Trenchless Technology (NASTT) publication is to educate owners and their agents of the benefits of a proven alternative technology known as "Pipebursting". For more information or to purchase copies, please visit the bookstore next to the registration desks at NASTT's 2011 No-Dig Show during exhibit hours. You can also purchase the book after the show by visiting *www.nastt.org*.

Q&A

Richard Thomasson, One of NASTT's Founding Fathers, Takes a Look at the Organization's Past, Present and Future

***NASTT's Trenchless Today (NTT)*:** Can you tell our readers a little bit about yourself and how you got into the trenchless business?

Thomasson: I worked for the Washington Suburban Sanitary Commission [WSSC] for 31 years and was the director of maintenance and the director of construction. While I was working in maintenance, we were very interested in all trenchless techniques for the rehabilitation of difficult sewers, which were in poor condition. In 1978, we worked with Insituform East to assist in the use of a trenchless lining system for the rehabilitation of sewers.

Through my contacts with various associations, I became involved in committee work dealing with trenchless technologies. I was the chair for the ISTT No-Dig show held in Crystal City, Va., with ISTT and WEF. Several of the representatives with various associations got together and decided to form NASTT, a North American society affiliate of ISTT.

***NTT*:** As one of the founding fathers of NASTT, can you describe the early beginnings of the organization?

Thomasson: The five of us — Tom Iseley [ASCE], Mike Argent [NUCA], Norm Sirna [NASSCO], Stephen Cordes [AWWA] and I [WEF] — started meeting and formulating a plan for the new association [NASTT]. We worked with ISTT representatives to gather all the information we needed for the formation of the organization. We determined that we needed some paid assistance from an association specialist to assist, since the five of us were all volunteers and worked full time for other companies all across the United States. We hired Bostrom to be our executive director and handle our affairs, as well as our annual No-Dig Shows.

***NTT*:** After spending four years as chairman of NASTT (1990-1993), what were some of your most memorable moments during your tenure?

Thomasson: First and foremost, I was only the chairman for this period of time because I was with a public utility and was seen as neutral from a business standpoint. To see an association focused on trenchless technology form from nothing to a relevant player in the industry was very fulfilling. Working with ISTT as a new affiliate association for the second international No-Dig in North America was memorable. I always felt good about our focus and path during the development of NASTT. There are so many good people with trenchless technology as their prime interest who have been so involved in NASTT's development. In addition, it was good to reach out and get such support from our Canadian friends during the development.

***NTT*:** How has NASTT evolved over the years? What have been the organization's greatest strengths?

Thomasson: The greatest strengths have been the ability to work through competing interests at times and to stay focused on the purpose for NASTT — the education and promotion of trenchless as a very effective and cost-conscious method for rehabilitation and new construction.

***NTT*:** Why should someone in the trenchless industry become a member of NASTT? What are the benefits of becoming a member?

Thomasson: NASTT provides the best source for networking with the major trenchless technology people in the industry. All phases of the industry are represented, and the sharing of experiences and information crosses all occupations. The relationships developed and interactions in the trenchless industry focused through NASTT are unparalleled. Access to information, education and networking are the primary benefits.

***NTT*:** What is your most memorable No-Dig experience?

Thomasson: Receiving the *Trenchless Technology* Person of the Year award after Tom Iseley received the first one. It was an honor to follow such a pioneer and un-tiring proponent for trenchless technology.

***NTT*:** How do you think the No-Dig Show has benefitted the trenchless community?

Thomasson: The No-Dig Show has been the only show which deals with all aspects of trenchless in technical papers and exhibits. For the money, you cannot gain a better use of your time if trenchless technology is your focus.

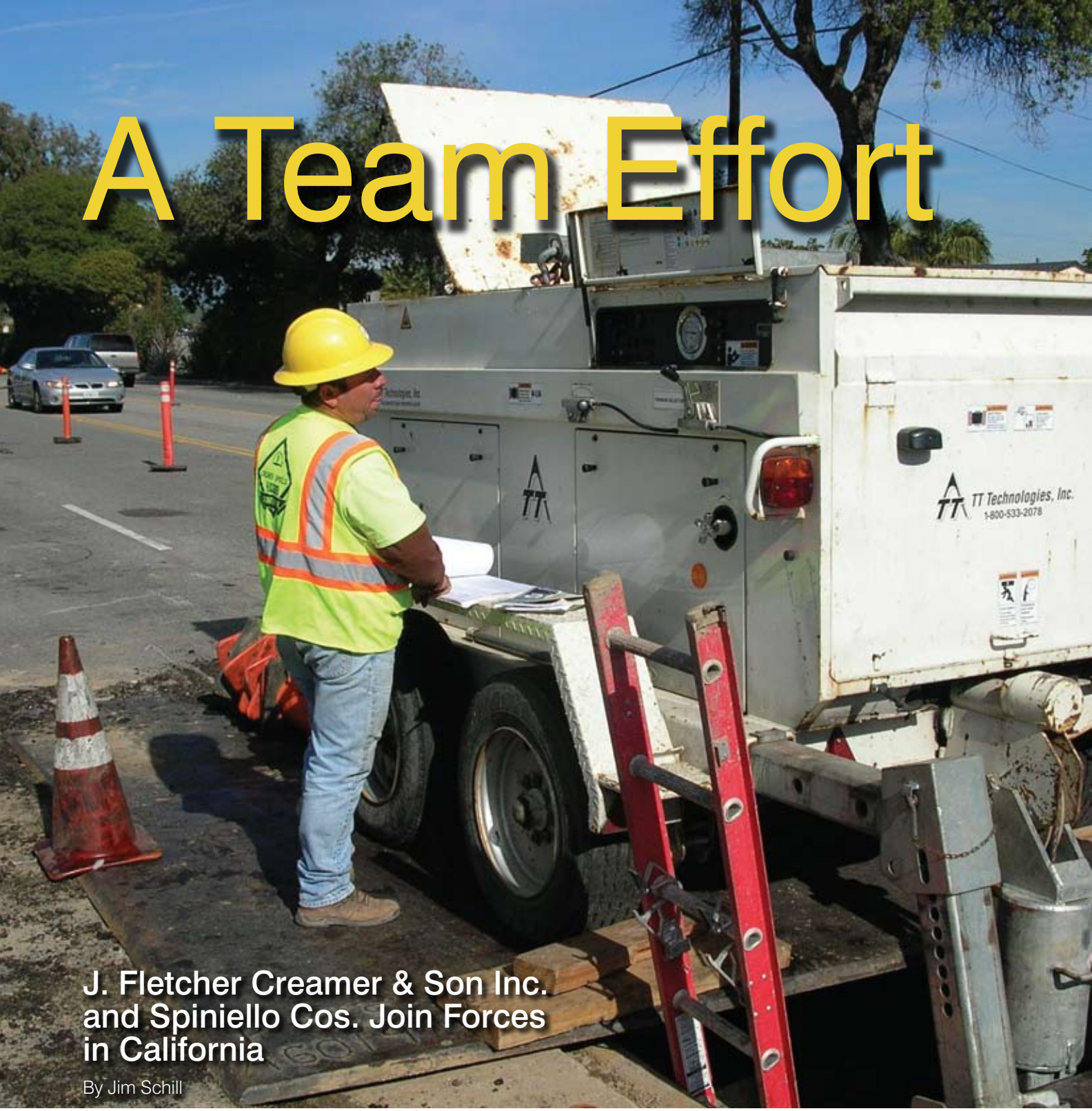
***NTT*:** What advice do you have for new members of NASTT or for professionals just getting into the trenchless market?

Thomasson: Become involved in various volunteer work as soon as possible. This will result in being a part of the many accomplishments achieved by NASTT. We have the unique opportunity to be a positive influence on the quality of life for people and it is extremely rewarding. Also, you become part of the continued advancement of education for people and the advancement of the trenchless technology industry. It's an always changing industry and you can be part of the positive change that takes place.

***NTT*:** As we continue to move forward into 2011, what outlook do you have for NASTT and the trenchless industry as a whole?

Thomasson: I believe that there are more opportunities than ever in trenchless technology. As infrastructure continues to deteriorate, more rehabilitation technologies will need to be developed. In new construction, there are major advantages to trenchless technology use. More focus is being placed on asset management and the trenchless industry has a prominent role in this arena. Sustainability and green infrastructure are primary focus areas and the trenchless industry can have significant participation in these endeavors.

A Team Effort



J. Fletcher Creamer & Son Inc. and Spiniello Cos. Join Forces in California

By Jim Schill

J. Fletcher Creamer & Son Inc. and Spiniello Cos. have a lot in common. The companies are two of the most recognized utility contractors in North America — each with headquarters in New Jersey, satellite offices around the country and more than 83 years in business. Both of them have their own tools, equipment and depth of experienced employee resources. Not to mention, both Creamer and Spiniello have been involved in some of the biggest, toughest, most diversified trenchless projects in the country.

Creamer's lines of business include pipe bursting, sliplining, site development, heavy construction, renewable energy, drilling, cement mortar lining, tunneling, telecommunications, fiber-optics, gas, power, electric and environmental services. Spiniello's expertise extends beyond its core heavy utility business as well, with capabilities that include large diameter cured-in-place pipe (CIPP) rehabilitation, structural CIPP NSF 61-approved liners for potable water mains, sliplining for round and elliptical pipe, cement mortar lining, pipe bursting and large diameter bypass pumping.

In a significant move, the two companies have joined forces to bid and perform work on unique, specialty and complex, trenchless pipeline rehabilitation projects nationally. The companies recently collaborated on a project for the city of Oxnard, Calif., which included a significant amount of pipe bursting and sliplining.

Understanding the Project

The city's Groundwater Recovery Enhancement and Treatment Program, Phase 1, included installing and rehabilitating approximately 40,400 lf of recycled water pipeline. Pipeline work consisted of sliplining approximately 15,000 lf of existing vitrified clay pipe (VCP) with 18- and 22-in. HDPE. Pipe bursting included approximately 9,000 lf of 15- and 18-in. VCP to 18-in. HDPE. Additionally, the project included sections of open-cut, auger boring, microtunneling and horizontal directional drilling (HDD). According to Dave Arthurs, resident engineer for AECOM, a global provider of professional technical and management support services to a broad range of markets, unique features of this project included the diversity of the trenchless methods used and the high productivity.

During the bidding process, trenchless specialist George Mallakis of TT Technologies, Aurora, Ill., worked closely with the Creamer and Spiniello joint venture to understand the scope of the work, soil conditions and lengths of runs, as well as the production expectations for both the pipe bursting and sliplining.

"We discussed various equipment options, equipment and personal support to get the job done in the most economical and productive fashion, while maintaining the highest of quality," said Mallakis. "Originally, the pipe bursting work was to be accomplished with an 18-in. Grundocrack pneumatic pipe bursting system.

"Once the project was awarded, Spiniello superintendent Ron Wigner recommended going with TT Technologies' 1250G static pipe bursting system instead of the 18-in. hammer because of various jobsite conditions. He and his crew recently used the 1250G on another project and were confident they could beat the estimated productions with less people and make longer runs with this equipment."

According to Andrew Vena, project manager for J. Fletcher Creamer & Son Inc., expectations at bid time were to allow 18 days for set up and 18 days to burst the 15- and 18-in. lines for a total of 36 days.

Getting to Work

The static bursting process is simple, yet effective. Specially designed bladed rollers are pulled through an existing line by a hydraulically powered bursting unit. As the bladed rollers are pulled through, they split the host pipe. An expander attached to the rollers forces the fragmented pipe into the surrounding soil, while simultaneously pulling in the new pipe.

Unique to this system, patented Quicklock bursting rods are linked and not screwed together like traditional drill stems or other static systems. This system speeds the installation significantly. The rods can be quickly removed one at a time at the retrieval pit during the bursting operation. While HDPE is commonly used, new techniques and technologies are allowing contractors a choice when it comes to product pipe. According to Mallakis, other pipe materials are being installed now through static bursting include ductile iron, fusible PVC, restrained joint PVC, sectional "No-Dig" VCP and steel.

Crews utilized a Grundoburst static pipe bursting system with Quicklock rods, bursting 15-in. VCP and pulling in 18-in. HDPE.

"Several techniques have been developed by TT Technologies, pipe manufacturers and partner contractors to allow the use of a variety of product pipe options with the static pipe bursting process," said Mallakis. "Beside its inherent trenchless aspect, this is one of the main reasons that the popularity of the method has really taken off. It really provides a level of choice and versatility previously not available with the bursting process."

The actual total days on the job were 20, instead of the estimated 36 days. Original plans called for 26 launch and receiving pits, but with the performance of the static pipe bursting equipment, crews were able to eliminate seven pits by increasing the length of the runs. The longest run was 787 lf, and bursting rates averaged approximately 5 ft per minute with the average daily totals of approximately 600 lf.

Crews were able to set up and burst one to two runs each day. Due to the Quicklock rod system and a newly designed hydraulic power pack, the contractors were able to beat their expected production while using less equipment and a smaller crew to accomplish the job as bid. Wigner and Jose Gerado, foreman for the project, demonstrated extraordinary skills and abilities, performing some of the most productive and efficient pipe bursting seen anywhere in the country.

Sliplining production was also impressive. The 18- and 22-in. pipes were expected to be slip-lined at a rate of one run per day, averaging 600 lf. With the use of the 20-ton Grundowinch, actual production averaged 1,200 lf per day with the longest run being 1,675 lf in a single day. Crews were able to fuse pipe in 500-ft sections. Once the winch was set up and the winch line placed (up to 2,000 ft at times), sliplining would begin at a rate of about 25 ft per minute. When crews reached the 450-ft mark, they would fuse on another 500-ft section and continue pulling.

Project Review

Since the project brought together two nationally renowned pipeline rehabilitation contractors that normally compete against each other, learning to work together was critical. Each company brought its own skills, equipment, personnel and depth of experience to complement each other. Even though these companies have worked together previously as a joint venture, this project was the largest and most complicated thus far for their partnership.

According to Vena and Wigner, there was some apprehension in the beginning on how these two companies' crews would work together. After a short trial period, both companies' personnel adapted to each others' styles and started to rely and lean on each others' strengths to get the job done.

Jim Schill is a technical writer based in Mankato, Minn.

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In the Trenches

NASTT Offers a Glimpse at a Handful of Its Dedicated Members

By Pam Kleineke

Since its inception in 1990, NASTT has grown to include thousands of members, 10 regional chapters and 12 student chapters scattered across North America. From engineers and contractors to manufacturers and academia, NASTT is comprised of professionals and students dedicated to promoting trenchless technology. Over the next two pages, the organization highlights three of its outstanding members — Dave Crowder, Dennis Doherty and Larry Kiest — and offers a peek into their lives and involvement with NASTT. From how they entered the industry to their most memorable No-Dig experiences, *NASTT's Trenchless Today* explores the careers and experiences of these valuable members.

Dave Crowder

For the last 24 years, Dave Crowder has been a part of R.V. Anderson Associates Ltd. — starting out as a surveyor and working his way to his current position as both manager of field services and project manager for trenchless projects. For more than two decades, Crowder has held an impressive list of job titles with the consulting engineering firm. As an inspector, he got his first dose of trenchless.

"During my early career as an inspector, I became heavily involved with municipal inspection projects, including large-diameter sewers and water mains, tunnels, bridges, road re-construction and the construction of large underground tanks and storm water ponds," says Crowder. "I started in trenchless by inspecting the installation of water services across a road in a subdivision using torpedoes and spot repairs of leaking joints in sanitary sewers. After that, I became very interested in CCTV inspections and worked on a large project for six months reviewing sewer videos and providing ratings for each sewer and coding."

After being bitten by the trenchless bug, Crowder looked to the Centre for Advancement of Trenchless Technologies (CATT) where he began to conduct research and attend lo-

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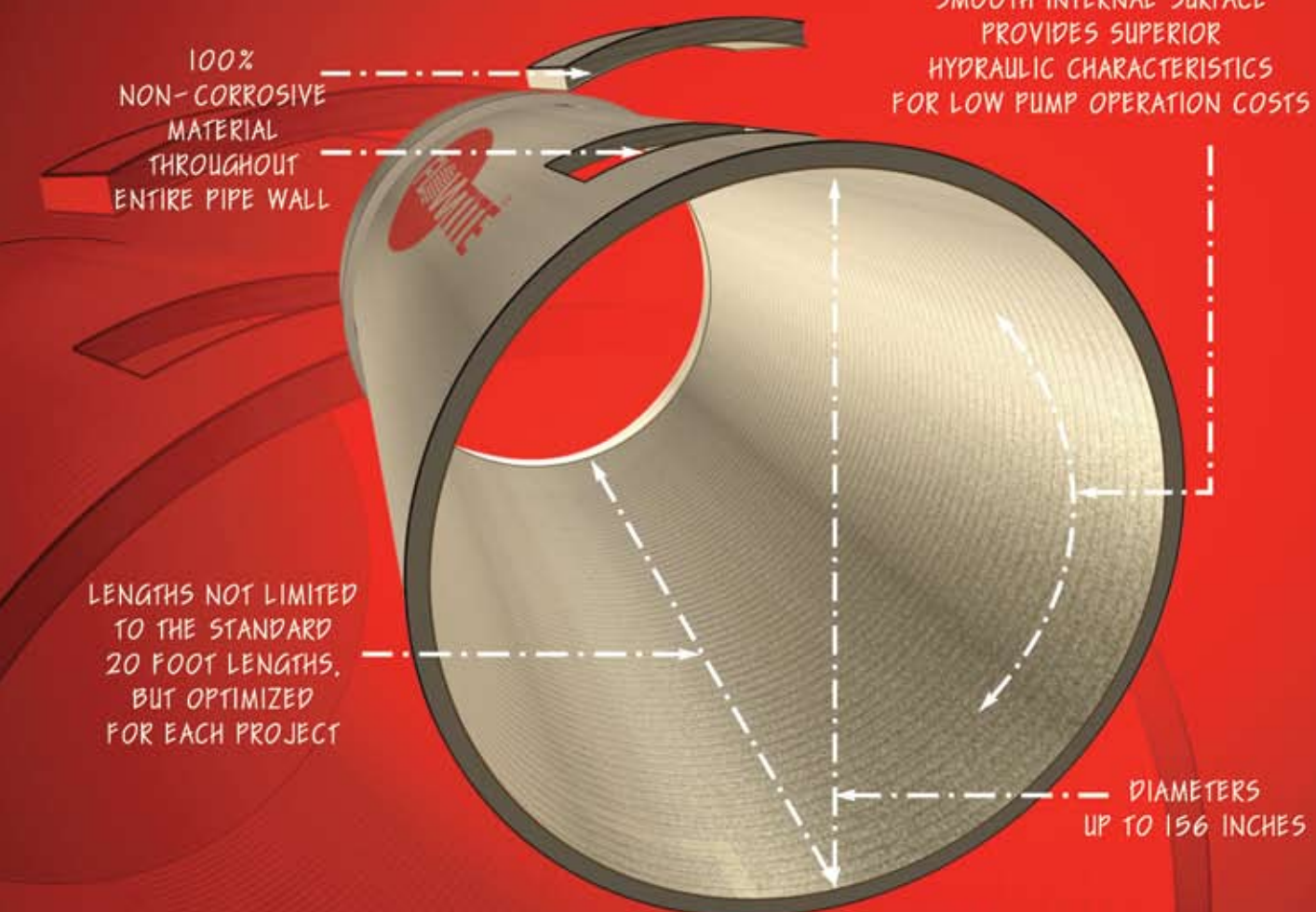

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cal seminars. Crowder started to use electro-magnetic technology to locate large-diameter sewers underneath existing buildings in downtown Toronto. Since using that technology, he has worked with others on how to locate and repair sewers and carry out condition assessments. He also became chair of CATT from 2008 to 2010.

On top of his involvement with CATT, Crowder became a member of NASTT in 2003. Five years later, in 2008, he became a member of NASTT's Conference Committee. Through his involvement in both the organization and No-Dig Shows, Crowder has continued on in his quest to learn about the industry and teach others from his own experiences through presentations.

"The most beneficial reason for me to be involved with NASTT is the knowledge I've gained through attending the No-Dig Show and NASTT-sponsored courses," he says. "It's the wealth of knowledge that attracts me to the events. You can listen to others talk about similar trenchless experiences or teach others by presenting a paper. You have the opportunity to show people new technologies that can save them money."

Looking back, Crowder's most memorable NASTT experience — and favorite No-Dig locale — was the 2003 No-Dig in Las Vegas. Not only was this his first No-Dig Show, but he also had the opportunity to present a paper to an international audience. Through this experience, Crowder was able to share his knowledge and answer questions from people all around the world.

Dennis Doherty

This year marks 22 years in the trenchless business for Dennis Doherty, who currently holds the position of national practice leader — Trenchless Technologies with Haley & Aldrich, a premier geotechnical firm. After working on his first trenchless project in 1989, Doherty became intrigued with this type of work and the opportunities that were available because of it.

"I became very interested in trenchless when I became the project engineer for a project known as the New St. James Avenue Project," says Doherty. "It involved pipe bursting, CIPP and microtunneling in a highly urbanized area. This project even ended up winning the 1996 *Trenchless Technology* Project of the Year."

In 1992, Doherty attended his first No-Dig conference, where he set out to learn as much about trenchless as possible. Not only did he learn, but he was also given the chance to meet some of the industry greats such as Dave Bennett, Tom Iseley, Bill Gray and many others who have remained his good friends ever since — friendships that he credits as being one of the biggest benefits of his time with NASTT. From then on, Doherty has remained a solid presence at the annual trenchless show.

"I presented my first paper in 1994 and have been presenting papers ever since," he says. "I have been involved with the No-Dig Program Committee for a number of years, reviewing papers and being a session leader. I have also been involved with a number of trenchless standards committees and have had the honor of teaching the HDD Good Practices Course with Dave Bennett."

After 22 years in the trenchless industry and 19 No-Dig Shows under his belt, Doherty has some trouble pinpointing his most memorable experiences with NASTT.

"That is a tough one," he says. "Was it the first No-Dig I attended in Washington, D.C.? Or was it the time I presented a paper in Toronto [in 1995] with a bag pipe band playing outside as accompanying music? Maybe it was the time I was asked to present someone else's paper in 2003 in Las Vegas with only a half hour to go and pulled it off? Or, the first Dallas No-Dig at DFW Airport and the Gala was a barbecue at the end of the runway?"

Doherty is a bit more decisive on his favorite place to stay — the Gaylord Opryland Hotel in Nashville, Tenn. He says, "That was quite an experience when they handed me a map at check-in to find my way around."

Larry Kiest

For 19 years, Larry Kiest has been the CEO and president of LMK Technologies, a provider of trenchless materials, equipment and know-how for the renewal of pressure pipes, gravity pipes, lateral pipes, manholes and cleanouts. His career path into trenchless all started by following in his family's footsteps.

"I followed my great uncle, grandfather and father into the plumbing business at age 17," explains Kiest. "I worked through the Department of Public Health apprentice program and obtained my master plumbers license. Working for my father, I did whatever was required and that included working as an operating engineer. My hometown [Ottawa, Ill.] is the silica sand capital of the world and the fine silica sand causes huge sink holes as it infiltrates the sewer system like an hour glass. Nearly 30 years ago, we were sliplining lateral pipes from a single access point. It was the beginning to a long road into renewing lateral pipes of all shapes and sizes."

In 1991, Kiest attended his first No-Dig Show in Kansas City, Mo., and has been an exhibitor at the event since 1992. Currently, Kiest is on the No-Dig Planning Committee, where he's active in assisting in education to the public by presenting papers and sharing his experiences in the trenchless industry.

Being a part of NASTT, Kiest points out the great networking opportunities the organization has to offer. By being surrounded with other trenchless professionals, members are given the chance to talk to people who work hard and dedicate a lot of their time to bringing solutions and education to the general public. This interaction highlights how the trenchless industry offers the means and methods for renewing our nation's decaying infrastructure system with minimal or no excavation. When thinking back on his time as a NASTT member, one of his most memorable experiences links back to the 1997 No-Dig Show in Seattle.

"At the show, two of my key workers and myself saturated an 8- by 30-ft long liner, inverted the liner and cured it," he says. "It was the most memorable because the three of us were dressed in tuxes with tails and white gloves in order to show the audience how clean an inversion spot repair can be when performed properly."

As we prepare to move on to Washington, D.C., for this year's No-Dig, Kiest recalls some of his favorite No-Dig destinations. While he enjoyed the 2009 show in Toronto, last year's convention center in Schaumburg, Ill., was a personal favorite. He says, "The facility was outstanding and the conference proved to be an all-time hit."

Pam Kleineke is assistant editor of *NASTT's Trenchless Today*.

No-Dig Heads to Washington

The Annual Trenchless Show Visits the Nation's Capital for Its 20th Anniversary

By Pam Kleineke

With a landscape full of history, monuments and museums, Washington, D.C., welcomes the 2011 No-Dig Conference and Exhibition, March 27 to 31 at the Gaylord National Resort and Convention Center. Sponsored by NASTT, No-Dig is the only conference and trade show in North America dedicated solely to promote trenchless technology.

"If you're tuned into trenchless technology, then you'll be in the right place," says Michael Willmets, executive director of NASTT. "Every year, we've grown the No-Dig Show with more exhibits, more technical papers and more unique opportunities to network. Our 20th annual No-Dig will set the bar even higher."

More than 2,000 municipal personnel, engineers, consultants, contractors and academia are set to attend the event that highlights all things trenchless. Over 130 exhibitors will be on hand to discuss their products, technologies and services and answer questions about their latest offerings. Attendees can roam about the 73,000-sq ft exhibition hall to take in the latest developments in the trenchless industry firsthand or set aside time to learn more about trenchless methods and projects.

To emphasize the show's commitment to education, the No-Dig technical paper program is stuffed with plenty of quality papers to satisfy any inquisitive mind.

"If inspiration and knowledge is what you're after, then the 2011 technical paper program will not disappoint — with 140 papers that will focus directly on the many advantages of trenchless technology," says Willmets.

These peer-reviewed technical papers will be presented in five tracks, focusing on a diverse range of trenchless topics, including horizontal directional drilling (HDD), cured-in-place pipe (CIPP), microtunneling, inspection, case histories, asset management, pipe jacking and ramming, water and sewer rehabilitation, project planning, inspection and trenchless research.

Pre- and post-conference seminars are scheduled for an additional cost. NASTT's Introduction to Trenchless Technology Short Course will take place on Sunday, March 27, and is ideally suited for both newcomers to the industry and for anyone who is interested in seeking a refresher course on trenchless technology methods.

The post-conference lineup — set from March 30 to April 2 — includes several informative courses presented by NASTT and NASSCO. From NASTT: Cured-in-Place Pipe Good Practices Course; Laterals Rehabilitation & Replacement Good Practices Course; HDD Consortium Horizontal Directional Drilling Good Practices Guidelines Course; Pipe Bursting Good Practices Course; and New Installation Methods Good Practices. From NASSCO: PACP Trainer Recertification; PACP Trainer Upgrade; Pipeline Assessment and Certification Program; and Lateral and Manhole Assessment Certification Program.

Time to Network

Although No-Dig is designed to promote trenchless technology through educational programs and exhibits, there's also an abundance of engaging networking opportunities for participants to take part in. Willmets says, "Networking is the backbone of the No-Dig Show and there are plenty of social events to enhance the experience."

The conference and exhibition gets rolling with the No-Dig Kick-off Breakfast on Monday, March 28. During the meal, the 2011 *Trenchless Technology* Person of the Year award will be presented to Bob Westphal, senior vice president of construction operations for Michels Corp. and NASTT vice chairman. On top of that, the 2010 Outstanding Papers in Rehabilitation and New Installation special awards will be announced and distributed.

Later on in the evening, the NASTT 10th annual Educational Fund Auction will take place. While mingling with colleagues, participants can bid on items that support a good cause. Since its inception in 2001, the event has raised more than $356,000 for the Educational Fund to support student chapters, target research, training modules and other student activities. This year's auction is jam-packed with some great items — all thanks to generous contributors — from construction equipment and electronics to trips and sparkling jewelry. For a complete list of items, check out the auction catalogue at *www.nodigshow.com*.

On Tuesday evening, March 29, NASTT will host the No-Dig Gala Awards Dinner where trenchless personnel can kick back, relax and enjoy some delicious food and lively entertainment. During the dinner, there are presentations

Joseph L. Abbott Jr. Innovative Product Awards

Does your company have this year's most innovative trenchless product or service in either new installation or rehabilitation? NASTT annually recognizes two companies with state-of-the-art products in either new installation or rehabilitation for their achievements in advancing the trenchless industry.

In October 2010, NASTT re-named these prestigious awards in honor of the late Joseph L. Abbott Jr., who was a long-time supporter of NASTT and the No-Dig Shows.

No-Dig 2011 exhibiting companies are eligible to participate. Award-winners receive coverage in *NASTT's Trenchless Today*, *Trenchless Technology* magazine, recognition on NASTT's website and may freely use receipt of the award in conjunction with their corporate advertising and marketing.

The award-winners will be formally recognized during the annual Gala Awards Dinner, Tuesday, March 29, 2011, at NASTT's No-Dig Show in Washington, D.C. Applications that were received prior to Nov. 29, 2010, were highlighted in the conference preview circulated with the January issue of *Trenchless Technology* and will appear in the onsite program distributed at the conference. Application forms are available at *www.nastt.org*.

More than 130 exhibitors will be on hand to discuss their products, technologies and services at this year's No-Dig Show.

honoring various professionals in the trenchless industry. The winners, runner-ups and honorable mentions of the 2010 *Trenchless Technology* Projects of the Year will be recognized, as well as the winners of the Joseph L. Abbott Jr. Innovative Product Awards (see the sidebar on page 27 for more information).

NASTT will also present the recipient of the Trent Ralston Young Trenchless Achievement Award. This annual award has been created to recognize a young individual who has demonstrated excellence in the early stages of their career and who has made a valuable contribution to the trenchless technology industry.

To wrap up the No-Dig festivities, a Closing Luncheon will be held Wednesday, March 30. Here, participants can grab some lunch and say one last goodbye to their fellow trenchless professionals before leaving the show. This year, this networking event will be paired with NASTT's Municipal & Utility Achievement Awards, which recognize exceptional achievement among American and Canadian municipalities and public utilities that have made significant contributions to the development and growth of the trenchless industry.

There's still time to get involved in this premier trenchless experience. For more information about the event or to register online, visit *www.nodigshow.com* or contact Benjamin Media at (330) 467-7588.

Pam Kleineke is assistant editor of *NASTT's Trenchless Today*.

NASTT's TRICKY TRIVIA

1. NASTT has partnered with the ISTT four times to co-present a No-Dig Show. The last joint No-Dig Show with our parent organization was the 2009 International No-Dig Show in Toronto and the first time was in Washington, D.C., in 1992. When and where in North America were the other two international shows held?
2. Through three regional chapters, Canada has NASTT representation from the Atlantic Ocean to the Pacific Ocean and to the Arctic Ocean. What were the last two Canadian provinces to join the NASTT family?
3. NASTT's Board of Director's is composed of 19 elected individuals from Canada and the United States representing municipalities, utilities, manufacturers, suppliers, academia, consultants, engineers and contractors. What is the maximum number of consecutive years a director may serve before stepping down from the Board?
4. It's got nothing to do with the Beatles but, in what U.S. town is the NASTT headquarters office located in?

Answers: 1.) 1996 - New Orleans and 2003 - Las Vegas; 2.) In January 2009, Saskatchewan and Manitoba joined Alberta to grow the Northwest Chapter; 3.) Six years via either two 3-year terms or three 2-year terms; 4.) Liverpool, N.Y., just outside Syracuse. To our knowledge, there is nobody in our Liverpool named Ringo.

NASTT Chapter News

Regional Chapter News

Great Lakes St. Lawrence & Atlantic

The Great Lakes St. Lawrence & Atlantic Chapter (GLSLA) is making efforts to publish an issue of its *Trenchless Report* magazine in 2011. There is a push to expand membership within the Atlantic Region, with Jamie Hannam acting as the regional director.

In October 2010, the GLSLA was represented at the Atlantic Canada AWWA — Atlantic Canada Conference in Saint-John, New Brunswick. Some GLSLA board members served as speakers and discussed the benefits of using trenchless technologies.

The GLSLA Chapter is looking forward to meeting with its members and student chapters at the No-Dig Show in Washington, D.C. The chapter has offered a $1,000 donation to the Student Education Fund. After the show, some GLSLA members will be giving the training course "Introduction to Trenchless Technologies (101)."

GLSLA members and Chris Brahler (far left) stop and pose for a photo at the 2010 No-Dig Show in Chicago.

In 2011, the GLSLA will have chapter presence at some important upcoming conferences including Atlantic Canada ACAWWA that will be held next October and INFRA 2011 that will be held this Nov. 7-9.

The GLSLA Chapter held three educational and training courses in 2010. Two of the courses — CIPP Sewer Main Inspectors' Course and CIPP Water Main Inspectors' Course — took place in June in Mississauga, Ontario, with 35 people in attendance at each event. A two-day HDD Good Practices Guidelines Course in partnership with the CERIU was held last December in Montreal where 18 people were in attendance.

Mid Atlantic

The Mid Atlantic Chapter (MASTT) held a successful Trenchless Technology, SSES and Buried Asset Management seminar in Pittsburgh, March 24-25, 2010. David J. Missenda, P.E., project manager, and Jeff Lenner, E.I.T., project manager, Pittsburgh Water and Sewer Authority (PWSA), were the guest presenters and the presentation was called, "Trenchless in Pittsburgh: The Rehab of Water and Sewer Lines by Pittsburgh Water & Sewer Authority."

Leonard Ingram, MASTT executive director, attended the NASTT Board of Directors meeting at the 2010 No-Dig Show on May 1, and presented the MASTT current report.

MASTT had a successful Trenchless Technology, SSES and Buried Asset Management seminar in Richmond, Va., on Aug. 25-26, 2010, at the Omni Hotel Downtown Richmond. George L. Gushe, P.E., Greeley and Hansen, was the guest presenter with the presentation "Systematic Approach to Develop the Rehabilitation Plan for a Downtown Sewershed."

MASTT had another successful Trenchless Technology, SSES and Buried Asset Management seminar in Newark, N.J., Dec. 15-16, 2010, at the Sheraton Newark Airport Hotel. The guest presenter was Eric C. Macfarlane, P.E., deputy commissioner, Infrastructure, New York City Department of Design and Construction, with the presentation "New York City's Trenchless Program."

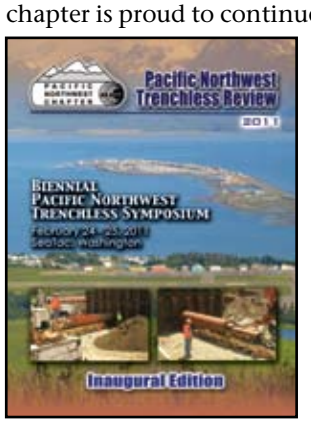
Midwest

The Midwest Chapter (MSTT) reports that Leonard Ingram, MSTT executive director, attended the NASTT Board of Directors meeting at the 2010 No Dig Show on May 1, and presented the MSTT current report.

MSTT had a Trenchless Technology, SSES and Buried Asset Management seminar in St. Louis, July 21-22, 2010, at the Crowne Plaza Hotel. Due to pending lawsuits, the City of St. Louis MSD was not able to be the guest presenter, but some of its engineers and employees attended to learn and network about trenchless technology. MSTT has plans for a trenchless seminar to be held in Milwaukee and Cincinnati, Ohio, in early 2011.

Pacific Northwest

Now in its second year as an organization, the Pacific Northwest Chapter (PNW) continues to provide opportunities for networking and the sharing of valuable information in both the public and private sectors. The chapter is currently finishing up production on the inaugural edition of the *Pacific Northwest Trenchless Review*, a chapter magazine sharing local trenchless highlights in construction, design and academic research. With this inaugural publication, the chapter is proud to continue its work toward the promotion of trenchless technology for the benefit of local engineers and consultants, as well as utilities and public works.



The Pacific Northwest Chapter is currently finishing up production on the inaugural edition of the *Pacific Northwest Trenchless Review*, a chapter magazine sharing local trenchless highlights in construction, design and academic research.

Additionally, based on its success at the 2009 Trenchless Symposium, the PNW Chapter has decided to host another conference for the benefit of members throughout its region. The 2011 Trenchless Symposium will be held Feb. 24-25, at the Cedarbrook Lodge in SeaTac, Wash. As part of the conference, the chapter will offer the NASTT Cured-in-Place Pipe (CIPP) Good Practices Course on Feb. 24. In the meantime, the chapter continues to work toward increasing membership throughout its region, particularly in the states of Idaho and Montana, which have newly been included in its geographic territory.

Northwest

Since the last report dated, July 16, 2010, the Northwest Chapter (NW) has conducted two board meetings; hosted the Northwest Trenchless Conference, which included the presentation of the NW Chapter Project of the Year; published the *NW Chapter Journal*; and helped organize the Trenchless Track

at the Western Canada Water Conference held in Calgary in October. In addition, local sections in Edmonton and Calgary have hosted technical lunches throughout the fall.

Board meetings via teleconference were held Sept. 7 and Dec. 9. The meetings were well attended by elected and ex-officio board members. Ongoing business items included reports regarding the status of local activities in Calgary and Edmonton and the Northwest Chapter Conference. Board meeting minutes are posted on the chapter's website at *www.nastt-nw.com*.

The NW Chapter Trenchless Conference was held in Edmonton, Nov. 17-18, 2010.

New business items included dealing with the resignation of one board member due to employment transfer, and a discussion of the chapter's required "Not-for-Profit Society" regulatory filing with the government. One item of note was the decision to retain legal counsel to undertake a review of the chapter's financial structure and provide an opinion if there is any risk to the chapter and its directors. Also, an opinion regarding the implications of the chapter undertaking activities outside of the Province of Alberta will be provided.

The chapter plans to host an NASTT Good Practices Course in Manitoba in late 2011, similar to the event hosted in Saskatoon, Saskatchewan, in June 2010. That event attracted 22 attendees and resulted in a small profit, to be split with NASTT upon final accounting.

Other new business items included agreement to support the NASTT Education Fund by purchasing goods in the amount of $2,500 for the auction to be held at the 2011 No-Dig Show.

The NW Chapter Trenchless Conference was held in Edmonton on Nov. 17-18, 2010, with the Symposium held the first day and HDD Good Practices Guidelines Course on the second day. One hundred eighty people attended the Symposium and 44 attended the short course. The Symposium featured 12 presentations on a variety of trenchless topics, as well as the award of the 2010 NW Chapter Project of the Year for the Athabasca River Forcemain Crossing. The Symposium also featured a trade show with 22 exhibitors. Thirteen corporate sponsors contributed to the financial success of the conference, which was praised as another successful event. Planning for the 2011 conference to be held in Calgary, Nov. 16-17, will start in February of this year.

With the completion of its publishing contract in 2009, the chapter solicited proposals for a new three-year contract and subsequently chose Craig Kelman & Associates from Winnipeg, Manitoba. This year's 48-page journal featured eight technical articles and was widely distributed using the chapter's mailing list, as well as at the 2010 conference. An online version is also available on the chapter's website. The chapter received approximately $3,000 in advertising proceeds, in accordance with the publishing agreement.

The chapter assisted by helping conference organizers solicit trenchless presentations and by promoting the Trenchless Track. Six papers were presented with excellent attendance at all. The board has offered the same assistance to organizers of the 2011 conference, to be held in Saskatoon, Saskatchewan, in September.

Monthly technical lunches were held in Edmonton and Calgary last fall, with attendance ranging from 20 to 30 in Edmonton and 10 to 20 in Calgary. Lunches will continue in 2011.

Rocky Mountain

The Rocky Mountain Chapter (RMC) completed a successful year in 2010. The chapter secured its leadership and undertook its first annual Rocky Mountain Regional No-Dig Conference and Exhibition. The conference was held in Denver, Oct. 21-22. It included the NASTT short course titled "Introduction to Trenchless Technology;" Piero Salvo and Tracy Lyman served as the course instructors. The conference and exhibition included 12 excellent presentations in four interest categories:

New Installations — chaired by Tracy Lyman, Brierley Associates; Rehabilitation and Repair — chaired by Joe Barsoom, PB; Planning and Asset Management — chaired by Al Paquet, CH2M Hill; and Trenchless Construction — chaired by Dave Emm, BTrenchless.

In October 2010, the Rocky Mountain Chapter held its first annual Rocky Mountain Regional No-Dig Conference and Exhibition in Denver.

Eighteen exhibitors supported the conference and the Rocky Mountain Chapter is grateful for their enthusiasm and support. More than 100 people attended the conference and the chapter received many favorable comments on the form, content and presentations. The net proceeds from the conference and exhibition were $11,123, which are in the Rocky Mountain Chapter treasury.

The Rocky Mountain Chapter leadership has taken a short break since the conference and intends to begin planning a regional conference in Denver in October 2011 in the next couple of weeks. Its goals for 2011 include: hosting its second regional conference; receiving consideration to host the national NASTT No-Dig Show in 2013 or beyond in Denver; and extending its active membership to interested persons in Wyoming and Utah. The chapter closed 2010 with an active chapter, increased membership and a growing, positive financial position.

Southeast

The Southeast Chapter (SESTT) held a Trenchless Technology, SSES and Buried Asset Management seminar in North Charleston, S.C., Jan. 27-28, 2010, at the Sheraton North Charleston (Airport) Hotel. Kin Hill, P.E., CEO, Charleston Water System, was the guest presenter with the presentation "Trenchless Technologies At Charleston Water System: Past, Present And Future."

Leonard Ingram, SESTT executive director, attended the NASTT Board of Directors meeting at the 2010 No-Dig Show on May 1, and presented the SESTT current report.

SESTT conducted another successful Trenchless Technology, SSES and Buried Asset Management seminar in Panama City Beach, Fla., at the Edgewater Beach & Golf Resort, June 2-3, 2010. The guest presenter was Mark Shaeffer, P.E., Baskerville-Donovan Inc. and his presentation was "Trenchless Technology Projects In Northwest Florida."

SESTT conducted a third successful Trenchless Technology, SSES and Buried Asset Management seminar in Chattanooga, Tenn., at the Sheraton Read House Hotel, Oct. 27-28, 2010. The guest presenter was Mike Patrick, P.E., City of Chattanooga, and Scott McDonald, P.E., Littlejohn Engineering Associates Inc., with the presentation "Chattanooga's Trenchless Program."

Western

The Western Chapter (WESTT) held its sixth annual Regional No-Dig Conference in Phoenix, Oct. 25-26, 2010, at the Sheraton Phoenix Airport Hotel. This was the site of WESTT's first-ever conference back in 2005. Attendance was good and sponsorship of the event was outstanding. More than 100 people turned out to enjoy 1 ½ days of excellent technical papers, an exhibition hall and networking meals and events. The chapter also sponsored NASTT's Pipe Bursting Good Practices Course on Nov. 16, 2010, in South Lake Tahoe, Calif., for the South Lake Tahoe Public Utilities Commission and surrounding areas. The training course was well-attended. The chapter also published its fourth annual *WESTT Magazine*, which was distributed right before the annual Regional No-Dig Conference. The latest edition contained 10 articles and case studies from experts within its membership region.

An annual members' meeting was held at the 2010 No-Dig Show where members discussed investigating the start of student chapters, scholarships and additional opportunities for growth and training.

Next year's regional No-Dig Conference will be in San Jose, Calif., in the fall. Preparations for the 2011 conference are already under way.

Student Chapter News

Arizona State University

Since being founded in 2001, the Arizona State University Student Chapter has been active, visiting conferences and interacting with members from the industry. In October and November 2010, the chapter met with four NASTT members and listened to lectures from these trenchless experts — Jeff Boschert, National Clay Pipe Institute; Bethany McDonald, Pure Technologies Ltd.; Joe Loiacono, Sanexen; and Arvid Veidmark, Specialized Services Co.

In 2011, the chapter hopes to focus on fundraising and awareness to promote student involvement in the trenchless industry. In January, a student from the chapter attended the 2011 UCT Show in Houston. The Arizona State University Chapter is also gearing up for the 2011 No-Dig Show in March, where students will attend and help organizers by working at technical sessions.

Concordia University

The Concordia University Chapter is keeping busy in 2011, with two seminars down and at least three more to go. In January, Piero Salvo gave a seminar on asset management and CCTV inspection. In February, Isabel Tardif also presented a seminar. Three more seminars are currently

planned. Michel Tremblay, research and development of materials and products for PM-Ministre des Transports, will speak on "Materials and Products of Pavement Marking" in March. Dr. Osama Moselhi will discuss integrated infrastructure management during an April seminar and May will bring a field visit to a HDD construction site.

CUIRE/University of Texas at Arlington

After a whirlwind year of guest speakers, conferences and field visits, the chapter is preparing for 2011. The chapter is gearing up for even more guest speakers and special presentations, including one from Jason Rush, a sales manager for Vermeer.

Members are also looking forward to getting out of the classroom and into the field for another visit to a jobsite. This year, the chapter is set to explore an HDD project in the Dallas area.

The chapter is also eager about the upcoming conferences and trade shows to attend. Members checked out the UCT Show in January. Next up is the NASTT No-Dig Show in Washington, D.C., ASCE in Seattle and the 2011 International Conference on Pipeline and Trenchless Technology (ICPTT).

Indiana University — Purdue University Indianapolis

For 2011, the chapter is planning to conduct a one-day trenchless technology seminar in April. It also hopes to arrange student chapter activities and increase involvement within the trenchless industry locally, regionally and nationally. Another goal for the year is to enhance students' networking opportunities with local trenchless and underground companies in order to get internships and full-time job positions.

Members will join other IUPUI students and travel to New Orleans to spend their spring break doing volunteer work to help Hurricane Katrina victims in the Broadmoor neighborhood who lost just about everything. A delegation of undergraduate and graduate students and faculty and staff will attend the No-Dig Show in Washington, D.C.

A delegation of faculty and staff will also attend this year's ICPTT, which will be held Oct. 26-29 at China National Convention Center, Beijing, China.

Laval University

In 2010, many new undergraduate and graduate students from the Department of Civil and Water Engineering at Université Laval joined the NASTT Student Chapter under the supervision of Professor Geneviève Pelletier. The chapter held three meetings during the Fall semester to elect its board and organize its participation at the INFRA2010 Conference in Montreal. These meetings were held on Sept. 30, Oct. 19 and Nov. 4.

The Laval University Student Chapter in Montreal.

This year, the chapter plans to continue recruiting new members and strengthening contact with past members who work on rehabilitation projects to have the

opportunity to visit nearby construction sites. The chapter will also organize its university's participation in INFRA2011 Conference in Quebec City.

McGill University

The McGill University Chapter will continue promoting trenchless technology through an increase in the number of events it plans to host. The agenda of the chapter for 2011 includes:

- A seminar on trenchless technology was given to undergraduate students who are taking a geotechnical engineering class. The event was planned to take place during the last week of January. The seminar was intended to spark the interest of many of the students as it did in the past years and raise the membership and the number of participants in the upcoming No-Dig.
- Plans are ongoing to invite a guest speaker from the industry to give a presentation on trenchless technology.
- A paper has been submitted to the upcoming No-Dig 2011 in Washington, D.C., and it will be presented by graduate student Sherif Kamel.
- The chapter will encourage students to prepare and submit poster presentations during the upcoming No-Dig Conference.

Queen's University

The Queen's University Student Chapter had an educational and hands-on year. In August 2010, a field trip was made to a construction site where a trenchless technology was utilized (CIP water pipe repair). The trip was organized via the city of Kingston in Ontario, Canada. A group of six students participated in this activity for a duration of almost a full work day where they watched and received ongoing explanation to the different stages of the repair process from the city engineer and the contractor technicians.

In November, the GeoEngineering center at Queen's-RMC ran two short courses — "Culvert and Sewer Deterioration and Repair Using Polymer Liners" and "Pipe Replacement Using Pipe Bursting." Both courses were instructed by Dr. Ian Moore.

The chapter also has some planned activities for 2011. First, it hopes to continue organizing educational field trips for undergraduate and graduate students to experience the significance and importance of trenchless technology. This work would include organizing through the chapter's current contacts of contractors and municipalities, and also organizing trips for large projects throughout big cities and municipalities like the city of Hamilton, Ontario. The chapter wants to organize educational seminars at the university by inviting expert speakers in the field. A mid-summer barbecue is also planned to promote the NASTT objectives and to increase membership enrollment among university and college students.

Trenchless Technology Center/Louisiana Tech University

In January, 16 students attended the UCT Conference in Houston. The students assisted with educational sessions, explored the exhibit hall and had the chance to interact with industry professionals. In March, at least eight students will be attending the NASTT No-Dig Conference in Washington, D.C. The students will assist conference organizers with the show and compete in the various student chapter competitions. Two students will present technical papers during the conference, and the chapter expects several posters to be exhibited during the students' poster competition.

In spring 2011, the TTC will hold a one-day seminar with local contractors and consultants, in collaboration with the Louisiana Contractors' Education Trust Fund. Members of the student chapter will be participating in a hand-on demonstration of CIPP wet-out, inversion and curing and attend technical presentations.

In the Spring Quarter of 2011, the TTC will offer its "Introduction to Trenchless Technology," a 30-contact hour course dealing with introduction to the capabilities and design considerations associated with various trenchless construction methods.

University of Alberta

The Alberta Student Chapter has several activities planned for 2011. Chapter members will continue to have their monthly meetings to discuss how they can increase trenchless activities in the local community. In order to increase interest in the chapter, members will give talks to graduate and undergraduate students to advertise its activities and attract new members.

Members will be encouraged to attend NW chapter technical lunches. Expenses will be covered by the student chapter. Two student chapter members are set to attend the No-Dig Show 2011. A poster will be presented to highlight the chapter's activities.

During the year, two field trips are planned to visit Edmonton's trenchless projects. This term, Dr. Alieza Bayat is offering a graduate course titled Trenchless Technologies. A few members from the student chapter are planning to take this graduate course. The chapter also plans to be active in this year's Northwest Chapter conference in Calgary. A few members will attend the conference.

Vanderbilt University

In 2010, the Vanderbilt University Student Chapter kept current with meetings held once a month during the academic year. Although the chapter was busy all year round, the final months were packed with three special presentations from trenchless professionals.

On Oct. 7, 2010, the chapter enjoyed a presentation by Katie Bell, Ph.D., P.E., environmental engineer for CDM, on "Trenchless Technology and Nashville." On Nov. 1, 2010, Kevin Colvett, assistant director of Brentwood Water Services, gave a presentation on "Ultraviolet Cured CIPP Application in City of Brentwood." To wrap the year up, chapter members welcomed Mark Bruce, president of CanClay Corp., for a special presentation on "Underground Utility Conflicts," Dec. 6. After Bruce's discussion, the chapter held its End-of-the-Year Holiday Reception.

Looking ahead, the NASTT Student Chapter and the ASCE Student Chapter at Vanderbilt University will be organizing a field trip to design and implement a potable water transportation and storage system for an isolated rural community in Guatemala, in a sustainable fashion as a part of Vanderbilt University's Alternate Spring Break (ASB), March 6-12, 2012.

Virginia Tech University

At the beginning of the Fall 2010 semester, the Virginia Tech Student Chapter (VT) held an interest meeting to get new students involved in the organization. The goal of the presentation was to answer the following questions:

1. What is trenchless technology?
2. What are the benefits to going trenchless?
3. What is NASTT?

4. How can you get involved as a student?
5. What are the benefits of joining the organization?

From this event, the VT student chapter spread awareness of the organization and what it means to be a part of it. In an effort to improve communication with its members and any interested students, the VT student chapter recently decided to develop a Facebook fan page. Members are encouraged to become fans so that they can stay up-to-date on upcoming events.

The Virginia Tech student chapter recently developed a Facebook fan page. Members are encouraged to become fans so that they can stay up-to-date on upcoming events.

Another interest meeting similar to the one held after the start of the Fall semester will be held at the beginning of the Spring semester. The meeting will address the same questions as before, but more emphasis will be put on the benefits of membership and the number of opportunities the No-Dig Show provides. Toward the end of the Spring academic semester, the NASTT student chapter members will be invited to hear a speaker on Asset Management. The exact topic of the presentation has not been determined.

The Adventures of No-Dig Doug

NASTT Regional Chapters

British Columbia

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

Chapter Contact
Preston Creelman, Chair
Phone: (905) 591-8134
E-mail: *pcreelman@royalpipe.com*

Website
www.nastt-bc.org

Elected Officers
Chair - Preston Creelman
Vice Chair - Anton Benes
Secretary - Rosa Hawkes
Treasurer - Bob Innis

Great Lakes, St. Lawrence & Atlantic

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

Chapter Contact
Isabel Tardif, Chair
Phone: (514) 848-7031
E-mail: *Isabel.tardif@ceriu.qc.ca*

Website
www.nasttglsl.on.ca

Elected Officers
Chair - Isabel Tardif
Vice Chair - Kevin Bainbridge
Secretary - Gerald Bauer
Treasurer - Derek Potvin

Mid Atlantic

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

Chapter Contact
Richard Thomasson, Chair
Phone: (703) 842-5621
E-mail: *rthomasson@pirnie.com*

Website
www.mastt.org

Elected Officers
Chair - Richard Thomasson
Vice Chair - Sunil Sinha
Secretary - Michael Delzingaro
Treasurer - Tom Wyatt

Midwest

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

Chapter Contact
Joe Butor, Chair
Phone: (317) 545-1335
E-mail: *rtumbelson@akkerman.com*

Website
www.mstt.org

Elected Officers
Chair - Joe Butor
Vice Chair - Jeff Boschert
Secretary - John Delich
Treasurer - Larry Kiest

Northwest

The Northwest Chapter was established in 1988 by members in the Canadian provinces of Alberta and British Columbia, Canada, and in Washington state. In 2005, the members in British Columbia established the NASTT-BC Chapter. In 2009, the members in Washington state established the Pacific Northwest Chapter and the Northwest Chapter adjusted the geographic area to include the members in the provinces of Manitoba and Saskatchewan, Canada.

Chapter Contact
Duane Strayer, Chair
Phone: (403) 262-4500
E-mail: *strayerd@ae.ca*

Website
www.nastt-nw.com

Elected Officers
Chair - Duane Strayer
Vice Chair - vacant
Secretary - Dan Willems
Treasurer - Mark Brand

Pacific Northwest

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

Chapter Contact
Laura Wetter, Chair
Phone: (425) 205-4930
E-mail: *laura@stahelitrenchless.com*

Elected Officers
Chair - Laura Wetter
Vice Chair - Erik Waligorski
Secretary - vacant
Treasurer - Chris Price

Rocky Mountain

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

Chapter Contact

Tracy Lyman, Chair
Phone: (303) 534-1100
E-mail: *tlyman@lymanhenn.com*

Website

www.rmnastt.org

Elected Officers

Chair - Tracy Lyman
Vice Chair - Peggy Ganse
Secretary - Ken Matthews
Treasurer - Aaron Burns

Southeast

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

Chapter Contact

Jerry Trevino, Chair
Phone: (877) 462-6465
E-mail: *jerry@mechanicaljobbers.com*

Website

www.sestt.org

Elected Officers

Chair - Jerry Trevino
Vice Chair - Tomasita Crowell
Secretary - Ed Paradis
Treasurer - Kelly Derr

Western

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

Chapter Contact

Jennifer Glynn, Chair
Phone: (925) 627-4100
E-mail: *jglynn@rmcwater.com*

Website

www.westt.org

Elected Officers

Chair - Jennifer Glynn
Vice Chair - vacant
Secretary - Jason Lueke
Treasurer - Matt Wallin

NASTT Student Chapters

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Tempe, Ariz.
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Concordia University
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Indiana University - Purdue University Indianapolis
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Arlington, Texas
Advisor: Dr. Mo Najafi
E-mail: *najafi@uta.edu*

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Virginia Tech University
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Comparison of Predicted and Observed HDD Installation Loads for Various Calculation Methods

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1. Introduction

Horizontal directional drilling (HDD) requires proper selection of pipe materials and wall thicknesses to resist the installation induced loads during pullback operations. Designers are often required to determine the anticipated installation loads and ensure the product pipe is sized appropriately to resist these loads. Contractors are often required to determine the anticipated installation loads based on their proposed means and methods to install the product pipe. Several methods are available for predicting these installation loads, which differ in the treatment of the slurry flow component within the bore. Often, the predicted and observed installation loads do not follow the same trends nor match the location where the maximum installation loads are observed.

Installation loads are a function of several factors. These include, but are not limited to, the product pipe material, weight, diameter, wall thickness and properties, the bore profile and diameter, entry and exit location elevations, presence of buoyancy compensation within the product pipe, speed of the installation, frictional resistance between the pipe and the ground surface (or rollers) prior to entry into the bore, frictional resistance between the pipe and the bore walls, increased side bearing pressure due to the presence of curves (sometimes referred to as the capstan effect), soil properties, drilling fluid and bore slurry flow properties, hydrokinetic/fluidic drag between the bore slurry and its interaction with the product pipe as it is pulled through this material, and resistance to pipe stiffness. Proper characterization of these factors is necessary for accurate load prediction during a specific installation. Some of these factors are commonly grouped together, depending upon which predictive method is used to estimate the installation loads. The accuracy of each of the methods is dependent upon how these factors are incorporated into each method of analysis.

This paper presents a new methodology for calculating the predicted installation loads by modifying the fluidic drag component in an attempt to replicate the actual flow dynamics of the drilling fluid and cuttings mixture within the bore. As an added benefit, the methodology also provides a means to predict the bore pressure required to induce slurry flow for any stage of the drilling process. This unique benefit provides the engineer with a means to compare predicted bore pressures along any portion of the bore to the maximum allowable bore pressure along the alignment and identify areas that may be susceptible to hydrofracture/inadvertent return events. The bore pressure predictions can also be used to determine when cross over will occur where the drilling fluid returns cease flowing to the pipe entry location and start flowing to the pipe exit or drill rig location. For some installations, this is a key consideration with respect to drilling fluid/slurry return management.

Three case studies are also presented in this paper. Descriptions of each case study is provided along with comparisons between actual installation loads are predictions based on the new methodology presented in this paper and to existing prediction methods.

2. Methodologies Used to Predict Installation Loads

Design engineers have used various methods to predict installation loads for HDD installations. The simple approach for each of these methods involves predicting the cumulative loads as the pipe passes through the entire bore. The ensuing loads and stresses are then assessed to ensure the integrity of the product pipe is not compromised as it is installed. Judgment and experience of the engineer are critical when predicting installation loads, especially on those projects involving large diameters, long lengths, where the bore geometry/alignment is complex, large differences in elevations exist between entry and exit locations, or when the bore encounters different soil and/or bedrock materials or properties.

The following discussions focus on the commonly used predictive methodologies including an approach presented in ASTM F1962 (and adopted by the Plastic Pipe Institute and several polyethylene pipe manufacturers) and a method developed for the American Gas Association (AGA) for installing steel pipelines (referred to as the AGA method). Commercially available software programs such as DRILLPATH, WELLPLAN, etc. are not included in this paper.

2.1 ASTM F 1962

ASTM F 1962 presents a series of equations to predict the installation loads for polyethylene pipe (PE) based on an idealized bore representation depicted in Figure 1. Installation loads are estimated sequentially at transition or discrete points A, B, C and D. The bore is represented as a series of straight and curved segments. The analysis accounts for installation length, depth of cover, entry and exit angles, changes in the bore trajectory, buoyant pipe weight, and coefficient of frictions between the product pipe and the ground surface (or rollers) and between the product pipe and the bore. Pipe material properties such as pipe stiffness and drilling fluid/bore slurry flow properties are not captured in the analysis. This method of predicting loads is recommended by PE pipe manufacturers and the Plastic Pipe Institute.

Suggested design values of 0.5 and 0.3 are given for coefficients of friction before the pipe enters the ground and within the bore, respectively. A value of 0.1 is suggested for the coefficient of friction before the pipe enters the ground if the pipe is placed on rollers. The buoyant weight of the product pipe is determined based on the specific gravity of the drilling fluid returns/bore slurry. A conservative estimate of 1.5 for the specific gravity of the drilling fluid/bore slurry is recommended by ASTM F 1962. This specific gravity represents a mud weight of approximately 12.5 lbs per gallons. This specific gravity is much higher than the mud weights of drilling fluid returns commonly observed during actual HDD installations, where observed drilling fluid return mud weights often range between 10 and 11.5 lbs per gallon.

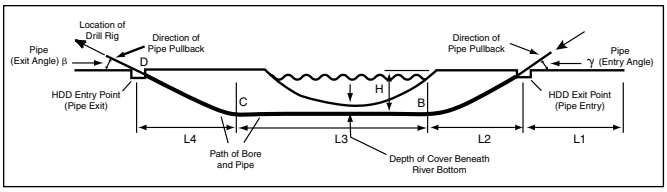

Figure 1. Simplification of the HDD bore (ASTM F 1962).

The ASTM F 1962 method allows for a provision to account for the hydrokinetic/fluidic drag acting on the product pipe during the installation as the drilling fluid/soil cuttings mixture is forced to flow out of the bore as the product pipe is installed. This drag force is estimated based on the following equation (ASTM F 1962):

$$\Delta T = \Delta P \frac{\pi}{8}(D_{bore}^2 - D_{pipe}^2)$$

Equation 1

Where ΔT is the additional pulling force in lbs, ΔP is the hydrokinetic pressure factor in psi, D_{bore} is the diameter of the HDD bore in inches, and D_{pipe} is the outer diameter of the product pipe in inches.

ASTM F 1962 recommends a value of 10 psi be used for the hydrokinetic drag pressure ΔP in Equation 1. The Plastic Pipe Institute suggests a range of between 4 and 8 psi for this factor.

While the ASTM F 1962 method attempts to account for the influence of the bore diameter, Equation 1 suggests that greater drag forces develop for installations where there is a large difference between the bore diameter and the outer diameter of the product pipe than a bore diameter that is sized only a little larger in diameter than the outer diameter of the product pipe. This assumption is in direct conflict with common sense and observations in the field In addition, the length of the bore is ignored by the ASTM method, which also is in direct conflict with common sense and observations in the field. The drag force should be greater for longer bores than for shorter ones since it acts over a longer length.

2.2 Engineering Design Guide: American Gas Association

The Pipeline Research Committee (PRC) of the AGA published a manual (PRC AGA 1995) detailing a procedure for analyzing HDD installation loads for steel pipeline installations. This method is referred to as the AGA method (Huey et al. 1996; Hair et al. 1995). Installation loads are reported to consist of tension resulting from frictional drag between the pipe and the wall of the bore (including additional frictional forces as the pipe negotiates curves in the bore geometry), fluidic drag as the pipe is pulled through viscous drilling fluid/bore slurry, and the unbalanced effects of the buoyant (or submerged) product pipe weight as it is pulled through the bore. The calculations do not consider the installation loads associated with the above ground portion of the fabricated pipe string; although these loads could be incorporated into the analysis. The load or pullback calculation generally predicts maximum installation loads at the moment the pipeline emerges from the exit point in front of the drill rig.

The bore is modeled as a series of straight and curved segments. The installation loads are determined sequentially at discrete locations representing changes in the bore trajectory and added in a cumulative manner as the pipe is installed within the bore. Equations are provided for both straight and curved segments. The method considers the geometry of the bore including bends, the product pipe properties, the buoyant weight of the product pipe, pipe stiffness, the frictional resistance that develops between the product pipe and the bore walls, the increased side wall friction as the product pipe is forced to negotiate bends and curves along the alignment, and fluidic drag between the bore slurry and the product pipe as it is displaced by the product pipe. Drilling fluid/bore slurry flow properties are not captured in the analysis.

The fluidic drag component incorporated into the analysis represents the frictional force that develops between the product pipe and the flowing slurry as the product pipe is pulled through the viscous drilling mud/bore slurry. The equation representing the fluidic drag component is as follows (Huey et al. 1996):

$$DRAG = 12 \times \pi \times DL \times \mu_{mud}$$

Equation 2

Where D is the outside diameter of the product pipe in inches, L is the length of the segment in question in feet and μ_{mud} is the fluid drag coefficient in psi.

The authors of this method originally recommended a value of 0.05 psi for the fluid drag coefficient. However, comparisons to actual field data have led to a lowered recommendation of 0.025 psi (Puckett 2003).

The fluidic drag equation considers the diameter of the product pipe and the length of the segment in question. However, it does not consider the diameter of the bore. Rather, it uses a simplified assumption that the bore diameter is 12 in. greater than the outer diameter of the product pipe. Therefore, the method would likely underestimate the drag force for HDD installations with a smaller annular space and overestimate the drag force for HDD installations with larger annular space.

3. Proposed Methodology for Fluidic Drag Component

The proposed methodology for predicting HDD installation loads is based on the AGA method but with a modified fluidic drag component. Rather than using a fluidic drag coefficient of friction, a Bingham rheological model is incorporated into the analysis to estimate the required velocity of the flowing drilling fluid/bore slurry (within either the annular space between the product pipe and the bore or the annular space between the drill pipe and bore in front of the product pipe) and the associated annular pressure loss within the bore for this viscous fluid. This annular pressure loss is then converted to an additional force and added to the other components contributing to the installation loads. In treating the fluidic drag in this manner, the actual flow properties of the drilling fluid/bore slurry can be modeled.

Most drilling fluids are non-Newtonian fluids, having viscosities that are dependent upon shear rate (Baroid Fluid Handbook 2001). Bingham, Power law and Herschel-Bulkley rheological models have been used to predict drilling fluid behavior across a wide range of shear rates. The typical profiles for Bingham plastic, power law fluids, typical drilling fluid and Newtonian fluids are shown in Figure 2. It is apparent in Figure 2 that these rheological models do not characterize non-Newtonian drilling fluids very well, can be used to provide a simplified characterization. Frictional forces develop as the drilling fluid/bore slurry is forced to flow through and around the bore. These frictional forces can be referred to as pressure drops and are influenced by the length of the installation, flow rate of the drilling fluid, fluid properties, bore geometry, pipe eccentricity, in-

stallation rate, etc. Eccentricity refers to the position of the pipe relative to the bore. When the pipe lies directly in the middle of the bore, the pipe is concentric. When the pipe moves to the top or bottom of the bore, the pipe becomes more eccentric. Greater detail on eccentricity and rheological models for HDD drilling fluids can be found in Baumert et al. (2005). For simplicity, eccentricity is not considered in the following calculation method (as is the case with the method outlined in ASTM F 1962 and the AGA method). In actuality, the installed product pipe can be located above or below the central axis of the bore depending upon the pipe material, the radius of curvature at bends, the bore and product pipe diameters, whether buoyancy control measures are used, and the drilling fluid properties.

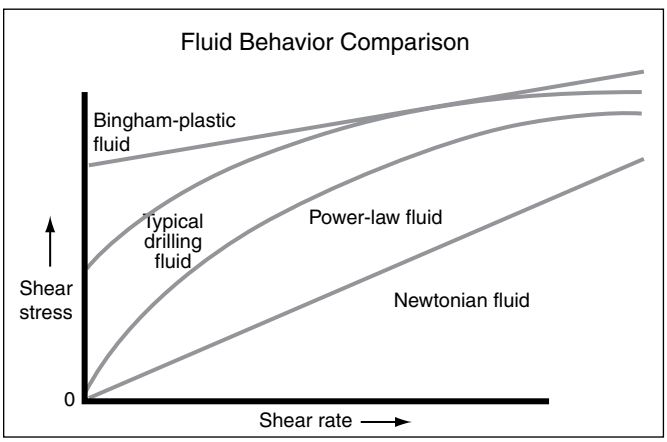

Figure 2. Fluid behavior comparison (Bariod Fluid Handbook 2001).

Research completed by Baroid suggests that the pressure drop calculations for laminar flow based on the Bingham rheological model over predict actual pressure drops whereas calculations based on the Power law model under predict actual pressure drops. The Herschel-Bulkley model reportedly models drilling fluids most accurately, but requires computer algorithms to obtain solutions (Baroid Fluid Handbook 2001). However, due to its relative ease of computation, the Bingham rheological model is proposed for use in this new method to predict installation loads.

The revised load prediction methodology begins with calculating the average drilling fluid/bore slurry velocity (V_a) (feet per second) within the annular space between the bore and the product pipe using the following equation:

$$V_a = \frac{0.408 \times PO_{GPM}}{(D_{bore}^2 - D_{pipe}^2)}$$

Equation 3

Where PO_{GPM} represents the drilling fluid pumping rate in gallons per minute, D_{bore} is the diameter of the bore in inches, and D_{pipe} is the diameter of the product pipe in inches.

As the product pipe is pulled into the bore, a large volume of the drilling fluid equivalent to the product pipe is displaced and forced out of the bore. The PO_{GPM} term in Equation 3 should be modified to account for the increased velocity of the drilling fluid caused by the displacement of the drilling fluids as the product pipe is pulled into the bore.

$$PD_a = \left[\frac{PV \times V_a}{1000(D_{bore} - D_{pipe})^2} + \frac{YP}{200(D_{bore} - D_{pipe})} \right] \times L$$

For laminar flow conditions, the pressure drop (PD_a) (psi) within the bore annulus associated with the flow of drilling fluids/bore slurry can be calculated using:

Where PV is the plastic viscosity of the drilling fluid in centipoises (CP), YP is the yield point of the drilling fluid in lb/100 ft^2, and L is the length of the bore in feet.

Equation 4 introduces two fluid flow properties representing the drilling fluid/bore slurry. Research completed by Harbin (2003) provides ranges for typical parameters for various soil types, mud weights and drilling fluid compositions. These flow properties are summarized in Table 1. Reported values reflect laboratory tests completed on slurries consisting of soil samples and raw drilling fluids mixed to specific mud weights in a laboratory setting. The effects of different soil types and drilling fluid compositions on the flow properties of the slurry mixture can easily be seen from Table 1. Similar fluid flow properties are reported in Duyvestyn (2004) during actual field installations. A conservative approach is recommended when determining the fluid flow properties to incorporate into load predictions for a specific HDD installation.

The final step in the analysis involves converting the pressure drop within the annular space to a drag force (ΔT_{Drag}) in lbs. This is accomplished using the following equation (Wellplan):

$$PD_a = \left[\frac{PV \times V_a}{1000(D_{bore} - D_{pipe})^2} + \frac{YP}{200(D_{bore} - D_{pipe})} \right] \times L$$

Equation 4

The parameters used in Equations 3 and 4 should be tailored to the specific HDD installation in question. Annular space velocities and resulting pressure loss should be calculated for the length between the pipe entry location and the point in question and between the pipe exit location and the point in question. The engineer can then determine which direction the drilling mud/bore slurry will flow at a particular point within the bore and use the appropriate pressure in the analysis. Once crossover has occurred, drilling fluid/bore slurry will not flow within the annular space between the bore and the product pipe but rather through the annular space in front of the product pipe towards the exit location. After crossover has occurred, the drilling fluid returns no longer flow within the annular space between the bore and the product pipe but rather flows in front of the product pipe towards the drill rig location. As a result, after crossover, the fluidic drag component will have reached its maximum value. In other words, the resulting fluidic drag component of the installation loads should reflect slurry flow towards the exit location after crossover has occurred. This is an important characteristic that the ASTM F 1962 and AGA methods are not capable of predicting.

An important benefit of the new approach described in this paper is that the minimum bore pressure required to induce slurry flow can be estimated using Equation 4. This unique benefit provides designers with a means to compare predicted minimum bore pressures to the maximum allowable bore pressures along the alignment and identify areas that may be susceptible to hydrofracture/inadvertent return events. The bore pressure predictions can also be used to determine when cross over will occur where the drilling fluid returns cease flowing to the pipe entry location and start flowing to the pipe exit or drill rig location. Predicting when crossover will occur can be a valuable tool for developing contingency plans to deal with drilling fluid

Soil Type	Drilling Fluid	Mud Weight (ppg)	Plastic Viscosity (cP)	Yield Point (lb/100ft²)
Poorly Graded Sand (SP) 50/70 Sand	BoreGel and QuickTrol LV	9.6	12	6
		11.0	15	18
	BoreGel and EZ Mud	9.6	11	15
		10.6	16	21
Poorly Graded Sand (SP) 20/140 Sand	BoreGel and QuickTrol LV	10.2	14	20
		11.5	23	22
	BoreGel and EZ Mud	10.2	13	38
		10.7	17	40
Silty Sand (SM) Holocene Alluvium	BoreGel and QuickTrol LV	10.2	19	8
		11.0	18	19
	BoreGel and EZ Mud	10.3	14	44
		11.1	24	64
Silty Sand (SM) Nevada Silt	BoreGel and QuickTrol LV	10.1	24	14
		10.5	21	18
	BoreGel and EZ Mud	10.1	16	23
		10.5	18	27
Sandy Lean Clay (CL)	BoreGel and QuickTrol LV	10.5	29	29
		11.1	34	77
	BoreGel and EZ Mud	10.4	23	106
		11.5	36	106
Plastic Clay (CH)	BoreGel and QuickTrol LV	9.5	24	22
		10.0	31	38
	BoreGel and EZ Mud	9.5	37	45
		9.9	18	116
Clayey Sand (SC)	BoreGel and QuickTrol LV	10.1	34	13
		10.5	30	35
	BoreGel and EZ Mud	10.3	14	55
		10.7	30	52
Elastic Silt with Organics (MH)	BoreGel and QuickTrol LV	8.8	19	17
		9.0	21	28
	BoreGel and EZ Mud	8.7	11	16
		9.0	21	19
Elastic Silt (MH)	BoreGel and QuickTrol LV	9.0	16	21
		9.4	21	68
	BoreGel and EZ Mud	9.0	28	50
		9.4	19	62
NOTE: Fluid properties provided in Table 1 cover a limited range of soils and drilling fluid additives and may not be representative of other soils and additives.				

Table 1. Observed drilling fluid/bore slurry properties for various soil types and mud weights (Harbin 2003).

returns and anticipated volumes. Note that this prediction requires the designer to determine the drilling fluid velocity and pressure drop at the point in question from both the entry and exit locations to determine the path of least resistance to fluid flow.

In summary, the new approach presented above incorporates more of the factors that contribute to the installation loads including the product pipe material, weight, diameter, wall thickness, and pipe properties, the bore profile and diameter, entry and exit location elevations, presence of buoyancy compensation within the product pipe, speed of the installation, frictional resistance between the pipe and the ground surface (or rollers) prior to entry into the bore, frictional resistance between the pipe and the bore walls, increased side bearing or pressure due to the presence of curves (sometimes referred to as the capstan effect), soil properties, drilling fluid and bore slurry flow properties, hydrokinetic/fluidic drag between the bore slurry and its interaction with the product pipe as it is pulled through this material, and resistance to pipe stiffness.

4. Case Histories

Three case histories are presented below. Each involves installing a high density polyethylene (HDPE) pipe using good practice HDD construction techniques. The bore profiles and pertinent details are provided for each installation. The data presented in this section are not only provided to support the proposed new methodology but also to provide a complete series of case studies to enable future predictions and comparisons of installation loads by the engineering and researching communities.

4.1 Case #1: Poole Slough Watermain Installation

This HDD installation consists of a 1,060 ft-long, 20-in. DR 9 IPS HDPE pipeline through silty clay and siltstone bedrock. The bore profile consists of a typical "U" shaped bore with steep entry and exit angles and a compound curve (bend in the vertical and horizontal planes). A relief well was installed to control the drilling fluid pressures during the installation process. The bore was completely reamed to a final diameter of 30 in. and a swab pass with a 26-in. barrel reamer assembly was completed prior to installing the product pipe. The 26-in. barrel reamer assembly was also used in front of the product pipe during its installation. Partial buoyancy control was used during the installation, amounting to an approximate additional weight of 10 lb/ft based on the available flow rate and product pipe installation rate. Crossover occurred approximately 560 ft into the product pipe installation. The mud weight of the drilling fluid returns ranged between 10.2 and 10.5 lb/gal during the product pipe installation. The drilling fluid pumping rate was approximately 100 gpm. To control and manage drilling fluid returns during the installation, a relief well was constructed in front of the drill rig. Additional information regarding this project can be found in Duyvestyn (2005).

4.2 Case #2: City of Newberg Watermain Installation

This HDD installation consists of a 2,600-ft long, 30-in. DR 9 IPS HDPE pipeline through silty clay, siltstone, sands, gravels and cobbles. The bore profile consists of a modified "U" shaped bore. The bore was completely reamed to 46 in. and a swab pass was completed prior to installing the product pipe. Water was added to the product pipe during the installation process such that the pipe entered the bore completely full. The mud weight ranged from 10 to over 11 lb/gal during the installation process. No further details are available. Additional information regarding this project can be found in Staheli and Ramos (2007).

4.3 Case #3: City of London Gravity Sewer Installation

This HDD installation consists of a 1,023-ft long, nominal 24-in. DR 9 DIPS HDPE pipe through alternating layers of silt, clay and sand. The product pipe was installed in an upward direction at a grade of 1.5 percent. The bore was completely reamed to a final diameter of 34 in. and a swab pass was completed prior to installing the product pipe. Water was not added to the pipe due to issues associated with filling the pipe at the bottom end of the installation and pulling the pipe in an uphill direction.

Additional information associated with this project can be found in Currey et al. (2009).

5. Comparisons Between Actual and Predicted Installation Loads

ASTM F 1962 and the AGA predictive methods are based on determining the cumulative installation loads at discrete points where changes in the bore geometry exist. It is important to note that these discrete locations/points may not coincide with the location where the maximum installation loads are observed during an installation. Hence, with any of these methods, it is highly recommended that designers breakdown the bore into a greater number of segments (adjacent curves and/or adjacent straight sections) than at transition points between straight and curve sections. In doing so, the predicted installation loads should better reflect the actual installation loads during an installation. This also allows the design engineer to change the input parameters for each segment to reflect changes in the soil type, soil properties, bore diameter, etc. along the alignment. For example, if a steel starter or conductor casing was to be installed on either end of the bore, it would be possible to change the bore diameter within this portion of the bore to reflect the size of the casing pipe. Similarly, if the soil encountered along the bore passed through a constricting soil layer, the bore diameter could be reduced through this section of the bore in an attempt to better model the field conditions.

Factors of safety are used in any design process to account for uncertainty in assumed parameters and calculations. For HDD induced installation load calculations, engineers tend to apply overly conservative values to input parameters and then apply a factor of safety to the end results producing predictions that are too conservative. A better approach would involve using the best and most accurate method to perform the calculations and then to apply an appropriate factor of safety to the end results. The new method proposed in this paper provides a better means to predict the actual anticipated installation loads. Engineers should still apply appropriate factors of safety to installation load calculations including loads generated using this new proposed method of treating the fluidic drag component.

The following field comparisons are provided to demonstrate the abilities of each of the predictive methods to estimate actual installation loads during HDD installations. The coefficients of friction and other parameters have been selected in each method to obtain the closest matches to the observed loads for all of the individual prediction methods. Again, for design purposes, a more conservative approach for selection of parameter values may be appropriate to ensure installation induced loads do not compromise the integrity of the product pipe during installation.

The actual installation loads presented in each of the case histories represent the loads arising from the tail string, the reamer assembly, the drill pipe, and the properties of the bore. No attempt has been made to separate out the loads associated with the reamer assembly and drill pipe in front of the product pipe. Hence, the actual pipe installation loads transferred to the product pipe are lower than the installation loads suggested by the effort of the drill rig (conversion of the thrust/pullback gauge to force).

To obtain similar comparisons between the predicted and actual loads due to the presence of the reamer assembly and drill pipe, a higher than normal coefficient of friction along the ground surface prior to pipe entry into the bore is used to match the initial installation loads observed based on the drill rig pullback force. It should be noted that the loads associated with the drill pipe and reamer assembly are assumed to be greatest at the start of the installation and decrease as the installation proceeds towards the drill rig.

5.1 Case #1: Poole Slough Watermain Installation

Comparisons of the predicted installation loads versus actual loads are provided in Figure 3. While ASTM F 1962 predictions are similar to the maximum observed installation loads through approximately the first half of the bore, the location of the maximum installation load does not compare well to the actual observed location. Similarly, the AGA methodology provides close comparison through the first half of the bore but significantly over predicts the maximum installation load. The new methodology appears to produce very similar comparisons to the maximum installation load and its location.

Approximately 540 ft into the product pipe installation, drilling fluid returns ceased at the pipe entry location and started flowing towards the relief well located in front of the drill rig. This location compares well with the bore pressure predictions based on the new methodology where maximum bore pressures are predicted at a distance of 510 ft into the installation. The AGA predictions, as previously discussed, do not account for the crossover and therefore, do not show good agreement with observed loads over the second half of the bore.

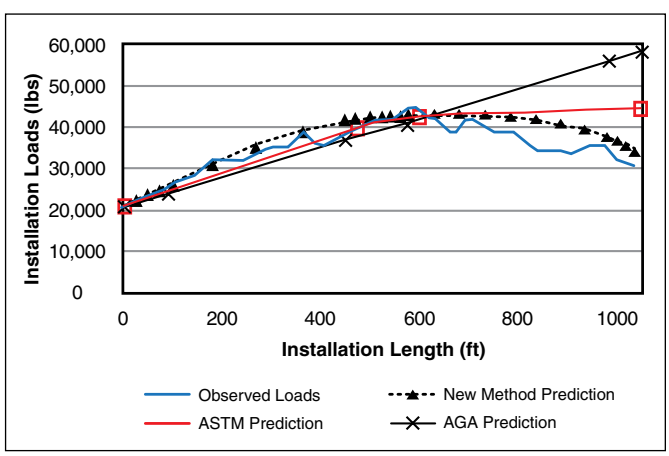

Figure 3. Observed and predicted loads for Poole Slough watermain installation.

It is interesting to note that, for this installation, the location of the actual maximum installation load corresponds well with the location of crossover. At the time crossover occurred, the fluidic drag component contributing to the installation loads was at its maximum.

5.2 Case #2: City of Newberg Watermain Installation

Comparisons of the predicted installation loads vs. actual loads are provided in Figure 4. As observed in Case #1, the new prediction method appears too closely match the actual observed installation loads. The ASTM F1962 method provides a good comparison at the end of the installation but appears to underestimate the installation loads in the beginning. The AGA method appears to significantly underestimate the installation loads in the beginning and over estimate the loads at the end of the installation. Unfortunately, no information is known regarding when crossover occurred during the pipeline installation.

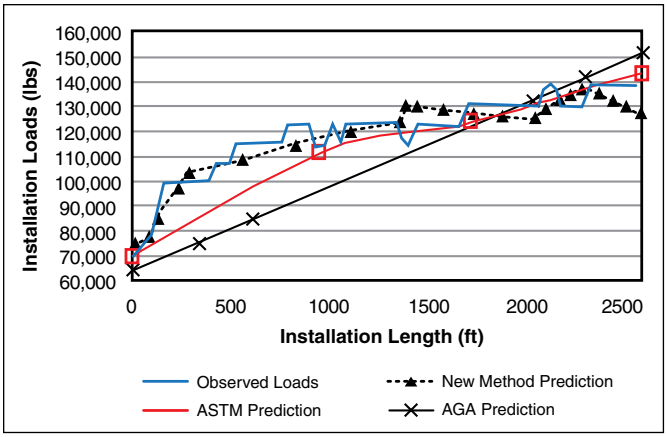

Figure 4. Observed and predicted loads for Newberg watermain installation.

5.3 Case #3: City of London Gravity Sewer Installation

Comparisons of the predicted installation loads versus actual loads are provided in Figure 5. The results using the new methodology compare well with the observed installation load, although the location of maximum installation loads and its magnitude do not match closely. Predictions based on the ASTM F1962 and AGA methods do not compare well to the observed installation loads. Unfortunately, no information is known regarding when crossover occurred during the pipeline installation.

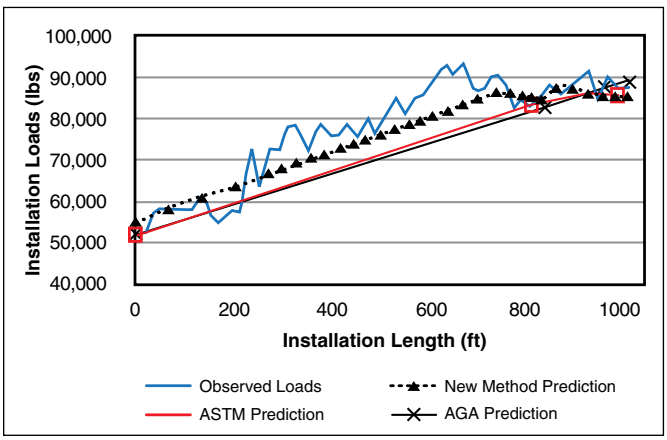

Figure 5. Observed and predicted loads for London gravity sewer installation.

6. Conclusions and Recommendations

A new methodology is proposed for treating the fluidic drag component contributing to the installation loads during an HDD installation of HDPE pipelines. While more complex than equations currently used to predict installation loads, the new method is based on assumed fluid flow properties of the drilling mud/bore slurry (estimated from empirical data), the required fluid flow velocities, corresponding pressure losses and forces, and the bore diameter and annular space behind and in front of the pulling head. Predictions based on the new method compare well with observed installation loads and locations for three presented case histories. This method overcomes significant deficiencies associated with prediction methods based on ASTM F 1962 and the AGA methods.

An important additional benefit of the proposed new method is its capability to predict the minimum required bore pressure to initiate slurry flow within the bore. This unique benefit provides designers and contractors with a means to compare predicted minimum required bore pressures along any portion of the bore to the maximum allowable bore pressure along the alignment and identify areas that may be susceptible to hydrofracture events. The bore pressure predictions can also be used to determine when cross over will occur where the drilling fluid returns cease flowing to the pipe entry location and start flowing to the pipe exit or drill rig location, aiding in drilling fluid return management.

The apparent benefits of the proposed improvements in predicting installation loads and minimum required drilling fluid pressures are significant. Additional research is encouraged to further extend the analyses presented within this paper.

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1-MN-320 Emergency Sliplining Project

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Introduction

"Do you want to be the reason the Twins can't play in their new stadium on opening day, 2010?" That was the question that MCES was faced with early in 2007 as the site preparation was about to begin for the long-awaited and debated Twins Stadium.

A cluster of major public facilities projects was ready to commence construction just west of downtown Minneapolis. The new major league baseball stadium was scheduled to begin site preparation in June 2007. Facilities for the Northstar Commuter Rail were scheduled to begin construction at the same location, 5th Street North, between 2nd and 4th Avenues, within the same time frame. An extension of the Hiawatha Light Rail was also about to begin.

Deep below the proposed construction lays one of the oldest interceptors in the MCES system, 1-MN-320. The sanitary sewer was constructed from limestone and brick in 1889, more than 100 years ago. In fact, the extension of the Hiawatha Light Rail line will pass directly over the pipe.

MCES was concerned that the multiple construction projects and the resulting additional imposed loads would have a high potential of damaging the fragile interceptor sewer. Anticipating this possibility, MCES looked to Brown and Caldwell to evaluate the alternatives, recommend a solution, and prepare construction documents in three months, a fraction of the time normally allowed for this kind of project.

The new Northstar Commuter Rail line will make use of an existing rail line owned by Burlington Northern (BN) that crosses directly over the pipe. The stadium will be located immediately to the south of the pipe. A service building will be constructed directly over the interceptor, under the Fifth Street Bridge. The south half of the bridge deck was removed and replaced at a flatter profile and increased width to accommodate the extension of the LRT line to the west and a connecting stadium plaza. The pile foundations for the bridge piers and west abutment straddle the interceptor. Where the two rail lines cross a new Intermodal Station will be constructed. The bridge and the Intermodal Station will be immediately adjacent to the interceptor.

Driving piles for the bridge, the station and stadium into 50 ft of clay was also a cause for considerable concern regarding potential vibration damage to the aged interceptor. Therefore, vibration monitoring during construction was necessary.

Project Objectives

The age and condition of the interceptor raised concerns that the construction activities would damage the pipe. MCES' primary goal was to gain additional assurance of the stability of the interceptor and thereby mitigate the risk of damage. Once the stadium and new development to the north were underway, access to the interceptor for repair or rehabilitation would be limited and highly disruptive. A failed pipe that missed this window of opportunity for rehabilitation would cause catastrophic damage and disruption to transit services and stadium operations. For MCES, this was a "now or never" opportunity.

Improvements to the interceptor needed to extend its life-expectancy through the current planning horizon. Master planning has been accomplished through the year 2050, and normal design life-expectancy is on the order of 80 years. The normal engineering parameters of hydraulic design, access structures, corrosion resistance, etc., all apply to any planned improvements to 1-MN-320. Structural improvements to the pipeline are also expected to reduce or eliminate infiltration into the pipe along the improved segment.

The schedule for the project required that flow through 1-MN-320 could not be interrupted. There is no parallel pipe to redirect flow to, and no route for temporary flow conveyance facilities that could be planned and constructed through the congested area and still support the aggressive schedule. In addition, acquisition of necessary temporary pumps would be nearly impossible within the given time constraints, and extremely expensive. Therefore, the chosen repair method needed to be implemented "in the wet," with wastewater flow in the pipe. That left only two possible repair methods: removing the interceptor crown and replacing it with cast-in-place concrete or precast concrete sections; or sliplining pipe within the interceptor sewer.

Construction schedule coordination between this project and the other two concurrent projects was essential. The contractor for the MCES project could not interfere with other construction activities. Therefore, careful consideration was given to when and where access to the interceptor was accomplished. Scheduling for material delivery and duration of construction activities was carefully and realistically assessed and coordinated with the other projects.

Date	Depth (inches)	Maximum Flow (MGD)
6/20/2000	41	58
7/08/2000	59	106
7/09/2000	63	128
9/2-3/2000	60	106

Table 1. Historical Flow Data for Interceptor 1-MN-320 during 2000 CSO Study period.

Reinforcing or stabilizing of the pipe structure could not reduce the capacity of the pipe below the projected ultimate flow of 150 million gallons per day (MGD). The interceptor was originally designed for service as a combined sewer. As sewer separation as been undertaken to remove storm water, there should, theoretically, be additional capacity available. However, the current and projected flows include suburban municipalities never imagined when the original sewer line was constructed. Projected flows have been calculated that will accommodate ultimate build-out of the service area. Those flows will be carried through 1-MN-320 after improvements are made in this project. Table 1 below details peak flows recorded at 1-MN-320 during the MCES/Minneapolis CSO Separation Evaluation Study conducted by BC in 2000.

Table 2 is a comparison of the capacity of various pipe sizes, shapes, and roughness coefficients (Manning's "n")

Size	Shape	Material	Mannings "n"	Flow (MGD)
8.5 ft x 6 ft[1]	Oval	Brick	0.016	113
7.5 ft x 7.5 ft[2]	Arch	Brick	0.016	185
8 ft Diameter	Round	Hobas	0.011	211
7.5 ft Diameter	Round	Hobas	0.011	185
7 ft Diameter	Round	Hobas	0.011	166
6 ft Diameter	Round	Hobas	0.011	110
5.5 ft Diameter	Round	Hobas	0.011	81
5 ft Diameter	Round	Hobas	0.011	63
Notes: 1. Shape of Interceptor 1-MN-320 immediately upstream of repair section 2. Shape of Interceptor 1-MN-320 through area to be repaired				

Table 2. Pipe capacities for various alternatives.

for use in Manning's equation. All of the flows in Table 2 are calculated with a pipe slope of 0.1 percent. Hobas Pipe Inc, supplied fiberglass reinforced polymer mortar pipe for the project.

Project Conditions

Bassett Creek Crossing

Between the BN railroad tracks and interstate highway I-394, Bassett Creek flows toward the Mississippi River through an underground conduit. Where the Bassett Creek conduit crosses over 1-MN-320, the creek conduit invert is below the crown of the interceptor. At that crossing, a special concrete structure was built to widen and flatten the interceptor to maintain the cross-sectional area. This constriction in the interceptor, completed in 1990, prevented the viability of certain types of pipe rehabilitation. Specifically, slip lining and Cured In-Place Pipe (CIPP) could not be utilized through this section of the interceptor.

Condition Assessment

Personnel from MCES and Brown and Caldwell entered the interceptor during the early morning hours on Feb. 20, 2007 and on March 9, 2007. The reach of the interceptor to the east of the Bassett Creek Crossing (east reach) was reviewed in the first visit, and the reach from Sixth Avenue North to the Bassett Creek Crossing (west reach) was inspected on the second visit.

Entrance was made after midnight to take advantage of the minimum daily flow that normally takes place before dawn. Even at that hour, the depth and velocity of the flow made inspection uncertain. Unseen debris on the bottom of the tunnel, bricks missing in some places along the pipe invert, and the usual slipperiness of a sewer pipe, made the endeavor treacherous.

The decision was made to hold the flow for as long as possible at two upstream pump stations: L-41 in Golden Valley and L-29 in Plymouth. Re-entry was made approximately two hours later, nearly 3:00 am, and the team was able to conduct their assessment of the tunnel. The delay in making entry however meant that only the easterly reach was viewed in this first trip.

The assessment team consisted of two BC engineers, an engineer and surveyor from MCES, and support staff for lighting, hoist operations and safety. Instrument use within the tunnel was impossible due to flowing wastewater and limited visibility, so the "survey" had to employ unusual and creative methods. Measurements were taken with sliplining understood as the likely repair method. One of the main objectives was to determine if deformities would limit the size of the sliplining pipe to be installed. Tunnel width was measured with a steel tape, and height was measured with a modified survey rod.

Pipe length was measured with a cloth tape from the manhole east of Bassett Creek and a nail was driven into the brick arch every 25 ft. Cross sectional measurements were taken at every nail from zero to 275 ft east of the access manhole and at other selected locations that may be more constricted or for other reasons as noted. The last cross-sectional measurement was taken approximately 50 ft from the blind drop that is shown on the drawings. Water rushing over the drop could easily be heard along the entire east reach of the interceptor, and the wastewater flowing through the pipe began accelerating toward the drop about one-hundred feet upstream. The inspection crew did not approach the drop any closer than 50 ft for safety reasons.

A curve in the pipe alignment is a feature of the reach east of the Bassett Creek crossing. The record drawings indicate that the pipe was constructed on a 59-ft centerline radius with a centerline length of 40.5 ft. This is a relatively short radius and the design of the lining took this feature into account. The reach of the pipe from Bassett Creek to the east was found to be in fairly good condition with only a few deformities noted. The minimum height dimension measured was 88 in., and the minimum width dimension was 79 in.

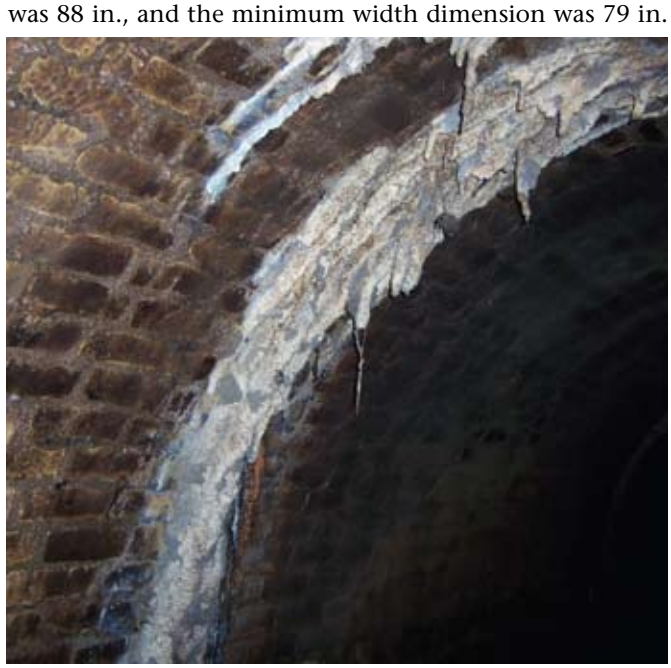

Figure 1: Mineral deposits reveal circumferential cracks in the brick arch.

The pipe reach west of the Bassett Creek crossing was inspected on March 9, 2007 and found to be only in fair structural condition. Two sags in the pipe were noted during the inspection. The first is in the offset section between two bends of approximately 5-degrees. The second, deeper sag began approximately 430 ft west of Bassett Creek, extending upstream approximately 45 ft. The minimum height measurements of 81 in., made in the 900-ft west reach, occurred in the sags, indicating cross-sectional deformation

of the interceptor. The minimum width dimension noted was 86 in.

Debris and sediment were found in both the east and west reaches during the inspections. This included bricks and other chunks of stone that may have been dislodged from the invert or walls of the pipe. Sediment depth was measured in the deeper sag at about 6 in., and sediment was evident in other areas as well. There were also portions of the inspected reaches where little or no sediment was noted during the inspection. It was concluded that the contractor would need to perform only moderate cleaning below the water surface for the lining operation. Both circumferential and longitudinal crown cracks were noted with attendant mineral deposits (see Figure 1). Removal of mineral deposits on the walls was also required, and several protruding service connections needed to be trimmed and reconnected.

The Bassett Creek crossing segment exhibited only minor corrosion and was determined to be sound to the extent that rehabilitation would not be necessary at this time.

Repair Alternatives

Only two alternatives were considered feasible: crown repair and sliplining; alternatives that were discarded included CIPP, coatings, and liners.

Crown repair would consist of excavating the entire length of the pipe, removal of the brick arch and reconstruction using cast-in-place concrete or precast concrete sections. A segment of the interceptor upstream of the project site was repaired using precast culvert half-sections in a previous repair project. The top of the pipe was removed and the precast C-shape was placed on top. This approach was discarded for four significant reasons: 1) Excavation of the entire length of the pipe was not desirable due to the disruption it would cause, 2) The pipe passes under the west abutment for the Fifth Street Bridge, 3) The time needed to acquire precast sections that were either coated or lined to resist corrosion, and 4) Excavation, repair and backfilling was too time consuming. An alternative to the precast segments utilizing fiberglass pipe was also considered but was deemed undesirable due to the extensive excavation required.

Sliplining the pipe would require opening up sections of the existing brick arch for installation of the sliplining pipe in segments. See Figure 2 below. The sliplining pipe would need to be corrosion resistant, and fabricated quickly. The pipe would be lowered into the host pipe, moved into position, connected to the previously placed section, blocked against flotation, and finally, grouted in place.

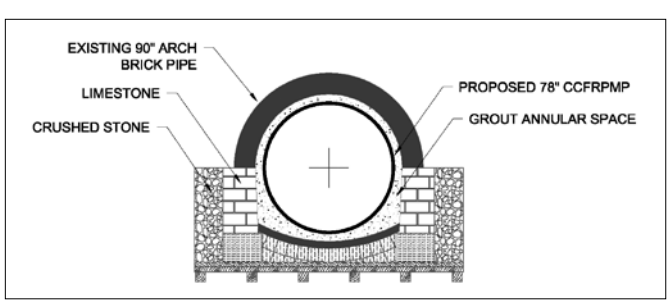

Figure 2: Cross-Section of the sliplined interceptor.

Repair Design

Brown and Caldwell interviewed prospective contractors to confirm design assumptions with the contractors' abilities and analyzed the need for access pits, determining that at least six pits would be necessary, including two rectangular pits over the sagged sections. In addition, a large pit would be necessary at the bend in the pipe near the east end of the project. Two prospective pipe manufacturers were contacted to provide prices on 72- and 78-in. diameter pipe. Meeting delivery deadlines was an important criterion in addition to price of the pipe and appurtenances. Hobas was selected to supply centrifugally cast, fiber-reinforced, polymer-mortar pipe (CCFRPMP).

It was determined that 72-in. pipe could be sliplined in the reach east of Bassett Creek, and 78 in. in the reach to the west. The design flow for 1-MN-320 is projected to reach a peak of approximately 150 MGD over the planning period (through 2050). When hydraulically modeled the 72-in. Hobas pipe showed a capacity of approximately 126 MGD in MCES's SewerCat model, indicating surcharging of the pipe during peak flows. However, the draw down due to the drop will minimize or eliminate the surcharging; bringing it more in line with the capacity computed using Manning's Equation (see Table 2) of 166 MGD. The 78-in. Hobas has a capacity of 185 MGD, exceeding the 150 MGD design flow.

BC worked with Hobas to fabricate the curve in segment that would fit within the existing pipe. The challenge was to fabricate sections that could be constructed and grouted into a pipe that could not be precisely surveyed. At the center of the curve, an access structure was constructed that included two outside drops for sanitary sewage from the new stadium, the Minikahda Storage building, and the future development to the north. In addition, BC worked with civil engineers from HGA, the designers for the stadium site improvements, to eliminate a storm drain that was illegally connected to the sanitary sewer at the same location.

Vibration Mitigation

Potential damage to the interceptor tunnel from vibrations was a major concern. Construction activities would impose vibrations that could directly damage the pipe, or cause damage through indirect means. BC determined the vibration sources, investigated industry practices, and recommended limits to imposed vibration. In addition, BC engineers worked with the bridge designers to prevent damage by locating abutment piles as far from the pipe as reasonably possible, and by coordinating the various construction schedules to the best advantage for each project.

Vibration Sources

Bridge Deck and Abutment Demolition. Demolition of the south half of the Fifth Street Bridge would involve sawcutting the length of the bridge, removing the bridge deck and bridge beams and sawcutting and removing the south half of the bridge piers. Falling debris and ground impact would likely cause vibration to the interceptor pipe, located directly below the demolition.

Pile Driving Operations. Construction of the five bridge piers would not allowed to overlap with sliplining operations. In addition, the piles for the piers will be driven approximately 40 ft away from the interceptor. Pile driving at the abutment will approach the pipe to within 7 ft. Considering damping effects of the soils on the pile vibration it was determined that the impact on the pipe would be two to six times greater from the abutment piles.

Abutment Construction. Construction equipment and movement of materials would introduce vibrations into the soil at the surface during the placement of formwork, reinforcing steel, and concrete for the abutment footing

and stem. Backfilling operations also introduce vibrations. These sources are not considered as significant as installation of the abutment piles.

Potential Impacts

Direct Damage. Pile driving operations could damage the brick arch, or limestone walls of the interceptor directly. If the pipe has been weakened by previous construction (especially near the west abutment) or by settlement, the vibrations could be enough to cause a failure.

Indirect Damage. Damage could be done to the pipe by settlement of the underlying soils as the pile-driving operations consolidate the soft underlying soils. Consolidation of the clay soils is less likely and slower than it would be for granular materials. If the water table is not lowered by construction operations, the clays should generally remain intact. However, the underlying sand layer could undergo consolidation as the piles vibrate those granular soils.

Recommendations — Schedule Management

Coordination with Other Contractors. Pile driving for the new west abutment of the Fifth Street Bridge was early on the construction schedule. It was our opinion that the most effective approach to reducing the risk of pipe damage due to pile driving operations was to prohibit pile driving until the pipe sliplining was complete for that section of the interceptor. Therefore, the contractor was directed to slipline this reach of pipe first. This also meant that the rail bed preparation for the Northstar Commuter Rail was restricted to areas beyond an approximately 100-ft reach adjacent to the abutment.

Schedule management and adjustment was only possible with cooperation of all of the contractors working at the ball park site. MCES was not in a position to impose constraints on the contractors working for the Northstar project, the LRT extension, or the stadium itself. However, weekly progress meetings were utilized to maximize communication and cooperation between all of the contractors and coordinate activities. Each of the agencies communicated to their contractor(s) the importance of cooperation in order to accomplish everyone's objectives in a timely manner.

Mass Excavation. It was determined that the contractor could save time by performing a mass excavation behind the existing west bridge abutment, in order to reduce the depth of the deepest access pit. This mass excavation would remove the top 12 ft of the planned pit. The pit was estimated to take one day for each foot of excavation. The mass excavation would be done in approximately one week. It was thought that this would produce a net time savings of at least two weeks. In actuality, no schedule improvement was realized due to buried obstructions.

Construct One Additional Pit. An additional pit was constructed between Basset Creek and the first bridge pier west of the railroad tracks. This allowed the contractor to install the sliplining pipe by pushing upstream beneath the bridge abutment. The relatively shallow pit (about 25 ft) was constructed faster than the pit west of the abutment (55 ft deep). It was this approach that produced the needed time savings and allowed the MCES to support the ball park schedule.

Vibration Limitations and Monitoring

If driving piles for the abutment or the bridge piers must begin prior to completion of the sliplining, it was required that only piling 40 ft or farther from the interceptor be installed prior to sliplining. If that was not possible, setting limitations on the vibrations to the unlined interceptor pipe may be the most reasonable approach. Literature on the subject is varied however, and a precise limit was simply a matter of comfort level. Technical papers and design guidelines consistently recommend vibration monitoring and warn of site-specific conditions that need to be considered. Monitoring of vibrations at 1-MN-320 was strongly recommended.

Recommended Limits. The published limitations are generally applied to protect residential and commercial structures. In the case of 1-MN-320, it was required that these limits be adhered to strictly. If monitoring indicated that these limitations were being exceeded, the construction activity causing the vibration would be halted. At that point, the interceptor would be inspected for damage and repairs and/or stabilization action taken as required.

To summarize our recommendations:

- The contractor should review daily and report on any changes to the pipe condition
- Drive no piling until the pipe is sliplined from the first pit west of the bridge abutment to the east end of the pipe (all of the pipe affected by the bridge construction)
- If that is not possible, drive only the piling that are 40 ft or more (horizontally) from the pipe until the pipe is sliplined
- Limit vibrations to the values in the table below for the interceptor reaches not yet sliplined. These limits would apply to the entire project.

The Table 3 below describes the limits to vibration that were detailed in the specification:

Impact Vibrations		Steady State Vibrations	
Frequency of Peak Particle Velocity	Allowable Peak Particle Velocity	Frequency of Peak Particle Velocity	Allowable Peak Particle Velocity
(Hertz)	Inches per Second	(Hertz)	Inches per Second
10 or less	0.50	10 or less	0.25
10 to 40	0.75	10 to 40	0.35
50	1.25	50	0.60

Table 3. Specified vibration limits.

Seismic readings were taken at the buildings on each side of Fifth Street: the Ford Centre Building, and the Environmental Services Building (both adjacent to the Northstar Commuter Rail tracks), and inside the interceptor. Readings taken during pile driving operations are shown below:

- Ford Center Building: 0.17 in. per second
- Environmental Services Building: <0.2 in. per second
- Inside 1-MN-320: 0.40 in. per second

All of the readings were below the lowest limit for impact vibration frequency.

Construction

Bidding Process. Two contractors were provided with construction documents and asked to provide bids and

schedule commitments. Lametti and Sons (Lametti) was the low bidder and could commit to meeting the ambitious deadlines required to keep the Northstar Commuter Rail and the Twins Stadium on schedule. Lametti's base bid was $2.9 million. The cost of procuring materials from Hobas was approximately $350,000. Shortly after the bid was awarded, the Northstar Commuter Rail authority requested that the project be accelerated in the area of the Fifth Street Bridge west abutment, which was on the critical path for installing the new rail line. Lametti added another pit, as previously described, that provided for the segment under the abutment to be installed first. The additional cost for that pit, removal of rubble in the area of one other pit, and other minor miscellaneous costs brought the total construction cost to approximately $3.8 million. Total project cost was just under $4 million.

Coordination with Other Contractors. Weekly construction progress meetings included designers and contractors for the other three projects. Coordination was maintained through interaction at these meetings and allowed sliplining beneath the Fifth Street Bridge abutment demolition and reconstruction, and demolition of half of the bridge itself. Lametti met the challenge of working under the bridge as it was being partially demolished. In addition, the Northstar Commuter Rail was installed directly above the pipe, on schedule, after Lametti had sliplined and grouted that segment.

Contractor Perspective

Lametti met with MCES & BC on March 20, 2007, to discuss the proposed project and participated in personnel entry inspection of the interceptor during low flow, starting

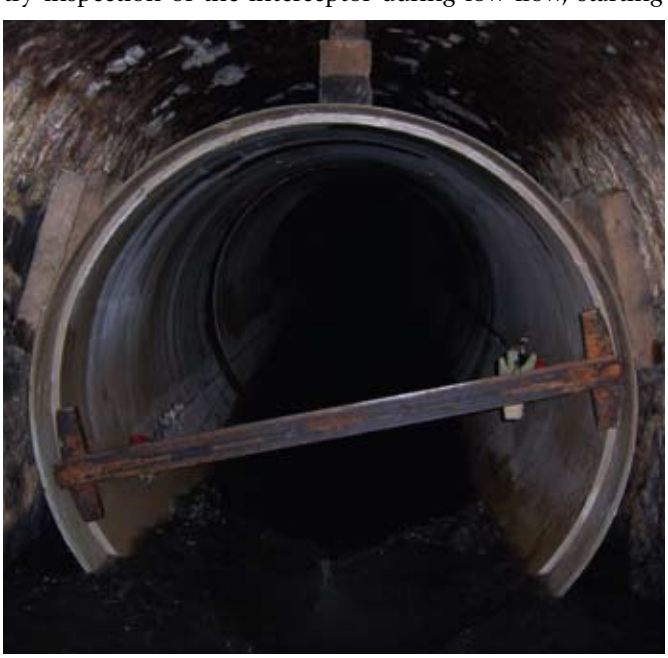

Figure 3: Sliplined pipe in place prior to grouting.

at 2:00 a.m., March 23, 2007 and again on March 25, 2007. We were furnished a preliminary RFP document on April 3, 2007. Pricing, schedule, and qualifications were submitted April 12, 2007 and the project was verbally awarded the morning of April 13, 2007.

We immediately started on the project, with a meeting the afternoon of April 13, 2007, scheduled by MCES with the other stakeholders of the Northstar Commuter Rail Construction, Minnesota Twins Ballpark Construction, and the City of Minneapolis to discuss the rehabilitation project and coordination with the other projects and the city.

While the major purpose of the project is to rehabilitate the interceptor by slipline, a major challenge was to gain access to the interceptor to perform the work. The depth from the surface to the crown of the interceptor ranged from 18- to 50-ft deep. Of course, working in a downtown urban area on an interceptor more than 100 years old, we needed to construct access sites without damaging existing buildings and utilities. With numerous projects going on in this area of Minneapolis, pedestrian and traffic changes had to be closely sequenced and scheduled.

The access pits consisted of a trench box for the shallowest pit and others consisted of either a 25- to 30-ft diameter circular ring beam and lagged pits or rectangular drilled soldier pile and lagged pits, modified to accommodate bends in the interceptor and inclusion of new structures.

The work of installing the slipline pipe consisted of cleaning the pipe of settled debris and removal of mineral deposits. In some locations we needed to remove some of the internal brick lining to accommodate the new pipe and to maintain the proposed grade. In order to maintain grade and with the close tolerance between ID of the interceptor and OD of the new pipe, each pipe was placed individually (see Figure 3). This required man entry in the interceptor and working at low flow times of the day. The new pipe was blocked into place and grouted in two lifts with cellular concrete.

Conclusion

The cooperative and efficient effort of the Project team in assessment, alternative analysis, material procurement, design, and construction coordination allowed the MCES to stabilize and extend the life-span of this valuable asset, without compromising the conveyance capacity of the interceptor. The short window of opportunity to accomplish these project objectives made engineering additionally challenging.

A secondary benefit to the public is that 1,275 ft of l pipe exhibiting significant infiltration was made tight. In addition, during the construction a rogue storm drain servicing the large parking area was found connected directly to the interceptor. This connection was eliminated and storm water is now being routed to surface waters, rather than to 1-MN-320. This reduces the amount of "clean" water that is sent to the Metro WWTP for unnecessary treatment, it reduces costs to Minneapolis rate payers, and preserves treatment capacity for "dirty" water that needs cleaning.

And finally, it looks like the Twins will play in a new stadium on opening day, 2010!

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Calendar

NASTT Training Courses, Conferences & Chapter Events

2011

March

2-3

Tri-State Trenchless Technology Seminar & HDD Consortium Horizontal Directional Drilling Good Practices Guidelines Course; Bowling Green State University — Bowling Green, Ohio
Contact Info:
Angela Ghosh
Phone: (703) 217-1382
E-mail: *aghosh@nastt.org*

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HDD Consortium Horizontal Directional Drilling Good Practices Guidelines Course; Caribe Royale Hotel & Conference Center — Orlando, Fla.
Contact Info:
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27

2011 No-Dig Pre-Conference Seminar: NASTT's An Introduction to Trenchless Technology Short Course; Gaylord National Resort & Convention Center — Washington, D.C.
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27-31

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30-31

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- NASTT's Laterals Good Practices Course

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May

2-5

ISTT International No-Dig 2011; Berlin
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2012

March

11-16

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2014

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13-18

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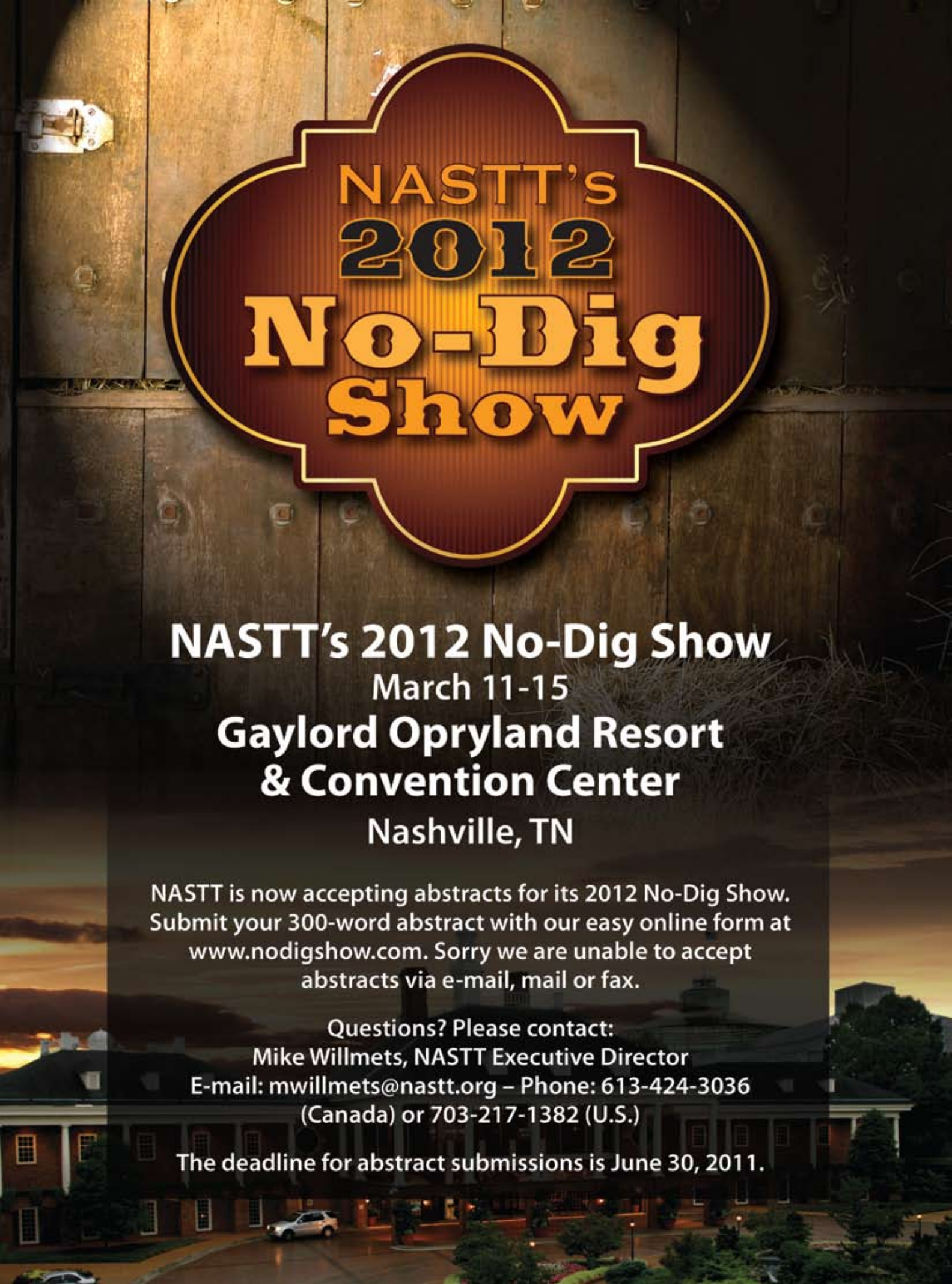

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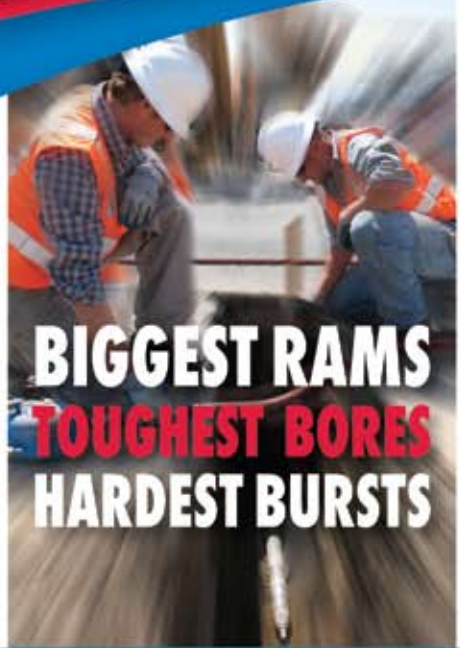

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