SOUTHEAST JOURNAL OF

# TRENCHLESS TECHNOLOGY 2015

OFFICIAL PUBLICATION OF THE SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY

## 2015 EDITION



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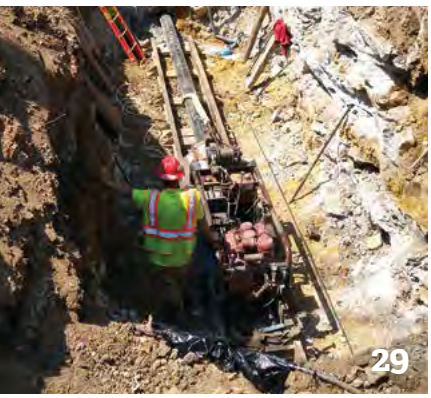


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# SESTT CHAIRMAN MESSAGE 2015

## Promoting Trenchless Technologies

### Jerry Trevino, SESTT Chairman

Welcome to the second annual publication of the Southeast Journal of Trenchless Technology.

While keeping my focus this year on work-a-day challenges of obtaining sufficient company work loads, maintaining a high quality experienced work force, staying ahead of environmental changes, increased regulations on healthcare insurance, product development and testing, and simply more demands on the general operation of a small business, I have on occasion stuck my head out of the daily grind to reflect on the progress that has been made in the Trenchless Technology industry over the last 15 years, since the creation of SESTT in the year 2000.

Through the various chapters of NASTT, and numerous 2 day seminars across the states, it is evident that the industry has matured significantly. The broad spectrum of challenges presented by the aging infrastructure and by urban population growth has spurred innovations in technologies, materials engineering, installation equipment development and better asset condition data from which municipality managers can make more informed decisions.

***"Through the various chapters of NASTT, and numerous 2 day seminars across the states, it is evident that the industry has matured significantly."***

While this is still a relatively young industry, I see more educational opportunities in Universities, Trenchless seminars, magazine articles and other media and associated organizations, continuing to educate decision makers on available technologies and further train installers on new and older processes required to rehabilitate and to increase the capacity of our infrastructure.

As our government and municipal leaders decide on how to best spend tax dollars on infrastructure upgrades, the private sector is busy increasing our options in the tool chest to meet their demands, and organizations such as SESTT, NASTT and the associate chapters are the education and training providers to select the best methods and processes to meet these challenges.

We all look forward to next year and encourage all to participate in the upcoming NASTT No-Dig Show March 20-24 2016 at the Gaylord Texan in Dallas, Texas. In addition, next year there will numerous planned two day seminars by SESTT, MSTT, and MASTT. A full schedule of these 2016 seminars will be posted to www.sestt.org in the New Year. Best wishes to all.

Sincerely,

Jerry Trevino
SESTT Chairman

SESTT SITE

SESTT

# GREETINGS FROM THE SESTT EXECUTIVE DIRECTOR

## Leonard Ingram, Executive Director, SESTT

I have been the Executive Director of the Southeast Society for Trenchless Technology (SESTT) since 2001 and have presented 41 seminars in 22 cities throughout the Southeast nine-state region. Through this active education outreach, SESTT has reached over 1700 classroom attendees. SESTT could not have had such success without the continued support of ASCE co-sponsorships, attendees, guest presenters, presenters, exhibitors and food sponsors. **Thanks for the support!**

On August 11th and 12th, 2015, SESTT conducted the "Trenchless Technology, SSES and Buried Asset Management" seminar in Birmingham AL. The Guest

***"Thanks for the support!"***

Presenters were Mr. Sonny Jones, P.E., Assistant General Manager, Birmingham Water Works with the presentation "Birmingham Water Works Board Trenchless Program" and Mr. Daniel White, P.E., Deputy Director, Jefferson County Environmental Services (Sewer) with the presentation "Jefferson County Environmental Services Trenchless Program". Needless to say, there was a lot of learning and network going on.

SESTT will conduct the "Trenchless Technology, SSES and Buried Asset Management seminar in Shreveport LA on December 16th and 17th, 2015 at the Louisiana Tech University Center in Shreveport LA. ASCE Shreveport Branch is the co-sponsor for the seminar and the Guest Presenter will be Mr. Tyler Comeaux, P.E., Kleinpeter, Inc., Project Manager with the presentation "Shreveport's Consent Decree And Trenchless Technology Program". The 2016 Proposed Seminar Schedule will be developed in January once the larger shows have established their show date in order to avoid conflict.

Louisiana Tech University, Ruston LA is the home of Dr. Tom Iseley, P.E. Dr. Iseley is the founder and current Executive Director of the Trenchless Technology Center Louisiana Tech. He also founder and President of the Buried Asset Management Institute – International (BAMI-I) that he manages at the Trenchless Technology Center. Most recently, he and numerous other experts in water asset management finalized the development of the CTAM (Certified of Training in Asset Management). Please go to www.bami-i.com to learn more about CTAM, and pages 15-17 in this magazine.

Dr. Iseley is one of five founders of our parent organization the North American Society for Trenchless Technology (NASTT) and is the Special Advisor to SESTT. I know his sweet wife Carol has spent many a night without him through his 30 plus years of dedicated service to the trenchless technology industry. Dr. Iseley has won numerous awards and has been the founder of many organizations including SESTT. I would like to congratulate my good friend Dr. Iseley on his most recent prestigious ASCE 2015 Distinguished Member Award in October at the Annual ASCE 2015 New York City Convention (see page 16). Truly a well deserved honor for a pioneer and vibrant leader in the trenchless technology industry.

Sincerely,

Leonard E. Ingram, Sr., AWAM
Executive Director, SESTT

# SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY
# BOARD OF DIRECTORS 2015

### Jerry Trevino - *Chairman*

Jerry Trevino is President of Protective Liner Systems, Inc., and principal owner of other construction and consulting companies. Jerry is an engineering graduate from the University of Texas in Austin. Before specializing in infrastructure rehabilitation, he worked as a project engineer and in research and product development for Procter and Gamble and Mobil Oil. He now specializes in the development, manufacturing and installation of all types of polymeric and cementitious coatings, liners and FRP composites used to rehabilitate infrastructure for municipalities and the industrial sector. He strongly believes that trenchless technologies offer numerous methods to maintain and upgrade aging infrastructure.

### Chris Ford – *Secretary*

Chris Ford is Vice President and Principal at Highfill Infrastructure Engineering, PC, a Carolinas engineering consulting firm specializing in community and municipal water and wastewater infrastructure engineering. With 25 years of experience, Chris serves as a leading trenchless technologies resource for public utilities in the Carolinas. Over the last 10 years he has focused on the use of trenchless technologies for condition assessment, evaluation, renewal, and replacement of both pressure and gravity pipelines. His experience includes large diameter ductile iron pipe splitting, pipeline renewal with high pressure liners, various methods of gravity sewer rehab, and new installations via horizontal directional drilling. A graduate of NCSU with a BS in Civil Engineering-Construction, Chris regularly presents at conferences including NC AWWA-WEA, NASTT No-Dig, and UCT.

### Ed Paradis – *Vice Chairman*

Ed Paradis is the National Sales Manager for Resiplast US Inc. A worldwide manufacturer of chemical grouts for over 25 years, Resiplast makes a full line of single-component and multi-component materials that are known as the new benchmark in chemical grouts. Ed attended Boston College while serving in the U.S. Army. He has been involved in the construction and rehabilitation industry since 1989, and further contributes to and advances our industry through active membership in various associations such as NASSCO, NASTT, SESTT, UCT, ICRI, and DFI (Deep Foundation Institute). He speaks nationwide for these organizations and sits on various boards that support the industry's growth.

### Brent Johnson – *Treasurer*

Brent Johnson has over 20 years of experience in the planning, design and construction of water and wastewater facilities. Since 2000, he has focused on the use of trenchless technologies for pipeline construction and rehabilitation. For the last seven years he has focused on the inspection and condition assessment of water and wastewater pressure mains and is the current chair of the NASSCO Pressure Pipe Committee. He has published magazine articles and presented papers at multiple conferences. He is located in the CDM Smith Raleigh, North Carolina, office and is the firm's technical leader for pipeline condition assessment and rehabilitation in the Southeast Region.

# MESSAGE FROM NASTT CHAIR

## Dr. Kimberlie Staheli, PH.D, P.E., NASTT Chair

Greetings Southeast Chapter Members! NASTT is having a great year, and I'm excited for the future of our Society during my term as Chair of the Board of Directors and beyond. As you may be aware, NASTT's 2015 No-Dig Show in Denver, Colorado was a huge success as we broke attendance records and experienced a sold-out exhibit hall! Personally, I heard a number of excellent presentations and have read numerous quality papers since the show. It is clear that NASTT's No-Dig Show is a mecca for trenchless education, and without a doubt, our website (www.nastt.org) houses the most comprehensive source of trenchless information.

One of the highlights this year was honoring Southeast Chapter Member Kaleel Rahaim of Interplastic Corporation with an induction into NASTT's Hall of Fame. Kaleel has been an active participant and supporter of the trenchless industry, at the local, regional and national levels for years. Kaleel served on the NASTT Board of Directors from 2006 to 2011. He has also served on the Program Committee for many years and is one of our most active instructors. Kaleel travels extensively to teach NASTT's CIPP Good Practices Course throughout the year. It was truly our pleasure to present this award to Kaleel.

NASTT would never be where we are today without the grass roots support of our volunteers and regional chapters. I would like to take this opportunity to thank the Southeast Chapter Members that served on NASTT's 2015 No-Dig Show Program Committee: Alan Ambler, Will Craven, Sanjiv Gokhale, Brent Johnson, George Kurz, John Matthews, Dorian Modjeski, Stephen O'Connell, Ed Paradis, Carlo Pilia and Kaleel Rahaim. I'd like to give a special thank you to Alan Ambler, George Kurz, Stephen O'Connell and Kaleel Rahaim who also served as Session Leaders this year. Serving on the Program Committee is a serious time commitment, a lot of hard work and requires volunteer travel. Without these individuals who believe in the industry and the power of education, the NASTT No-Dig Show could not succeed. Thank you.

In addition to NASTT's No-Dig Show, NASTT provides many trenchless training courses. NASTT is focused on trenchless education and our instructors provide their expertise strictly on a volunteer basis. They take personal time to travel all over North America to provide top notch training about trenchless technologies. I would like to thank the following Southeast Regional Chapter Members: Alan Ambler of the City of Casselberry who taught our Pipe Bursting Good Practices Course, Don Del Nero of Stantec who taught our New Installations Methods Good Practices Course, John Matthews of Pure Technologies who taught our Introduction to Trenchless Technology – Rehabilitation and Laterals Good Practices Courses and Kaleel Rahaim who taught our CIPP Good Practices Course this year. Thank you all for your dedication!

One of the goals that the Board of Directors identified through strategic planning is to engage a larger group of trenchless professionals to participate in the many volunteer opportunities provided by NASTT. NASTT has a very wide variety of volunteer openings that allow for satisfying and rewarding involvement at any level. If you are interested in more information, please visit our website at www.nastt.org/volunteer. There you can view our committees and learn more about NASTT's goals. Please consider becoming a volunteer – we would love to have you.

NASTT has a very promising future and your Southeast Chapter is stronger than ever. Thank you again for your continued support and dedication to NASTT and the trenchless technology industry.

Dr. Kimberlie Staheli
NASTT Chair

# UPCOMING TRENCHLESS EVENTS

January 21, 2016
**Rocky Mountain Regional Chapter (RMNASTT) Utah Training Day**
8:00 AM - 5:00 PM
Larry H. Miller Training Center
(SLCC Campus)
Salt Lake City, Utah
Information: www.nastt.org/calendar

January 27, 2016
**NASTT CIPL (Cured-in-Place Liner) Good Practices Course**
8:00 AM - 5:00 PM
PSE&G Edison Training and Development Center
Edison, New Jersey
Information: www.nastt.org/calendar

March 20-24, 2016
**NASTT 2016 No-Dig Show**
Gaylord Texan Hotel & Convention Center
Dallas, Texas
Information: www.nodigshow.com

March 20, 2016
**NASTT Introduction to Trenchless Technology – New Installations**
8:00 AM - 12:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 20, 2016
**NASTT Introduction to Trenchless Technology - Rehabilitation**
8:00 AM - 12:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT CIPP Good Practices Course**
March 23 2:30 PM - 5:30 PM
March 24 8:00 AM - 1:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT Gas Good Practices Course**
March 23 2:30 PM - 5:30 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT HDD Good Practices Course**
March 23 2:30 PM - 5:30 PM
March 24 8:00 AM - 2:30 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT Laterals Good Practices Course**
March 23 2:30 PM - 5:30 PM
March 24 8:00 AM - 12:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT New Installation Methods Good Practices Course**
March 23 2:30 PM - 5:30 PM
March 24 8:00 AM - 1:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

March 23 – 24, 2016
**NASTT Pipe Bursting Good Practices Course**
March 23 2:30 PM - 5:30 PM
March 24 8:00 AM - 12:00 PM
Gaylord Texan Convention Center
Dallas, Texas
Information: www.nastt.org/calendar

## SESTT Member Kaleel Rahaim Inducted into 2015 NASTT Hall of Fame

At the NASTT 2015 No Dig in Denver, SESTT Chapter member and former NASTT Treasurer Kaleel Rahaim was inducted into the 2015 NASTT Hall of Fame. Kaleel served on the NASTT Board of Directors from 2006 to 2011, and was Program Chairman for the No Dig Show in Dallas, TX in 2006. Involved with many other trade organizations for the trenchless remediation industry, Kaleel is a voting member of ASTM and a member of NASSCO. He is also a coauthor of the *NASTT Manual for CIPP Good Practices*.

Kaleel is a graduate Chemical Engineer from Mississippi State University. He has experience in many different aspects of Engineering such as project and process engineering and has been involved in the thermoset polymer industry for almost 30 years. His experience includes process improvements for many thermoset resin applications including cured-in-place pipe (CIPP).

Currently, Kaleel is Business Manager, Remediation Polymers for the Thermoset Resins Division of Interplastic Corporation. In his position with Interplastic Corporation, Kaleel is responsible for the trenchless remediation market for thermoset polyester and vinyl ester resins across North America and other parts of the world. The trenchless processes include CIPP, sliplining, pipejacking, and fiberglass reinforced panels.

Congratulations Kaleel on this honor recognizing your contributions to the advancement of the trenchless industry.

# IS PIPE BURSTING THE RIGHT FIT FOR YOUR PROJECT?

By: Chris Ford, P.E., Highfill Infrastructure Engineering, P.C.

*Redundant bypass pumping set up*

As pipe bursting becomes more commonplace, most municipalities are beginning to understand the tangible and intangible benefits of trenchless replacement of pipeline when compared to open-cut replacement. These benefits include the following:

- Social impacts are significantly reduced, including disturbance of personal property (driveways, retaining walls, culverts, fences, ornamental structures, landscaped areas), local traffic impacts, and reduced access to businesses and properties.
- Construction costs for removal and restoration of pavement and conflicting utilities are significantly reduced, resulting in significant savings over open-cut replacement.
- Because the construction footprint is smaller, the associated restoration costs are also significantly reduced.
- Permitting requirements may be less extensive because of less disturbed area.
- Construction time can be shortened, further reducing cost and social impacts.

While these benefits can certainly make pipe bursting the most cost-effective pipeline replacement option, utility owners must consider multiple factors before employing this technology.

## Cost Effectiveness Considerations

The cost-effectiveness of pipe bursting is affected by a number of conditions including the following:

- Location within or proximity to paved or improved surface areas.
- Proximity to existing utilities and structures, both parallel and crossing (horizontal and vertical).
- Location within rights of way and easements, and the associated construction requirements of the land owner.
- The presence of fittings, concrete encasement, and previous repairs.
- Physical project constraints such as insufficient room for insertion pits, receiving pits, or the fused pipe string.
- Soils and the potential impacts from heave, settlement, and vibration.
- Restoration requirements.
- Bypass pumping requirements.
- Easement acquisition requirements.
- Parameters affecting the risk of the installation, including existing pipe size, material, depth and condition (collapsed pipe, sags, offsets joints, debris, root intrusion, cross-bored utilities, etc.); upsize requirements; burst length.
- Changes in host pipe material.

These factors may result in favorable or unfavorable conditions that dictate whether pipe bursting is technically feasible for a particular application. Once technical feasibility is established, the cost implications of these parameters must be considered to determine whether pipe bursting is the most cost-effective solution. A case study may be helpful in illustrating this point.

## Case Study: Sanitary Sewer Rehabilitation Phase 2, Burgaw, North Carolina

The Town of Burgaw is located in southeastern North Carolina and has a population of approximately 4,000. Their wastewater collection system dates back to the mid-1930s, when the initial sanitary sewer system was installed for separate conveyance of sanitary wastewater to a central treatment facility. Since that time, the collection system has been expanded numerous times. Burgaw's current wastewater collection system consists of 6-inch to 15-inch diameter gravity sewers. Older sewers are vitrified clay and truss pipe, while newer sewers are PVC.

A recent condition assessment of the Town's sewers revealed that rehabilitation or replacement was necessary to address sewer defects, reduce infiltration, and

*Pipe insertion pit*

*Pipe bursting machine pit*

upsize sewers that are currently at capacity. The Town completed two phases of rehabilitation. Methods for rehabilitation included lining with cured-in-place pipe (CIPP), open-cut excavation and replacement, and pipe bursting. The rehabilitation method in each case was selected based on the pipe condition and the cost-effectiveness of the various alternatives.

As part of the overall rehabilitation project, approximately 1,574 linear feet (LF) of 8-inch diameter gravity sewer was located in the center of Wilmington Street, a 48-foot wide NCDOT roadway which is a primary travel route through the central business district. The sewer was at its hydraulic capacity and required upsizing to 12-inch pipe. NCDOT would permit two alternatives for excavation and replacement of the sewer. The first alternative required the installation of active shoring for the full length of the trench excavation. The second alternative would allow trench side slopes to be excavated at a 1:1 ratio. Due to the depth of the sewer (8-12 feet) and the location in the center of the roadway, this alternative required significant excavation and complete replacement of the roadway. Both alternatives were projected to be cost prohibitive.

Pipe bursting was identified as a technically viable alternative, with the potential for considerable cost savings. However, this methodology had not been approved by NCDOT on a state-wide basis, therefore requiring review and approval at both the local and state levels. NCDOT conducted a rigorous technical review of the design documents before agreeing to allow pipe bursting. In addition to the typical design documents, NCDOT reviewed calculations for projected installation loads, potential pipe stress, insertion pit sizes, potential for settlement and heave, and risk classification. The package was reviewed locally by NCDOT and then sent to the NCDOT State Utilities Engineer, who ultimately accepted the approach and methodology. The project was then permitted, bid and successfully constructed.

Because the project included both open-cut excavation and pipe bursting, bid prices were used to evaluate the cost-effectiveness of pipe bursting in this specific case. Bid

**Table 1 – Range of Unit Prices Bid**

| PAY ITEM | UNIT | UNIT PRICES | |
|---|---|---|---|
| | | MIN. | MAX. |
| OPEN-CUT EXCAVATION PAY ITEMS | | | |
| Excavate and Replace Existing Sanitary Sewer with 12-inch PVC, 8-10 foot cut | LF | $64.00 | $125.00 |
| Install PVC Sewer Lateral Tap Fitting on PVC | EA | $850.00 | $1,200.00 |
| PIPE BURSTING PAY ITEMS | | | |
| Clean, Televise and Inspect 8-inch Sewer Mains | LF | $2.35 | $4.00 |
| Pipe Burst 8-inch Sewers to 12-inch DR-17 DIPS HDPE | LF | $61.00 | $76.00 |
| Install Fused 4-inch Service Lateral Tap Fitting on 12-inch HDPE | EA | $750.00 | $1,400.00 |
| ADDITIONAL PERTINENT PAY ITEMS | | | |
| Restoration of Pavement | SY | $72.00 | $112.00 |

**Table 2 - Alternative Cost Comparison**

| PIPE REPLACEMENT ALTERNATIVE | COST | |
|---|---|---|
| | LOW BIDDER | 2ND LOW BID |
| NCDOT Alternative 1 - Install Trench Shoring | $1,077,631 | $985,874 |
| NCDOT Alternative 2 - Excavate Trench Sideslopes to 1:1 | $984,187 | $1,182,110 |
| Pipe Bursting | $200,357 | $204,561 |
| SAVINGS BY PIPE BURSTING | $783,829 | $781,313 |

*Installation of a fused-on gasketed lateral service fitting adjacent to an electrofusion coupling*

*Maintaining service to residential laterals*

prices received for the project are provided in Table 1.

Costs for NCDOT Alternatives 1 and 2 include excavation and replacement with SDR 35 PVC, demolition and removal of the existing clay pipe, installation of service lateral tap fittings, either shoring or excavation of the sideslopes to 1:1, depending on the alternative, and pavement restoration. Shoring costs were estimated based on other similar work in the area.

Costs for pipe bursting included cleaning; inspecting the sewer with CCTV prior to bursting; pipe bursting from 8-inches to 12-inches with DR-17 DIPS HDPE; installing fusible, gasketed service lateral fittings; and pavement restoration at the access pits. A comparison of the costs for the two lowest bidders is provided in Table 2.

The savings recognized by pipe bursting rather than open-cut excavation in this example are approximately $780,000. For the pipe replacement alone, pipe bursting under these conditions is approximately 20% of the cost of open-cut excavation.

## Conclusions

As demonstrated above, several key factors impact the cost-effectiveness of pipe bursting when compared to open-cut excavation. When considering rehabilitation alternatives, look for one or more of these conditions that can make pipe bursting not only a viable alternative, but the more cost-effective solution for your project:

- Location beneath paved or improved areas.
- Areas where shoring is required for construction rather than trench boxes.
- Proximity to right of way or easement limits where open-cut excavation requires easement acquisition in areas with high property values.
- Proximity to environmentally sensitive areas where encroachment into those areas will require costly permitting and mitigation.

## The First Step

If pipe bursting appears to be a potential solution for rehabilitation of your pipelines, consider a feasibility evaluation to:

- Identify site specific conditions and obstacles that may adversely affect or prevent bursting of the pipeline.
- Investigate the factors that can impact the cost-effectiveness of pipe bursting.
- Confirm that pipe bursting is a viable and cost-effective rehabilitation alternative.

The scope of the feasibility analysis should reflect the criticality and complexity of the project. If your project conditions are similar to those encountered in our case study, you very likely will find pipe bursting to be a cost-effective solution.


**ABOUT THE AUTHORS:**

***Chris Ford P.E.*** *is the Trenchless Technology Specialist, Vice President and Principal at Highfill Infrastructure Engineering, P.C. With 25 years of experience, Chris provides a leading trenchless technologies resource for public utilities in the Carolinas. Chris has extensive knowledge of the benefits of trenchless methods and currently serves as SESTT Secretary. His bio is on pg.8.*

# TTC and BAMI-I Launch a Comprehensive Asset Management Certification Program

## CTAM 300 & 400 Courses Released At Successful Training Event in Raleigh NC

By: Saleh Behbahani, Trenchless Technology Center

The Trenchless Technology Center (TTC) is an industry/university/government research center at Louisiana Tech University. For 25 years TTC has served as a global leader for the development of technologies influencing almost every aspect of trenchless construction methods. TTC has established a partnership with the Buried Asset Management Institute-International (BAMI-I) to continue to develop a comprehensive approach for utilizing best business practices in managing the treasures beneath our feet.

The Buried Asset Management Institute (BAMI) was established in the Department of Watershed Management (DWM) for the City of Atlanta in 2003 as a result of the leadership and inspiration of Mayor Shirley Franklin and DWM Commissioner Jack Ravan. In 2004, BAMI transitioned to BAMI-International (BAMI-I) as a non-profit organization. In 2006, BAMI-I was selected for U.S. EPA Cooperative Agreement (CP 83 282901-1), which was completed in 2008.

BAMI-I launched the first Certificate of Training in Asset Management course (CTAM 100) in 2010. The CTAM 100 course provides a comprehensive introduction to Asset Management principles and concepts – with special emphasis on their application to "buried assets" associated with water and sewer systems. The initial success of the CTAM 100 course created awareness of the need to broaden its scope and provide more detailed training in an expanded sphere of utility system concerns. This led to the release in 2013 of the CTAM 200 course level, which focused on the specifics of how to develop an Asset Management Plan. In July and August 2015, BAMI-I released the CTAM 300 and CTAM 400 course levels respectively. CTAM 300 & 400 focus on the ongoing management of the Asset Management Plan, as well as the financial aspects of funding Asset Management Plans.

*Participants listen attentively. For the first time, all four CTAM courses were taught in a classroom format.*


*Dr. Tom Iseley introduces CTAM 300 course materials during successful training event Aug 17 – 20 in Raleigh NC.*

In summer 2015 the 300 and 400 level course materials were introduced in a live training session. TTC, in partnership with the BAMI-I, conducted a 4 day "Asset Management Training for Water Infrastructure", Certification of Training in Asset Management (CTAM) session in Raleigh, NC August 17 – 20. For the first time, all four CTAM courses were taught in a classroom format. After completion of these 4 courses (CTAM 100-400), participants received designation as an Associate Water Asset Manager (AWAM) plus 30 hours of PDH credits.

***"The materials are very thorough and the instructors have been phenomenal, straight from industry"***

Among the approximately 30 participants involved in this successful training event were:

- Professional Engineers in senior management positions,
- Professional service providers in the sanitary sewer system evaluation and rehabilitation industry,
- Professors and Research Professionals from academia directly involved in trenchless technology and asset management,
- Employees of public municipal utilities,
- State Government officials and employees involved in water infrastructure who desire to promote asset management principles within their state, and
- Asset Management Professionals actively involved in the development of asset management plans and promoting asset management principles in the USA.

# Dr. Tom Iseley Elected as a Distinguished Member in ASCE

*On Oct. 11-14, the 2015 Distinguished Member Ceremony was held at the ASCE annual convention in New York City in which Dr. Tom Iseley was elected as a Distinguished Member in the American Society of Civil Engineers (ASCE). "A Distinguished Member is a person who has attained acknowledged eminence in some branch of engineering or in the arts and sciences related thereto, including the fields of engineering education and construction."*

*Dr. Iseley has over 35 years of experience in the planning, design, and construction of underground infrastructure systems. From 1982 until 1995, he served on the faculty of Mississippi State University, Purdue University, Louisiana Tech University, and as chairman of the Department of Construction Technology at the Purdue University School of Engineering and Technology in Indianapolis.*

*In 1989, Dr. Iseley established the Trenchless Technology Center (TTC), an industry/university cooperative research facility, at Louisiana Tech University and served as Director for 5 ½ years and as Director of Development for 2 years. He returned to Louisiana Tech & TTC on July 1, 2014.*

*He is a founding director of the North American Society for Trenchless Technology (NASTT). Also, in 1993, Dr. Iseley was selected as the Trenchless Technology magazine Person of the Year. He received the ASCE 1995 John O. Bickel Award and the 1999 Stephen D. Bechtel Pipeline Engineering Award.*

*In 2016 the Underground Construction Technology Association (UCTA) and Underground Construction magazine will honor Dr. Iseley as the 2016 UCTA MVP (Most Valuable Professional) in a special luncheon ceremony held February 3, 2016 12:00 – 1:30pm at the Georgia World Congress Center, Atlanta GA in conjunction with the UCT annual conference.*

*Dr. Iseley holds a B.S. in Civil Engineering, an M.B.A. from the University of Alabama in Birmingham and a Ph.D. in Civil Engineering from Purdue University.*


*Photo by David Hathcox for ASCE*

# TTC Launches a Global Pipeline Internship Program

*Providing a new breed of underground infrastructure industry leaders is urgent and immediate action is required. TTC is launching a rapid response to meet this need through a global internship program for Civil Engineering (CE) and Construction Engineering Technology (CET) students.*

*This Internship program is structured to maximize students' exposure to the underground pipeline industry during their college education experience. It consists of the following 3 phases:*

- *Phase I: Students who have completed their freshman year in CE or CET - these students will be assigned to work in the field to get maximum exposure to real-world construction projects.*
- *Phase II: Students who have completed their sophomore year - these students will be assigned to work in the office to get maximum exposure to the administration of construction projects.*
- *Phase III: Students who have completed their junior year - these students will be assigned back in the field to work under a project manager mentor.*

*Each phase will consist of a minimum of 10 weeks at 40 hours per week.*

***SUPPORT PROVIDED BY TTC:***

- *Promote the program within the College of Engineering and Science to attract excellent student candidates at all levels. Review previous experience and background, conduct internal interviews and mentoring sessions,*
- *Develop a relationship with partnering organizations to understand their needs and objectives,*
- *Work with the interns and organizations to ensure compatibility, and*
- *Follow up with interns and organizations to ensure that objectives are being met.*

***BENEFITS TO THE INDUSTRY INTERNSHIP PARTNERS:***

- *Organizations begin to identify and evaluate potential full time employees early.*
- *They can be proactive in the students education and training to insure they thoroughly understand the culture of the organization*
- *The student evaluation consists of a 3 year process with the student assigned to 3 phases of work related to 3 separate work environments.*

# TTC Strengthens its China and Hong Kong Operations

*Dr. Iseley recently returned for his 5th trip to China and Hong Kong this year. These areas are expanding rapidly and with highly dense populations, there is much need and opportunity for trenchless solutions. TTC has committed to establish operational bases in Shanghai, Tianjin, Wuhan, Chengdu and Hong Kong. TTC is pleased to announce that Banzan International Group Corporation which is based in Shanghai is the first China based company to join the TTC IAB (Industry Advisory Board). TTC is in the process of establishing effective technology transfer mechanisms to help utility owners have access to the best solutions. Several Chinese utilities have expressed interest joining the Living Lab program which TTC is establishing.*

JD Solomon, one of the participants in the Raleigh CTAM program, is a member of the State Water Infrastructure Authority in North Carolina and an asset management practitioner with CH2M Hill. After finishing CTAM 100-400, he said, "I have been impressed with the instructors and they bring a lot of practical experience and a lot of practical stories to the course. Training material was well focused and gives an overview of asset management but it really drilled into the buried asset management, which is the focus of BAMI-I. And I have been really impressed by the…depth of detail that goes to the buried asset on the water and sewer side".

Another participant in the Raleigh CTAM program, Dan Clinton, is a storm water engineer for Cary NC - a suburb of Raleigh with a population of about 150,000. When asked about the training materials, he replied: "I found the materials were excellent, a very comprehensive course that provides a good foundation for starting up a program through managing it as well as the financial side of things. The materials are very thorough and the instructors have been phenomenal, straight from industry and were able to provide a lot of practical experience that is used on a daily basis - they were able to share experience and what they have learned with the students."

**ABOUT THE TRENCHLESS TECHNOLOGY CENTER (TTC):**

***The Trenchless Technology Center (TTC)*** *at Louisiana Tech University was established by Dr. Tom Iseley in 1989. It was created to promote research, development and technology transfer in the trenchless technology industry. The TTC is a cooperative research hub for academia, government and industry, and has world-class research and testing facilities at the National Trenchless Technology Research Facility (NTTRF) in South Campus at Louisiana Tech. TTC is supported in part by industry leaders who serve on the Industry Advisory Board (IAB). This IAB is dedicated to not only provide financial support but to provide direction for advancing the industry through research, innovation, validation, and education.*

# MICROTUNNEL IN BIRMINGHAM ROCK

## Carson Loop Water Main - Challenging 1,165 LF Drive in Mixed-Face & Mixed-Reach Conditions

By: Mike Wanhatalo,
Bradshaw Construction Corporation

*DIP carrier pipe readied for installation with casing spacers in place*

Bradshaw Construction Corporation (Bradshaw) recently completed work on the **Carson Loop Phase VI-B project** in Leeds, Alabama. The project owner was the Birmingham Water Works Board and the design engineer was Volkert and Associates. Bradshaw was chosen as the microtunneling subcontractor by the prime contractor Rast Construction. The project increased water capacity delivered to a rapidly developing commercial and residential area by adding 7,165 LF of 36-inch DIP water main. The project required a single 1,165 LF microtunnel drive of 60-inch steel casing.

This article discusses the challenges overcome, actual performance, and conclusions drawn from successfully completing this long microtunnel drive through mixed-face and mixed-reach ground conditions.

### Challenges & Solutions

The microtunneling drive was necessarily long, since the planned location of the water main was under six lanes of Interstate 20 and four lanes of State Highway 78, which left no area for an intermediate shaft. Long single drives in microtunneling, such as this, pose unique challenges because of increased jacking loads due to pipe friction and greater difficulty with guidance.

The challenge of increased jacking load was even more difficult to overcome because of the requirement for casing spacers when installing the DIP. This requirement made use of an Intermediate Jacking Station (IJS) impractical due to reduced Inner Diameter (ID) of the casing of 4 to 6 inches. In order to alleviate the increased jacking load a telescopic tail can (tele-can) was used behind the microtunnel boring machine (MTBM). The tele-can added jacking thrust capacity, allowed isolation of pressure on the MTBM disk cutters, and enabled oscillation of the casing string if mining was delayed. As an additional measure, the overcut space of the MTBM versus the casing diameter was maximized by installing 59-inch casing instead of the 60-inch. Doing this reduced friction with the self-supporting rock. The increased overcut enabled nearly complete filling with the bentonite lubrication, further reducing friction.

Proper guidance for a long microtunnel is problematic because the MTBM operator is normally dependent on the laser beam from the shaft. Temperature deviations within the tunnel and shaft can cause the laser beam to deflect, and ground vibrations can cause the laser beam to blur. The project crew innovated and overcame these problems by using adequate ventilation in the tunnel to balance temperatures and shock-absorbers in the laser mount. An electronic water level was used to ensure accuracy on elevation.

### Geologic Conditions

Perhaps the greatest challenge for this long microtunnel drive was the geological conditions encountered throughout, which consisted of variable sticky shales and hard sandstones. By definition, the Carson Loop microtunnel drive was mixed-face and mixed-reach. Mixed-face is when the MTBM face encounters two (or more) distinctly different ground types at the tunnel face at any one location throughout the drive. Mixed-reach is when the MTBM encounters a full face of any two (or more) different ground types at separate locations along the drive.

The first 575 feet of drive length was through decomposed shale with some thinly interbedded coal and medium clay seams (N=50+). The next 200 feet was mixed-face shale with sandstone above. The final 390 feet was a full face of moderately hard to hard sandstone - up to 19,470psi Unconfined Compressive Strength (UCS) and 87% to 100% Rock Quality Designation (RQD).


*Launch shaft, under 230kv power lines, with view of Highway 78 and Interstate 20 in background.*

In a mixed-face and mixed-reach tunnel the MTBM cutterwheel is selected for its ability to deal with the hardest rock in the drive. This can often slow the tunnel excavation through the softer ground, as evident on this project. A hard rock cutter wheel with 14 disk cutters was chosen to handle the hard sandstone. Mining the first 575 feet was extremely laborious and slow, as the soft shale acted like plastic clay. Disk cutters are meant to break rock not scoop sticky clay! In response the microtunneling crew tried various tooling methods on the cutter wheel. There was some success with the different cutting tools, but the time required for face intervention to make tool changes offset any productivity gains. What proved ultimately most helpful in the excavation and separation of the claylike shale was proper use and chemistry of drilling fluids.

The hard sandstone mined in the final 390 feet of the drive impacted productivity because a 60-inch diameter MTBM is the smallest that allows access to the back of the cutter wheel to change tools. But, as true with any piece of construction equipment, a smaller machine means less power and durability to handle the wear and tear of the hard, abrasive rock. Face access in a 60-inch MTBM involves entry through a tiny 18-inch port. That makes it very difficult for even a small person to get in the cutting chamber to change the heavy disk cutters.

## Site Challenges

Site challenges in the Carson Loop project were not critical to productivity, but were important considerations in the preconstruction phase. One such challenge was proximity to overhead power lines. The launch shaft was located directly underneath 230kv lines requiring 20 feet of clearance at all times. Fortunately, the line towers were high enough and the launch shaft was down in a valley that the minimum clearance was easily achieved with a lift restriction on the crane. As additional precautions, all mechanized equipment was grounded, and spotters were used when the crane was set-up.

Additional site factors were the steep grade of the tunnel drive (1.1%) and high water table up to 63 feet above tunnel profile. The steep grade was less impactful because the tunnel was driven

*MTBM recovery in receiving shaft*


upstream. It did result in increased flows at the launch seal, but this was handled by the shaft sump pump.

## Performance

The overall average production rate achieved for installation of the 59-inch steel casing was 10.8 feet per shift including interventions. Once the MTBM got through the shale/sticky clay the average rate was 16 feet per shift. 22 shifts were spent changing disk cutters/tooling with a total of 6 separate interventions at the face. All the efforts taken during setup to improve guidance over the drive length paid off as the tunnel finished on-line and just .01 foot off plan grade. The same applied to the measures taken to minimize jacking thrust. Though 336 tons of jacking force was predicted, only 320 tons of thrust was needed at peak. This reduction was accomplished through proper lubrication, increased overcut space, and tight guidance control.

## Conclusions

Initially, at the bid phase of the Carson Loop project, it was estimated that the soft shale segment would yield the best production rates of the entire drive. In actuality, the soft shale acted like sticky clay, which plugged up the rock cutter wheel, and bogged down the separation plant. Therefore, contrary to expectations, the poorest production rates on the job were in the first 575 feet, through the softest part of the shale. Still, to avoid running the risk of a complete stoppage, the rock cutter

***"contrary to expectations the poorest production rates on the job were in the first 575 feet, through the softest part of the shale"***

wheel had to be used in order to mine the hard sandstone rock later on in the drive. This meant proper drilling fluid chemistry during the soft shale was even more critical both to clear the face of the MTBM and to separate the soils more quickly.

When predicted jacking thrust is a concern, measures must be taken beginning in the preconstruction phase to alleviate the thrust necessary over the length of the drive. Measures used in this project that

# ROCK MICROTUNNELING

**Following is an excerpt from "Microtunneling in Rock: Fact or Fiction?" originally presented at the Colorado School of Mines. (Lester M. Bradshaw, Jr. President, Bradshaw Construction Corporation.) Download the full paper @ www.bradshawcc.com/docs/MT_ROCK_WHITE_PAPER.pdf**

*Rock microtunneling presents unique challenges for the MTBM and jacking pipe as well as the means and methods utilized. After nearly a decade of experience, we have the following observations and recommendations:*

*1) MTBM Advance Rate – A simple formula for calculating rock TBM mining rates per shift is instantaneous penetration rate per revolution x cutter wheel revolutions per minute x mining hours per shift. Conventional hard rock TBM cutter wheels turn at 10-18 RPM while MTBM cutter wheels turn at 2.5 to 5 RPM. MTBMs also have significantly lower instantaneous penetration rates due to their disk cutter's lower thrust capacity. Therefore, MTBMs mine hard rock substantially slower than any conventional TBM and this difference gets greater as the rock gets harder.*

*2) Cutting Gage – Perimeter gage disk cutters mine the tunnel opening. They do it by being turned nearly perpendicular to the direction of the tunnel and thus are subject to significantly greater wear from abrasion than the other disk cutters. If they wear too much, then the MTBM becomes obstructed by its own shell. The microtunnel drive must be short enough or the MTBM must allow face access to replace them in hard abrasive rock for the drive to be successful.*

*3) Overcut - For rock microtunneling, where settlement is rarely an issue, we recommend the overcut selection be left up to the contractor. From experience, we generally set the overcut 25% to 50% greater than in soft ground microtunneling to allow the gage cutters to wear down and not obstruct the MTBM. Debris in the overcut void can create substantial and damaging increases in friction since the rock tunnel walls do not yield like soft ground soils do. Increasing the overcut seems to minimize the impact of such debris build up. However, the overcut cannot be so large as to limit the MTBMs ability to develop articulation steering reactions.*

*4) Cam Locking and Pipe Wedging – Cam locking creates point loading from an object trapped in the overcut void. Wedging involves slurry cuttings passing under the MTBM cutter wheel which leads to lifting then wedging the MTBM and pipe string against the roof of the tunnel. These two conditions can happen repeatedly during a rock microtunnel drive and can cause jacking loads to spike by 50% to 100%. This creates two critical problems.*

*a. Telescopic Tail Can – The jacking load spikes result in surges in the pipe string that in turn causes thrust load spikes to the MTBM cutting tools unless the MTBM is isolated from the pipe string advancement by the use of a telescopic tail can (tele-can). This is basically a pipe inter-jack station (IJS) that is directly attached to the rear of the MTBM. The operator uses the tele-can to advance the MTBM independent of the pipe string. This allows more careful control and measurement of the thrust applied to the MTBM and indirectly to the cutting tools. Surging from cam locking and wedging of the MTBM itself is minimal thus surging to the cutting tools is as well. Without a tele-can, surge loads can cause excessive wear and even shock load damage to the cutting tools particularly in harder rock formations.*

*b. Pipe Failures – All pipe materials subjected to cam locking and/or wedging can fail. Clay pipe should not be used for rock microtunneling because of its low tensile strength. Steel casing is by far the most conservative selection.*

*In conclusion, during the past ten years rock microtunneling has become far more fact than fiction. The key is to know when, where, and how to use microtunneling in these challenging conditions*

*59-inch steel casing was used in lieu of 60-inch to increase overcut in self-supporting ground*

were confirmed to help minimize thrust included; increased overcut space, bentonite lubrication, use of a tele-can, quality steering control, and the use of Permalok steel casing to increase productivity and improve casing quality control.

The most important conclusion to be drawn from the Carson Loop project is that cooperation and close consultation between Owner/Engineer and Contractor/Subcontractor through project duration, from early in the preconstruction phase and then throughout construction, is crucial to the success of a challenging project. There were several instances of cooperation by the Owner/Engineer when methods proposed by the Contractor/Subcontractor were allowed: allowance of increased overcut by reducing casing size, and acceptance of Permalok joints as an alternate to welded joints. Because all members of the project team were able to work together cooperatively the tunnel was completed November 1, 2014 on-time and within budget.


**ABOUT THE AUTHOR:**

***Mike Wanhatalo** is a project manager with 15 years of experience in heavy/civil construction, including 11 years at Bradshaw. Bradshaw Construction Corporation is a tunneling contractor with over 50 years of experience covering a wide range of trenchless techniques.*

# RELINE UNDER AIRPORT RUNWAY, MOBILE, AL

## Multiple Pipe Segments Pulled Through Existing 1740 LF Culvert

By: Hugh B. Mickel, P.E., Contech Engineered Solutions LLC

*Airport runway continued to operate while SRPE pipe was sliplined into existing culvert*

Locally owned and operated, the Mobile Regional Airport is located in southern Alabama and is the second airport in the country to have a federalized screening workforce. The Airport is also home to the U.S. Coast Guard Aviation Training Center where advanced training is provided to U.S. Coast Guard pilots and aircrew.

In February 2013, the Mobile Airport Authority filed an application with the Federal Aviation Administration to garner a small stipend intended for continued development and rehabilitation for the airport. Part of that involved the rehabilitation of a single 1,740-foot long, 132-inch diameter culvert under Runway 14/32.

Given the location of the existing culvert, replacement was completely out of the question. The Airport did not want to have to shut down daily operations while construction was underway. Ultimately, they turned to a 120-inch nominal diameter DuroMaxx® steel reinforced polyethylene (SRPE) liner pipe manufactured by Contech Engineered Solutions to slipline into the existing culvert. The fact that Contech has been involved in relining drainage structures, supplying both products and engineering consultative services, since the 1930s provided additional confidence in this sliplining solution.

Rehabilitation and relining a drainage structure is complicated and requires a site specific analysis process. As a result, there were several elements that had to be considered during the structural and hydraulic design for the reline project. The structural design for the SRPE liner pipe had to completely omit the load carrying capabilities of the host pipe. Contech supplied calculations as outlined by the project which also met the requirements of the AASHTO LRFD Bridge Design Specifications (7th Edition – Section 12). Another important component in the structural design was the varying heights of cover (some areas carrying almost 35 feet of cover).

Maintaining or exceeding the existing hydraulic flow capacity was an important consideration. In certain circumstances, it is possible to increase the overall capacity of a culvert or sewer when slip lining, due to the cross sectional area being reduced. Even though there was a reduction in the inner diameter (I.D.) when sliplining the host pipe with the SRPE liner pipe (132-inch nominal diameter versus the 118-inch I.D. of the SRPE liner pipe), the smooth interior profile of the DuroMaxx SRPE liner pipe provided a Manning's "n" of 0.012. This profile allowed for a 186% increase in hydraulic capacity based on outlet control conditions.

The design also incorporated an existing junction box with a grade change of 0.2% to 1.04%. The entire installed length was 1,740 LF – the reline segments totaled 1,500 LF while an additional 240 LF were directly buried.

The sliplining process varies from product to product and shape to shape. For this particular project, the contractor, Indiana Reline, Inc., created a unique system that allowed them to pull multiple pipe segments (trains) through the existing culvert utilizing a large heavy-duty winch that was set

*A lightweight cellular grout was used in multiple lifts through tubes at the headwall as well as grout ports in the pipe.*

up near the upstream end of the culvert. They created an exceptional pulling system that enabled them to avoid overloading the joints during the push. The initial push was a preassembled train of 540 LF of thirteen 40-foot length pipes and a standard 20-foot length pipe which was pulled the entire way through the pipe. The initial train was grouted first before additional trains were placed into the existing culvert.

Next, several smaller trains were created and pulled into place. Each train was fused together using welded, internal coupling bands to form a watertight joint and ensure the hydraulic flow remained at optimal levels. As a part of this sliplining process, a leveled timber rail system was created on the floor of the existing culvert and in some places on the ceiling to guide the liner pipe through the host pipe helping to ease the installation process. Additional blocking was used to aid in the grouting process.

A lightweight cellular grout was used in multiple lifts through tubes at the headwall as well as grout ports in the pipe. The tubes varied in lengths of 2-inch diameter PVC located primarily in the 10 o'clock, 12 o'clock and 2 o'clock position. This allowed the contractor to grout at multiple locations to accelerate the grouting process. An internal bracing system was also utilized to prevent flotation and displacement during the grouting process.

***"we were pleased with the pipe's performance and ease of handling"***

Owner of Indiana Reline, Inc., Chris Wisehart stated, "Our company has installed a wide variety of both small and large diameter liner pipe products over the years. This was our first time installing DuroMaxx steel reinforced polyethylene pipe for large diameter pipeline rehabilitation and we were pleased with the pipe's performance and ease of handling. DuroMaxx was strong enough to maintain its shape against flotation forces, while also providing necessary buckling resistance to the grouting operation. The special 40 foot lengths reduced the number of pieces we had to handle and minimized the amount of joint welding we had to perform. We will gladly use DuroMaxx again."

**ABOUT THE AUTHOR:**

***Hugh B. Mickel, P.E.*** *is the Vice President of Reline Technologies for Contech Engineered Solutions and has been with the company for 30-years with 19-years of direct experience relining pipes, culverts and small bridges. Hugh holds a B.S. in Civil Engineering from Purdue University and has been a registered Professional Engineer since 1990.*

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- Asset Management Origins
- Asset Management - Definition
- Infrastructure Asset Management: General AM concepts as related to water and wastewater systems
- Underground Infrastructure Asset Management: General AM concepts on buried infrastructure
- Asset Management – Advantages, Rewards, Obstacles
- Planning
- What and Where considerations
- System Inventory – Content
- System Inventory – Geographical Considerations
- System(s) Asset Naming and Numbering Conventions
- System Inventory Tools
- Condition Assessment – Wastewater Collection Systems
- Condition Assessment – Water Distribution Systems
- Data Content and Analysis
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The CTAM program was developed by BAMI-I (Buried Asset Management Institute International) in conjunction with the Trenchless Technology Center at Louisiana Tech and Indiana University-Purdue University at Indianapolis, in partnership with *UIM: Water Utility Infrastructure Management*, and is hosted by the Trenchless Technology Center at Louisiana Tech.

Course fees range from $345-$495 per course, which includes course manuals, exams, study tools, certificates of completion and CEUs/PDHs. Additional fees will be required for AWAM and PWAM certification applications.

*Registrants have six months from the time of enrollment to complete each CTAM course. Each course takes an average of 20 hours to complete depending on the individual's background and experience. CEUs/PDHs will not be issued until each course and its exams are completed. Each course is independent of the others; however, it is recommended that they be taken in sequence. All courses must be completed prior to applying for AWAM or PWAM certification.

For more information and to register, call 330.467.7588,

e-mail, vminer@benjaminmedia.com or visit Conference.com/Benjamin/CTAM/CTAM_Home.html

# DEVELOPMENT OF CONSTRUCTION MATERIALS FOR SEWERAGE INFRASTRUCTURE *(AND ITS PITFALLS)*

By: Jerry Trevino, Protective Liner Systems

Throughout the ages, mankind has through series of trial and error methods made use of readily available materials to build tools and shelter, for security, survival, and other necessities. Even animals utilize the materials found in nature to build their homes and shelter. Some even use existing materials as simple tools to crack open animal shells and facilitate processing their food. Trial and error processes and man's ingenuity quickly determined the durability of various materials. Mankind then learned to modify these materials to further extend longevity.

Across the planet, societies with no contact with other people independently developed their own tools, shelters, the use of fire, weapons and other necessary items to survive and withstand threats that included changing environments and extreme weather cycles. Thus, the science of Materials Engineering was created and continues to evolve today. We would not be where we are today without our ancestors going through these trial and error processes to determine what works, what does not and determining which types of different woods, stones, minerals, plants, soils, and animal parts were needed to not only survive but also to cure illnesses, heal injuries, and continuously improve our quality of life. Of course, there were no PEs at that time to utilize mathematical models to concur or validate the results of thousands of years of Materials Engineering development.

I once read a newspaper article that stated without Bernoulli's Equation airplanes would not be able to fly. My thoughts were that was a ridiculous statement. So, I guess if Bernoulli was never born, we may have not have airplanes flying today! I also guess birds, bees, and other flying insects never got that memo since they have been flying for millions of years!

*Infiltration between the host pipe (54 inch Diameter) and the new CIPP liner.*

Today, we are still utilizing trial and error processes to what works, and to continue to modify existing materials. Through more advanced methods of testing and documentation, and through better worldwide communications we can continue to use the most appropriate construction materials to build, rehabilitate and restore infrastructure. As the environments change we are challenged to further modify our materials and technology for longer durability and for ease of construction and rehabilitation. Through these changes, and ongoing processes of product development, we must remain open to competing schools of thought and the various methods available to repair and rehabilitate infrastructure.

*A cementitious lined manhole with bottom section epoxy lined after 54-inch CIPP was externally sealed for infiltration*

We have to be careful and diligent and not short circuit methodical scientific product and material development because of the influence of misinformation or desire to take the easy way. For example in manhole and underground structure rehabilitation, if a certain material does not bond to the host structure, then mathematical equations can be generated (typically suspect) which may suggest that the specified material does not have to bond to the host structure as long as the material can sustain a certain loading. Because the math may suggest that it might possibly work, it becomes justified. Suggestions that certain materials are more corrosion resistant than others are often accepted at face value rather than actually conducting simple chemical exposure experiments. Many are too quick to jump on band wagons and the latest fad, mesmerized by mathematical equations and bling and hearsay. If solutions are accepted by one reputable firm, then others quickly jump on board without first proving that those solutions actually do work in the field and often discredit other solutions which also work.

***"If the materials do not 100% bond to the host structure, then there is a high probability that the liner will allow infiltration behind the liner. The infiltration is hidden from sight"***

In the mid 1980's, our first cured-in-place composite manhole liner consisted of manufacturing a three layer bag which conformed to the shape and size of the manhole to be lined. We used two exterior fiber glass cloths with a center layer of synthetic felt to serve as a resin reservoir. Then we inflated a bladder to locate the bag in place, and to squeeze and dispense the epoxy resin from the felt through both fiberglass layers onto the manhole walls, and one as a chemical barrier. Even though all mathematical equations said the liner should work and withstand hydrostatic loading, we later found it was nearly impossible to load up the felt with sufficient resin to fully saturate the walls with sufficient quantity and thickness to prevent infiltration. The infiltrating water traveled between the host structure and the liner into the invert. Even though it could not be seen, core samples indicated the infiltration. We then modified our process by applying a layer of cement to fill in all manhole imperfections, then applied at least 100 mils of moisture insensitive epoxy on the walls first before installing the resin saturated bag. Today, we have further modified this process to a hand layup composite liner, once cement repairs are made, and infiltration is stopped. Even a less structural liner consisting of just epoxy at a thickness of at least 125 mils thick was sufficient to withstand hydrostatic loading and stop infiltration. The more flexible and more elastomeric the material is, the more thickness is required to withstand hydrostatic loading and hold back infiltration. If the coating material is too rigid, it may break and not withstand the loading and allow infiltration. So, the proper mechanical properties of materials are required. Material with higher compressive and tensile strengths, may not be better.

Materials that do not intimately bond to the host structure and to the new repair mortar will not stop infiltration. A similar problem currently exists in most CIPP installations where the liner does not bond 100% to the host pipe. The infiltration is merely diverted in between the host pipes and new liner and directed to the nearest manhole. Thus, the notion that a PE should verify that the new structure liner should sustain all earth, hydrostatic and dynamic loading without support by the existing structure can be a diversion by manufacturers stating that their materials do not have to bond to the host structure. If the materials do not 100% bond to the host structure, then there is a high probability that the liner will allow infiltration behind the liner. The infiltration is hidden from sight.

With extensive studies, trial and error, research and experience, we first determine what works, what does not, and then can quantify the detrimental factors affecting construction materials such as corrosion, wear and tear, and which destructive chemical and biological processes are causing deterioration within our infrastructure. Through experience we can now test and document the important and useful properties of the materials being used. Exciting advancements are being made in Materials Engineering. Some of this progress will undoubtedly result in more durable construction materials and better technology being used to build and rehabilitate our crucial infrastructure.

**ABOUT THE AUTHOR:**

***Jerry Trevino*** *is President of Protective Liner Systems, Inc., specializing in infrastructure rehabilitation since 1984. As longtime SESTT Chairman, Jerry strongly believes that Trenchless Technologies offer numerous methods to maintain and upgrade aging infrastructure.* *His full bio is on pg8.*

# NATURAL GAS PIPELINE PROJECT STAYS ON TRACK

## Hard Limestone under CSX Railway, South Loop, Third Phase – Knoxville TN

By: A to B Publishing Inc.

*Hard limestone under railroad tracks presented obstacle to completion of natural gas pipeline project*

When US Crossings owner Mike Lind took the phone call from the contractor, he began to think how his experience over the past couple years horizontal drilling pipeline networks through the Marcellus and Utica shales might help with the current problem. A crucial segment to complete a natural gas pipeline project in Knoxville TN was stalled, because a bore under the CSX railroad attempted by a local subcontractor had failed twice. This short 140 LF shot through hard rock was holding up completion of a three phase project totalling 10 miles of 8-inch and 16-inch high pressure steel natural gas pipeline.

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Worse yet, the railroad had just put the contractor and owner on notice they were only allowed one further attempt to bore under its double track easement – if this one also failed they would have to wait for a minimum of one year before another bore attempt would be permitted.

During the phone call with the contractor, Lind was brought up to speed on the problem, "The railroad told both parties that they had one more attempt and if it failed they wouldn't be allowed to bore across the tracks for at least a year. Keep in mind that they had pipe stubbed on both sides of the tracks. The contractor explained to me over the phone about the how hard the rock was, being limestone, and the importance that this third attempt work."

Near completion, this important natural gas pipeline project now hung in the balance. The crucial segment in question was a portion of the third and final phase of the South Loop Natural Gas Pipeline project, for the Knoxville Utilities Board (KUB), a municipal utility serving nearly 500,000 customers in Knoxville and adjacent counties.

A new natural gas pipeline installation, the South Loop project will enable the University of Tennessee to convert its coal-fired steam plant to natural gas by late 2015. This conversion will eliminate a major source of airborne pollution roughly equivalent to removing 7,000 passenger vehicles off the road each day. Phase two of the project was completed on schedule in June 2015. The third and final phase underway covered the final 2 miles of 8-inch steel pipeline to connect the university steam plant to a new natural gas regulating station. Up until this point the project had maintained the rigorous schedule required by the owner to reduce community impacts. Now, in late August 2015, with the finish in sight, both pipeline completion and steam plant conversion could grind to a halt if this third attempted crossing failed.

Mike Lind understood the urgency: "We are very busy with work so I had to pull some guys together from 2 crews to take on this project. I knew what I was getting into. We had our men and equipment on location within 48 hrs from the first call."

*US Crossings ordered a 9-7/8 inch PDC bit out of Texas and had it hot-shotted over night to the jobsite.*

*The 5-½ inch full hole threads were cut off the PDC bit and converted over to 2-1/4 inch hex to fit the auger bore rig.*

With over 24 years HDD experience, US Crossings is known for always going above and beyond what is expected, finding creative solutions to the job at hand. As a full service pipeline contractor specializing in HDD, conventional bores and tunneling, US Crossings had gained practical knowledge over the years boring through some of the hardest rock around. The past two years the company had been doing lots of work drilling midstream oil and gas pipeline installations through the dense Marcellus and Utica formations.

Lind knew from his previous experience in the dense Marcellus and Utica shales that Polycrystalline Diamond Compact (PDC) drill bits for HDD were suitable and very effective through hard sedimentary rock formations like sandstone, shale and limestone. PDC bits were first used in the oil industry in the 70's. More recently, technological advancements increasing Rate of Penetration (ROP) and critical bit longevity have widened the range of applications for PDC bits.

*"We went into the rock right out of the gate!"*

Realizing he had no time to have a PDC bit custom fabricated to fit the auger bore rig, Lind decided to improvise:

"We have been using the PDC bits on our HDD rigs up in the Marcellus and Utica shale for two years now and they performed great. With this in mind I decided to order a 9-7/8 inch PDC bit out of Texas and had it hot-shotted over night to Knoxville. Once on location I had a 798 welder start cutting the 5-½ inch full hole threads off the PDC bit and convert it over to 2-1/4 inch hex for our auger bore rig."

While the PDC bit was being converted to 2-1/4 inch hex, Lind quickly evaluated the previous two failed bores to make sure this final attempt under the tracks had the best chance for success. The entry and exit points were up hard against the railroad easement on either side, one side dirt, one side limestone rock. For this critical bore to succeed, it was important to get it right from the get go:

"The first subcontractor's pit was dug in dirt with no rock present so I decided to move the entry pit to the exit side of the crossing. We went into the rock right out of the gate!"

With only one shot left, failure wasn't an option. Due to the working restrictions imposed by the CSX railroad any pull-back to check or change the PDC bit meant it was game over. Lind did everything possible to ensure success including drilling at greater depth than the previous two failed bores and using laser guidance to keep cutting straight on grade through the dense limestone face. Everything worked, thankfully, because of careful preparation.

*The crossing under the railroad easement was through 120LF hard limestone*

*Laser guidance made sure the PDC reamer was cutting straight on grade*

With a grinding daily average pace of 7 feet Lind said "it was a slow process" drilling through the hard limestone, which comprised 120 LF of the 140 LF total. The work also had to accommodate both the CSX railroad schedule and University of Tennessee requirements – work was suspended on two out of three Saturdays because of Tennessee Volunteers football games at Neyland Stadium, close to the jobsite. Despite the challenges, with steady persistence and working long shifts, this crucial 140 LF crossing was completed in 3 weeks, with "only a few minor field issues". Pipeline and steam plant conversion could now proceed to completion with no further obstacles.

Reflecting on the success of his innovation in the field, Lind doesn't think PDC bits have ever been used this way before in a conventional auger bore: "I was told we were the first."

Certainly not the last, as Lind intends to make full use of the experience gained on this project. He thinks US Crossings will be doing other challenging auger bores in future using the PDC bit set up:

"I have a great crew and you can bet we're going to be using these bits again for the next tough auger bore situation".

U.S. Crossings Unlimited

**KEY PROJECT PERSONNEL:**

*Mike Lind, Phillip Hodges, Ronnie Cousins*

# CUES AMP™ CASE STUDY

## Accurate Gyroscopic Mapping Tool Verifies Gas Pipeline Installation

By: Pete Monday, CUES Inc.

### PROBLEM OVERVIEW

A contractor had run into complications during a horizontal directional drill (HDD) of a 1,600 LF 36-inch steel gas transmission pipeline. During the installation of the pipeline, the contractor had to pull back and reinsert the pipe multiple times. CUES pipeline inspection technology was brought in to map the pipeline and provide the engineers bend radii data in order to verify the pipeline met the required bend radius specifications.

### ACCURATE MAPPING PROBE (AMP™)

The CUES Accurate Mapping Probe (AMP™) will improve any HDD implementation procedure, whether the pipeline is made of steel, concrete, HDPE or PVC. This mapping system locates defects such as pipe sags, misaligned joints, and any deviation from horizontal and vertical design. Since the AMP™ is not subject to soil type, adjacent utilities, and equipment depth limitations, it is ideal for use in areas that are not available to conventional survey. Through the use of web-based AMPVUE PRO™, clients can perform mapping projects anywhere in the world and have their data processed and delivered within the same day.

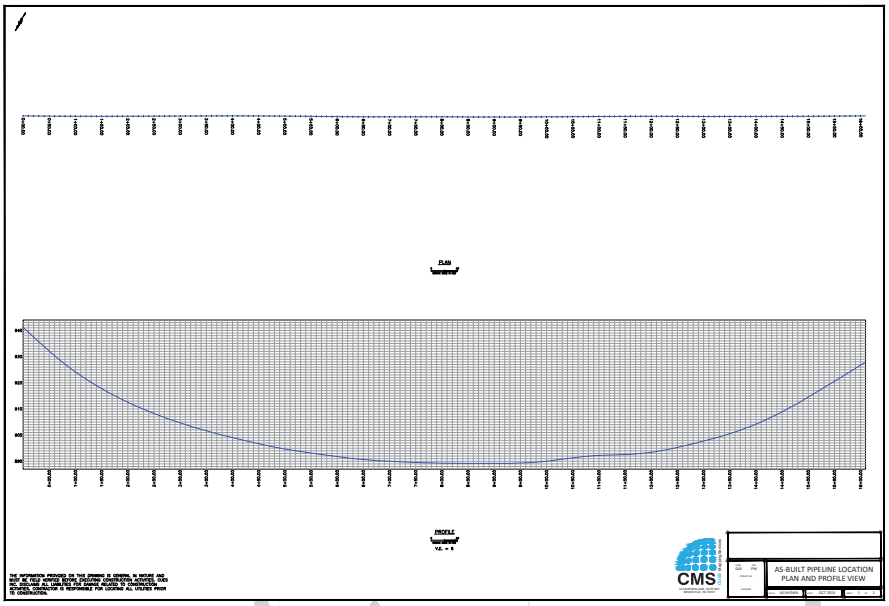
A unique system of ex-changeable centralizing wheel units gives this gyroscopic tool an operational range of 3.5 inches (ID90mm) to 58 inches (ID1473mm). With centralization, the AMP™ may be pulled either by a hand operated wire line or a mechanical winch. Also, in certain cases, the tool may be pumped through the pipeline.

### CUES APPROACH

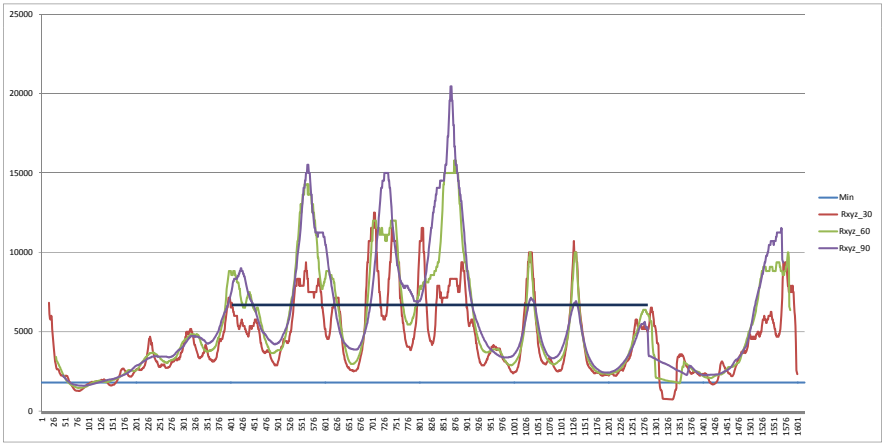
CUES used this opportunity to verify newly developed pulling reels which allow efficient set up and simple operation. In order

**Figure 1: Exit Location Configuration**

**Figure 2: Plan & Profile**



## Figure 3: Bend Radii Data




to keep the AMP™ in the centerline of the pipe, the mule tape attached to the probe on either end was set up to be pulled directly through the center of the pipe. At the entry location, the reel was located on a dirt mound to give it the proper angle. At the exit location, a hook was rigged on the end of the pipe to ensure the tape would be pulled through the center of the pipe (Figure 1). The newly designed reels were very successful, pulling consistently and smoothly at the desired rate. CUES performed 2 runs (entry to exit and exit to entry for each run) with no issues, and received quality data that showed consistency and repeatability.

## RESULTS

The requested Plan & Profile and Bend Radii data (Figures 2 & 3) were generated the same day mapping was performed. As shown in the Profile graph in Figure 2, an upward bend creating a concave section can be found between 1,000 feet and 1,200 feet. Also, the bend radii data in Figure 3 detailed that under the 30 foot intervals the bend radius exceeded the minimum 1,800 feet (client specified), however the 60 foot and 90 foot intervals were within specifications. The contractor informed CUES that the bend radius is calculated over three drill stems, which is equal to 90 feet (industry standard). Findings such as the concave section and bend radii show the kind of invaluable data that can be obtained by utilizing the CUES AMP™. With this data available the pipeline was verified as installed to specifications.

### ABOUT THE AUTHORS:

"The Standard of the Industry"

***CUES** is the world's leading manufacturer of closed circuit television video (CCTV) inspection, rehabilitation, pipe profiling equipment and pipeline inspection/ asset management software for sanitary and storm sewers, industrial process lines, and water lines. It provides the broadest product line meeting today's varied stringent inspection and regulatory requirements for any pipe size, material or inspection conditions.*

# RIVER OAKS BASIN SANITARY SEWER REHAB – HILLSBOROUGH COUNTY FL

## Miller Pipeline LLC Completes Challenging 205,000 LF Reline Project on Aggressive Timeline

By: Jeff Newman, Miller Pipeline LLC

In October 2015, Miller Pipeline LLC completed a project to rehabilitate 205,000 LF of sewer for Hillsborough County in Tampa, Florida. Inclusive as a public bid contract, this was the single largest sewer rehabilitation project for both Miller Pipeline and Hillsborough County in both their histories. The project consisted of sanitary and stormwater sewer lining of mainline segments ranging in size from 8-inch through 60-inch. The project goals were aggressive with a 1.2 year timeline for completion, condensed residential population, and multiple weather implications all culminating in a rather challenging undertaking for both Hillsborough County and Miller Pipeline.

***"Hillsborough County was an early and rather effective adopter of the technologies offered by the trenchless sewer rehabilitation community"***

### Hillsborough County's Evolution

Hillsborough County Public Utilities is located in west central Florida and includes 160,000 billed accounts in the Tampa Bay area. It provides water, wastewater and reclaimed water service to customers throughout the unincorporated areas essentially stretching from the southern reaches of the Tampa metro area, east Tampa Bay, and all the way north to the edge of the metropolitan area. The service area was formed in the 1970s through a series of acquisitions and has grown steadily over the last 40 years.

The Tampa area started full scale integration and installation of sewer utilities in concert with its growth through the 20th century, with the typical array of piping material installed in most sewer systems throughout the area. Though a high volume of the assets in Hillsborough County are vitrified clay pipe or schedule 40 PVC, there is also a large

amount of galvanized iron, cast iron, and a small amount of tongue-and-groove oak in the system.

The topography of the area is rather flat with a high littoral influence due to the adjacency of the Gulf of Mexico. High ground water combined with high sulfur and sodium chloride content in the existing environment cause very corrosive and stressing effects on the existing utility system. This is further aggravated by the normal annual weather patterns that create intense storm events which test and stress collection systems and accompanying treatment plants.

Hillsborough County's sewer collection system covers a rather extensive service footprint with 32,567 manholes and 33,864 pipelines. Broken down separately, the system includes 1322 miles of gravity sewer mains, 617 miles of force mains, 80 miles of low pressure sewer mains, 2245 miles of potable water mains, 348 miles of reclaimed water mains, 732 sewage pumping stations, six regional and one sub-regional wastewater treatment plants, and four water treatment plants. The sheer size of this system and the County's ongoing acquisition of new assets requires paramount attention to maintenance and rehabilitation efforts. Thus, Hillsborough County was an early and rather effective adopter of the technologies offered by the trenchless sewer rehabilitation community.

The management and maintenance of a diverse system of this size in such an environmentally caustic area, due to tidal influence, weather stresses, and high ground water, required a pronounced approach. Under the guidance of the Hillsborough County Public Utility Department, the County developed a project under the Line Maintenance Section to undertake the task of maintaining the system in an equitable fashion for their customers and public. The strategy of the Department was to first address major problems, then conduct trenchless rehabilitation of the remaining system based on condition and conduct a full scale inventory of the system assets.

Hillsborough County began this strategy in 1997 with a first set of projects focusing on existing known problems stemming from sewer back-ups, road collapses, sand or vagrant material in pump stations, and above average sewer flows at both pump stations and treatment plants. Through the Line Maintenance Section, a series of

contracts were issued to shore up these rather vivid and distinct issues, to address the emergent and critical problems first. Though at first most of these projects were done in a non-Trenchless fashion, they helped lay the groundwork for future work that would cover a wider scope of area via trenchless means. The focus then shifted to understanding the system a whole.

***"Contracts under this capital program were developed and deployed with rehabilitation efforts centered on trenchless technologies"***

Hillsborough County implemented its next strategic phase by enacting a Rehabilitation and Replacement Capital Improvement Plan in 2003, shifting the program's funding from an operational maintenance basis to a capital expenditure program. This reduced the County's overall revenue to expense ratio and increased the bond rating of the entity. The capital program allowed the County to deploy funding through public bid contracts without burdening the existing operational budget. Rather, project costs were amortized into the asset system based on the newly extended usable life of the collection system. Annual spend under these contracts ranged from one to two million dollars per year.

Contracts under this capital program were developed and deployed with rehabilitation efforts centered on trenchless technologies. Specifications allowed for the use of cured in place liner for all pipe sizes, and expandable PVC Fold-and-Form liner for sewer pipe sizes 8-inch, 10-inch, and 12-inch. Specifications also required all reinstated services were grouted within 14 calendar days of reinstatement, regardless of lining material used, to ensure the system was rehabbed in a rapid manner. Thus, all identified lines in a project would have infiltration effectively minimized. The most current contracts include lateral rehabilitation based on emergent needs using a structural lateral rehabilitation product as necessary.

## Miller Pipeline's Involvement

Miller Pipeline is a gas and water utility contractor based in Indianapolis, Indiana, with offices and operations throughout the eastern United States, including Lakeland, Florida. Miller Pipeline was formed in 1956 as a gas utility contractor and has grown at a steady pace for the last 60 years to an organization with over 2,800 employees. Miller entered the trenchless water market in the 1970s with the invention and deployment of their proprietary WEKO seal, an internal joint seal designed to seal pipe of all types designed to convey water from 18-inch up through 256-inch. Then Miller entered the

trenchless sanitary sewer lining market in the early 1990s through acquisition of both licenses and small companies. Miller installs both resin impregnated cured in place pipe (CIPP) and expandable fold and form pipe (EX) under contracts throughout the midwest and southern United States.

Miller's presence in Florida and ultimately its service to Hillsborough County sewer rehabilitation contracts began in the early 2000's through the acquisition of a local sewer rehab contractor based in central Florida. Over the past 10 years, Miller has bid and conducted numerous sewer rehabilitation contracts in Hillsborough County, installing both CIPP liner and EX fold and form PVC liner as part of the ongoing effort to reduce infiltration and increase the structural life of the existing sewer system.

### 2014 Sewer Rehabilitation Contract

In 2012, western Florida experienced a rain event associated with Tropical Storm Debby that imparted a particularly high toll on the existing collection system. The River Oaks treatment plant in Hillsborough County experienced double its normal flow, prompting a special focus on the basin's collection system. Almost half of the County's remaining vitrified clay pipe slated for rehabilitation is located in this basin. This prompted a new contract scope that was unique in funding and size - in 2013, Hillsborough County placed out to bid a contract to rehabilitate 220,000 LF of gravity sewer focused in the River Oaks Basin.

After a lengthy bid process, Miller Pipeline was awarded the contract and started work in April, 2014. The timeline for completion was 1.2 years, with contingency built in for extreme weather events and additional work. Miller took on this rather aggressive timeline which required approximately 3,928 LF of installation per week through the duration of the project.

Though this 1.2 year timeline was a daunting and very challenging project goal, Miller used the following simple strategies to deal with the unique volume of this job and the aggressive timeline: 1) assigned a dedicated on-site manager to supervise all aspects of material ordering, line cleaning, installation scheduling, post-grouting, and deliverables; 2) partnered with a local subcontractor to assist in line preparation, grouting and post video production; 3) contracted a temporary storage yard in the heart of the project in an unused portion of a church parking lot; and 4) deployed 2 expandable PVC fold and form crews and 1 CIPP lining crew to execute the work at the production level necessary to meet the project deadline.

***"The collection system where a bulk of the sewer system has been rehabilitated has seen few emergency failures and issues"***

Alongside Miller employees there were 2 cleaning crews, 2 grouting crews, traffic control support, inspectors and management. In total, there were 40 full time employees working daily to keep the project moving in the right direction.

Approximately 187,000 LF of the project was completed using expandable fold and form PVC, covered under ASTM F1504 and specified by multiple municipalities in the Midwest and Florida. Expandable PVC is allowed as an "or equal" installation product, specified as an alternative product to traditional resin impregnated CIPP. It is installed by being heated until soft, then pulled between MHs using a winch and then heated again above 180 degrees and a pressure of 9 PSI. After it is heated and expanded into place, ambient air is pushed through the line to cool and thus cure the liner in place. Lateral reinstatement is conducted, and then a separate crew follows to grout these sewer connections.

At times, the project was far from perfect in execution and design. Some unique problems encountered included rain events resulting in surcharged lines, difficult easement shots, shots through a private school property, shots in busy shopping center lots, 39 terminal lines requiring individual support, and always the aggressive timeline. Operationally, Miller experienced critical growing pains resulting from personnel turnover at the labor level, simple mistakes in installation, and the subsequent management of these mistakes.

Ultimately, through the process of focused management and monthly progress meetings with the inspectors, the County, and Miller, and through maintaining awareness of issues and project tracking, any problems were typically addressed rapidly. Miller maintained an average weekly rate of installation right at the targeted average minimum of 3928 LF per week and the River Oaks Basin lining was completed by the specified contract completion date. The real effect of the lining project and intent of the program has been seen in reduced flows at the River Oaks plant, based on a comparison of treatment plant flow versus years prior to the lining project, and versus other plants in the area.

## Conclusion

The summer of 2015, just concluded, saw a massive spike in major rain water events throughout the city of Tampa and Hillsborough County systems. Though aggregated data is still being compiled, the collection system managed by Hillsborough County, where a bulk of the sewer system has been rehabilitated, has seen few emergency failures and issues.

In comparison the adjacent system owned by the City of Tampa, where a comprehensive rehabilitation program was behind schedule, is now beginning to be executed in earnest as a reaction to the extreme wet weather this summer.

Hillsborough County and Miller Pipeline have developed a strong working relationship as customer/vendor, operating in a professional and effective manner to add life and value to the assets within the collection system owned by the County. This project was a strong representation of this relationship and is a template in management and execution for future projects of similar scope and size.


**ABOUT THE AUTHOR:**

***Jeff Newman*** *is Project Manager with the Municipal Services Division of Miller Pipeline LLC, where for the past 3.5 years he has managed sewer rehabilitation projects in Florida. He spent 7 years managing aggregate operations for Lafarge in Chicago and Denver, and served 7 years with the US Army Corps of Engineers. Jeff earned his B.Sc. in Math and Engineering from Vanderbilt University and his M.Sc. in Engineering Management from the University of Missouri – Rolla.*

# PEACHTREE CITY SAVES WITH CCCP

By Angus W. Stocking, L.S.

Peachtree City, Georgia, in the Atlanta metro area, is an interesting place; it's a designated foreign trade zone, and it's also known for its 90-mile network of golf cart paths—about 9,000 households own a golf cart, and they're a major component of the city's transportation infrastructure. They must be doing something right—as recently as 2009, Peachtree City was ranked 8th on Money magazine's list of the 100 Best Places to Live in the United States.

But like many cities, Peachtree City is struggling to keep up with failing infrastructure.

"A little more than 95% of the City's stormwater pipe network is corrugated metal pipe" explains Stormwater Manager Michael Madison. "Almost half of our corrugated metal pipe currently in the ground is beyond its expected service life. We are routinely identifying pipe systems that are severely corroded, most to the point where the pipe invert is completely rusted through leaving holes in the invert of the pipe."

For rehabilitation of failing large-diameter storm sewer, Peachtree City is now routinely using a proven technique called centrifugally cast concrete pipe (CCCP), a process pioneered by AP/M Permaform. The company's technology is called CentriPipe and, simply put, is based on a concrete spincaster being pulled through pipe at precisely controlled speeds. The spincaster applies one or more coats of high-strength cementitious grout which cast what is essentially a new concrete pipe inside the failing pipe. The new pipe is structurally sound, and doesn't rely on support from the existing pipe. And because the new pipe is smooth, and quite thin—engineered pipe thickness is usually well under two inches—flow capacities aren't significantly reduced.

***"We inspected the work after a year and found no deficiencies with the work or the product."***

"The Fayette County Stormwater Department invited us to observe a CentriPipe project they were involved in, and we were impressed by the whole process, especially the compact and unobtrusive nature of the work," says Madison. "We've used it on several projects since then, and it really works well for us."

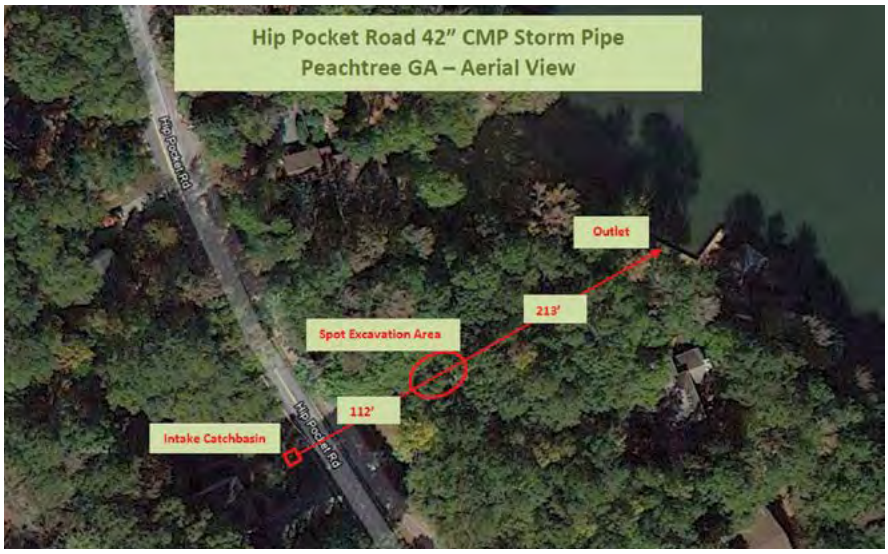
## A Sensitive Project

One unexpected project the City encountered gives an idea of CentriPipe's potential, and where it fits into Peachtree City's stormwater system maintenance and rehabilitation program. A sinkhole opened up around a drop inlet on Hip Pocket Road. Inspection revealed that about 325 feet of 42-inch diameter CMP was severely corroded with complete rust through of the pipe invert in several locations. Several large voids had also developed below the pipe. The estimate for a conventional trenching and replacement was $230,000. Why so high? Well, in several areas of Peachtree City, the sanitary

sewer is constructed with a product called truss pipe. Truss pipe, introduced in 1965, is basically plastic pipe with a truss-like matrix between thin outer and inner layers. On paper, truss pipe has a lot of advantages: it's light, strong, relatively cheap, etc. But in Peachtree City, at least, it has proven to have a fatal flaw—it has become quite brittle with age, to the point where it can't really be disturbed. "We try not to disturb truss pipe as much as possible," says Madison. "Just bumping into it can cause small cracks to form and run along whole sections. Once cracked, it has to be replaced" On Hip Pocket Road, the 42" CMP crossed the truss pipe sanitary sewer in several locations. An 8-inch diameter truss pipe sanitary sewer was also co-trenched with the 42-inch CMP. Essentially then, digging up and replacing the storm sewer would also require the replacement of multiple sanitary sewer lines and extensive bypass pumping.

Fortunately, CentriPipe requires no trenching at all, and works from inside the pipe. Utility Asset Management Company (UAM), based in Byron, Georgia, are CentriPipe contractors and began work by repairing the rusted CMP invert and voids—because the spincaster needs to be withdrawn without jogging or bumping, CentriPipe projects often begin with the creation of a smooth new concrete 'runway' along the invert, especially on CMP. On the Hip Pocket Road project, some voids below the pipe were quite large and required quite a bit of new concrete. And one area of pipe was badly bellied and required a spot excavation so that a section could be lifted and leveled.

With invert repairs accomplished, work went smoothly despite difficult access—one end of the storm sewer run ended in a




3-foot by 3-foot junction box and the other discharged a few feet above Lake Peachtree. "It was a tight fit, that's for sure," says UAM President Anita Clyne. "But we were able to do our work."

All in all, the project took four days from start to finish. The thickness of the pipe and the number of layers was established by engineers contracted by AP/M Permaform, and in this case three passes that laid down less than an inch of new pipe were sufficient. The grout used was PL-8000, supplied by AP/M Permaform—PL-8000 is a fiber-reinforced cementitious grout specially developed for spincasting. It's quite strong, sets quickly, and adheres tightly to most pipe surfaces, including steel, clay, and brick.

Best of all, the CentriPipe project ended up costing Peachtree City just $72,000, a savings of $158,000 compared to the trench-and-replace estimate.

Quality control and inspection was accomplished by tracking the amount of PL-8000 applied, spot-checking layer thickness with simple gauges, and visual inspection of the cured layers and final pipe. Spraycasted PL-8000 was also used to coat and seal the junction box.

## A Successful Solution

The Hip Pocket Road storm sewer was the fifth CentriPipe project to be completed in Peachtree City. Previous projects have typically been shorter, beneath areas of heavy residential development or, in one case, an ornamental golf cart bridge that would have been expensive to replace. The golf cart bridge project rehabilitated a section of arched pipe—"The invert arch pipe had completely rusted away and there was about a two foot deep void below the pipe," says Madison. "But CCCP repaired it completely and even kept the arch shape. We inspected the work after a year and found no deficiencies with the work or the product."

CCCP has been so successful that it is now the city's first choice for repair of storm sewer over 30-inches that for one reason or another cannot be open cut and replaced; resinous linings are typically used for smaller diameter pipes. "We inspect 20 percent of our stormwater system annually, and of course we respond to sinkholes and other evidence of failure immediately," Madison says, "We know we're going to be doing a lot of storm sewer rehabilitation, and CCCP is proving to be a very cost-effective method."

**ABOUT THE AUTHOR:**

***Angus W. Stocking, L.S.*** *has been writing full time about infrastructure since 2002. Feature articles by Stocking have appeared in several dozen infrastructure trade journals. Prior to taking up writing full time, he enjoyed a 14-year career as a licensed land surveyor, working in California, Idaho, Kentucky, and Wisconsin, including stints as a right-of-way surveyor for CalTrans and survey manager at Midwest-based consulting firm MSA Professional Services.*

# WHAT FAILS YOU MAKES YOU STRONGER:

## Miami-Dade Country Water and Sewer Department Addresses Aging Water and Sewer Infrastructure with Proactive Assessment and Replacement Program

By: Mark Fodchuk, Pure Technologies

Sometimes it takes a costly pipe failure to trigger the framework for ensuring future pipeline management success.

In June 2010, that was the case for Miami-Dade Water and Sewer Department (WASD), when a critical 54-inch prestressed concrete cylinder pipe (PCCP) water transmission main failed, requiring immediate pipeline inspection, repair and replacement. The failure also caused a massive 40 by 40 foot sink hole in the middle of an intersection, causing significant collateral damage for WASD. Overall, the incident cost $2.5 million to remediate.

Shortly after, a 72-inch PCCP force main also failed in a similar fashion, dispensing wastewater into the environment and resulting in expensive reactive maintenance.

The unexpected failure of these two major pipes led to WASD deciding on a remedial course of action: the implementation of an Infrastructure Assessment and Replacement Program (IAARP) to renew its water and wastewater assets, including pipelines, treatment facilities and pumping stations.

A major part of the IAARP aimed to find and implement the best available inspection and rehabilitation technologies to address potentially damaging deficiencies in PCCP that indicate a pipeline might eventually fail. To help WASD manage the IAARP, the utility partnered with Pure Technologies, a global leader in infrastructure management.

### Addressing potentially damaging deficiencies in PCCP

The majority of the WASD large-diameter water and wastewater pipelines are made of PCCP. In total, WASD has more than 250 miles of PCCP 48-inches and larger that have been installed since 1949. Over time – like all materials – PCCP may deteriorate as the steel prestress wire used to preserve structural integrity deteriorates due to external corrosion and hydrogen embrittlement. The predominance of 50-year old PCCP in its water and sewer pipelines is one reason that WASD has embarked on its large-scale infrastructure renewal program.


*Miami-Dade Water and Sewer Department have increased large-diameter pipeline reliability through an asset management approach.*

### Four proactive solutions to manage PCCP pipelines

Within the program, WASD partnered with Pure Technologies to perform four main functions to manage large-diameter PCCP pipelines:

- Regular leak detection on large-diameter transmission mains
- Electromagnetic condition assessment using advanced non-destructive technologies
- Structural risk analysis
- Ongoing monitoring of PCCP pipelines through acoustic fiber optic (AFO) monitoring technology or regular re-inspections

Regular leak detection on large-diameter pipe is an important pre-screening function of a pipeline management program, as leaks are often a preliminary indication of pipeline failure. WASD currently conducts an annual leak detection program that surveys more than 8,000 miles of various pipe materials and has located more than 1,400 leaks to date.

### WASD initiates sewer force main management program in 2011

The initial IAARP ramped up in 2011, after the 72-inch PCCP force main experienced failure. WASD contacted Pure Technologies to perform a robotic inspection and develop a management plan for the asset. Subsequent data analysis, structural modeling and engineering evaluation were performed to provide rehabilitation/replacement recommendations for WASD.


*Crews prepare inspection tool for deployment.*

### Selective asset rehabilitation increases reliability at fraction of cost

Based on the success of the initial 72-inch PCCP force main inspection, WASD has continued inspection of its large diameter force main system. WASD is thereby able to gain valuable condition data on its pipeline assets and selectively rehabilitate its pipelines. The cost of a complete replacement program for WASD's entire PCCP infrastructure is estimated at roughly $2.5 billion. This means a program of selective asset rehabilitation through large-diameter pipeline management has increased reliability at a fraction of the cost needed to replace the entire PCCP inventory.

### Less than 1 percent of pipes require immediate action

As WASD inspects its PCCP assets each year, the typical number of segments showing any type of degradation has not exceeded 2.5% on average; less than 1% requires some sort of immediate rehabilitative action. A full replacement program would therefore end up replacing the 99% of the pipelines in the WASD system that have significant remaining useful life. With respect to PCCP water transmission and sewer force mains, this "fix-it-first" approach maximizes the useful life of this portion of the WASD critical infrastructure.

If the pipeline assessment and management program is any indication, the initial reviews show that the WASD water and wastewater systems are in much better condition than expected based on age and operating capacity. Much of this can be credited to WASD employees who have very high standards and always plan for more than they can accomplish in any given year.

Although the pipeline management program is only part of the overall infrastructure renewal plan, it acts as an exemplary model of how successful renewal of infrastructure can increase service reliability and tackle the problem of aging infrastructure within a manageable capital budget.

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# PRESSURE PIPE CONDITION ASSESSMENT

## City of Brevard – Neely Road DIP Force Main

By: Brent Johnson, CDM Smith

*Traffic Control for ARV Manhole Testing*

In the not too distant past municipalities in North Carolina simply operated their pressurized piping systems until the combination of frequency and cost of repairing breaks drove them to replace the mains. Typically the entire main would be replaced even though the breaks may be isolated to a certain section of piping. Improper bedding or backfilling that creates point loads, over deflection of the pipe, corrosive soils, stray current, defective pipe material and poor installation techniques can all diminish the design life of a piping system.

Advances in technologies have made it cost effective to perform condition assessment of existing pipes to aid in determining its remaining useful life. Therefore many municipalities have begun efforts to perform condition assessment of pressurized pipelines within their collection and distribution systems. There are many measureable benefits to these proactive condition assessment projects. These include an overall strengthening of their asset management programs, improved distribution system master planning, ability to more accurately focus upcoming Capital Improvement Plans, and increased confidence in the reduced risk of public impacts created by pipeline failures.

One such recent condition assessment involved ultrasonic testing of 14-inch DIP sewer force main in the City of Brevard which was used to determine the extent of replacement necessary.

### Background and Project Goals

The wastewater force main from the Neely Road pump station in Brevard, North Carolina was identified as a high priority project for improvements. The City had experienced six failures of the 14-inch DIP Neely Road force main resulting in sanitary sewer overflows (SSOs). The most recent failure occurred in December 2013. The force main failures all occurred because of deterioration in the invert (6 o'clock position) of the pipe. The majority of breaks were on a section of the force main expected to empty by gravity and thus be dry when the pump station is not operating.

### Desktop Analysis

A desktop analysis was performed of the force main profile and break locations. This analysis showed that the force main breaks were along Old Hendersonville Hwy between stations 100+00 (Neely Road) and 60+00 (Osborn Road). Until recently, the air release valves (ARV) for the force main were inoperable for approximately twenty years. Inability to release the trapped hydrogen sulfide (H2S) gases from inside the force main would ultimately cause the formation of sulfuric acid (H2SO4), which would attack the pipe wall typically starting at the pipe crown but sometimes at the 2 o'clock and 10 o'clock positions. What was unusual in this case is corrosion was occurring at the pipe invert or 6 o'clock position. The Neely Road pump runtimes indicated a short cycle time between pump shutdown and restart which meant that any sulfuric acid formed in the crown of the pipe that ran down the pipe wall to the invert would soon be washed downstream by the force main flow.

Another possible explanation was erosion of the pipe invert due to lack of grit

removal equipment at the Neely Road Pump Station. A large amount of grit or gravel moving slowly down the force main pipe is a condition called a "sliding bed". This can cause deterioration of the pipe liner, and ultimately erosion of the pipe wall. The Neely Road force main, however, has high velocities which would result in a more random erosion of the force main liner and pipe wall due to the solids moving more erratically around the interior of the pipe. The large amounts of grit and gravel required to erode the force main would also cause wear and impingement damage on the pump impellers at the pump station. No wear or damage was found.

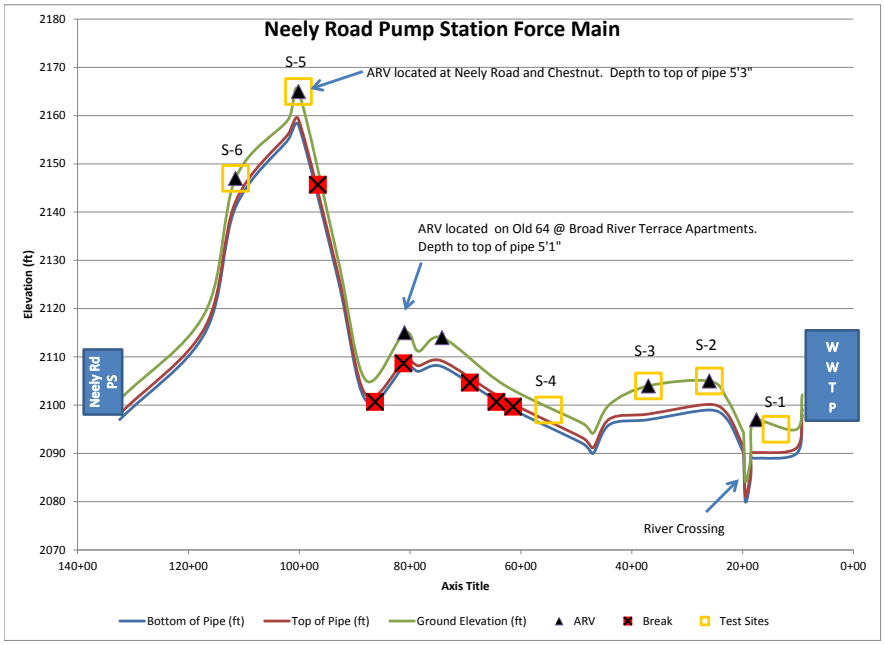
*Excavated Pit for Ultra Sonic Testing*

The Neely Road pump station receives typical residential/commercial wastewater flows from the collection system. There are no known industries discharging into the system that could add chemicals that would be caustic to the force main piping. Several times a year the county discharges leachate from their landfill directly into the Neely Road wet well from pumper trucks. Another theory was that this leachate contained a chemical that was corrosive to the ductile iron pipe (DIP) force main. The leachate was ph tested and proven neutral. In theory any chemical that would be corrosive to the DIP force main would also be corrosive to the pump casings and impellers. No corrosion has been evident in the pump casings or impellers.

*Invert of Failed Pipe Section*

## Field Testing

CDM Smith subcontracted with S&ME to perform ultrasonic thickness testing of the Neely Road force main pipe. The field testing was conducted in March 2014. Six sites were tested with two of the sites in excacated pits and four of the sites in existing ARV manholes. Prior to the testing City crews re-




*Neely Road Force Main Profile with Break and Ultra Sonic Testing Sites*

moved all washed stone from within the ARV manholes and prepped the force main exterior by removing any large scale or rust formations. S&ME crews took multiple thickness readings at the 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock positions for each of the six sites.

All six sites had consistent readings for all four clock positions at each site indicating the pipe wall was still uniform with no interior deterioration. Five of the six sites –Neely Road and all four sites downstream of Osborn Road - showed consistent thickness between 0.35 and 0.42 inches. However test site #5 (Old Hendersonville Hwy / Neely Road) stood out due to the fact its thickness readings were consistent on all clock positions but significantly thinner when compared to the other five pipe sections. Test site #5 had an average wall thickness of 0.28 inches. This measured thickness was similar to the thickness readings taken from the pipe samples removed during the repairs of the Neely Road force main breaks.

This led to the conclusion that the section of force main between Sta 100+00 (Old Hendersonville Hwy/Neely Road) and Sta 60+00 (Osborn Road) had an average pipe wall thickness of 0.28 inches indicating that a lower pressure class piping (150 psi) had been originally installed. This was most likely due to the fact this section of the force main acted more like a gravity sewer and was installed at average depths which allowed the opportunity to reduce capital cost by installing a thinner pipe. This thinner pipe section was now under attack by corrosive H2S gas and had less pipe wall material to resist the corrosion, preventing breakage and subsequent overflows.

## Recommendations

Due to no history of breaks and the ultrasonic thickness testing results showing sufficient pipe thickness present on the pipe sections from the Neely Road Pump Station to Sta 100+00 (Old Hendersonville Hwy/Neely Road) and from Sta 60+00 (Osborn Road) to the WWTP, CDM Smith recommended that those force main sections remain in service. However, it was further recommended to conduct full replacement of the force main piping from Sta 100+00 (Old Hendersonville Hwy/Neely Road) and Sta 60+00 (Osborn Road). This section contains piping that has a thinner wall than the rest of the force main and remains empty when the pump station is not in operation. All six previous force main pipe breaks have occurred within this section.

It is our opinion that this section of the Neely Road force main piping is experiencing one or a combination of several of the following conditions. First, because this section is steeper sloped than the remaining force main sections, this could concentrate any grit or gravel movement into the invert causing liner failure and pipe wall erosion. Secondly, this section experiences frequent wet/dry cycles during pump station operations which can accelerate H2S attack. Any gases formed inside the force main between the lift station and the top of the hill at the Old Hendersonville Hwy and Neely Road intersection would rise and gather at the ARV. If not properly vented this would cause formation of sulfuric acid which could run downstream in the piping invert and cause deterioration of the pipe liner, and corrosion of the pipe wall material. Thirdly, any caustic chemicals contained in the County landfill leachate could leave a residue behind between pump cycles. This residue could also settle to the pipe invert causing deterioration of the pipe liner and corrosion of the pipe wall material.

*Testing in ARV Manhole*

Since the force main failures are attributed to a possible combination of mechanical and chemical forces, we are recommending that the replacement pipe material have properties of both scouring resistance and chemical inertness. For the City of Brevard this condition assessment project zeroed in on the problem and prevented unnecessary replacement of nearly 8,000 lf of 14-inch DIP force main. Because of this project, the City can rest assured about the structural integrity of two thirds of the force main piping, especially the section that crosses under the French Broad River.

***(Condensed from paper TM1-T1-04 presented at NASTT No-Dig Conference 2015 Denver, Colorado)***

### ABOUT THE AUTHOR:

***Brent Johnson*** *is focused on the condition assessment and rehabilitation of water and wastewater pressure mains and is current Chair of the NASSCO Pressure Pipe Committee. He is the CDM Smith technical leader for pipeline condition assessment and rehabilitation in the Southeast Region. Brent serves as the SESTT Treasurer. His full bio is on pg.8.*

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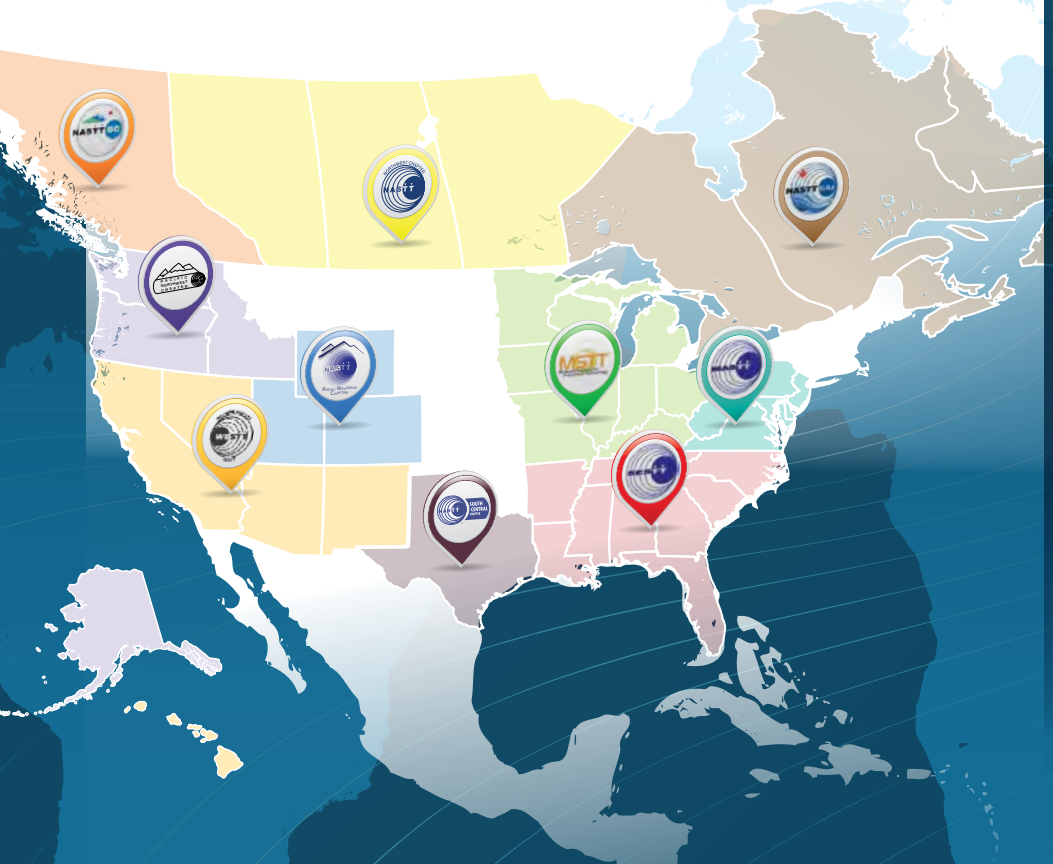

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