



SOUTHEAST JOURNAL OF  
**TRENCHLESS TECHNOLOGY 2016**  
OFFICIAL PUBLICATION OF THE SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY

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**Miami Microtunnel**

**30 Feet Under**



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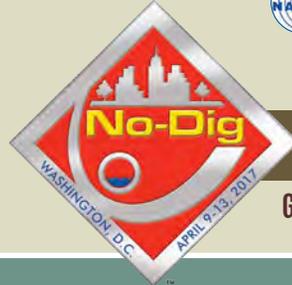
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“The presentations were extremely useful- especially the topic of Culvert Replacement Utilizing Pneumatic Pipe Ramming. Interesting to see how trenchless pipe ramming is most valuable in situations that require a quick mobilization and surface protection in sensitive locations.”

**Adam McKnight**

Project Manager Engineer  
Upper Trinity Regional Water  
District

Chris Knott, Director of Business Development/ Estimator at BTrenchless always looks forward to NASTT's Educational Fund Auction & Reception. The auction is a great place to catch up with fellow peers and network in a fun, laid-back atmosphere.

One reason I enjoy this show every year is due to the quality time spent networking with contractors and engineers in the Exhibit Hall. I could be talking with someone about their project and end up showing them a way to make their project go smoother, or I might be simply educating new faces in the trenchless technology field. A good way to make lasting relationships in the industry.

**Luc Lupien**

Director of U.S. Western  
Region Operations  
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Two days of informative trenchless technology presentations, networking and ideas, along with food, refreshments and a cash draw. Jointly sponsored by the ASCE Miami-Dade Branch, the Nov 16-17 seminar offered a great learning opportunity with knowledgeable industry presenters and trenchless technology topics.



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# SESTT CHAIRMAN MESSAGE 2016

## Moving Trenchless Technology Forwards

Jerry Trevino, SESTT Chairman

**W**elcome to our third annual edition of the *Southeast Journal of Trenchless Technology*. This new magazine is a fresh opportunity to reflect on the progress that has been made in the Trenchless Technology industry over the last 16 years, since the Southeast Society for Trenchless Technology (SESTT) was founded as a NASTT Chapter in 2000.

SESTT was formed shortly after a very motivating and convincing meeting headed by Dr. Tom Iseley and Leonard Ingram in Atlanta, Georgia, in 1999. A handful of people from the corporate and municipal sectors were also present. I remember very keenly Dr. Iseley presenting the case that there was a need to create a Southeast Chapter of NASTT to share information and promote trenchless technology at the local level.

Per the Charter & Bylaws, the primary objective of SESTT is to “promote Trenchless Technologies” by conducting training and education through seminars, short courses and field demonstrations. Since 2000, we have held numerous seminars in locations throughout the Southeast. Leonard Ingram, the Executive Director of SESTT, has been the muscle pushing through many obstacles to schedule, organize, and conduct these seminars.

The seminars continue to be an important forum to educate decision makers on the Trenchless Technologies

**“The seminars continue to be an important forum to educate decision makers on the Trenchless Technologies available to rehabilitate and to increase the capacity of our infrastructure.”**

available to rehabilitate and to increase the capacity of our infrastructure. 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. Organizations such as SESTT, NASTT and the other regional chapters are important education and training providers helping select the best methods and processes to meet these challenges.

Moving forwards, the trenchless technology industry must continue highlighting the need to not only to maintain our infrastructure but also to upgrade it to the next level for future generations in order to maintain a healthy nation. One of government’s foremost obligations is to provide its citizenry with clean and safe drinking water and an efficiently functioning infrastructure. It will challenge us all to the core to create the necessary new materials, processes, and technologies to achieve this.

We all look forward to next year and encourage everyone to attend the upcoming NASTT No-Dig Show April 9 - 13 at the Gaylord National Hotel and Convention Center in Washington DC. In addition, next year there will be a full slate of planned two day Trenchless Technology seminars by SESTT, MSTT, and MASTT. A full schedule of these 2017 seminars will be posted to [www.sestt.org](http://www.sestt.org) in the New Year. Happy New Year and best wishes to all.

Sincerely,

Jerry Trevino  
SESTT Chairman



SESTT SITE



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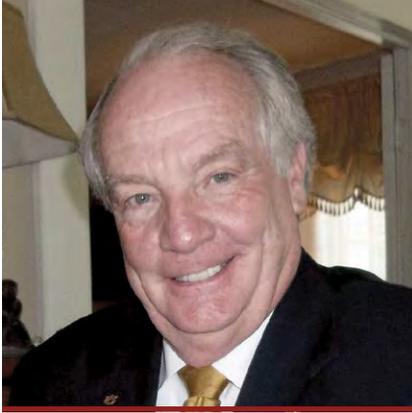
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# GREETINGS FROM THE SESTT EXECUTIVE DIRECTOR

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

Welcome to the 3<sup>rd</sup> annual publication of the Southeast Journal of Trenchless Technology 2016. This magazine highlights some of the many trenchless projects performed around the Southeast. It shows the successes and continued rapid growth in demand for trenchless projects and presents some of the new ideas, products and innovations coming from SESTT members. Please help me thank the journal advertisers, SESTT Board of Directors and their companies for their support throughout the year and for their effort in making this Journal a reality. The SESTT Board of Directors is listed on page 8. The list of journal advertisers is on page 46.

Back in May of 2016, SESTT conducted the Trenchless Technology, SSES and Buried Asset Management seminar in Nashville TN. The Guest Presenter was Mr. Greg Ballard, P.E., M.ASCE, Engineer III, Deputy Director, Clean Water Program, Metro Water Service, Nashville TN. The presentation was very informative and everyone there experienced a lot of learning and networking during the seminar. I want to thank ASCE Nashville Branch for being the co-sponsor for the seminar. I also want to thank our SESTT Vice Chairman, Mr. Ed Paradis, with Resiplast for stepping in and conducting the seminar in my absence.

Recently, at the Sheraton Miami Airport Hotel on November 16th and 17th SESTT hosted a very successful and well attended "Trenchless Technology, SSES and Buried Asset Management" seminar. Mr. Juan Bedoya, Chief, Miami-Dade Water & Sewer, Wastewater Collection and Transmission Line Division, was the Guest Presenter. He gave a knowledgeable and interesting presentation on the Miami-Dade Trenchless Technology Program. ASCE Miami-Dade Branch was co-sponsor of the seminar. There was excellent networking and learning. More details and some photos from the event are on page 36-37

I am also the Executive Director for the Midwest and Mid Atlantic NASTT Chapters. The Midwest Society for Trenchless Technology (MSTT) is planning the "Trenchless Technology, SSES and Buried Asset Management" seminar in St. Louis on December 14<sup>th</sup> and 15<sup>th</sup>, 2016. The response in St. Louis has always been great and we have ASCE as a co-sponsor and a great guest presenter onboard. Register will be allowed until the same day to attend and support the seminar. There is lots of great networking and learning planned. To avoid schedule conflicts, the MASTT, MSTT and SESTT Proposed 2017 Seminar Schedule will be released in January once the larger shows have established their show dates.

The future of water quality is what Trenchless Technology is all about. SESTT's non profit purpose is to promote trenchless technology through education for the public benefit. At our

seminars, we always have attendees looking for another technique, piece of equipment, method, or process to add to their tool box that will help them better water quality and quantity. In the past we observed Engineers specifying open cut with trenchless methods as an alternative. Then they started specifying trenchless methods with open cut as an alternative. Now we are seeing Engineers specifying just trenchless methods. Cost adjustments, technology, inventions and education have brought this about.

Sincerely,

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

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# SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY BOARD OF DIRECTORS 2016



**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 Principal and Vice President of Operations at Highfill Infrastructure Engineering, PC, a Carolinas engineering consulting firm specializing in community and municipal water and wastewater infrastructure engineering. With 26 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 25 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 ten 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.

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# MESSAGE FROM NASTT CHAIR

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

**G**reetings Southeast Chapter Members! NASTT has had another great year, and I'm excited for our future during the remainder of my term as Chair of the Board of Directors and beyond. As I'm sure you know, NASTT's 2016 No-Dig Show in Dallas was a huge success as we experienced a sold-out exhibit hall and had excellent attendance.

NASTT could not reach this level of excellence without the dedicated and selfless volunteers at the National level and within our 11 regional chapters. I would like to personally thank the following Southeast Chapter Members that served on NASTT's 2016 No-Dig Show Program Committee and gave their time and expertise to review each and every abstract to ensure that the Show delivers a program with the highest quality technical content and excellent educational presentations: Shaurav Alam, Edward Alan Ambler, Ralph Carpenter, Will Craven, Shana Durkee, George Kurz, Tara Lamoureux, John Matthews, Stephen O'Connell and Kaleel Rahaim. I would also like to extend a special thank you to Shaurav Alam, Edward Alan Ambler, George Kurz and Kaleel Rahaim for serving as Session Leaders, providing peer review and comments for technical papers within a session that falls within their expertise. This contribution is vital to the quality of the Show and we acknowledge the enormous amount of time you expended in a devoted effort to ensure NASTT's No-Dig show is unsurpassed.

The recent 2016 Southeast Trenchless Seminar in Miami offered a variety of presentations on trenchless topics along with exhibitors and networking opportunities. Read pages 36-37 in this issue to learn more about this great event.

During our strategic planning efforts, the Board of Directors identified goals of engaging larger groups of trenchless professionals to participate in the many volunteer opportunities provided by NASTT. These opportunities prove to be very satisfying and rewarding. NASTT has a wide variety of ways to participate that allow involvement at any level. If you are interested in more information, please visit our website at [www.nastt.org/membership/volunteer](http://www.nastt.org/membership/volunteer). There you can view our committees and learn more about these great ways to stay involved with the trenchless community. Please

consider becoming a volunteer – we would love to have you get more involved.

NASTT has a very promising future and we're thrilled to have the Southeast Chapter as part of our organization. Thank you again for your support and dedication to NASTT and the trenchless technology industry.

*Kim Staheli*

Dr. Kimberlie Staheli  
NASTT Chair

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# UPCOMING TRENCHLESS EVENTS

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December 14 – 15, 2016

**MSTT Trenchless Technology,**

**SSES & Buried Asset Management Seminar**

St. Louis, Missouri

Information: Leonard Ingram, [mstt@engconco.com](mailto:mstt@engconco.com)

January 11 – 12, 2017

**Pacific Northwest Chapter 2017 Symposium**

Cedarbrook Lodge

Seatac, Washington

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

February 6 – 9, 2017

**24<sup>th</sup> Annual Microtunneling Short Course**

University of Colorado Boulder

Boulder, Colorado

Information: [conferences@benjaminmedia.com](mailto:conferences@benjaminmedia.com)

April 9 – 13, 2017

**NASTT 2017 No-Dig Show**

Gaylord National Hotel & Convention Center

Washington, D.C.

Information: [www.nodigshow.com](http://www.nodigshow.com)

April 9, 2017

**NASTT Introduction to Trenchless Technology – New Installations**

8:00 AM - 12:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 9, 2017

**NASTT Introduction to Trenchless Technology - Rehabilitation**

8:00 AM - 12:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12, 2017

**NASTT Gas Good Practices Course**

March 23 2:30 PM - 5:30 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12 – 13, 2017

**NASTT HDD Good Practices Course**

April 12 2:30 PM - 5:30 PM

April 13 8:00 AM - 2:30 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12 – 13, 2017

**NASTT Laterals Good Practices Course**

April 12 2:30 PM - 5:30 PM

April 13 8:00 AM - 12:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12 – 13, 2017

**NASTT CIPP Good Practices Course**

April 12 2:30 PM - 5:30 PM

April 13 8:00 AM - 1:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12 – 13, 2017

**NASTT New Installation Methods Good Practices Course**

April 12 2:30 PM - 5:30 PM

April 13 8:00 AM - 1:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

April 12 – 13, 2017

**NASTT Pipe Bursting Good Practices Course**

April 12 2:30 PM - 5:30 PM

April 13 8:00 AM - 12:00 PM

Gaylord National Convention Center

Washington, D.C.

Information: [www.nastt.org/training/events](http://www.nastt.org/training/events)

March 25 – 29, 2018

**NASTT 2018 No-Dig Show**

Palm Springs Convention Center

Palm Springs, California

Information: [www.nodigshow.com](http://www.nodigshow.com)

# SESTT FOUNDER DR. TOM ISELEY ELECTED UCTA 2016 MVP

The Underground Construction Technology Association (UCTA) and Underground Construction magazine honored Dr. Tom Iseley as the 2016 UCTA MVP (Most Valuable Professional) in a special luncheon ceremony held February 3, 2016 in conjunction with the UCT annual conference at the Georgia World Congress Center in Atlanta.

Dr. Iseley is a founding director of both the North American Society for Trenchless Technology (NASTT), and the SESTT Chapter. Dr. Iseley is also Chairman of the Buried Asset Management Institute – International (BAMI-I) and motivating force for the delivery and creation of the important Certificate of Training in Asset Management (CTAM) program, which has enrolled individuals from 14 countries, including, most recently, Colombia (see page 38).

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, and has over 35 years of experience in the planning, design, and con-

struction 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.

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. He was elected as a Distinguished Member in the American Society of Civil Engineers (ASCE) at the annual ASCE convention in October 2015.

Congratulations Dr. Iseley on the UCTA 2016 Most Valuable Professional designation:

another milestone achievement in a lengthy and distinguished career of service and innovation in advancing trenchless technology!



Dr. Tom Iseley accepts 2016 UCTA Most Valuable Professional honor



Dr. Iseley with Trenchless Technology Center staff and students

Photos courtesy Underground Construction Magazine

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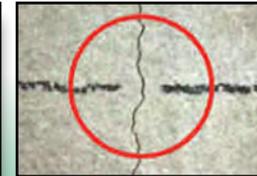
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# NASTT'S BOOKSTORE IS EXPANDING!

## **CIPP Good Practices Guidelines and Laterals Good Practices Guidelines**

The North American Society for Trenchless Technology bookstore is a valuable resource for industry professionals on the job. Two new publications have been added to NASTT's ever-growing library.

Cured-in-place pipe or CIPP is a proven and trusted trenchless method used worldwide to rehabilitate municipal sewer mains. This new peer reviewed publication written by industry experts is the complete guide to this important trenchless technology.

Sewer lateral rehabilitation is a rapidly evolving trenchless technology with major benefits and costs savings for both property owners and municipalities. This manual presents trenchless solutions without extensive excavation or property damage for an often overlooked but critical part of municipal infrastructure.

**Visit [nastt.org/bookstore](http://nastt.org/bookstore) to order your copy today!**





# MICROTUNNELING SOLUTIONS IN MIAMI

## Design-Build Innovations in a Congested Downtown Setting

By: Ashley Heckman P.G., MWH, now part of Stantec  
Aaron Burns P.G., P.E., MWH, now part of Stantec

**M**etropolitan areas across the United States are currently faced with a balancing act. They are forced to address aging infrastructure, increased demands on their existing structures, and the need to maintain continuous service to their customers.

This delicate situation presented itself in the densely populated Miami area. The solutions that were implemented addressed the complexity of construction in a city center with an innovative project design which utilized the industry's latest technologies to cause the least disturbance to the local population. The solutions implemented in Miami can serve as a model for other cities as they face similar issues.

### Understanding the Unique Issues Facing Miami

The Miami-Dade Water and Sewer Department (WASD) manages the flow and treatment of hundreds of millions of gallons of water daily and is dedicated to progressive planning concerning wastewater disposal. New development was planned in downtown Miami and WASD needed to evaluate its current wastewater conveyance system to ensure adequate capacity. It was determined that the existing wastewater pump station, Pump Station No. 8 (PS8), could not meet future demands, and that WASD would need to build a new pump station equipped to handle the increased

flows from additional customers. To ensure greater online capacity was ready by the time construction on the new downtown development was finished, WASD prepared two projects on an aggressive schedule:

1. A new Master Pump Station, Pump Station No. 3 (PS3), and
2. A new gravity sewer interceptor (30, 36, 48, and 54-inch diameter) to reroute flows from the existing pump station (PS8) to the new pump station (PS3).

Due to the urban location of the new sewer line installation and the large number of existing underground utilities, rerouting these flows proved to be a unique

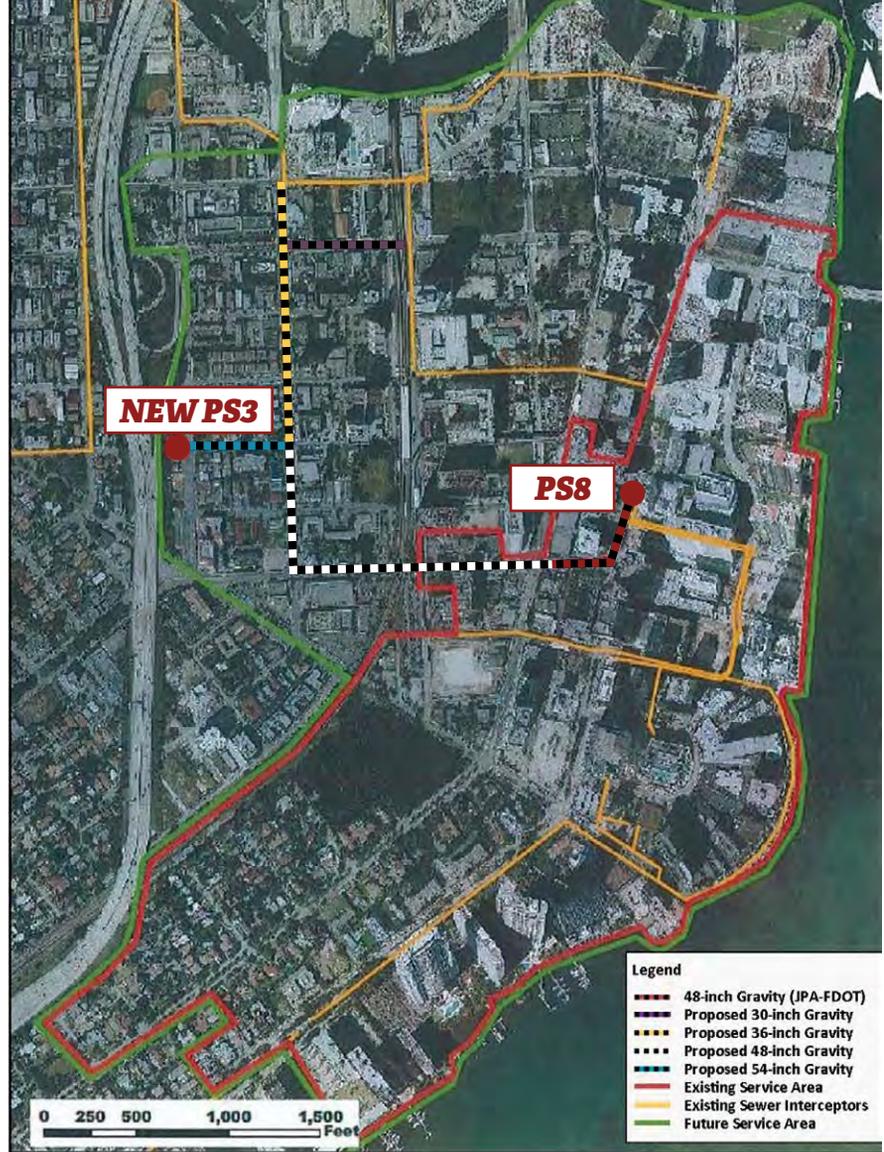
and challenging project. WASD selected the design build approach for the gravity sewer interceptor to shorten the overall project schedule to meet the milestones associated with the nearly completed PS3 design. The use of design-build allowed the work to be conducted in a series of work packages which minimized the overall project risk and expedited the construction schedule.

MWH, now part of Stantec, has worked with WASD for over 20 years, and was chosen to design PS3 and to develop the design criteria package for the gravity sewer interceptor contract. MWH also served as the owner's representative during construction of both projects and provided daily construction oversight. To ensure success, these projects required a series of innovative engineering approaches to address the unique challenges, including the use of microtunneling for the installation of new pipes, innovative construction methods to reduce impact to local communities, and a contract delivery method that would foster innovation. Also, given the dense urban environment of the pipeline alignment, WASD required pipe and manhole materials to have an 80-year service life with the intent of minimizing future disruptions to this area.

### Navigating an Urban Landscape

The new gravity sewer pipelines traversed through the Brickell neighborhood of greater downtown Miami, a densely populated area of financial institutions, foreign consulates, luxury residential towers, and many of Miami's popular restaurants, shops and entertainment locations. As such, the construction would impact heavily trafficked roadways and in a city where congestion was already an issue.

Brickell is the fastest growing area in Miami, so added to this already complex issue was the ongoing development of high-rise businesses and properties in the project area. There were also existing overhead and underground utilities that would affect the pipeline routing. To add further complexity, the Miami downtown's elevation is near sea level, so managing the groundwater along the pipeline route was an important aspect of the construction. The MWH team critically scoped out and



Located in densely populated downtown Miami, the new wastewater conveyance system required innovative solutions. A new gravity sewer interceptor was needed to reroute flows from existing pump station PS8 to new pump station PS3



The secant pile shaft, at the busy intersection of SW 11th St and SW 2nd Ave, was the main launch shaft for three of the five microtunnel drives



Foundation columns for an elevated rail line had to be navigated to install the receiving shaft in the heavily congested intersection of SW 8th Street and SW 1st Avenue

sited the available space for shafts, laydown areas and manhole locations, with the ultimate goal of producing a solid and constructible design-build contract package.

All of these issues had to be factored into any design created by the MWH team.

### Tackling the Challenges One Location at a Time

The first step in developing the project was to select the pipeline route. The MWH design team walked each potential route to identify possible construction challenges, utility conflicts, tunnel shaft locations, and availability of laydown area. This information was used in the final analysis and route selection. While walking the route the team identified a series of challenges and conflicts.

First, the main working shaft at the intersection of SW 11th Street and SW 2nd Avenue was identified as a challenge. The site was boxed in by overhead power lines on three sides, a fire station, and subsurface utilities running in both directions on both sides of the street. To work around this challenge, the Design-Builder constructed a circular secant pile shaft in the center of the intersection between the surrounding utilities thereby minimizing the number of utilities that needed to be temporarily relocated. Other utility coordination also required coordination with Florida Power and Light to de-energize overhead power lines.

Second, a receiving shaft at the intersection of SW 8th Street and SW 1st Avenue was identified as a conflict. The site was boxed in by the Miami-Dade Transit Metromover, overhead power lines, and many subsurface utilities. The 30-inch, 695 foot pipeline (alignment

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3) would need to cross underneath the overhead rail at this location. The eastern end of the alignment cut a new manhole into an existing 24-inch interceptor in close proximity to the existing concrete foundation support columns for the rail. To avoid impacting both the utilities and the foundation for the rail, the Design-Builder utilized open cut methods, with approval from FDOT, to install alignment 3, and had no major issues.

A third identified conflict involved siting the receiving shaft near the intersection of SW 13th Street and Brickell Avenue, located in the high-profile upscale Brickell Area of Miami. The 48-inch, 2,330 foot pipeline (alignment 1) would need to cross underneath the overhead rail at the intersection of SW 13th Street and SW 1st Avenue, and end just before the intersection. The route passed by an elementary school on SW 13th Street so the shaft locations were selected outside of the school boundaries to minimize school impacts. The area also had a history of flooding in times of wet weather, making the site a heightened concern during construction. Ultimately, a shaft closer to S. Miami Ave was constructed, approximately 300 feet west of Brickell Avenue, and open cut was done to the connection point.

Lastly, due to the urban nature of the project, laydown areas and shaft work areas were a concern. It was anticipated that shafts would be rectangular due to space limitations, however they could also be circular, as in the case of the main work shaft. Shafts were constructed through Sand Fill and Miami Limestone layers. High groundwater levels paired with soft and/or potentially unconsolidated material limited the acceptable shaft construction methods in this urban setting.

It was the responsibility of the Design-Builder to develop designs and construction methods that were capable of performing adequately in submerged and highly corrosive environments. Shaft walls and floors were required to be designed to prevent movement caused by the combination of hydrostatic and ground forces, control upwelling of groundwater, and limit infiltration of groundwater into the shaft. The Design-Builders were also required to develop plans to manage cobble sized limestone fragments and zones of

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harder limestone expected to be encountered while advancing the shaft support structures.

### Understanding Geological Conditions before Construction

Before construction began it was vital the team fully understood the geological conditions it faced. This uncovered the need to address a distinct and problematic limestone, and its effect on groundwater issues.

The project site was within Miami Limestone, a soft, cross-bedded, marine oolitic limestone formation varying from sandy limestone to relatively pure calcium carbonate. While Miami Limestone is generally described as soft rock, areas of stronger, harder rock occur within it, which can cause problems with excavation and pipe installation during construction. Based on Tunnelman's Ground Classification, the Miami Limestone was anticipated to behave as firm to fast raveling ground with the sand layers and lenses behaving



*Shaft walls and floors were required to be designed to prevent movement caused by the combination of hydrostatic and ground forces, control upwelling of groundwater, and limit infiltration of groundwater into the shaft*

as flowing ground when saturated. The groundwater in the project area was near the ground surface, so excavations required active support measures to prevent the flow of sands and water. The Design-Builder utilized excavation and support methods which effectively supported the ground in both saturated and unsaturated conditions.

In addition to the limestone, the low elevation of the area was a concern. Due to the elevation, flooding would frequently occur throughout the project site. In fact, standing water greater than a foot in depth was known to occur during heavy rain fall. Groundwater levels at the site varied with time, weather, and changes in season, and

fluctuated due to influence from surface water, including storm water surges from both the Miami River and the Atlantic Ocean. Groundwater was high within the Miami Limestone and levels were high during construction. Because of the high water table and the potential for variances

at different locations in the project area, the team utilized equipment and shoring that operated effectively and supported the ground in both saturated and unsaturated conditions.

### **Constructing with the Least Impact Possible**

The team knew it had an obligation to build a project with the least amount of impact on the surrounding communities, while still addressing the very complex needs of the tunneling project.

Before engaging MWH, WASD initially considered an open cut installation of the proposed gravity sewer interceptors. During the evaluation of alignments, it became clear that the proposed alignments were highly congested with existing utilities and that roadways were heavily trafficked. With an open cut installation, the diameter and depth of the proposed sewer interceptors would require extensive sheeting, shoring, and dewatering. Congestion of existing utilities makes sheeting and shoring infeasible without first relocating numerous existing utilities, which is both cost and time prohibitive, and creates excessive risk. Given the depth of the proposed pipeline and the amount of dewatering required, construction of the dewatering system and disposal of water would be difficult. Additionally, open cut construction would cause significant disruption to traffic, and to surrounding businesses and residences along the entire length of the alignment. For these reasons, open cut construction was judged to be infeasible and trenchless construction methods were selected instead.

Given the existing conditions along the alignment and the large diameter of the proposed sewer interceptors, microtunneling was identified as the most appropriate trenchless construction method. Advantages of microtunneling include:

***“Given the existing conditions along the alignment, and the large diameter of the proposed sewer interceptors, microtunneling was identified as the most appropriate trenchless construction method.”***



*Pump station architecture and odor control were vital to meet Miami 21 zoning, due to location in the heart of downtown Miami*

- Minimizes the disruption on the local environment, traffic, and residents.
- Reduces the amount of excavated material that has to be piled or disposed compared to open trench.
- Pressure-balanced tunneling equipment eliminates the need to dewater the pipe trench, thereby significantly reducing the risk of settlement to surrounding structures or roads.
- Increases operator/pipe installer safety due to the lack of a trench.
- Remote control reduces the need for man entry into the pipe/tunnel and improves operator/worker safety.
- Minimizes surface disruption and the resulting restoration work along the pipe route.
- Higher strength jacking pipe materials result in a higher quality finished pipeline.
- There is not the usual significant cost penalty for going deeper with the sewer. The pipeline can be lowered with minimal impact on the construction cost.
- Unlike conventional jacking methods, the microtunneling machine can handle mixed and varying subsurface conditions

including sand lenses. Microtunneling machines can excavate through potentially high strength limestone rock while controlling mixed-face subsurface conditions including potential flowing ground.

Ultimately, MWH and the Design-Build contractor used a mix of microtunneling and open cut methods in the project construction ensuring that the best solution was provided to the client.



*Existing overhead & underground utilities affected the routing of the new pipeline & choice of construction method*



*MWH designed the pump station to be aesthetically pleasing and fit in with the local community*

## **A Pump Station Worthy of the Neighborhood**

The complex tunneling issues that were addressed would lead to the new Pump Station No. 3 (PS3). Being in the downtown urban corridor, PS3 needed to follow the City's Miami 21 zoning codes - a holistic approach to land use and urban planning representing the Miami of the 21st century. To blend in with the neighborhood, the pump station design needed to mimic the street view of the surrounding high rise towers. The pump station is remotely operated. This unmanned facility is operated from the Central District Wastewater Treatment Plant.

Because of its location in the heart of downtown Miami, PS3's architecture and odor control were vital. MWH designed the pump station to be aesthetically pleasing and fit in with the local architecture, per the Miami 21 zoning requirements. Additionally, an innovative odor control solution was used. Most odor control systems withdraw air from the wet well and treat the air to remove the odorous compounds with wet chemical scrubbers or biological bio filter systems, but due to space constraints this was not an option for PS3. The team turned to the Vapex

O-Mega odor control system. This system dilutes ozone into tiny atomized particles of water averaging less than 5 microns that are sprayed on the wet well headspace in a high speed stream of dilution air. This creates a hydroxyl radical fog throughout the entire air space in the wet well, effectively treating the odorous compounds, while still maintaining a safe and limited corrosion atmosphere inside the wet well.

The final design and construction of the pump station provided the necessary support to the WASD system while also fitting seamlessly into the surrounding community streetscape.

## **A Thorough, Thoughtful Plan and Execution**

The innovative solutions found and lessons learned on this project are applicable to future urban infrastructure planning. Each project presents unique challenges and these projects were no exception. The best results are achieved when a team takes a holistic approach to the issues being faced by the client, understands the various impacts on local communities, and applies the most appropriate and effective technology. 

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### **ABOUT THE AUTHORS:**



**Ashley Heckman, P.G.**, is the Geology and Tunnels Group Lead and tunnel engineer with MWH, now part of Stantec. She has 14 years of experience in rock engineering, geologic characterization, tunnel planning, analysis, design, and construction in a variety of hard and soft ground conditions. She holds a Master of Science in Mining and Earth Systems Engineering from Colorado School of Mines.



**Aaron Burns, P.G., P.E.**, is a principal geotechnical and geological engineer with MWH, now part of Stantec. He has over 17 years of experience in planning, design, and construction of tunneling, water resources, and hydroelectric projects. Mr. Burns has designed over 20 tunnel crossings for water supply pipelines. He earned a Masters in Geological Sciences from the State University of New York at Buffalo.



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# THIRTY FEET UNDER:

## Horizontal Directional Drilling the 30-inch Mill Creek Force Main in Columbia, South Carolina

By: Jameson Kelso, P.E., CDM Smith

In response to steady growth in the area as well as an aging existing pipeline, the City of Columbia contracted with CDM Smith in 2012 to design and oversee the construction of a new 30-inch diameter sanitary sewer force main from the Mill Creek Pump Station to the City's Metro Wastewater Treatment Plant (WWTP). The new ductile iron force main, measuring approximately 24,000 linear feet (LF), replaced an existing 24-inch

diameter force main originally constructed in 1975. The existing force main connected into a 54-inch diameter gravity sewer line, exacerbating overflow and surcharge conditions in that line. The new force main was therefore extended and aligned parallel to the existing 54-inch gravity line until discharging into the Metro WWTP influent pump station.

Along its alignment, the new force main was located adjacent to a major roadway

for approximately 15,000 LF before entering open-field areas near Interstate 77. The remaining 9,000 LF was constructed through open fields and wetland areas until its termination at the WWTP. The variation in site conditions along the alignment included two major creek crossings and a large wetland crossing, thereby necessitating several different installation techniques, including open-cut as well as various trenchless methods.

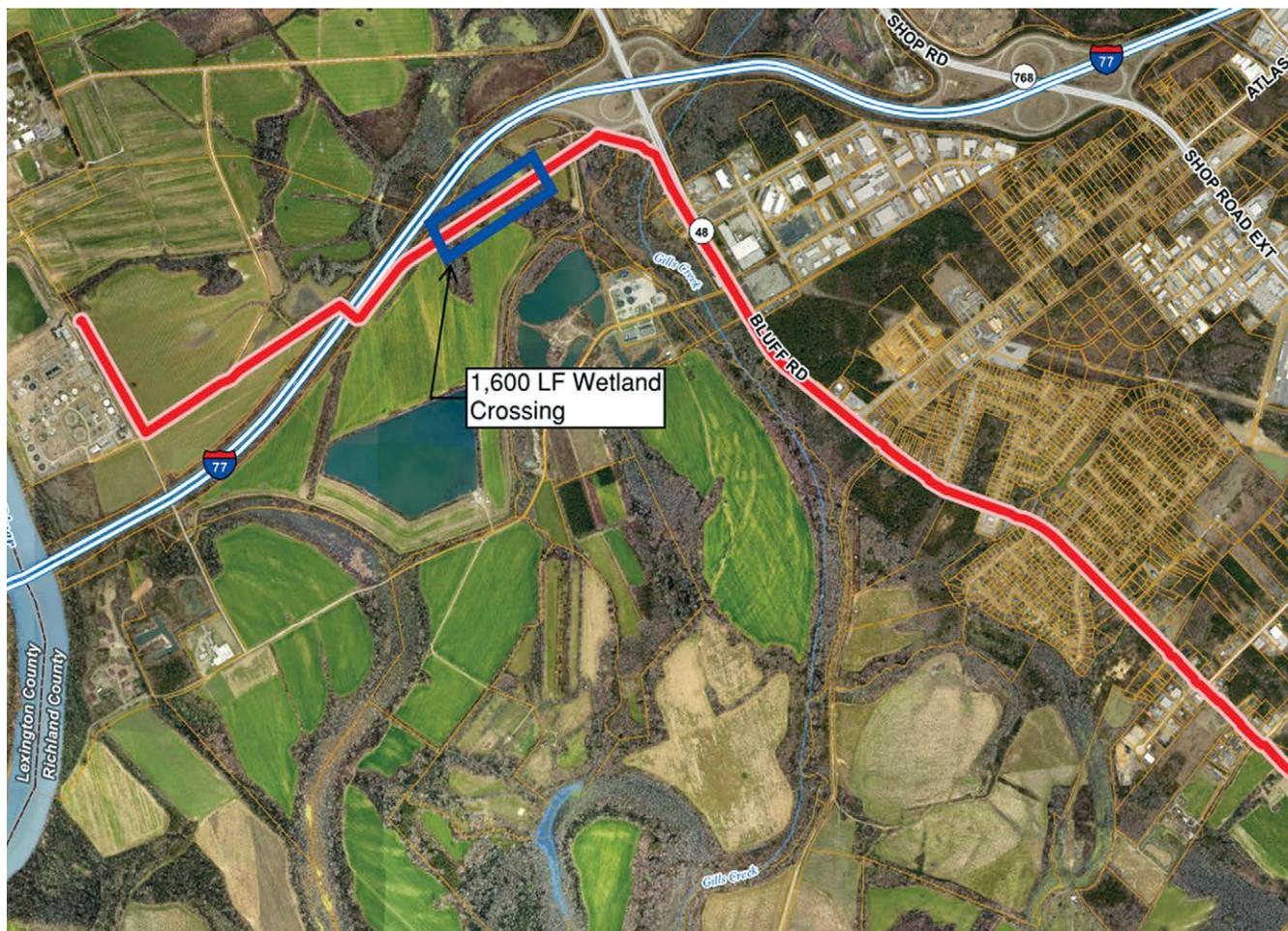


Figure 1. Location Map



Figure 2. fPVC Pipe String

During the design and permitting phase it became apparent that the portion of the project alignment traversing the large wetland/swamp area would not allow for an open-cut pipe installation, due to an average water depth of approximately four feet along the entire length of the crossing. In addition to the consistently high water table and standing water, heavy rain events upstream could quickly increase the water depth in the wetland to as high as eight feet in certain areas. Additionally, at an estimated crossing length of approximately 1,600 LF, and without any intermediate access locations available, the crossing was considered too long for standard jack-and-bore or pipe jacking trenchless techniques.

In response, CDM Smith's wastewater and geotechnical engineers designed a Horizontal Directional Drill (HDD) installation, beginning with a material selection decision between High-Density Polyeth-



Figure 3. Pilot Bore Tracking Boats



*Figure 4. Rock Reamer and Pipe*

ylene (HDPE) and fusible PVC (fPVC). After examining each material's advantages and disadvantages, including required outside diameter pipe size, maximum allowable pull strength, and maximum allowable radii of curvature, CDM Smith elected to design the HDD crossing using 30-inch diameter fPVC pipe.

As project construction began in mid-2016, CDM Smith oversaw preparations for the entire HDD process, including multiple reviews of the contractor's HDD plan and on-site pipe fusing. Prior to initializing any

on-site drilling, the fPVC pipe was delivered to the site by the pipe supplier and fused together along its entire length.

Following fusing, the pipe was initially hydrostatically tested at a pressure of 100 psi for two hours to ensure proper fusing. The pipe was then left in place until pipe pullback, with a second pressure test occurring just prior to pipe pullback to ensure that the pipe had not been damaged during the period it lay idle on-site. As a part of the HDD installation plan requirements, the general contractor, drilling sub-contractor, engineer,

and owner participated in two separate conference calls prior to and during drilling exercises to ensure all parties were in agreement regarding the HDD process, schedule, and methods. Due to the depth of water through the wetlands as well as heavy tree growth, the drilling contractor was unable to setup wire lines along the HDD alignment tracking the pilot hole depth and location. In their place, the contractor procured two small boats for his crew to traverse the length of the HDD crossing and manually locate the pilot bore head via GPS devices.

Upon completion of HDD preparations, CDM Smith continued with full-time on-site observation of the HDD process, overseeing construction efforts that included pilot bore hole installation, two reaming passes, pipe pullback, and hydrostatic pressure testing. Pilot bore hole drilling began with the contractor's decision to drill the pilot bore hole at a depth of approximately 41 feet, significantly greater depth than the design depth of 22 feet provided with the construction drawings. This decision was approved by CDM Smith and was based on the contractor's desire to minimize the possibility of a frac-out, a condition where hydraulic drilling fluid travels through the soil and reaches the surface, within the wetlands limits. After approximately 300-feet, however, the pilot bore head encountered extremely hard rock material, significantly slowing the rate of progress of the drilling operation. The contractor elected to abandon this alignment and submit a revised HDD plan at a depth that closely matched the design depth. This pilot bore hole was installed without major incident, although one small frac-out did occur near the boundary of the wetland area. Fortunately, the frac-out was in a dry portion of the wetlands and was easily accessed with small equipment to remove the visible drilling fluid with minimal disturbance.

Following pilot bore hole installation three reaming passes (24-inch, 36-inch, and 45-inch diameter) were scheduled to occur to allow for pullback of the 32-inch outside diameter fPVC pipe. While one additional frac-out occurred during the 24-inch reaming pass, it was also located in a dry portion of the wetland near the boundary, allowing for a simple cleanup process. Upon completion of the 36-inch reaming pass, an examination of the drill head confirmed the presence of abrasive rocky material along the HDD alignment. The steel drilling head showed substantial wear along its outer perimeter, and moderately sized river rock was extracted with the head.

Based on this discovery, the drilling contractor elected to utilize a 42-inch rock reamer in lieu of the originally planned 45-inch standard drill head. Although the rock reamer diameter was less than what was originally planned to be used for the third reaming pass, the rock reamer would help ensure a smooth outer wall along the length of the HDD installation.

The 42-inch rock reamer was attached to the leading face of the 30-inch fPVC pipe, and pipe pullback was initiated on a Monday morning. Pipe pullback continued without incident until approximately midnight that Monday, at which time it became apparent that the length of pipe provided was sufficient, but would not extend beyond the excavated pits at each end of the bore hole. To keep the drilling mud in the pipe entry pit out of the pipe interior, work was temporarily stopped until Tuesday morning, at which time the contractor placed a cap on the trailing face of the fPVC pipe and prepped the pipe for final hydrostatic testing. Pipe pullback restarted and was quickly completed once the final 50 feet of pipe was pulled into place. CDM Smith on-site engineers noted that the pulling force required to pull the pipe on Tuesday morning was approximately 50% greater than the average forces required during the main pullback effort on Monday. This increase was likely due to pipe settling into the bore hole, leading to increased friction forces along the length of pipe.

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Although the force was higher than what was experienced the day before, the maximum force required was still 40% less than the maximum allowable pullback force for fPVC pipe. Upon completion of pipe pullback the 42-inch rock reamer was removed and the pipe was successfully hydrostatically tested at 150 psi, approximately two times the maximum expected operating pressure of the force main.

The design of the HDD crossing by CDM Smith, along with full-time construction oversight and regular communication between all parties, mitigated the City's concerns and instilled confidence in the HDD method chosen. Despite minor setbacks during several stages of the HDD installation process, including two frac-outs, access limitations during periods of heavy rainfall, more difficult subsurface conditions, and a brief challenge during the pipe pullback, the installation was successfully completed over a six-week period, and the project remains on schedule and on budget. †

## ABOUT THE AUTHOR:



**Jameson Kelso P.E.** is a Project Manager with CDM Smith in their Columbia, SC office. He has over 10 years of design and construction management experience and has managed several large diameter gravity sewer, force main, and water transmission main conveyance projects. He graduated from Clemson University in 2006 with a BS in Civil Engineering.



# CSX RELINE FOR TIMBER BEAM BRIDGES – HOMERVILLE, GEORGIA

By: Donald Herbert, Contech Engineered Solutions LLC

*CSX needed to quickly replace or repair two timber beam bridges*

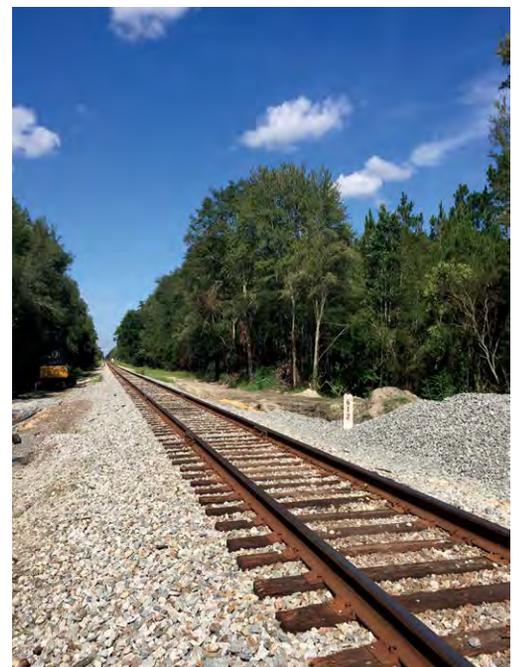
**C**SX Corporation, together with its subsidiaries based in Jacksonville, Florida is one of the nation's leading transportation suppliers. For nearly 190 years, CSX has played a critical role in economic expansion and industrial development across the eastern United States and into parts of Canada.

With over 2,700 miles of track and more than 2 million carloads handled in the state of Georgia alone, CSX maintains a busy schedule not only transporting loads along those lines but also maintaining and inspecting the existing track areas to ensure deliveries, shipments, and schedules are consistently met.

In accordance with the Federal Railroad Administration (FRA) regulations, which requires an annual inspection and determination of the safe load capacity of railroad bridges, CSX engineers will routinely inspect bridges, paying special attention to any signs of unexpected wear, weakness

or damage that might indicate fatigue or premature aging of the structure. Inspections include a careful evaluation of all the key components of a bridge – the deck, superstructure and substructure – noting any exceptional condition that suggests unusual wear or deterioration. If an issue is identified that compromises the safety of employees, local residents, rail equipment or customers' freight, inspectors are empowered to take immediate action based on the conditions they see.

Along the track from Valdosta Yard to Homerville, Georgia, CSX engineers noticed two timber beam bridges that had severely deteriorated to the point where they were in need of either replacement or repair. Timber bridges have a longstanding history in the track development in both the United States and Canada where cheap lumber was widespread and readily available in nearby forests. However, early timber bridges had their drawbacks. Untreated lumber only



*A completely structural solution was installed with minimal delays to the track above*



*CSX track workers dewatered the area and placed the CSP segments*

lasted about 20 years. Today, timber trestles are still commonly found on railroad bridges throughout North America but with the increased loads and freight weights that trains are experiencing, there has been a significant negative impact to the overall life expectancy of those timber beam bridges still in service and many railways have needed to repair and replace much sooner than expected.

Upon identifying these two timber beam bridges, CSX turned to STV Incorporated to perform a hydraulics and hydrology capability assessment report to determine what options were available and what the best solution might be. STV is an engineering firm known for its engineering, environmental and construction management services, with locations across the nation. The Jacksonville, Florida location worked closely with CSX to conduct the assessment report for the two timber beam bridges in need of repair. STV provided a report on the existing condition of the structures as well as a proposed condition and possible alternatives. The modeling and hydraulic analysis was performed to size the proposed structure and to determine any change in storage from the existing condition to the proposed condition.



*Grouting and backfilling the area reduced ongoing maintenance costs.*



*Most efficient cost-effective solution was sliplining with a multi-barrel corrugated steel pipe (CSP) culvert*

In order not to delay the track schedule, CSX preferred a solution that would have as little negative impact as possible to the rail track. STV determined that sliplining the existing structures with a multi-barrel corrugated steel pipe (CSP) culvert would be the most efficient and cost-effective solution. Determining the proper material type, size and shape that should be used for a particular site is a bit of science mixed with art. The evaluation process should consider the usual items considered for new structures including loading requirements and other structural needs, hydraulics, velocities in the structure and at the outlet, material type and service life needs, site specific construction obstacles and accessibility limitations, contractor experience, grouting methods, etc.

Typically, the most pressing considerations are the geometric dimensions of the existing structure since maximizing the new structure's hydraulic area or clearance capability usually governs the approach. Considerations must be given to issues such as the worst case obstructions, overall alignment, sag or settlement of the structure, and

slope. These items can impact the size and shape of what will fit as well as the length of preassembled segment of new structure that can be maneuvered into position. It also can impact the grouting process and rate, and the amount of preparation work that must be done.

In order to help with this process, STV reached out to Contech Engineered Solutions for assistance in identifying the right product and design solution. With over 70 years of experience, Contech provides permanent, fully structural solutions based on time-proven designs and suggested using aluminized type 2 (ALT2), 10 gage HEL-COR® corrugated steel pipe (CSP) to reline the existing bridge structures. Contech was able to manufacture the HEL-COR® CSP at their local manufacturing plant located in Conyers, Georgia, to provide a 72-inch diameter, triple-barrel culvert to slip line under one of the wooded beam bridges and another 78-inch diameter, 6-barrel, pipe-arch culvert under another wooden beam bridge just a few yards down the track.

Not only did the proximity of the Contech manufacturing facility help cut costs

considerably, but CSX was able to use their own track workers to dewater the area and slide the culverts into place before grouting and backfilling the area which also severely reduced the cost of maintenance.

They laid a slurried concrete slab down for improved working conditions and, with minimal delays to the track above, were able to finish the installation for a completely structural solution that would extend the service year life expectancy substantially. †

---

#### **ABOUT THE AUTHOR:**



***Don Herbert** is the Director for Rail Markets at Contech Engineered Solutions. He joined Contech in June of 1991 and has held many positions within Contech*

*including sales engineer, regional sales engineer, area technical manager and most recently – area manager drainage. Don has a B.S. in Civil Engineering from Manhattan College and M.S. in Civil Engineering from Texas A&M University.*



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# DELTA DIRECTIONAL ROCK, HDD'S LESS TRAVELED PATH

## An Interview with Billy Cleveland, President, Delta Directional Drilling LLC

By: Malloy Akston

**D**elta Directional Drilling is recognized as one of HDD's best rock drilling contractors and undoubtedly one of the industry's great success stories. Achieving this reputation, as rock drilling experts, is no small accomplishment. The struggling economy has added increased challenges to what was already one of construction's riskiest fields. Nowhere is the risk greater than drilling rock. You can never be sure what is below the ground and even slight deviations in drilling conditions can multiply the costs. (These hazards are magnified by an ominous industry trend, which attempts to place all the risks squarely on the contractor's shoulders.) Yet, rock drill after rock drill, year after year, Delta Directional continues to raise the bar, and get the job done.

**I asked Billy Cleveland, Founder and President of Delta Directional, to share some of Delta's rock drilling expertise.**

"I don't think the term expert fits. It isn't a title you give yourself. We do drill a lot of rock and we are good at it. Our reputation was earned one drill at a time, rock or not. We practice detailed planning and studious record keeping, all with a focus on safety. This creates a safer work place and minimizes down-time. Years of success, and a majority of that work drilling rock, have created a strong relationship with our clients. We have more repeat customers in hard rock formations than we do in any other strata. Our business success is attributable to experienced, dedicated employees and a close working relationship with clients."



**Today, Delta has 22 rigs; several that have drilled exclusively in rock for years. As of last month, they have completed over 60 rock projects in 2016 alone. You started Delta Directional in 2001 with two Vermeer 80x100's and a 36x50. What was your personal background?**

"I began in 1990 with Horizontal Drilling International (HDI). Worked my way up to Rig Superintendent and was lucky enough to travel the globe watching and learning from some of River Crossing's true pioneers."

**Delta works up and down the east coast. Are rock drills your business plan?**

"No. That's not a plan. We complete as many crossings in softer formations as we do rock. However, rock crossings take longer and are far more costly, so rock crossings are prominent on the time and cost charts. I understand why many HDD contractors avoid rock. Horizontal directional drilling is an extremely risky business. That risk goes up with rock. There are many variations of rock, further increasing the risk. If someone needs a crossing installed in rock, they look for a contractor who has a record of getting them done. Any type of rock presents a challenge. That's one reason we work all across the country. We routinely have projects in Texas, Oklahoma, Colorado, and have worked just about everywhere else. We do a lot of work around the Appalachians and that can be some hard rock. We are based in



*“HDD is an extremely risky business. That risk goes up with rock. Any type of rock presents a challenge.”*

***“...each client and each drill is our most important. A good business plan is to have a good drill plan. I see our advantage as our experience and commitment.”***

Newton, Mississippi so we do a lot of work down south as well. As far as business plans go, ours is that each client and each drill is our most important. A good business plan is to have a good drill plan.”

**So, what is the hardest rock you have drilled and what is the secret to successful rock projects?**

“With Delta, the hardest rock was in North Carolina, 57,000 PSI. We have drilled plenty others pretty close to that PSI. The deal is that we knew it was hard and planned for it. Planning for a 15,000 PSI formation and encountering 20,000 PSI can double the cost.

“I don’t think there is a secret but successful rock drills just don’t happen. The cost of enlarging a rock crossing to the needed diameter can be tremendous but it all starts with the pilot hole. A good straight pilot hole improves hole opener performance. From planning to demobilization, we have to give our clients our best effort each and every drill. It takes conscientious people with the experience to get the job done. One mistake could cost millions. The entire team needs to be focused and have pride in doing what they are doing. This is where Delta Directional does have an advantage. Our Superintendents have years of experience drilling rock and our crews are proud to work under them.



*Delta has earned a solid reputation for successful HDD crossings and precise work in variety of challenging conditions*



*Delta Directional President Billy Cleveland takes the hands-on approach to getting the job done*

“All the parts need to work together, not against one another; people on site with a goal of getting things done, not a goal of hindering progress or personal egos. It starts with good clients providing a well-engineered plan along with good core samples. Our relation with our service companies adds valuable expertise to our plan and our tooling. That combination, added to Delta’s experience and commitment has resulted in very efficient drilling operations and successful projects for a long time.”

**Are you saying Delta Directional’s advantage is that they are on the cutting edge of HDD technology?**

“No. In fact, it is just the opposite. I see our advantage as our experience and commitment. Some contractors are searching for a magic bullet, some new secret weapon that gives them an advantage in rock. There will always be someone out there who will sell them that promise, which makes them susceptible. We depend on proven methods and practices developed over decades. The methods that worked best in the rock of Eastern Europe or drilling under North Carolina’s Billy Graham Parkway twenty-five years ago still work best today. Contractors who claim they have an edge due to technology are fooled or, perhaps, fooling someone else. Knowledge and experience is the key. And it isn’t easy. It takes time to learn and discipline to implement. Delta has invested in both.”

**Is there new technology for HDD?**

“There are advances. Things are more computerized, communications are near instantaneous. Rigs are better but the pipe and iron are still pipe and iron. Oilfield drilling tools have become more customized for HDD use. Stronger, more durable, short-radius motors and hole openers designed for the hazardous conditions common with

construction drilling have improved performance but all the above must be operated by someone who knows rock.

“Claims of new products are rampant but a good dose of skepticism is important. The industry has grown so large and so fast, that things we tried decades ago are now successfully marketed as new. You need to be aware that new isn’t always better and the majority of the time isn’t even new.

“Our experience is that good products combined with good practices produce wanted results. For example, we use the most accurate steering method available and our navigators are the best in the industry. Today, using our DataTraX Earth program, I could watch the entire guidance operation from my office in real-time. I can see just what the navigator is seeing and how the job is set up. This is an added twist, upgrading a proven method. We are taking advantage of new technology. Drilling is still drilling and proven practices haven’t changed. We take the same attitude on every aspect of a drilling operation because our employees and clients deserve the best.”

**How much has your market changed?**

“That is always an issue. Increasing regulations and oversight are affecting my customers and that, in turn, affects us. The use of HDD continues to expand and we need to know the market. We have new customers and we have to earn our reputation with them the same way, one drill at a time. There are always competitors knocking on our client’s doors and I can’t blame them for taking a chance based on some of the prices they are offered. Rock drills don’t get done cheap and without experience some don’t get done. These incidents are bad but they solidify our client base.”



Right on the money! Delta practices detailed planning and meticulous record-keeping, with a strong focus on safety, to ensure the success of each drill

**“No matter how good we are today, we need to be better tomorrow.”**

Clearly, Delta has chosen the path less traveled and there has been a lot of rock down that path. Looking ahead, what concerns you and how do you see Delta Directional navigating those concerns?

“Regulations are an increasing concern. At some point, they will completely saturate the industry. There will nothing left to regulate or permit. I am not sure what will happen then but no one has an advantage, those challenges will be faced by all.

“I suspect rock drills will be always be a forte of Delta Directional. We are always planning for the future and things are always changing. Our future depends on good, skilled employees and satisfied clients. We are investing a lot of resources to ensure our skill level continues to improve.

“No matter how good we are today, we need to be better tomorrow.”

**ABOUT THE AUTHOR:**



Malloy Akston is currently a freelance writer residing in Houston Texas. With a 30 plus year career in Oil & Gas exploration and development, he has written numerous product manuals and industry magazine articles. He has also written for sports magazines.

**EXPERIENCE, INTEGRITY, AND PERSEVERANCE**



**Delta Directional | Where the Job Gets Done**

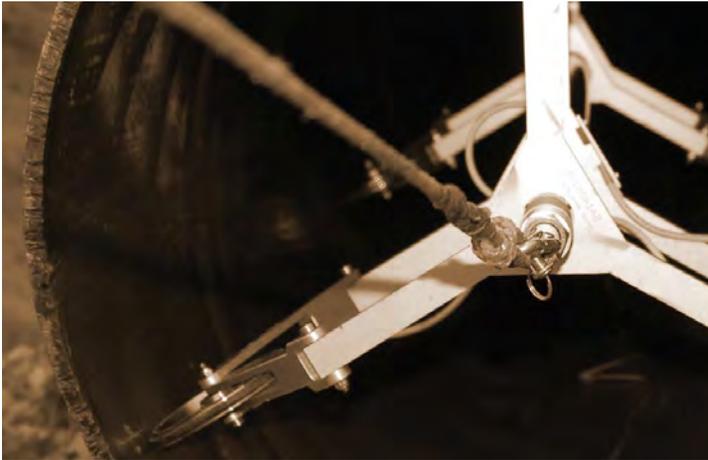
PO Box 219, 9027 Eastside Drive Ext. 15, Newton, MS 39345 | Phone (601) 683-0879 | Fax (601) 683-3376 | Deltadirectional.com



# CUES AMP™ CASE STUDY

## Accurate Gyroscopic Mapping Tool Verifies HDD 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.

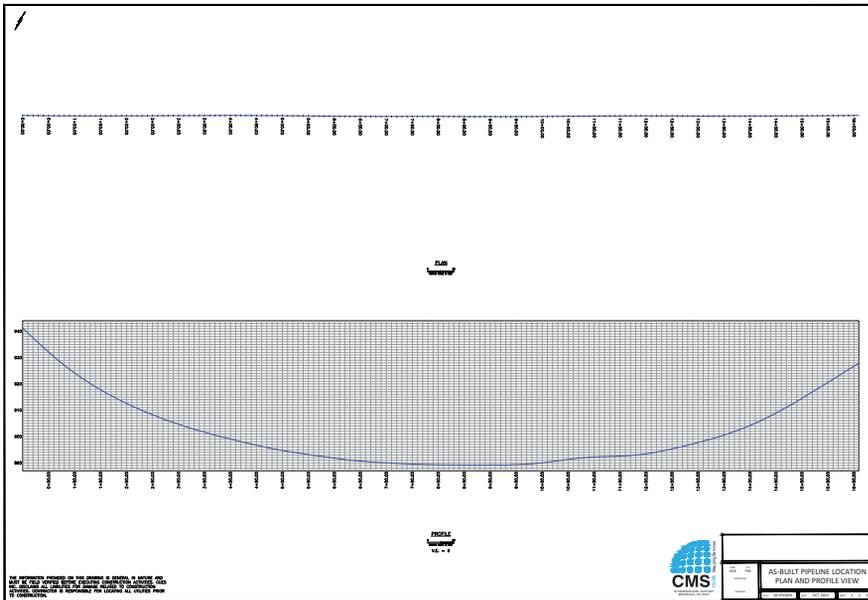
### CUES APPROACH

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

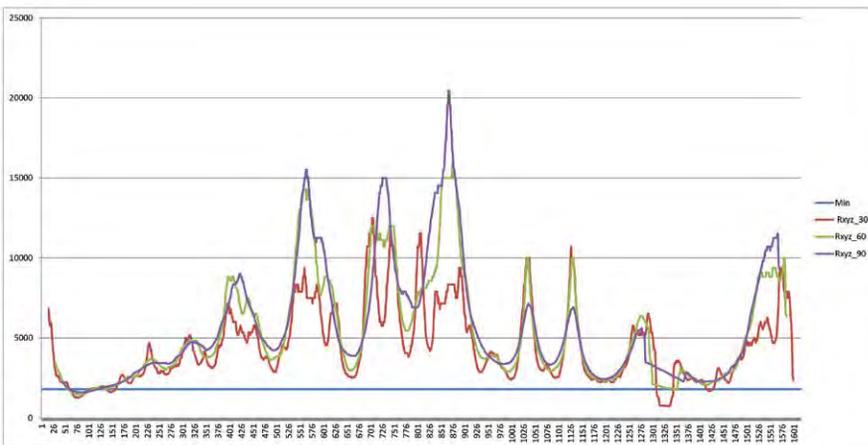
Figure 1: Exit Location Configuration



**Figure 2: Plan & Profile**



**Figure 3: Bend Radii Data**



The Accurate Mapping Probe was also utilized to verify pipe location and bend radius of HDD pipe after another installation.

## 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 AUTHOR:

"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.

# SESTT MIAMI TRENCHLESS TECHNOLOGY SEMINAR



## Lots of Trenchless Project Work Happening In Miami!

The recent SESTT Trenchless Technology SSES and Buried Asset Management Seminar at the Sheraton Miami Airport Hotel November 16 - 17 featured Special Guest Presenter Mr. Juan Bedoya, Chief, Miami-Dade Water & Sewer Department, Wastewater Collection & Transmission Line Division. His presentation, "Miami-Dade's Trenchless Technology Program", was followed with close interest by over 65 participants who attended the seminar. There was a lively Q&A discussion following Mr. Bedoya's informative talk on the massive program underway in Miami-Dade.

Jointly sponsored by the ASCE Miami-Dade Branch, the information-packed two day seminar agenda offered a fantastic learning opportunity, with an excellent series of trenchless technology topics and knowledgeable industry presenters in a small informal classroom setting. The sessions included the following topics and speakers:

**WELCOME ADDRESS and "Liquid Assets" Overview Video,**  
Leonard Ingram, SESTT Executive Director

**Trenchless NSF 61 Watermain Rehabilitation,**  
Fred Tingberg Jr., Lanzo Trenchless Technologies

**Conquering Microbial Induced Corrosion in Miami Dade County,**  
Scott Kelly, AP/M Permaform

**Inspection Tools for Determining Remaining Useful Life,**  
Ed Diggs, Pipeline Inspection Partners Corporation

**Structural Rehabilitation of Manholes,**  
John Fuquay, Hydrotech, LLC

**Expanded In Place PVC Pipe "Styrene Free Sewer Rehab",**  
Jeff Newman, Miller Pipeline

**Infiltration Control Using Chemical Grouts,**  
Ed Paradis, Resiplast

**An Overview Of Trenchless Pressure Pipeline Rehabilitation,**  
Andrew Costa, Insituform Technologies, LLC

**Pilot Tube Guided Boring,**  
Troy Stokes, Akkerman Inc.

**Features and Benefits of Segmented PVC Pipe,**  
Paul Blastic, Paul Blastic & Company

**Sealing the Collection System: Focus On Main-To-Lateral Rehab,**  
Jason Mathey, LMK Technologies

**"Close Tolerance HDD" New & Replacement Sewer, Pressure & Asbestos Pipe,**  
Ted Dimitroff, Trenchless Consulting, LLC

**Cost Effective Rehab of Sewer Systems,**  
Chris Hamilton, Avanti International

**Rehabilitation with A2, DuroMaxx SRPE & SPR-PE Technologies,**  
Justin Walton, Contech Engineered Solutions

**Comprehensive Approach for Infiltration Reduction through Trenchless Technology,**  
Glenn Hill, Carylon Corporation Marketing Group, LLC

**Reinforced Concrete Pipe and Trenchless Technology,**  
David McClintock, Forterra

**Cured-In-Place Laterals,**  
Gordon Marshall, BLD Services, LLC

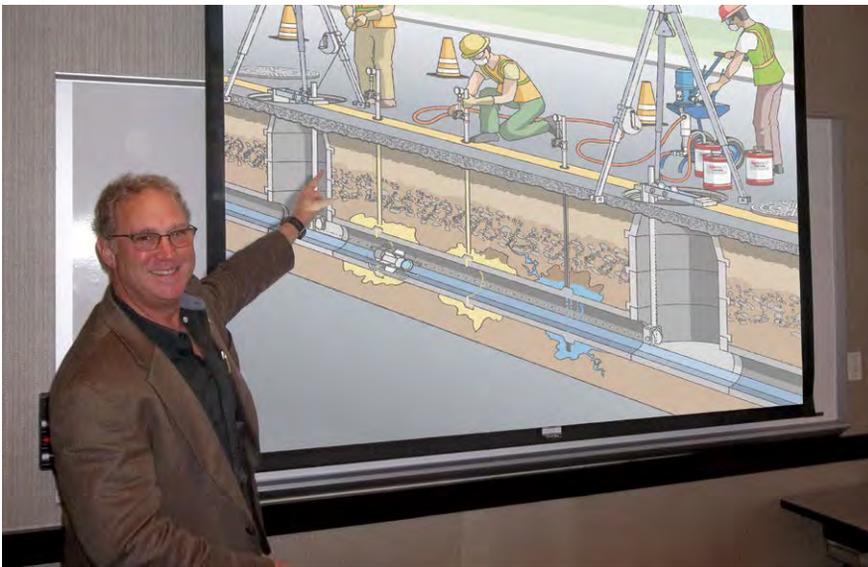
**Trenchless Point Repairs, "Not A Trend, Now A Necessity",**  
Ron Dick, Infrastructure Repair Systems.



*Juan Bedoya, Miami-Dade Water & Sewer Department, gives details on the WASD Trenchless Technology program*



*Informative two day Trenchless Technology seminar was an excellent learning & networking opportunity*



*SESTT Vice Chairman Ed Paradis, Resiplast US explains Infiltration Control Using Chemical Grouts*

The Miami SESTT seminar was a very well-attended educational and informative two days of trenchless presentations, product demonstrations, networking and ideas, along with breakfast, lunches and all day refreshments! Participants were all glad to stick around for a drawing for two one hundred dollar bills held at the end of the seminar! The seminar was approved by the Florida Board of Professional Engineers and certificates were issued for 10 PDH credits.

Special thanks are extended to refreshment sponsors for the good food and drinks: **JR Cruz Corporation, Pipeline Inspection Partners Corporation, LMK Technologies, Miller Pipeline, Akkerman Inc., Trenchless Consulting LLC and Carylton Corporation.** †

**For information dates and locations of the 2017 SESTT Trenchless Technology, SSES and Buried Asset Management seminars planned for cities in the Southeast, visit:**

**[www.sestt.org](http://www.sestt.org)**

# BAMI-I INTRODUCES CTAM PROGRAM TO LATIN AMERICA

By: The Trenchless Technology Center (TTC)

**I**n August 2016 BAMI-I officially introduced its Certification of Training in Asset Management (CTAM) program to Latin America at the Instituto Colombiano de Tecnologías de Infraestructura Subterránea (ICTIS) Conference in Cartagena, Colombia. Colombia is a pioneer of the trenchless technology industry in Latin America.

DDr. Tom Iseley, BAMI-I Chairman and TTC director, was Guest Speaker at the ICTIS Conference. BAMI-I will translate the 4 CTAM courses into Spanish, serving its industry partners in Latin America, with the goal of having presence in more Spanish-speaking countries and sharing knowledge of asset management and trenchless technology.

## Buried Asset Management Institute-International (BAMI-I)

The Buried Asset Management Institute - International (BAMI-I) is a non-profit corporation whose main purpose is to educate and assist those who have an interest in applying best buried asset management practices to extend the life and efficiency of their assets. Although BAMI-I has been mainly focused on water and wastewater systems, the principles of asset management apply to all different types of buried assets including for instance gas distribution pipes, electric cables.

Good buried asset management practices will:

- Maximize life-cycle value of assets
- Sustain economic development
- Protect public health
- Improve the environment
- Enhance the quality of life

The purpose of BAMI-I is to provide a center of excellence for owners of underground water infrastructure to join with

industry and researchers, using sound science, to evaluate and/or develop buried asset management protocols for application worldwide.

## Certification in Training of Asset Management (CTAM)

The Certification of Training in Asset Management (CTAM) is an exclusive four part series in Asset Management coursework and certification. The CTAM program was developed by BAMI-I in conjunction with the TTC (Trenchless Technology Center) at Louisiana Tech and IUPUI (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. CTAM is offered online and per request in classroom format. More than 655 individuals from 14 countries have enrolled in the CTAM program.

The CTAM program Certification Board is chaired by Richard Thomasson P.E., Arcadis, BAMI-I Vice Chair, and MASTT Chair. Also serving on the Certification Board are Kurt Wright, SDG Engineering, CTAM-400 Chair; Jim Harris, Jacobs Engineering, CTAM-300 Chair; Ronald Thompson, Southeast Engineering & Consulting; and Tod Phinney, Souder, Miller & Associates.

There are three levels of certification available – Certificates of Completion, the Associate Water Asset Manager (AWAM) and Professional Water Asset Manager (PWAM) designations. To date 55 AWAM and 12 PWAM certifications have been awarded.

## Benefits of CTAM Courses to Professional Engineers

CTAM Courses benefit Professional Engineers with years of experience in management of underground asset infra-

structure. These courses are developed by industry professionals for industry professionals. Many of the course development professionals are PEs with many years of experience.

## Benefits of CTAM Courses to Municipalities

Municipalities benefit from participating in CTAM training and certification process. The CTAM courses allow them to cost-effectively train staff, and attract and retain qualified professionals. It also provides a basis to recognize and reward individuals who attain the AWAM and/or PWAM certifications. This system of training and certifications also assists smaller municipalities with the hiring process and pay slotting for open positions.

The principles and practices of water asset management taught in the CTAM courses are appropriate for all sizes of utilities, both public and private. A key feature is the CTAM program was developed with a commitment to provide value to the 93% of utilities that serve fewer than 10,000 customers. For more information, and application requirements, please visit <http://bami-i.com>

## 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.

# ALTERNATIVE LINING TECHNOLOGIES

## Trenchless Lining Solutions for Underground Structures

By: Alternative Lining Technologies

**C**ustom manufactured CIPM™ Liners from Alternative Lining Technologies are saving collection systems thousands of dollars in repair and rehabilitation budgets, while adding years to aging structures, and reducing, or completely eliminating, costly and damaging infiltration and exfiltration problems. Unlike other adhesives or coatings, Alternative Lining Technologies CIPM™ liners form a complete reinforced structure within the host structure and are easily installed to all types and sizes of underground structures.

### How it Works

The CIPM™ Liner is a cured-in-place rehabilitation technology which keeps sewer and wastewater systems working better and longer. Designed and manufactured specifically for each structure, and shipped dry to the installer, the unique and patented design employs an inward-facing layer of PVC which forms an impervious barrier against sewer-gas corrosion and ground-water infiltration. Fabricated to consistent standards,

***“the liners add years of useful life to aging sewer structures while saving tens of thousands of dollars through rehabilitation rather than reconstruction”***

CIPM™ Liners do not significantly reduce the opening into the host structure, typically no more than 0.5-inch access diameter is lost.

A custom-blended epoxy resin is mixed and applied to the CIPM™ Liner on site. The epoxy-coated liner is then inserted into the manhole interior. The liner is cured with heat (180°F) and kept under pressure with steam conforming the liner to the shape of the manhole, and promoting high bonding strength to the substrate. The application of continuous pressure helps the resin penetrate the substrate to form strong and stable epoxy anchors.

Typically, the liner is cured in about an hour forming a protective barrier within the manhole. Completion time will vary depending on job scope and the prior condition of the wastewater system. Alternative

Lining Technologies uses a carefully groomed process to ensure minimal down-time and rapid repair on every job.

### Benefits

Designed to withstand ground water pressure between it and the host structure, the patented construction of CIPM™ Liners stop ground-water infiltration and the extra expense it adds to sewage treatment. This same patented technology also halts waste stream exfiltration into the environment.

The flexible PVC on CIPM™ Liners bridges potential cracks caused by settling, dynamic traffic flow and freeze-thaw conditions. The fiberglass reinforcement also reduces the likelihood of cracks. And together, the layers stop soil seepage into the manhole and the resultant dimpling in the asphalt around the frame and cover.

CIPM™ Liners also provide complete protection from the hydrogen sulfide released by bacteria in the wastewater system. The liners extend from the sewage flow line (or below it) to the support lip of the manhole cover so



Epoxy resin is mixed and applied on site, then liner inserted into the manhole interior



*CIPM™ liners form a complete reinforced structure within the host structure and are easily installed*

all gas-exposed surfaces are lined, completely blocking corrosion, and the associated failure and pollution problems.

The smooth white PVC interior results in a brighter manhole for easy access and inspection, and is much easier to clean than brick or concrete substrates.

### Preferred Technology

CIPM™ Liners are often the preferred technology of municipalities, utilities and others for rehabilitating manholes, vaults, wet wells, pump stations and other underground

structures. Engineers, Utility Owners, and Industrial Facilities know they can depend on Alternative Lining Technologies products and knowledge based on many years of service to the underground industry. Custom fabricated liners are a protective barrier from corrosive gases and ground water infiltration, affording a like-new condition and peace of mind.

Since their introduction in 1998, CIPM™ Liners have met the demands of countless commercial and municipal clients for projects both large and small. Proven superior in acid resistance to other technologies in tests conducted by the Sanitation District of

Los Angeles County, the liners add years of useful life to aging sewer structures, reduce or eliminate infiltration and exfiltration, while saving valuable infrastructure dollars through rehabilitation rather than reconstruction.

**“Besides the annual savings in treatment costs, they saved us \$8 million by delaying the necessity for a new treatment plant.”**

– Carol Schuehler, P.E., Lower Frederick Township, Zieglerville, PA

### ABOUT ALTERNATIVE LINING TECHNOLOGIES:



*Alternative Lining Technologies provides multiple solutions for the rehabilitation of sewer infrastructure. An extensive selection of quality tested and certified materials eliminates costly excavation and replacement. Learn more about these trenchless solutions and what they can do for your community at [www.altliner.com](http://www.altliner.com).*



# ALTERNATIVE LINING TECHNOLOGIES

616-583-7100   altliner.com   info@altliner.com

## The Reliable Solution for Manhole Rehabilitation




## Cured-In-Place Manhole Lining



**The AltLiner™ CIPM™**

# CONVERSION HAPPENS!!!

## AN INTRODUCTION OF THIS PHENOMENON TO TRENCHLESS TECHNOLOGY

### A Viewpoint on Calcium Aluminate Cements

By: Jerry Trevino, Protective Liner Systems

**T**he phenomenon of Conversion is inevitable when working with Calcium Aluminate Cement (CAC). Like the proverbial “white on rice”, or corrosion associated with steel, all Calcium Aluminate cements and mortars undergo a Conversion process during hydration, resulting in a significant lowering of concrete compressive strength due to increased porosity. While extensive research and experimentation has been conducted to mitigate Conversion, it is still a defining characteristic and material deficiency of all cement and mortars using CAC constituents. The behavior of CACs is also very different than that of Portland cement mixes, therefore, with respect to application and testing, different results should be expected.

An increase in the past fifteen years in the use of these CACs in the rehabilitation of underground sewerage structures warrants a discussion and possibly an introduction to the Conversion process to many specifiers and municipalities. While being involved in hundreds of presentations, seminars, demonstrations and reading various trenchless technology

articles, I have never encountered the term. However, almost every technical write-up regarding CACs warns of the seriousness of Conversion and its effects on final products. In fact, Conversion is synonymous with Calcium Aluminate. The hydration processes of Ordinary Portland Cement (OPC) are quite different than the lesser known processes of CAC.

The objective of this paper is to introduce the term Conversion to the trenchless technology industry, principally to specifying engineers and to municipalities, so that it can be factored into the decision making process during the development of specifications for rehabilitation projects. It is important to discuss the effects of Conversion and the implications of CAC use in the rehabilitation of sewerage structures. Since this phenomenon does not occur with OPC, most engineers are not familiar with it, and it is not yet factored into material data sheets or testing data. In addition, there are some abnormalities and sensitivities associated with the application of CAC that need to be considered. Field application environments versus laboratory conditions are very different, and the

behavior of CAC is much more affected in the field than OPC. My objective is not to down-talk the use of CAC in the trenchless technology industry but rather to raise awareness and not ignore the obvious issues associated with these products. I will also include scientific sources to substantiate these claims.

#### History

Jules Bied patented CAC in 1908 when he fused bauxite and ferruginous material low in silica with lime with the intent to create a cementitious material with higher sulphate resistance. The new material exhibited surprisingly high early strength characteristics. Early manufacturing experienced considerable trouble where some batches were useable while other batches with the same exact mixes were found to be useless. Early discoveries first named the physical and chemical changes associated with CACs as “inversion”. When Thomas and Davey first noted the loss of strength in warm and wet conditions in 1929, these changes were associated with a change in color and loss in strength. By

the mid-1950s the term was changed from “inversion” to “Conversion” to more accurately describe the chemical change that was happening.

Significant research was conducted by Watkins and Lea, and Newman. The British Standard Code of Practice Digest No. 27 (1951) was published and recommended that the water to cement ratio (W/C) should be near 0.5. Reference was made to a loss in strength if the CAC was exposed to moist hot conditions. Precast members with post tensioning were casted under very controlled conditions with hope that Conversion would not be an issue, however, Conversion occurred. Thus, in 1964 the British Standards Code of Practice CP116 concluded that for precast concrete a w/c ratio should not be greater than 0.5, for reinforced concrete the w/c should be 0.4, the concrete should be kept cool and moist for the first 24hrs, then the concrete should be kept dry and cool after its initial curing. Building failures followed.

George (1974) concluded that, in some of these failures, the CAC was highly converted with porosity measured at 22.6 percent. Even though there were many successful CAC placements, CAC had much lower actual performance than expected in most applications. In 1973/1974 the UK Department of the Environment warned that buildings made with CACs remained suspect, and a recommendation was made that CACs should not be used in structural applications. Midgley (1990) concluded that: “prudence dictates that the structural design should be based on minimum converted strength”.

*\*This very brief history was taken from the paper “High Alumina Cement in Construction-A Future Based on Experience”, by Henry G. Midgley (1990). Midgley is considered the guru of, and the biggest proponent for the use of CACs.*

## Research

There is little scientific in-depth third party research available on CACs. Most research to date has been funded by CAC manufacturers. Even with this influence, the results of most of the research conducted over the last hundred years arrive at similar conclusions regarding Conversion. In the Doctoral Dissertation of Anthony

# “The hydration processes of Ordinary Portland Cement (OPC) are quite different than the lesser known processes of CAC.”

Bentivegna, (University of Texas, 2012), which can readily be found on the internet, pages 11-13 describe the chemical phases and chemical reactions of Conversion and explain the results as a reduction of strength due to the increase in porosity. The higher the water to cement ratio, the higher the increase of porosity over time, resulting in lower strength. In addition, placement of CACs in warm moist environments, increases Conversion and is not recommended by most research.

Significant research has been conducted in efforts to find additives, processes, and methods to mitigate the ill effects of Conversion. Very highly educated scientists with very generous funding and access to elaborate laboratories with plenty of cheap labor of highly educated undergraduates have made attempts to discover admixtures to combat Conversion.

Bentivegna (2012) restates research by Scrivener (2003), where, with phases of metastable hydrates of CA, conversion to more stable hydrates are very temperature and moisture dependent. At normal construction temperatures of 50 to 90 degrees F, the reactants are very unpredictable, compared to being more consistent at temperatures of 150 degrees F.

The American Concrete Pavement Association (1998) warns of the loss of strength of rapid hardening cements, as does the Texas Department of Transportation Tx-Dot SS-4491, by Barorak (2010).

## Application

What does all this have to do with the use of CACs in sewerage structures? Plenty!! An applicator in the field will experience a wide range of temperatures, wind, moisture and other environmental conditions which will lead to a large range of varying finished products. The applicator will only use enough water in the

cement mix to be able to spray, to spin cast, or to hand apply any cement. It is never the objective of the applicator to create more work for himself, therefore, only sufficient water is added to achieve the rheology needed for the application. The use of too much water will cause the wet mortar to slide down the walls. Too little water the cement mix will be too dry, and will not be able to pump or adhere to the surface.

There is very little horizontal flat work in the rehabilitation of underground structures. It mostly involves vertical wall applications and some overhead work. The manufacturer instructs the applicator to use only one gallon of potable water per bag of CAC plus or minus a quart depending on conditions, size of the bag, distance of pump to structure, and atmospheric conditions. Almost all applications of CAC are for the interior of the structure which will have 100% humidity, water vapor transmission created via hydrostatic pressure, in addition to varying water table level fluctuations, and loading of sewer water inside the structure. This usage totally contradicts the findings of HG Midgley (1990), George (1974), Scrivener (2003) and scores of other researchers, who state that very controlled water to cement ratios must be adhered to, and to apply CAC, in dry, not wet and warm, applications. Thus the use of CAC cement in underground structures is not recommended by researchers.

Ideally, more predictable hydration in CAC occurs at 150 degrees F. When applied in underground sewer structures as thin coats of half an inch, the structure wall acts like a heat sink, and keeps the material at 50 to 80 degrees F. At these temperatures and conditions, the end product will be unpredictable. Voluminous amounts of moisture released during the curing phases will create a w/c ratio well above the 0.4 threshold, chemical shrinkage will be unchecked, and the Conversion phenom-

enon that is unique to CAC will result in something else than what is stated in data sheets.

Even for manufacturers, when the cement mix is tested under ideal laboratory conditions, varying results also will occur, due to the fact that the hydration temperature is conducted below the ideal 150 degree F. In some cases entire batches of CAC are rejected and disposed of due to unpredictable results, with absolutely no known reason why the material behaves capriciously. We have seen similar results with several formulations. Unpredictable results are the norm with the use of Calcium Aluminate cements. This unpredictability is stated in research papers over and over again.

Applicators and product formulators are left in a quandary attempting to follow historical standards based on Portland cement products, when in actuality CAC is a very different material.

Once CAC is applied to a wall, it is extremely difficult for it to be troweled or consolidated, unlike OPC. The material will release a lot of water and fall off, therefore, most CAC applications are not troweled or

consolidated properly, which will contribute to an even higher porosity and permeability. Defects on the surface are typically corrected afterwards with different compositions of cements. In colder times of the year, CACs are much more sensitive and may not even cure for several days. If temperatures are under 55 degrees F, it is extremely difficult to pump and apply CAC. Hand applications at this temperature are very difficult and sometimes impossible. In sunny hot summer days, the material must be applied only early in the morning with very cold water. Past noon in most parts of country, the difficulty in application increases.

When CAC is mixed with water, a small amount of heat is liberated within minutes, then no hydration occurs throughout the next 2-3 hours (dormant period), followed by very rapid and almost complete hydration in 24 hours. (Kirca, 2006, p14)

### Specifications

Since all CACs and mortars Convert, specification for underground structure rehabilitation should include the converted

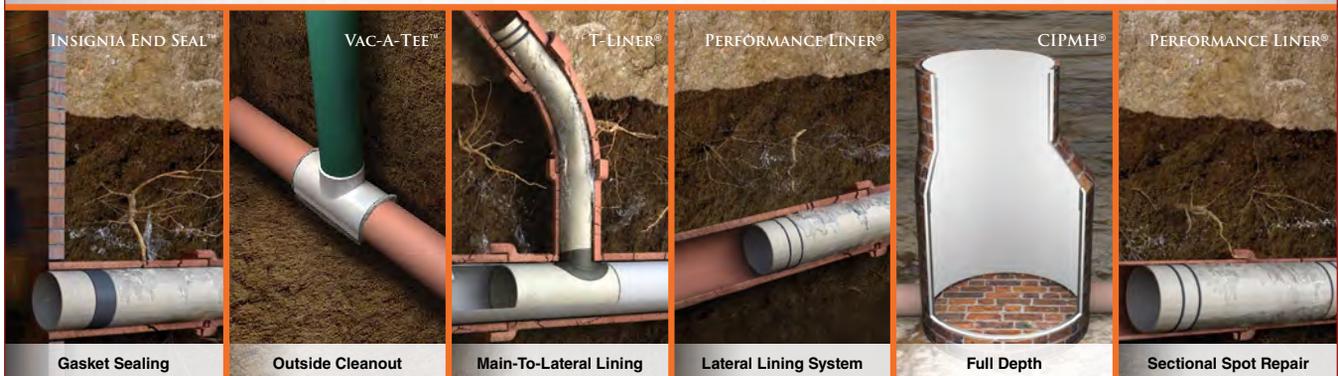
expected strength of the cement versus the 1-day, 7-day, and 28-day physical properties. The testing protocol should be conducted with similar amounts of water as required at installation, not at the 0.4, and lower, water to cement ratio. Curing of the test cubes should be in a similar environment to the structures in which it is applied. Since porosity is an inevitable result of Conversion, permeability measurement should be conducted after Conversion occurs.

### Conclusions

Calcium Aluminate Cements should be tested after Conversion. The porosity increases and a major decrease in strength occurs, thus, Conversion Happens!!! Real test data should include the Converted strength and porosity measurements. One-day and seven-day tests are meaningless unless longer tests are performed. The application of CAC in sewerage structures is against the recommendations of researchers, because hydration happens in temperatures of under 150 degrees F, and within



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areas of uncontrolled amounts of moisture. CACs cannot be troweled on walls to consolidate them. The taking of material for test samples might have to be altered. Since CACs are quite a different “animal”, using the typical sampling methods used for OPC will yield different results.

### End Quote:

**“Under virtually practical conditions, conversion is inevitable. However, provided the water/cement ratio is 0.4 or less, the stable converted strengths are satisfactory for most purposes. Therefore, any design must be made on the basis of this converted strength and testing of the concrete should ensure that it is satisfactory strength in the converted condition.”**

*-Lea's Chemistry of Cement and Concrete, 1935, p745*

### References

Barborak, R. (2010). *Calcium Aluminate Cement Concrete (Class CAC Concrete) Tx-DOT Special Specification SS-4491 Tip Sheet*. Austin, TX: Texas Department of Transportation Construction and Bridge Divisions.

*(\*Note that different mix designs are needed for flat work versus mortar. The size and quantity and type of aggregate are very different than for walls and ceiling of underground structures. This article can be found in the internet.)*

Bentivegna, A. (2012). Multi-Scale Characterization, Implementation, and Monitoring of Calcium Aluminate Cement Based-Systems. Doctoral Dissertation: University of Texas. (Can be readily found on the internet.)

Kirca, O. (2006). Temperature Effect On Calcium Aluminate Cement Based Composite Binders. Doctoral Thesis: Middle Eastern Technical University. (Can be readily found on the internet.)

Midgley, H. (1990). High Alumina Cement in Construction - A Future Based on Experience. In R. Mangabhai, *Calcium Aluminate Cements* (pp. 1-26). London: E. & F.N. Spon.

Scrivener, K. (2003). Calcium Aluminate Cements. In J. A. Newman, *Advanced Concrete Technology* (pp. 2/1-2/30). Oxford: Butterworth-Heinemann. †

### 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.*

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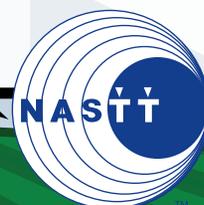
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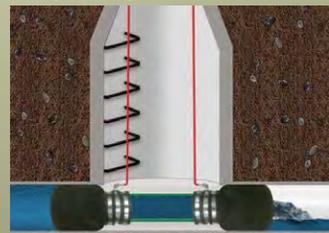
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