Western Regional Trenchless Review

2020

Guided Auger Boring in Sacramento

Beale AFB Water Line Rehab

Mile High Sliplines

T&D Services, Inc.
dba T&D Trenchless

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Pipe Ramming
Auger Boring
Pilot Tube Microtunneling
Pipe Jacking
Pipe Bursting

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Please contact us with any questions:

Tom Van Dyke, President
Office: 951-304-1190 • Fax: 877-812-7927 • Email: info@trenchless.biz • www.trenchless.biz

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ALSO:

Departments:

WESTT Chair – Lisa Arroyo
lisa@arroyotrenchless.com

WESTT Magazine Committee Chair – Michelle Beason, PE
mbeason@nationalplant.com

PUBLISHER

A TO B PUBLISHING INC.
662 Dudley Avenue
Winnipeg, MB Canada
R3M 1R8

EDITORIAL

Andrew Pattison
204.275.6946
marcomap@shaw.ca

ADVERTISING SALES

Bert Eastman
204.997.6371
bert@atobpublishing.com

PRODUCTION TEAM

harper media
your social media strategy & web marketing partner
700 - 200 Main Street
Winnipeg, MB
R3C 1A8

DIRECTOR

Aaron Harper
204.318.1121 xt. 101
aharper@harpermedia.ca

LAYOUT ART & DESIGN

Joel Gunter
204.318.1121 xt. 108
joel@harpermedia.ca

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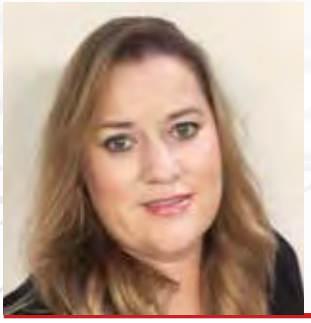

MESSAGE FROM THE WESTT CHAIR

Lisa Arroyo, P.E., Chair, WESTT

Although the past several months have been challenging for many due to Covid-19, the WESTT Chapter Board of Directors has been working hard on key initiatives that will benefit our membership.

In April, the chapter voted to approve amendments to the WESTT Bylaws. Amending our Bylaws was a significant work effort by the board. The updated Bylaws are now more consistent with the NASTT Bylaws, our Charter Agreement with NASTT, and our current operating practices. Thank you to all members who participated in the vote to amend our Bylaws!

On July 30th we launched WESTT's Trenchless Technology Webinar Series. This was the first of three webinars designed to provide our membership with quality education during the Covid-19 pandemic. Our 2nd Webinar was on October 1st and our third webinar is scheduled for December 10, 2020. If you have not attended one of the free webinars, there is still time to register. Please see our webpage for registration and additional details.

In October, we went live with our new website. Our website has a clean new look and provides a ton of information to its viewers. Please visit the home page where we post upcoming events, information regarding the WESTT Chapter and how to become a NASTT member. We have information regarding our committees and how to get involved. We have information regarding our past events and plan to post the webinar videos on the website so that you can view them at your leisure. If you have not seen our new website yet, please check it out at west.org.

On November 12, 2020, we will be holding a WESTT Chapter Virtual Chapter Meeting. Attending the Chapter Meeting is a great way to get involved. We will discuss the various WESTT committees and encourage our members to volunteer on one of the committees. Please see our webpage for registration details.

WESTT will be holding elections for new board members soon, so keep an eye out for an email announcing the details. If you wish to get more involved in the organization, I encourage you to run. The current board is filled with passionate individuals who work to advance the practice of Trenchless Technology through education, training, and research. I am truly honored to get to work with this very talented group of individuals. Interested parties should contact our Election Chair, Greg Watanabe, at **Greg.Watanabe@ghd.com**.

As I finish up my first year as Chair, I would like to thank the WESTT Board of Directors, committee chairs, and other member volunteers for their continued involvement. This has been a particularly challenging but rewarding year with all the work that has been accomplished. It has been an honor to work with so many passionate individuals who share the goal of advancing the practice of Trenchless Technology through education, training, and research for public benefit. A special thank you to Kate Wallin as my Vice Chair and Brian Avon, Immediate Past Chair. They have worked tirelessly to push forward with the webinars and other key initiatives that will benefit our chapter members.

> *"Thank you for your continued support of WESTT."*

To stay connected and hear about upcoming events, visit our website (**www.westt.org**) or LinkedIn account (WESTT NASTT). If you want to get involved in WESTT activities, please reach out to me or any of our Board members. Thank you for your continued support of WESTT.

Lisa Arroyo

Lisa Arroyo, P.E., Chair, WESTT

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MESSAGE FROM NASTT CHAIR

Craig Vandaelle, NASTT Chair

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

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

In August we launched our NASTT Good Practices Courses as virtual events. These courses are a rescheduling of the 2020 No-Dig Show Good Practices Courses and our entire suite of courses will be available as live training events. Our four-hour courses will take place in one day and our eight-hour courses will be split into two-day sections to allow for schedule flexibility for our attendees. All NASTT Good Practices Courses include Continuing Education Units, a training manual and the accompanying NASTT Good Practices Guidelines book if applicable. Visit nastt.org/training/events for the full schedule and registration details.

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

We are looking forward to coming together in Orlando next March for the NASTT 2021 No-Dig Show. It will be particularly exciting to come together again as a group and celebrate the trenchless industry in North America as we learn and network together. By all accounts, the NASTT 2019 No-Dig Show in Chicago was a resounding success, hosting a record-breaking 200+ exhibitors and over 2,200 attendees. We're going to come roaring back strong and break these records at No-Dig 2021 in Orlando!

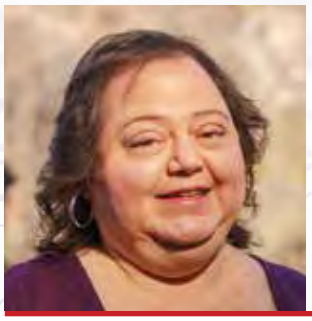
> *We are looking forward to coming together in Orlando next March.*

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

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

Craig Vandaelle

NASTT Chair



TALK TRENCHLESS

Carolyn Hook, NASTT Membership Outreach & Database Manager

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

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

Establish your professional identity.

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

Discuss industry-related hot topics with your peers.

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

Increase your network.

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

Find answers you need.

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

Pay it forward.

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

Access the right tools.

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

"It's Time to Talk Trenchless talk-trenchless.nastt.org"

How to Get Started

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

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

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

WESTERN REGIONAL CHAPTER

ELECTED OFFICERS:

LISA ARROYO - CHAIR
Arroyo Trenchless, Inc.

lisa@arroyotrenchless.com

Lisa Arroyo is the founder and owner of Arroyo Trenchless, a general engineering construction company in California. Prior to starting Arroyo Trenchless, Lisa was the Wastewater System Manager for the City of Santa Barbara.

During her 17-year tenure with the City of Santa Barbara Lisa oversaw the operation and maintenance of the City's wastewater treatment plant, collection system and laboratory. She managed a multi-million dollar Capital Improvement Program and a $20 million operating budget. Lisa has experience with both CIPP and directional drilling methodologies and has long been a champion of trenchless technology, as it is an effective and economical solution for improving wastewater collections systems. Lisa holds Bachelor of Science degrees in mathematics and civil engineering, and she is a licensed professional civil engineer in California. Lisa was elected to the Board of Directors for the WESTT Chapter in 2016, and was elected to the NASTT Board of Directors in 2018.

TIM TAYLOR – TREASURER
Carollo Engineers

ttaylor@carollo.com

Tim is currently the Infrastructure Practice Director and a Senior Vice President with Carollo Engineers. He has been working on water and wastewater infrastructure projects for over 33 years. Tim has been heavily involved in the planning, design, construction and project management of projects for water distribution systems, wastewater gravity sewer collection systems, large and small pump stations, storage reservoirs, as well as incorporating trenchless construction techniques for projects across the nation. He has also worked on pipeline condition assessment and rehabilitation projects for many clients.

Tim is registered to practice Civil Engineering in multiple states and has been working for Carollo Engineers for over 25 years.

KATHRYN WALLIN – VICE CHAIR
Bennett Trenchless Engineers

kate.wallin@bennetttrenchless.com

Kate Wallin is a Senior Scientist with Bennett Trenchless Engineers, located in Folsom, CA. She has been involved with trenchless design since 2005 and has provided design and construction management services on projects using horizontal directional drilling, microtunneling, pipe ramming, guided boring, and earth pressure balance pipejacking. Kate has cultivated relationships with owners, engineers, permitting agencies, contractors, and manufacturers for new installations using trenchless technology to improve the standard of practice in the field. She is a coauthor on the 2017 revisions of the Horizontal Directional Drilling Good Practices Guidelines and Presentation as well as the 2018 Trenchless 101 – New Installations course and book. Kate was very honored to be the recipient of the 2011 Trent Ralston Young Trenchless Achievement Award.

RACHEL MARTIN - SECRETARY
McMillen Jacobs Associates

martin@mcmjac.com

Rachel Martin has 19 years of experience in design and construction management on civil projects focused in the fields of water, wastewater, and hydropower. Her experience includes trenchless and tunnel design, development of contract drawings and specifications, construction management, design and constructability reviews, project controls, quality management, and cost estimating. Rachel has developed designs for microtunneling, pipe jacking, HDD, and sliplining projects throughout the US, Canada, and New Zealand.

BOARD OF DIRECTORS 2020-2021

ELECTED OFFICERS:

BRIAN AVON – PAST CHAIR
Carollo Engineers

bavon@carollo.com

Brian Avon is an Associate Vice President and Trenchless Technology Practice Lead at Carollo Engineers, Inc. Brian earned his B.S. in Business Administration and Management from the University of Southern California and his B.S. in Civil Engineering from the University of the Pacific. He has more than 14 years of experience in the planning, design, and construction management of water and sanitary sewer pipelines, with extensive experience in the condition assessment of pipelines and design of CIPP, pipe bursting, horizontal directional drilling, auger bore, and microtunnel projects.

JENNIFER GLYNN
Woodard and Curran Inc.

jglynn@woodardcurran.com

Jennifer Glynn is a Senior Technical Practice Lead and Principal for Woodard & Curran out of their Walnut Creek, California office. Jen has over 24 years of experience in Project Management and Infrastructure Design, with an expertise in Condition Assessment and Trenchless Rehabilitation.
Jen has been authoring papers and presenting at conferences both domestically and internationally for the past 20 years. She is a past Executive Board Member for NASTT and is currently an NASTT training course instructor for two classes: Introduction to Trenchless Rehabilitation and Pipe Bursting Good Practices. She is also a member of the AWWA Water Main Rehabilitation and Water Main CIPP Standards Committees.

DIRECTORS AT-LARGE:

MICHELLE BEASON – National Plant Services Inc.

mbeason@nationalplant.com

Michelle received a BS in Civil Engineering from Purdue University, and is a registered California PE with almost 30 years of water and wastewater experience. She has worked as a Project Engineer for Black &Veatch, as an Asset Management Engineer with the East Bay Municipal Utility District, she owned her own Engineering & Construction firm for 5 years, and for the last 10 years has specialized in multi-sensor inspections and trenchless rehabilitation of sewer, storm, and water assets. She is currently the Regional Manager for National Plant Services, Inc., covering the 12 Western States, including Hawaii and Alaska.
Michelle is also active in many industry organizations. In addition to serving as a Board Member of WESTT, she is a Board Member of NASSCO, and is Chair of the NASSCO Infrastructure Assessment Committee which manages all revisions to NASSCO's PACP/ MACP/LACP coding.

JACQUIE JAQUES – Sekisui SPR Americas

jacquie.jaques@sekisui-spr.com

Jacquie Jaques is the Regional Manager for Sekisui SPR Americas for the Western US. Jacquie has over 25 years of industry experience working with manufacturers and contractors specializing in pipeline condition assessment and trenchless rehabilitation solutions.
She started her career working for a technical services company specializing pipeline cleaning and CCTV condition assessment. During that time, she worked with municipalities, FEMA and OES on post-earthquake pipeline condition assessment inspection that enabled agencies to obtain federal funding for projects. With a high demand for cost effective solutions to repair our infrastructure, she became involved with cutting edge trenchless technologies that could meet stringent industry design and performance standards.
Jacquie has been actively involved in numerous industry committees over her career. Early on, she was a member and recording secretary for the "Green Book Pipeline Rehabilitation Task Force" which

DIRECTORS AT-LARGE:

JACQUIE JAQUES – CONT'D

evaluated new trenchless technologies that were germane to public works construction. This task group wrote the first Part 5 of the "Green Book" "Pipeline System Rehabilitation". Jacquie is still active on the committee today and works with the subcommittee to ensure that the specifications are current and still relevant to public works construction. As a WESTT Board Member, she is the Education Liaison for the university members and conducts the outreach on behalf of the committee. Jacquie has also authored several industry papers and presented at national and regional conferences including NASTT, WESTT, Pipe Users Group and HWEA. She has also authored or contributed to several magazine articles including NASSCO and Trenchless Technology.

SASHA MESTETSKY – Central Contra Costa Sanitary District

smestets@centralsan.org

Sasha Mestetsky is a Senior Engineer in the Capital Projects Division at Central Contra Costa Sanitary District (Central San) located in Martinez, California. He manages Central San's Collection System Program with an annual fiscal budget of approximately $40 million. Sasha is responsible for the design and construction management of all sewer system replacement and renovation capital improvement projects. Most of these projects utilize various trenchless technologies.

Sasha has over 25 years of experience in design and construction of collection systems projects. He holds a Bachelor of Science degree in Civil Engineering from California State University, Sacramento and is a California-licensed Civil and Mechanical Engineer.

Sasha serves as the At-Large Representative of WESTT Chapter Board of Directors. He is a long time member of Water Environment Federation (WEF), North American Society for Trenchless Technology (NASTT), and Northern California Pipe Users Group (PUG). Sasha is passionate about everything trenchless, enjoys sharing his experiences, and actively promotes trenchless technology education.

MIKE ROCCO – AUI Inc.

rocco@auiinc.net

Michael Rocco has over 30 years' experience in Trenchless Technologies and is the Trenchless Manager for AUI,Inc., headquartered in Albuquerque, NM. He obtained his Bachelor's Degree from the University of New Mexico in 1993 and received his CPE status - Certified Professional Estimator- from the American Society of Professional Estimators - ASPE - in 2016. His experience includes rehabilitation of water, storm sewer and sanitary sewer pipelines by Slip-lining, Pipe Bursting and Spiral Pipe Rehabilitation trenchless methods. He has been employed with AUI, Inc., for over 29 years and works in the estimating, project management and marketing departments.

GREG WATANABE - GHD

greg.watanabe@ghd.com

Mr. Watanabe is a Civil Engineer registered in California, Hawaii, and Guam and has more than 20 years of engineering experience of which the last 8 years have been largely focused on trenchless technologies for both rehabilitation and new construction. During this time he has planned, assessed, and designed over 100-miles of pipelines up to 96" for public utility systems. His project experience includes alternative construction and rehabilitation methods including horizontal auger boring, burst and insert, HDD, point repairs, CIPP, PCIPP, and microtunneling.

He currently manages the Linear Infrastructure business (which includes the Tunneling and Trenchless services sector) for GHD's US West region consisting of California, Arizona, Oregon, Washington, Hawaii, Guam, and Saipan. He is also GHD's managing Principal for the firm's NASTT No-Dig participation across North America. Mr. Watanabe manages a dedicated team of trenchless engineers throughout the US West who have been involved in over 100 trenchless construction projects installing over 250,000 feet of pipelines throughout North America.

BOARD OF DIRECTORS 2020-2021

COMMITTEE CHAIRS:

WESTT Conference & Webinar Committee:
Kate Wallin

WESTT Trenchless Review Magazine Committee:
Michelle Beason

WESTT Board Elections Committee:
Greg Watanabe

Student Chapter Liaison Chair:
Jacquie Jaques

The Western Society for Trenchless Technology Presents

Western Regional Chapter Trenchless Technology Webinar Series

Part 3: Thursday, December 10 11:00 – 12:30 PST

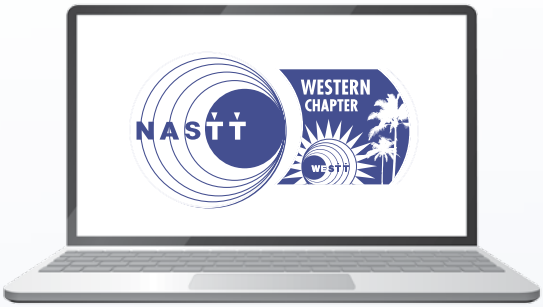
2020 WESTT Regional Chapter Trenchless Technology Webinar Series

Join us for the third in a series of Trenchless Technology webinars, WESTT is proud to host in 2020 in place of our annual in-person conference, exhibition, and training event. The first two webinars were held July 31 and October 1 and featured presentations covering trenchless rehabilitation and new installation topics.

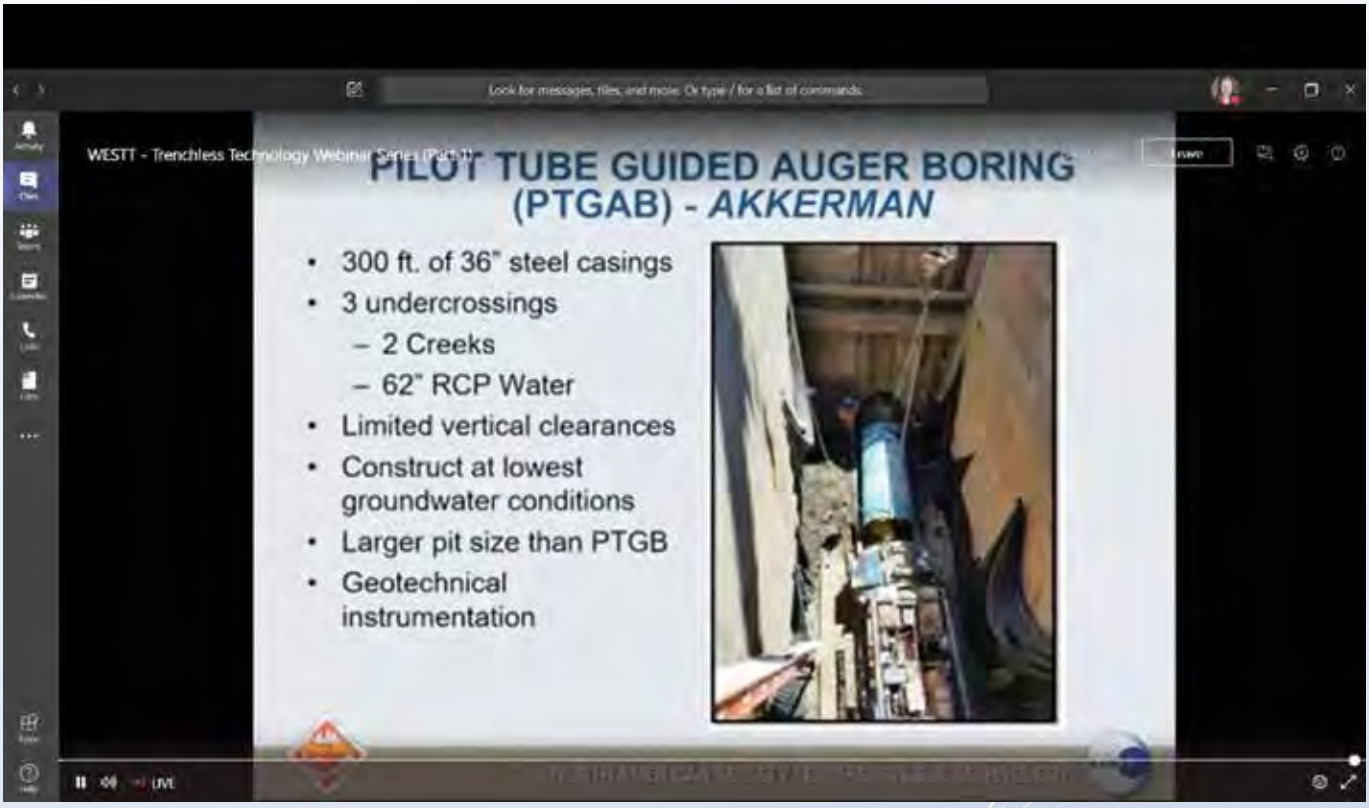
For information on the 3rd WESTT Chapter webinar held Thursday, December 10 11:00 - 12:30 (PST), or to register for the event please visit:

www.westt.org

WESTT Continues to Educate with Trenchless Webinar Series



By: Kate Wallin, WESTT Vice-Chair, Bennett Trenchless Engineers



The WESTT Chapter webinars are free, open to anyone who wants to attend

Traditionally, the Western Chapter of NASTT hosts an annual Conference, Exhibition, and Training in the fall which provides an educational opportunity for members within our region that may not have been able to attend the larger No-Dig Conference in the spring. Unfortunately, the emergence of the COVID-19 pandemic canceled the national conference and resulted in travel restrictions for many companies within the trenchless industry. The uncertainty regarding the ability to safely and successfully hold an in-person conference led the Board of Directors to pivot their efforts toward a virtual platform.

After several months of planning, WESTT launched their free Trenchless Method Webinar Series on July 31 and presented three case studies that

"Thank you for providing a webinar which showed trenchless technologies being used in construction projects!! The lesson learned from the project managers was great information"

Pilot Tube Guided Auger Boring, 36-inch I.D. Steel Casing

"I think it worked very well and possibly better than what one might expect pre-Covid."

Bypass pumping for CIPP Project

Auger-driven SBU for drilling through rock

covered a wide variety of topics in various areas throughout our region. The first presentation discussed pilot-tube and front-steer guided auger boring installation of 7,900 feet of 24-inch gravity sewer in densely developed neighborhoods in Pleasant Hill, CA. The second presentation discussed auger boring installation of 350 feet of 48-inch steel casing for 20-inch water main in San Diego, CA under Caltrans right-of-way in challenging rock conditions. The third presentation discussed emergency CIPP rehabilitation of a 16-inch ductile iron force main in Riverside, CA after multiple line ruptures. The presentations were each followed by a moderated session where webinar attendees could ask questions of the speakers to gain further insight into the design and construction processes for the trenchless construction projects.

Although the topics were focused on trenchless construction projects within the western region, registration for the free webinar was open to anyone who wished to attend. Over 350 people registered for the event and while most attendees were from within the western region, the webinar had wide-reaching participation from 31 states, Canada, Mexico, Brazil, Guam, and New Zealand! Feedback from the attendees was overwhelmingly positive and many elected to be automatically registered for future webinars.

Front Steer Guided Boring, Drill Casings Installation

"Nice selection of such seasoned professionals to present."

The second installation in the series was held on October 1, and presented another three case studies where various trenchless methods were used. The three papers discussed liner rehabilitation of a 60-inch trunk sewer in La Jolla, CA, an HDD installation of a 24-inch watermain under Pearl Harbor in Hawaii, and the pipe bursting replacement of a 16-inch gravity sewer in Newport Beach, CA. The Board is currently developing a third webinar to be held Thursday December 10. Registration for the December 10 webinar will be available on the WESTT Chapter's newly revamped website www.westt.org in early November. For interested parties that are not able to attend, recordings of the webinars are also available for viewing on the chapter's website: www.westt.org.

CIPP inversion tower

"Given the current situation and my prospects for traveling to a conference, this was a very welcome webinar."

Calling All Civil Engineering Students!!!

Are you looking to learn more about new pipeline construction practices? Advance your knowledge about new installation and rehabilitation technologies? Network with industry professionals and find new career opportunities? Then you should learn more about THE NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY (NASTT) and all of the great resources that you would have available as a student member of our organization.

MISSION

Founded in 1990, NASTT's mission is to continuously improve infrastructure management through trenchless technology. NASTT provides a representative voice for all sectors of the trenchless technology industry. It is affiliated with the International Society for Trenchless Technology (ISTT), and periodically co-sponsors with ISTT's International No-Dig Show.

STUDENT CHAPTERS

The rapidly developing field of trenchless underground methodology represents the leading edge of construction technology today. Students enrolled full-time in construction management, engineering and other related professional programs are seeking opportunities to keep abreast of these developments. One of the most effective ways of accomplishing this is by combining these individual efforts in the form of a student chapter. Student Chapters promote education, encourage networking and provide an avenue for growing NASTT and raising awareness of trenchless technology at the local level. NASTT has 17 student chapters throughout North America.

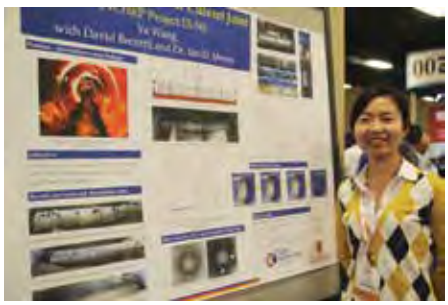
NASTT STUDENT MEMBERSHIP

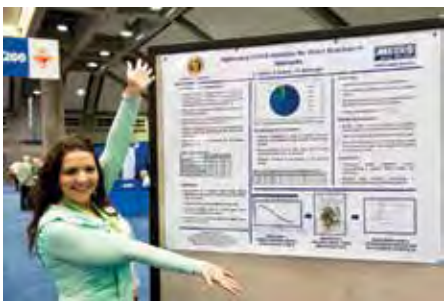
Student membership in NASTT is free and open to any individual who is a full-time student currently enrolled in a two or four-year undergraduate or graduate program of a nationally or regionally accredited educational institution of trade school or enrolled in a recognized apprentice program. The major interest must be related to the field of trenchless technology. Please note that student membership is available only to those students who are members of a current student chapter of NASTT.

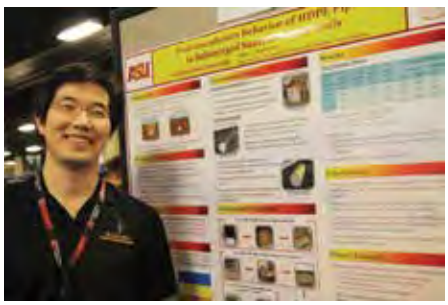
NASTT EDUCATION & TRAINING

NASTT offers eight training courses covering an Introduction to Trenchless Technology for Rehabilitation and New Installations; Horizontal Directional Drilling (HDD), Pipe Bursting, Cured-in-Place-Pipe (CIPP), Gas, Laterals and New Installation methods such as auger boring, pipe ramming, pipe jacking and the pilot tube method. The annual No-Dig Show is NASTT's education flagship event, offering an impressive collection of quality papers, an exhibition hall with more than 200 trenchless companies displaying their products and services, a series of specialized training courses and many entertaining networking events and special awards.

To learn more about becoming a member of NASTT and/or starting a Student Chapter at your university, please visit: **www. nastt.org/membership/student-chapters**







Northern California Pipe Users Group (PUG)

Pipe Users Group (PUG) of Northern California is a non-profit organization founded in 1992 comprised of local agencies, municipalities, consulting engineers, product suppliers, and industry related professionals. PUG's mission is "**Sharing Technologies Together**" and is dedicated to providing its members with current technical information and training opportunities to stay up to date with industry news and technology.

Surviving COVID-19. For nearly two decades, PUG has held monthly meetings at Brown & Caldwell's office in Walnut Creek where we would discuss projects, converse with colleagues, and enjoy presentations given by members or invited guests.

Then, as social distancing restrictions took effect, PUG, like most other professional organizations, was forced to begin virtual meetings. Since April, our monthly meetings are now conducted using Zoom Video Communications.

Although we're missing the face-to-face interactions, virtual meetings have allowed those working outside of typical driving range the opportunity to attend, and allowed us to attract speakers from further away. This has helped us to further our group's main goal which is to share information, so the more participation we have the more effective our group can be.

29th Annual Sharing Technologies Seminar will be held February 18, 2021 on a virtual platform. This is a great opportunity for us to share both our successful construction experiences and our lessons learned with others in the industry. We are currently accepting abstracts for presentations focused on new technologies, installation methods, project obstacles, challenges and successes.

Call For Papers:

2021 Sharing Technologies Seminar, February 18, 2021

DEADLINE: November 13, 2020

Join us for an Upcoming Meeting

- November 10th: Uni-Bell PVC Pipe Association on Best Practices for Specifying and Inspecting PVC pipe
- December 8th: Sewer AI will describe their NASSCO AutoCoding and Inspection Management Software

For more information, check out our website: **www.norcalpug.com**
Or drop us a line: **pugnorcal@gmail.com**

Guided Auger Boring Project Under UPRR Tracks in Sacramento CA

By: Justin Peterson, Carollo Engineers, Inc.
Mary Neher, Bennett Trenchless Engineers

INTRODUCTION

The City of Sacramento initiated a city-wide water meter installation program in 2005 to comply with California State Law Assembly Bill 2572 which requires urban water suppliers to install water meters on all unmetered municipal water service connections on or before January 1, 2025. In response to drought conditions, the City Council approved a resolution in 2015 to accelerate the water meter installation program. Approval of the resolution to accelerate the installation of water meters enhanced the City's ongoing water conservation measures and better enabled the City to promote conservation through consumption-based billing. Carollo Engineers, Inc. was selected to provide program management and engineering services for the new Accelerated Water Meter Program (AWMP). The AWMP is designed to enable the City to complete water meter installation by June 2021, three and a half years ahead of the State of California's deadline.

The AWMP is comprised of thirty projects throughout the City to meter approximately 40,000 residential, commercial, and irrigation water services. Given the large-scale construction effort, the City elected to leverage design and construction efficiencies by replacing aged and deteriorated water distribution mains concurrent with meter installations, thereby minimizing public disruption and reducing long-term rehabilitation and replacement costs. Of the more than 1,500 miles of water mains in the City, approximately 60 miles of 6 to 12-inch water mains were designated for replacement.

The River Park neighborhood was developed in the 1950s and is bounded by the American River to the north and Union Pacific Railroad tracks to the south with limited ingress and egress. The AWMP water main assessment indicated that nearly 90 percent of the neighborhood's 12 miles of water mains were in need of replacement, including a primary supply main crossing beneath the UPRR tracks.

Figure 1. Aerial view of guided boring crossing of the two sets UPRR tracks showing key project constraints. Work areas are shown shaded in red.

To maintain adequate water supply and system pressure, a new trenchless crossing of the UPRR tracks was required as there were no available corridors for open-cut main installation. Carollo partnered with Bennett Trenchless Engineers to assist with trenchless construction evaluation and design of the UPRR crossing.

PROJECT REQUIREMENTS

To meet the requirements of both the City and UPRR, a casing was required for the 12-inch cement-mortar lined and coated steel (AWWA C200) carrier pipe. The 0.75-inch thick wall, 20-inch diameter steel casing required passive magnesium anode cathodic protection for long-term corrosion control. UPRR required that launch and reception shafts be located a minimum 50 feet from their right-of-way and ground settlement be monitored to verify that track settlement was limited to less than 0.25 inches.

The only feasible launching and receiving locations for trenchless installation of the new pipeline were an industrial laundry parking lot on the south side of the UPRR tracks (launching shaft) and a community baseball field on the north side (receiving shaft). A City storm drain pump station with a 66-inch diameter force main represented an additional alignment constraint in the industrial parking lot. Due to limited space and the presence of several existing

utilities between the UPRR right-of-way and outfield fence, the smaller receiving shaft was located in the ballpark's centerfield. Work areas were identified on both sides of the crossing to limit impacts to operations of the industrial laundry and to minimize necessary restoration in the baseball field. The launching and receiving shafts and their work areas for the 250-foot trenchless crossing are shown in Figure 1 with key project constraints.

Due to the high public visibility of AWMP construction, careful coordination with groups that would be potentially impacted by the trenchless work was required. The primary schedule driver was the local baseball league, which required use of the field by September 1, 2020. To ensure that construction would not impact operations at the baseball field, the contract documents included a requirement that all trenchless construction, including restoration of the outfield grass, be completed by August 31. Because of the strict schedule requirements, close coordination with UPRR was required to avoid delays to the contractor's construction sequencing.

TRENCHLESS DESIGN

Two geotechnical borings were drilled on either side of the UPRR embankment to evaluate the anticipated ground conditions for the trenchless crossing. Both borings encountered mixtures of sand, silt, and clay with generally medium stiff and medium dense consistencies. Groundwater was encountered approximately 20 feet below the ground surface, approximately 10 feet below the pipe invert, indicating that watertight construction methods were not necessary.

Several trenchless construction alternatives were identified as potential candidates for completing the trenchless crossing including auger boring, guided boring, pipe ramming, and microtunneling. All four alternatives were deemed technically feasible for the anticipated geotechnical conditions and approximately 250-foot crossing length. Two of these methods, however, were considered less desirable for this project due to logistical constraints. Pipe

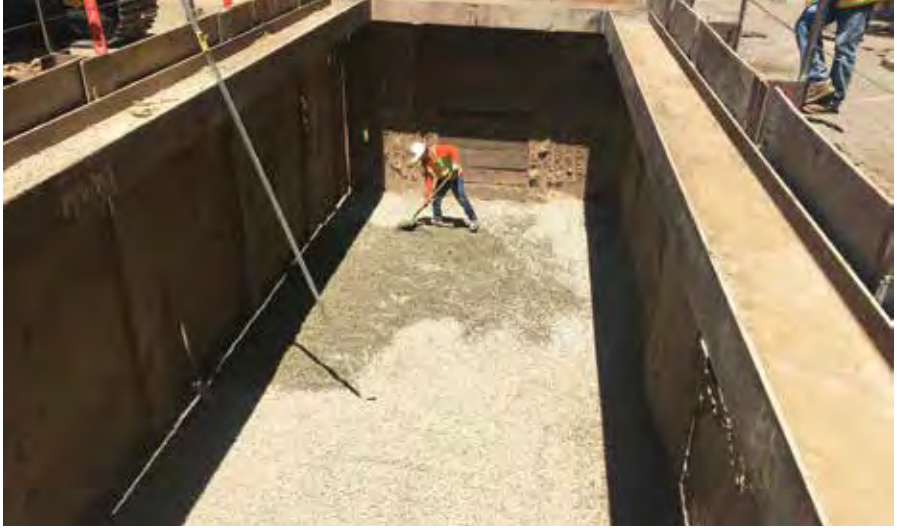


Figure 2. Launch shaft constructed using soldier piles with steel plate lagging due to low groundwater and stable ground conditions.

Figure 3. Auger boring rig set in the launch shaft with pilot tube guided boring equipment in foreground. Installation of 250 feet of guided pilot tubes took two hours.

Figure 4. Reception shaft located in community baseball park's centerfield. Careful coordination with local baseball league was required and construction schedule was restricted to minimize construction impacts on community.

ramming, although generally well-suited to crossing railroad embankments, was eliminated from consideration for this project due to noise concerns for the nearby residential neighborhoods and its lack of steering capabilities. Microtunneling was eliminated from further consideration due to its relatively high cost and relatively long construction schedule compared to the other feasible methods.

Although auger boring and guided boring were both viable and cost-effective trenchless installation alternatives, guided boring was selected as the preferred construction method. This decision was made due to the limited steering capability of auger boring and relatively minimal cost impact of adding the pilot tube guidance step to the process. Limited steering was not a concern from the perspective of the pressurized water line installation, where line and grade were not as critical as they would have been for a gravity pipe. However, steering limitations were a concern due to the risk of striking or damaging the site features on the northern side of the crossing which included trees, existing utilities, and baseball field infrastructure (scoreboard, lights, etc.). The design team felt that the additional cost of specifying the pilot tube guidance step was offset by reducing the risk of schedule impacts and/or claims due to damaging or striking an existing site feature.

Figure 5. Pilot tubes entering reception shaft and being removed as 20-inch casing is advanced. Pilot tubes entered reception shaft precisely on line and grade.

Figure 6. Auger boring installation of 20-inch casing beneath two sets of UPRR tracks.

CONSTRUCTION

The general contractor for the trenchless crossing was Navajo Pipelines (Sacramento, CA) with Pacific Boring (Caruthers, CA) as the trenchless subcontractor and Blue Iron Foundation and Shoring (West Sacramento, CA) as the shaft subcontractor. Blue Iron mobilized for shaft construction on July 8, 2020. Both the launch and reception shafts were constructed with soldier piles and steel plate lagging due to the low groundwater and stable ground conditions. The 10-foot deep launch shaft, including placement of the crushed rock shaft floor, was completed on July 13 (4 days) and the 11-foot deep reception shaft was completed on July 16, 2020 (3 days).

Pacific Boring mobilized to the launch shaft on July 20, 2020 and launched guided boring operations the following day. A UPRR representative was on site throughout guided boring operations to ensure that the approved work plan was followed. Pacific Boring began installation of the pilot tubes at 10:30 in the morning and by 12:30 had successfully installed the tubes to the back of the shoring in the reception shaft. The pilot tubes were pushed into the reception shaft and survey confirmed that they had been precisely installed on design line and grade. With plenty of work hours remaining in the day, Pacific Boring then proceeded to remove the pilot tube equipment from the pit and completed installation of the first section of 20-inch casing. Installation of the remaining 240 feet of 20-inch casing took place over the following two days. Installation of the 12-inch cement-mortar lined and coated product pipe inside the steel casing was completed in three days, completing the trenchless components of the project.

Site restoration included removing

Figure 7. Installation of 12-inch cement-mortar lined and coated steel carrier pipe inside the 20-inch casing installed with guided boring took three days.

all shoring elements, backfilling and compacting the excavation, repaving the parking lot (including a section of pavement outside of the shaft footprint where construction equipment had caused damage), and reseeding the baseball field. Due to COVID-19 halting baseball operations, the completion deadline of September 1 was no longer a schedule constraint. Given the extra time available, the City is currently considering additional improvements to the ball field.

SETTLEMENT MONITORING AND RESULTS

As mentioned previously, one of the UPRR permit requirements for the trenchless crossing of their facilities was to limit track settlement to less than 0.25 inches. During design, a settlement evaluation was performed to identify the risk of exceeding this limit based on anticipated ground behavior for the selected trenchless construction method. An important component of the magnitude of settlement anticipated due to the collapse of the annular space between the pipe and the excavated bore (commonly known as systematic settlement) is the clearance between the bore and the feature of interest. For this project, the two sets of UPRR tracks were located on an embankment approximately 18 feet above the surrounding ground. The increased clearance provided by the embankment allowed the designer to avoid deep shafts while still maintaining low risk of settlement damage to the tracks.

During construction, settlement values were monitored using six sets of surface settlement monitoring points. Each set consisted of three points: one over the centerline of the bore and one offset 10 feet on each side of the centerline. Three sets of points were located inside the UPRR right of way, but none of them were at track level due to limited work area at the top of the embankment and safety concerns related to installation and reading of the survey points. All monitoring points were located at the elevation

of the surrounding grade (which was approximate the elevation of the toe of the UPRR embankment). Settlement points were monitored during shaft construction, daily during guided boring operations, and at intervals following completion of the crossing to check for possible ongoing ground movements.

Three of the 18 total settlement monitoring points exhibited ground motion values greater than 0.25 inches (just over 0.02 feet) during construction. It is notable, however, that no point was surveyed to have moved more than 0.03 feet (0.36 inches) at any time. On the surface, this might have been alarming but there were several factors that indicated to the design team that there was no cause for alarm. One of the three points showed 0.03 inches of ground movement the first time it was surveyed after the initial reading, well before guided boring operations began. Additionally, since the tracks had an additional 18 feet of cover, it was determined that even if settlements at the elevation of the surrounding ground surface were a hundredth of a foot greater than 0.25 inches, track settlements would be significantly less and therefore permit conditions were still met. Ultimately, the settlement monitoring points within the UPRR ROW did not indicate track settlement greater than 0.25 inches caused by guided boring operations and the points did not show any additional or continuing ground movement after trenchless operations were complete.

ACKNOWLEDGEMENTS

To date, approximately 94 percent of AWMP meters and 88 percent of water main replacements have been installed with final completion anticipated by mid-2021. The authors would like to thank Michelle Carrey (City of Sacramento DOU, Supervising Engineer), Marc Lee (City of Sacramento DOU, Senior Engineer), and Chris Powell (City of Sacramento DOU, Construction Coordinator) for their support and contributions to this article.

ABOUT THE AUTHOR:

Justin Peterson, PE, *is a Senior Engineer with Carollo Engineers, Inc. located in Sacramento, CA. Justin has 12 years of experience in planning, design, and construction of water and wastewater infrastructure.*

ABOUT THE AUTHOR:

Mary Neher, PE, *is a Senior Project Engineer/Project Manager with Bennett Trenchless Engineers located in Folsom, CA. Mary has 13 years of experience designing and inspecting trenchless projects including HDD, microtunneling, and guided boring construction methods.*

Beale Air Force Base Water Line Rehabilitation

Existing Water Main Sliplined with Fusible PVC® Pipe

By: Jacob Ferriera, Underground Solutions

Beale Air Force Base (AFB) currently covers approximately 23,000 acres of rolling hills just north of Sacramento, California. The base has a rich military history dating back to World War II, when the facility was far busier than it is now. Through the years, Beale AFB's functionality has been reduced, and much like any infrastructure as age sets in, so does the need for repair. Even though a diminished active population reduces the stress on infrastructure, the 50+ year old water system at Beale AFB needed rehabilitation.

There is a large amount of space associated with Beale AFB and the water system that serves it. The overall scope of this project required the rehabilitation or replacement of approximately two and a half miles of their existing water system. Typically, aging pipes would be dug up and replaced in kind. However, current environmental concerns would not allow for simply digging up the old system and installing new pipe. To minimize environmental impact, Greg Haling of Haling and Associates, the design engineer for this rehabilitation effort, had to consider modern trenchless solutions.

Existing 18-inch concrete lined steel water pipe had an I.D. of 17.5 inches

Haling reviewed the viable trenchless options, including horizontal directional drilling, pipe bursting, cured-in- place pipe, sliplining, and other options. Several different trenchless technologies were utilized on various phases of this project, but Haling chose sliplining as the rehabilitation solution best suited for the design on this phase. Sliplining, or loose-fit sliplining, is when a new pipe is slid inside an existing pipe, reconnected at either end, and the new, smaller pipe is then used as the new asset.

Project site had wide open spaces for pipe layout

This method limits excavation and surface disturbance because rehabilitating the old pipeline only requires digging at either end for entry and exit pits for the new pipe. This method drastically reduces land disturbance and subsequent environmental impact. For a loose-fit slipline solution to be acceptable, pipe flow area reduction must be acceptable. However, since Beale AFB has seen a historic decrease in overall functionality, its water system demand has also been reduced and the flow area reduction was manageable.

Typically, in loose-fit slipline applications, two replacement pipe material choices are used: high-density polyethylene (HDPE) or Fusible PVC® pipe. Both pipe materials are assembled into long, monolithic lengths using thermal butt-fusion and then pulled into the existing pipe during the sliplining process. While both pipe materials will work, the hydrostatic design basis of PVC is two and a half times that of HDPE. This means that for a given pressure

> *This project required the rehabilitation or replacement of approximately 2.5 miles of existing water system.*

Pipe was pulled using the winch cable, which worked well

requirement, Fusible PVC® pipe has a thinner wall than HDPE pipe. When it comes to sliplining applications, the outer diameter of the new pipe is fixed by the inner diameter of the existing pipe. For a given outer diameter and pressure class, Fusible PVC® pipe has a larger flow area and capacity than HDPE pipe. In addition, less material means less material cost, leading to a lower cost alternative in using Fusible PVC® pipe. Ultimately, 14-inch DR 25 Fusible PVC® piping was chosen as the sliplining material for this phase of the project.

TEPA, LLC was awarded the water line rehabilitation work to slipline an existing 18-inch concrete lined steel water pipe at Beale AFB. The existing steel pipe had quarter-inch thick walls, which resulted in an inside diameter (I.D.) of 17.5 inches. The outside diameter (O.D.) of the 14-inch Fusible PVC® pipe was 15.3 inches, which allowed for just over two inches of annular space. A minimum clearance of two inches between the O.D. of the new pipe and the I.D. of the existing pipe is an industry standard best practice for loose-fit sliplining applications.

The project site provided the luxury of wide-open spaces for pipe layout, so the new pipe was pre-fused into long runs prior to pulling it into the host pipe. Entrance and exit pits were strategically located to minimize environmental impact and double as necessary excavations for valves, fittings and other appurtenances. In order to pull the pipe into place, TEPA chose to use a TT Technologies 12-ton constant tension winch with 2,300 feet of pulling cable, which worked well for the application.

While getting prepared to pull the pipe, TEPA found that the standard external pull head for the 14-inch Fusible PVC® pipe turned

Fusible PVC® pipe during the slipline insertion process

out to be slightly too large to fit inside the existing pipe. Instead of swapping it for a lower profile internal pull head, TEPA simply drilled bolts through the front of the Fusible PVC® pipe and hooked

Fusible PVC® pipe utilizes standard waterworks fittings for reconnections

Pipe was installed in typical run lengths of 500-1,000 feet

the winch cable to the bolts for pulling the pipe. This setup worked well and they installed approximately 8,415 linear feet of 14-inch DR 25 Fusible PVC® pipe in typical run lengths of 500-1,000 feet.

After the Fusible PVC® piping was pulled into place, it was reconnected to the existing water main piping using standard waterworks fittings with restrainer glands, so tie-ins were simple with no special fusion equipment or knowledge required. Overall, the loose-fit sliplining technology proved to be an efficient and cost-effective means of rehabilitating a significant amount of existing water main piping at Beale Air Force Base. As Greg Haling concluded, "Underground Solutions provided excellent technical and onsite support throughout the project. Their proposal was thorough, complete and provided everything we needed to complete our design and feel confident with Fusible PVC® pipe."

ABOUT THE AUTHOR:

Jacob Ferriera *has sales responsibility for Northern California, Northern Nevada, and Hawaii. Prior to joining Underground Solutions/Aegion, he spent 2+ years as an Outside Sales Engineer selling pumps and pump service throughout California's Central Valley in the Industrial, Food and Beverage, and Municipal Water/Wastewater markets. Before that, Jacob spent 10 years as an Application Engineer with various responsibilities related to Pumps, Mixers, and Jet Aerators in the Municipal Wastewater industry. He has a BS in Manufacturing Engineering from California State University, Chico.*

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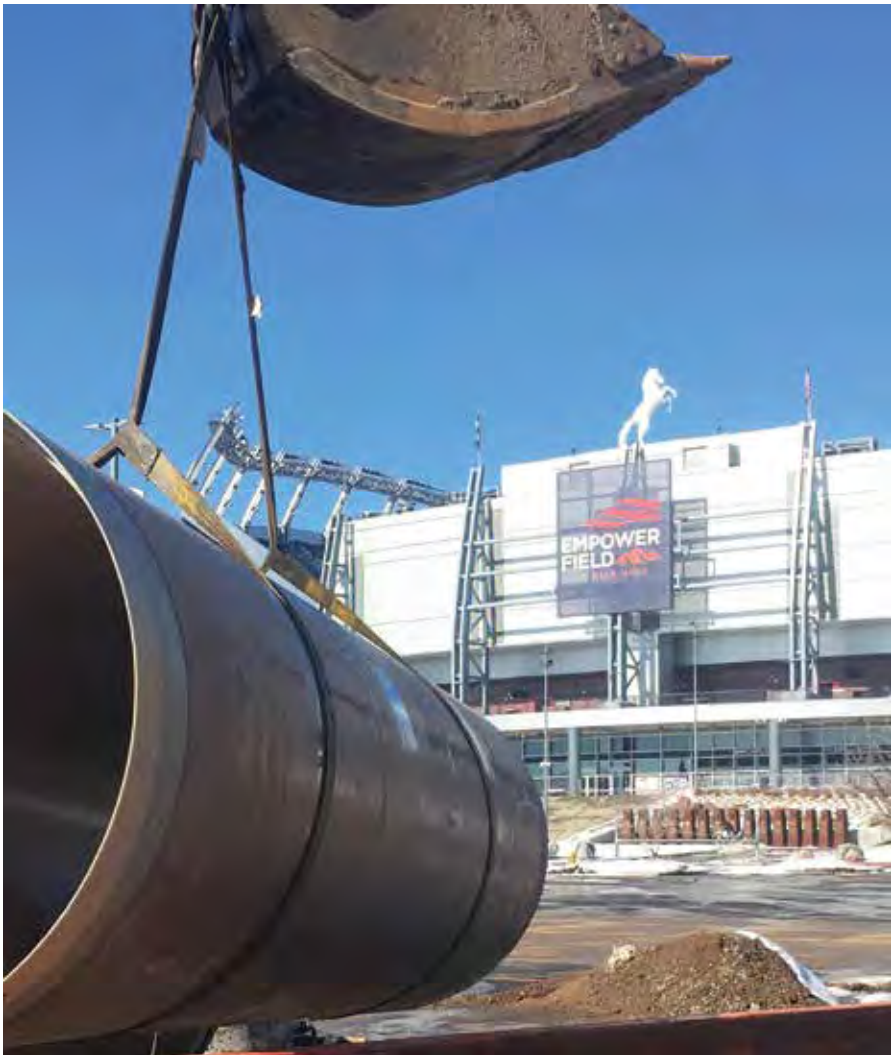
Sliplining @ Mile High!

AUI Inc. Rehabs Denver Broncos Stadium & Colorado Army National Guard Sewerlines

By: Mike Rocco, AUI Inc.



High strength thin wall of Hobas pipe segments ideally suited for sliplining large diameters

Although no fans, or very few, are currently allowed to attend Denver Broncos football games at least the sewer is still flowing with no disruptions. AUI, Inc., a heavy civil contractor from Albuquerque, NM successfully completed a large diameter sewer interceptor rehabilitation project for the Metro Wastewater Reclamation District (MWRD) located in Denver, Colorado. The project had two different locations within the City of Denver. The first location started in front of the Denver Broncos Football Stadium and traveled south under a creek. The second location was at the Colorado Army National Guard Recruiting office, and ran parallel to the South Platte River.

When the new Denver Bronco Football Stadium was built they constructed a new 72-inch sewer around the stadium, however the upstream section of the 72-inch RCP line had never been rehabilitated. The old sewer line at the stadium was a 72-inch RCP line that started close to the entrance of the stadium and traveled south under a creek. This remaining segment of old 72-inch line was installed in the 60s and was in need of rehab due to age and hydrogen sulphide attack. The sewerline has manholes located approximately 500 LF from each other. However, there was one manhole segment that was laid in a curve linear alignment.

Ever-changing Denver weather added to the challenge

Since the line curved, we used 10-foot segments of pipe manufactured by HOBAS to negotiate this curve.

The other segment of older sewer line needing rehabilitation was at the Colorado Army National Guard Recruiting center. This section had two different sizes of pipe to slip-lined. The first was an old 90-inch RCP and the second was an old 72-inch RCP line. The 90-inch RCP was to be rehabilitated with an 84-inch HOBAS Pipe with an outside diameter size of 88 inches and the 72-inch RCP was to be rehabilitated with 69.3-inch outside diameter pipe. Most of the work at the Army National Guard Recruiting center ran next to the South Platte River and the rest of the segment was in the Recruiting center parking lot. AUI.Inc., had never attempted to slip-line a large diameter 90-inch pipe before so this would be a first for our trenchless crew! The biggest pipe we had previously rehabilitated was 72-inch RCP and this new 84-inch slipline would be extremely challenging.

Ten-foot pipe segments were used to slipline the curved section of host pipe

BRONCOS STADIUM

The MWRD had specified 66-inch HOBAS Flush Relign pipe as the material to be slip-lined inside the 72-inch RCP at Broncos stadium. This pipe has an inside diameter of 66 inches and an outside diameter of 69.3 inches. Hobas is widely used in sliplining for many reasons. The pipe high strength yet thin wall allows for the largest possible inside diameters after rehabilitation. Often flow is maintained or even increased even though there has been a reduction in diameter. The corrosion

Twenty-foot pipe segments were lowered into the insertion pit

Custom fabricated push plate was used to evenly push the pipe into the host RCP using an excavator

Closure couplings joined both sections of pipe once sliplining was completed in both directions

> *"We'd never attempted to slip-line a large diameter 90-inch pipe before so this was a first for our trenchless crew!"*

resistant fiberglass composite provides for a long maintenance free 100-year design life. Hobas has been manufacturing fiberglass pipe at its Houston facility since 1987 and has been providing pipes to the Denver area since 1996.

The slip-line process began with cleaning and televising the existing RCP sewer to visually inspect the old pipe. After review of the video and one-call made to locate the existing utilities, an Insertion Pit was strategically located along the sewer line for the insertion of pipe. At the insertion pit a 26 x 12-foot trench box was installed and the existing 72-inch RCP sewerline was exposed, the top half of the pipe was saw cut and removed. After the top half of the sewer was removed a test mandrel was pulled through the sewer to verify clearance of the new 69.3-inch O.D. pipe segment.

After these preparations were complete, the new pipe was installed inside the old pipe. The loader would bring a segment of pipe, usually 20 LF to the insertion pit and the excavator picks up the pipe joint and sets it in the old 72-inch RCP, which was cut to the spring line. After the pipe is set a custom made push plate is used to install the new pipe segment inside the old RCP. The push plate is made to evenly push the pipe inside the old RCP using an excavator. Heavy duty rubber pillows are then placed between the old pipe and the

Sliplining 84-inch pipe inside the 90-inch RCP set a new record for the AUI crew!

new pipe in order to hold the new pipe segment in place while the excavator stabs the next joint. This process is repeated and continues until all of the pipe is installed. This installation was completed while the sewer around the stadium was still flowing. No-by pass pumping was ever required on this project!

Once all the pipe segments were slip-lined in both directions from the insertion pit, a closure coupling was attached to join the two sections of pipe in the pit. Flowable fill or Lean fill is placed on top of the Hobas pipe in the insertion pit and the old cut sections of the RCP are placed on top of the Flowable/Lean fill. The insertion pit is then backfilled with excavated material and the surface is restored. The line segments were grouted with a slurry between the old host pipe and the new pipe. A final CCTV run confirmed the integrity of the newly installed sewer line.

COLORADO ARMY NATIONAL GUARD

Slipline rehabilitation of the old sewer lines at the Colorado Army National Guard followed a similar installation process to the work at Broncos stadium. The existing 90-Inch sewer was in need of rehabilitation and the new pipe was 84-inch Hobas Flush Relign Pipe. The most challenging aspect of this segment was cleaning the old 90-inch pipe. A lot of wire, rope, steel, bricks and you name it were pulled out of the sewer and disposed of properly. Once the sewer was cleaned and televised the new 84-Inch Hobas fit right in with no problems. This 90-inch host RCP was the largest diameter our crew had ever sliplined before!

Project Summary:

Bronco Stadium Segment:	2,011 LF of 66-inch Hobas Flush Relign Pipe
Colorado National Guard Segment:	1,739 LF of 84-inch Hobas Flush Relign Pipe

SPECIAL THANKS TO THE FOLLOWING WHO MADE THIS JOB A SUCCESS!

AUI Project Manager: Corey Bond
AUI Project Superintendent: Archie Lucero III
AUI Foreman: Miguel Acosta
AUI Foreman: Jeramie Schafer

ABOUT THE AUTHOR:

Mike Rocco has been employed with AUI, Inc., for over 27 years and works in the estimating, project management and marketing departments. His experience includes rehabilitation of water, storm sewer and sanitary sewer pipelines by Slip-lining, Pipe Bursting and Spiral Pipe Rehabilitation trenchless methods. Mike has well over 30 years' experience with various trenchless applications, and is a long-serving Director on the WESTT Chapter Board.

Wastewater Service Laterals: The Most Neglected Sewer Pipes

- Lateral Ownership, Issues, Regulatory Drivers, and Repair Solutions.
- Lateral Lining... the Versatile and Cost-Effective Rehabilitation Choice.

By: Michelle Beason, PE, National Plant Services, Inc.

In the United States, there is estimated to be over 800,000 miles of sewers that serve the public, and an additional 500,000 miles of private sewer laterals that connect businesses and residences to the public sewers[1]. These critical pipelines are located under public streets and through private properties to safely transport wastewater for treatment, reuse, and disposal.

Public agencies and cities that own the public sewers are required to maintain and inspect these sewers on a regular basis, making timely repairs as needed. However, service laterals have long been ignored and/or overlooked by many agencies due to the historically private nature of the ownership of most laterals. In addition, public funding has typically been prioritized to maintain and repair the larger public sewers, many that are reaching the end of their remaining useful life (RUL). Private owners often don't even realize that they own their sewer laterals, and will not even think about them until there is a problem with their lateral, or until they are forced to make repairs by the public sewer owner.

LATERAL OWNERSHIP

Lateral ownership varies greatly by state, and even varies between adjacent cities. Sewer laterals have been historically owned and maintained by private property owners. Prior to trenchless technology repair options, the only way to repair a failed lateral was to dig it up and replace it with new pipe. As these laterals often lie under pavement or expensive landscaping on private property, cities were reluctant to get involved, so left the maintenance and repairs up to the property owners. The types of lateral ownership that are most common are as follows:

Historically, most sewer laterals are owned and maintained by private property owners

- Property owner owns the entire lateral from the connection at the main sewer to the structure.
- City owns from the sewer connection to the private property line; Property owner owns the lateral from their property line to the structure.
- City or agency owns entire lateral from sewer connection to the structure.

COMMON LATERAL PROBLEMS

Older sewer laterals were typically made of cast iron or clay. Most of those have reached the end of their useful life and are in need of repairs or replacement. Cast iron pipe will rust so much that the walls get thin and holes develop in the pipe walls, which allows roots to enter and exacerbate the failure. These pipes will also corrode from the inside and severely restrict the lateral capacity, possibly causing a backup into a home. Clay pipes suffer from earth movement and develop cracks and offset joints, often leading to collapse, which also allow roots to enter and further degrade the lateral.

Cast iron corrosion

Clay pipe root intrusion

When these pipes fail in this manner, a more significant issue that affects nearby citizens and the environment is 'exfiltration' of the wastewater from the damaged pipe into the surrounding soil, groundwater, streams, and even public beaches. The extent of this exfiltration problem has only recently been studied and evaluated.

Elevated E-coli levels have been found in the soil of cities with the worst lateral problems. In California, the State Water Resources Control Board has implemented a TMDL (Total Maximum Daily Load) program that requires collection system owners to find and eliminate the sources of pathogens entering waterways and beaches. This program is requiring system owners to implement sewer and lateral inspection and repair programs to locate and stop these sources of TMDL[2].

Another issue with failed sewer laterals is groundwater 'infiltration' into the failed laterals. It is estimated that up to 80 percent of all infiltration and inflow into collection systems can be from service laterals. This creates significant additional wastewater treatment costs to treat this additional water, plus requires larger size sewer mains to transport this surge of infiltrated groundwater during wet weather.

Many cities and agencies didn't previously correlate wet weather quantity surges to a problem with sewer laterals. Millions of feet of public sewer mains were lined across the U.S., with only a minor reduction in infiltration surges, resulting in greater attention and infiltration studies now directed towards sewer laterals.

Community	Percentage of I/I from Private Sources
Lower Paxton Township, PA	60%
Lynchburg, VA	20%
Houston, TX	80%
Columbus, OH	55%
Washington Suburban Sanitary Commission	43%

Estimated I/I Associated with Private Sources. (Source: Report for Sanitation District No. 1 of Northern Kentucky, October 2006[3])

REGULATORY MEASURES TO ADDRESS PRIVATE LATERALS

Over the past decade, we have noticed more public agencies and cities passing regulations that require homeowners to inspect and then repair their failed sewer laterals. Inspection types vary by jurisdiction, but are either completed by a Closed Circuit Television (CCTV) inspection or through an air test of the lateral.

One such agency is the East Bay Municipal Utility District (EBMUD) in Oakland, CA. EBMUD and the cities that contribute to the EBMUD wastewater system implemented the Regional Private Sewer Lateral (PSL) Ordinance beginning in 2011. The ordinance applies if you are buying and selling property, building or remodeling a structure, or changing the size of a water meter[4]. If one of these conditions exist, the sewer lateral must undergo and pass an air test to verify there are no leaks. If the lateral is free of leaks, a compliance certificate is issued, allowing the owner to obtain a permit or transfer title on their property. If the verification test fails, the lateral must be repaired.

More agencies are implementing these types of programs to facilitate repair of these neglected sewer laterals, while passing on the cost to the property owner. While unpopular at first, most property owners eventually accept this regulatory process as a necessary cost of home ownership, and a way to protect the environment and the public.

Where public or political pressure prevents a public agency or city from requiring owners to test and repair laterals, some agencies are deciding to take over the maintenance and repair of the private laterals themselves. Root issues can travel down sewer laterals and into mainline sewers, causing frequent maintenance issues and blockages in the public sewers. By repairing the laterals, the agency reduces future maintenance costs caused by the failed lateral condition.

In addition, agencies have repaired laterals as part of an infiltration reduction program, where lateral repair costs far undercut what they would spend to upgrade their wastewater collection and treatment facilities. Agencies have also developed programs to share costs with homeowners, and some have developed payment plans to help lessen the financial hardship on homeowners by adding the repair cost to water bills or property taxes.

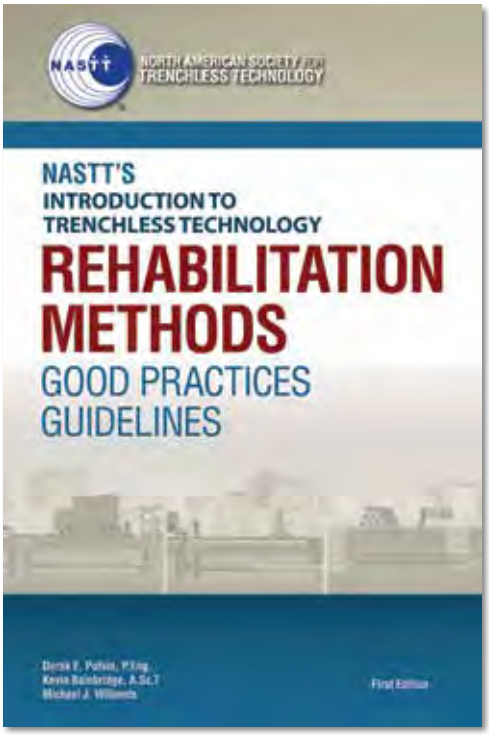
LATERAL REPAIR METHODS

A CCTV inspection of the lateral performed by a NASSCO LACP (Lateral Assessment Certification Program) certified Operator is typically performed first to determine the location of defects and the overall condition of the lateral.

Once it is determined that a lateral needs repair, there are two commonly used trenchless alternatives for lateral repair that can be performed depending on the condition of the sewer lateral, and depending on site constraints. A good source for various rehabilitation methods is NASST's Rehabilitation Methods Good Practices Guidelines[5].

Rehabilitation Method	What is it?	Digging/Insertion Pits Required	Advantages	Disadvantages
Pipe Bursting	A bursting head is inserted into the existing lateral, which bursts the old pipe, while pulling a new pipe in place behind it.	Yes	Can upsize an existing pipe.	Some existing pipe materials like ductile iron or steel pipes cannot be bursted. But new pipe splitting technologies can be used for 6" and larger maleable pipe materials.
CIPP Lateral Lining	CIPP lining of laterals using resin-impregnated fiberglass/felt tube to create a new pipe within a pipe.	No	Completely trenchless, installed from the sewer main and/or cleanout; can line only the portions of the lateral that need repair.	Cannot line through collapsed pipe.

Lateral Rehabilitation Methods Comparison



The NASTT Rehabilitation Methods Good Practices Guidelines is a good useful source

CIPP LATERAL LINING

The CIPP (Cured-in-Place Pipe) lateral lining process will be discussed more in depth here as a versatile, cost effective, and completely trenchless process (no insertion or extraction pits needed) to repair the connection to the main sewer, the entire lateral, a portion of the lateral, or any combination thereof. CIPP lateral lining can be used to line any pipe material, with lateral diameters from 3 to 8 inches.

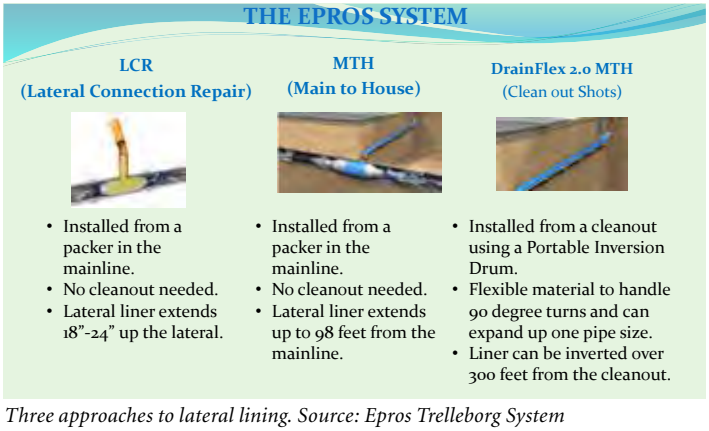
There are several manufacturers that offer lateral lining products. The most versatile systems use a remote packer that allows for lateral-to-mainline connection repairs, and that will line the connection plus the entire lateral in one step via a remotely operated inflatable packer. These Main-to-House liners can be used to line the connection and the lateral for lengths of up to 100 feet from the mainline sewer.

Another lining technology used by many contractors is the use of a portable Inversion drum that will install lateral liners from a cleanout back toward the public sewer main. Long inversion lengths are possible that can line up to 300 LF of a lateral in one step.

Lateral lining uses the process of inversion to place the resin-impregnated liner into a lateral from a mainline sewer or cleanout. Polyester, Silicate, and epoxy resins are the most commonly used, with hydrophilic seals required to seal the ends of liners utilizing shrinkable resins. Once the liner is inverted, steam is typically used to cure the resin to create a fully structural new pipe within the existing sewer lateral.

Since the lateral lining rehabilitation method can be completed from the public right-of-way and from inside the mainline sewer, this is a good method for cities and sewer agencies that are looking to take on the financial responsibility for repairing laterals in their jurisdictions. The lateral lining process results in a structurally sound lateral without the need to enter private property, and that won't require any digging that may disturb landscaping or pavement.

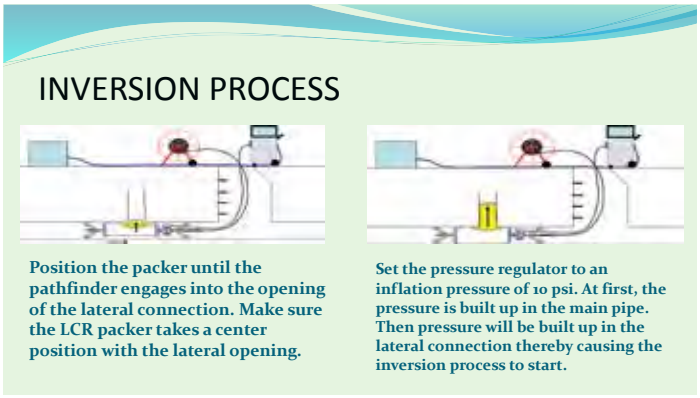
Lateral can be lined in one step with a remotely operated inflatable packer



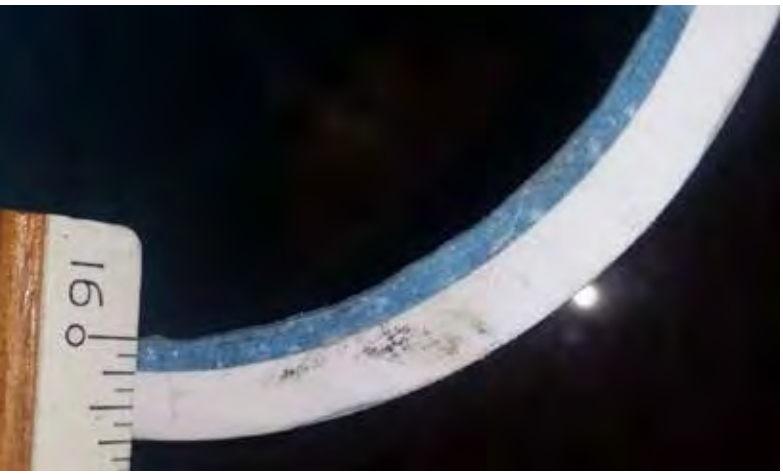
Three approaches to lateral lining. Source: Epros Trelleborg System

Portable inversion drum

> *Up to 80 percent of all infiltration and inflow into collection systems can be from service laterals.*



Inversion process



Liners impregnated with epoxy resins create a tight frictional interface between it and the host pipe

CONCLUSIONS

Private sewer laterals are a critical, but often overlooked, component in the effective operation and maintenance of our sewer collection systems. We must facilitate the inspection of sewer laterals to determine their condition, and either allocate public funding for their repair, or institute policy and regulations that will require the homeowners to repair them. Only then can we reduce collection and treatment costs by eliminating infiltration into these failed pipelines, while at the same time protecting the environment and the public from pathogen migration from inside the sewer laterals to surrounding soils and water bodies.

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ABOUT THE AUTHOR:

Michelle Beason, PE, *is Regional Manager for National Plant Services, Inc., covering the 12 Western States, including Hawaii and Alaska. She received a BS in Civil Engineering from Purdue University, and is a registered California PE with almost 30 years of water and wastewater system maintenance and trenchless rehabilitation experience. Michelle is a Board Member of WESTT and a Board Member of NASSCO.*

Examining the Costs of Bypass Pumping for Pipe Rehabilitation

By: Sekisui SPR Americas

Bypass pumping (for trenchless sewer and storm water pipe rehab) is a means to redirect the existing pipeline's flows while a liner installation takes place. This is accomplished using pumps capable of handling sewage & effluent (which come in many different forms) and piping to transport the flows. The pumped flow can range from just a few to thousands of gallons per minute (GPM).[1] The flow is pumped from an access point (suction manhole) to a discharge area. The trenchless repair section is isolated from the suction and discharge. This is often achieved using plugs to block the flow. Many factors impact the details of a bypass pumping plan; such as the type of pump required, peak flow (highest flow level possible within the day), space requirements, lift (vertical height from the suction to the pump), acceptable noise level, fuel, etc.

> *Bypass pumping operations are more likely with longer runs and larger pipes.*

SETUP & PROCESS

The bypass setup includes a pump and piping, which come in a variety of forms. Per NASSCO's Bypass Pumping Specification, a comprehensive bypass pumping plan often includes (but is not limited to)

- Staging areas for pumps
- Sewer plugging method and types of plugs;
- Number, size, material, location and method of installation of suction piping;
- Number, size, material, method of installation and location of installation of discharge piping;
- Bypass pump sizes, capacity, number of each size to be on site and power requirements;
- Downstream discharge plan;
- Method of protecting discharge manholes or structures from erosion and damage;
- Method of noise control for each pump and/or generator;
- Schedule for installation of and maintenance of bypass pumping lines;
- Plan indicating selection location of bypass pumping line locations.

For most cases, the bypass pumping process is as follows; flow is stopped one manhole prior to the section of pipeline being renewed. This area is known as the suction manhole, where flow is being pumped from. The level of flow that builds up within the suction manhole is the surcharge, which is monitored and kept at a certain level (as required by the project). The flow is pumped from the suction manhole to the area of discharge; a point past the repair section that reintroduces flow into the pipeline.

USE IN TRENCHLESS REHABILITATION

Trenchless rehabilitation technologies that involve curing in the lining process require flow to be pumped around the area of repair. Additionally, many trenchless rehabilitation methods require bypass for larger diameter pipelines, especially those with higher flow levels. In the case of CIPP, certain smaller diameter applications will properly handle flow solely with plugs and no bypass. However, in the instances of longer runs and larger pipes, a bypass pumping operation becomes much more likely.

CONSTRUCTION FOOTPRINT

While portions of a bypass pumping operation occur below-ground, most equipment is surface level. As stated in the NASSCO spec, the operation's staging area must be determined. This includes the area for the pumps near the suction manhole and the piping to transfer flows to the discharge area.

The piping will cover any necessary length the rehabilitation area requires. The pipes used to transport flow typically range between 2 to 30 inches in diameter, depending on the scale of the operation. Pipe material will vary between HDPE, steel or PVC.[2]

According to the NASSCO Spec:

"The bypass pumping pipelines are to be located off streets and sidewalks, and on the shoulders of roads. When the bypass pipeline crosses local streets and private driveways, the contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to preconstruction condition and restore all pavement."[3]

The pumps themselves occupy a minimal amount of space near the suction manhole, of course depending on the type of pump (self-priming, prime-assisted, submersible, etc.) and size of pump.

When the suction lift is greater than 25 feet, a submersible pump becomes necessary. A submersible pump operates within the suction manhole, as opposed to self-priming or prime-assisted. These take up limited above-ground space, however, require a generator if a nearby electric source is unavailable.[4]

TIME

Time factors to consider for a bypass operation include setup, operation and tear-down. A longer repair area results in a lengthier bypass piping network. Piping that crosses local streets of private driveways requires additional time for either trenching (with subsequent paving and restoration) or installing bypass ramps.

Although some projects permit the pump to be shut off at the end of the day, most projects require 24-hour pumping. For such operations, a pump watchman may be utilized to ensure the pump is always operating properly.[5]

Additionally, diesel pumps need servicing every 250 hours of run time for the engine oil and filters. Additional routine maintenance items need to be checked, such as the clearances between the impeller and wear plate. All these instances add to the duration of the bypass and rehabilitation operation.[6]

FUEL & NOISE

Pumps are typically gas, electric or diesel powered. The fuel consumption can be estimated by the pump engine's RPM. If the pump is to be run 24/7, a fuel program needs to be instated to ensure the pump has enough fuel for constant service. As previously mentioned, if the pump is electrically powered it either requires a nearby electric source or onsite generator to power the pump continuously.

In addition to fuel, noise must be monitored to prevent pollution/disturbance within communities. As stated in the NASSCO Spec:

"Noise control levels shall be within the City's noise ordinance".[7]

Certain projects may also require a Noise Reduction Plan to reduce the sound impact on the surrounding area. This may include setting up temporary walls/barriers in different locations to absorb the noise pollution.[8]

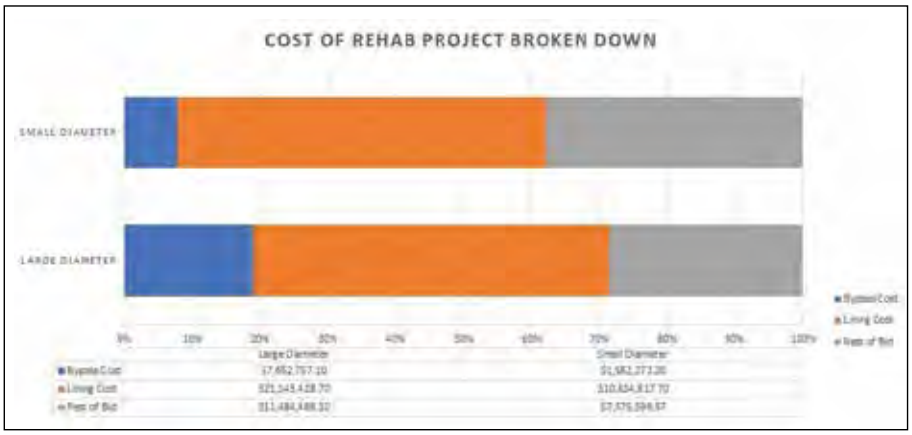

Figure 1. Cost of Rehab Project Broken Down

BID ANALYSIS METHOD

The key factor for bypass pumping related to rehab is the cost the entire operation will bear on the project. CIPP bid tabulations from 2015 - 2019 were analyzed. For disclosure, 86 project bid tabulations were collected, however, the means by collecting these tabulations varied. No correlation can be made regarding the number of projects collected against those that were analyzed. These projects were gathered from 25 states. The data collected from each bid tabulation was from the lowest recorded bidder within the tabulation.

For better comparison of project by project, the pipe diameters within one specific bid tabulation were averaged. For instance, a CIPP lining project of 8, 10- and 12-inch sewer lines was averaged out to be 10 inches as the diameter for that project.

The three line items collected/analyzed were *bypass pumping*, costs for the *lining portion* and *total bid amount*. Only projects with specific line items pertaining to bypass pumping were taken for analysis. Of these projects, 40 contained bypass pumping of at least $4,500 USD. This was the benchmark for analysis, and these 40 projects are the only ones represented in the following data analysis. $4,500 was chosen arbitrarily as the gauge for a "minimal"

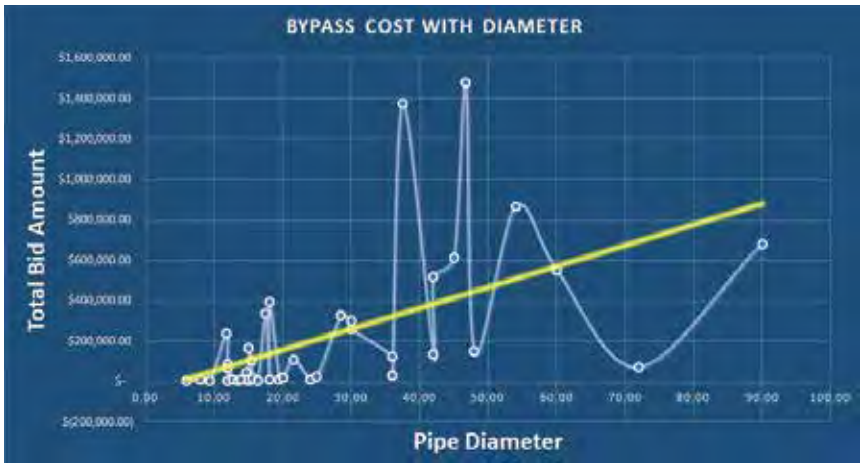

Figure 2. Bypass Cost with Diameter

bypass operation, to collect projects with smaller bypass requirements while excluding projects with no bypass requirements.

SUMMARY DATA & INSIGHTS

As summarized in Figure 1, nineteen projects were at or above an averaged 20 inches in pipe diameter (to be referred to as *large diameter*). Twenty-one projects averaged below 20 inches in pipe diameter (to be referred to as *small diameter*). The total bid amount for all projects added up to $60.25M USD, resulting in an average of $1.51M USD per project. The total bypass costs equaled $9.23M USD, resulting in the average bypass pumping portion at $230K USD, or 15.3 percent per project analyzed.

This illustrated bypass pumping as a consistently significant portion of CIPP rehab tabulations.

This is especially true when CIPP projects increase in diameter as the relationship between diameters renewed and bypass pumping costs were found to be the strongest (0.42 r value), shown in Figure 2. Meaning, as the average pipe diameter for a given CIPP project increased, there is a positive correlation between this effect and the percent bypass pumping costs for a CIPP project.

Taken in a broader context, from this exercise bypass pumping for larger diameters will not only cost more than smaller diameter projects but increase disproportionately compared to line items for CIPP lining or the rest of the bid items summed together (Figure 3). Projects at/above 20 inches in diameter had an average of 19.00 percent of the total bid as bypass pumping.

The rest of the bid and lining portions decreased as a percentage cost of the total bid when the project diameter increased. The various attributes that impact a bypass operation for pipe rehab (as mentioned in this article) may be responsible for the disproportionate rise in price, when diameter is increased.

An obvious factor with larger diameter rehab is the presence of more flow in the pump, requiring more powerful pumps, multiple pumps and a larger discharge piping network. When scaled these factors seemingly increase the price of the operation dramatically.

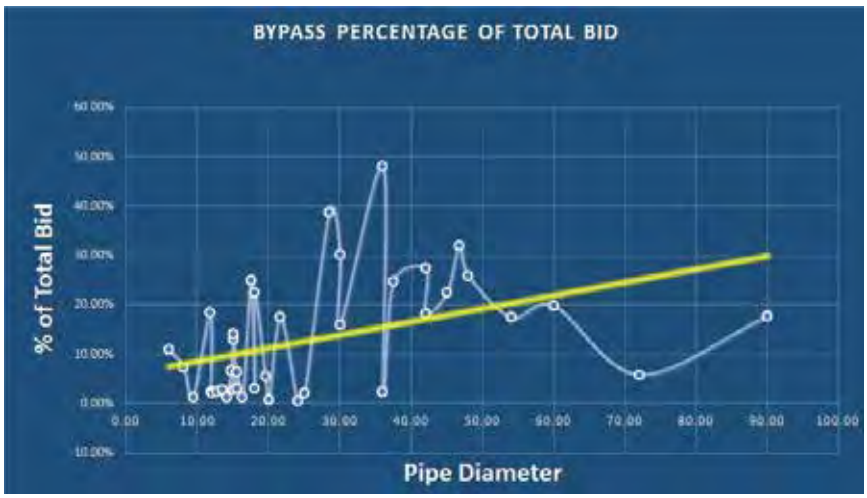

Figure 3. Bypass Percentage of Total Bid

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ABOUT THE AUTHOR:

SEKISUI SPR Leading-Edge Trenchless Solutions

SEKISUI SPR Americas, LLC *provides Spiral Wound liners for trenchless pipeline rehabilitation. Spiral wound involves constructing PVC liners inside existing pipelines utilizing machinery. SEKISUI SPR is based out of Atlanta, GA with representatives on the East and West Coast U.S.*

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PE4710 Pipe: The Best Solution for Water Systems

An Overview of HDPE Electrofusion Pipe Joints: Pipe Surface Preparation

By: Camille Rubeiz, P.E., F. ASCE, Plastics Pipe Institute, Inc. (PPI)

High-density polyethylene (HDPE) pipe has been used for municipal and industrial water applications for almost 50 years. HDPE's heat-fused joints create a leak-free, self-restraint, monolithic pipe structure. The fused joint will also eliminate infiltration into the pipe and exfiltration into the environment. HDPE pipe has other benefits including chemical, abrasion, fatigue, seismic and corrosion resistance, and is designed for water and wastewater applications meeting the latest AWWA C906 and ASTM F714 standards.

Heat fusion can be used to join sections of HDPE pipe, including high-performing PE4710 pipe, while electrofusion is used to add couplings, tapping tees, branch saddles and other fittings. Proven to be an extremely reliable joining system, an electrofusion joint is heated internally, either by a conductor at the interface of the joint or by a conductive polymer. Heat is created as an electric current is applied to the conductive material in the fitting.

"Pipe preparation is among the most important aspects of making a sound electrofusion joint"

All heat fusion joining methods require that there is no water flowing or standing in the pipe that can reach the fusion surfaces. De-watering of the site may be required to prevent ground water from reaching the fusion and contaminating the surfaces to be joined.

In repair or cut-in situations, flowing water in the pipe may be present due to leakage of valves. Flowing water in contact with the fusion surfaces during the assembly or fusion cycle must be avoided as it can cause voids as the moisture turns into expanding steam during the fusion process. PE squeeze-off tools can be used to control the flow of water in cases where a valve is not present or will not shut off completely - refer to ASTM F1041.

TIP: *Some practical temporary methods for stemming water flow and avoid the need to disinfect the line, are the use of organic absorbent materials, such as bread, which can later be flushed from the system at downstream hydrants.*

Typical Electrofusion Joint

Electrofusion has proven to be an extremely reliable joining system

TIP:

Tip: Dry ice placed in the pipe upstream of the fusion location will temporarily freeze small amounts of flowing water until the fusion process can be completed. In smaller diameter pipes inflated latex balloons also provide good temporary stoppage of trickling water. The balloon will burst during pressure testing and can be flushed from the system at a downstream outlet.

Electrofusion fittings can be installed in ambient temperatures as recommended by the manufacturer. A typical qualified temperature range for installation is 14°F minimum to 113°F maximum. Some manufacturers have lower and/or higher temperature limits and will state their qualified range in the technical specifications. Contact the fitting manufacturer to verify.

Improper pipe preparation is overwhelmingly the leading cause of unsuccessful electrofusion joint attempts because the installer may not completely understand the goal of pipe scraping, which is to remove a thin layer of the outer pipe surface to expose clean virgin material beneath.

Pipe surfaces exhibit surface oxidation from the extrusion process, transportation, and outdoor exposure. Surface oxidation is a normal chemical reaction that results in a physical change to the molecular structure of the polymer chains on the pipe surface. Oxidation acts as a physical barrier and therefore those surfaces cannot be heat fused. Simply roughing the pipe surface is not sufficient. In order to achieve fusion, this layer must be removed. Even new pipe must be properly scraped before a fusion will be successful.

The outer oxidation layer on a pipe surface is very thin. It does not increase in depth of more than a few thousandths of an inch even over long periods of exposure, so regardless of the amount of time the pipe has been stored before scraping, the scraping depth requirement is the same. An adequate minimum amount of material that must be removed is just seven one-thousandths of an inch (.007 inches) – approximately the same thickness as two sheets of ordinary paper.

Sandpaper, emory cloth, or other abrasives should ***never*** be used to prepare a pipe surface for electrofusion. Abrasives don't adequately remove material, and can redistribute contaminates on the surfaces, and the grit left behind forms another barrier that will also prevent proper fusion.

The only tools used for surface preparation are those that are specifically designed for electrofusion scraping and peeling, which can peel the pipe surface to a controlled depth. Tools with serrated blades are also available. These tools physically scrape the pipe surface by pulling the serrated blade across the pipe in a perpendicular position. Serrated blades sometimes mask the pipe surface by leaving behind score marks that make it difficult to visually tell if all of the original surface material has been removed.

Types of scrapers that are ***not*** recommended are "hand scrapers" such as wood rasps and metal files. Using these will result in inconsistent surface preparation and difficulty in mastering skills required for uniform surface preparation.

No matter what type of tool is used, it is strongly recommended that witness marks be made on the pipe surface prior to scraping with a permanent marker, such as a Sharpie® marker or another brand that dries fast and contains no oils. (Some markers that dry slowly or contain oils that can spread onto the fusion surface and should not be used.) Any marking that remains after scraping is evidence that areas were missed or that more scraping is required.

TIP: *A visual indicator can be very helpful to ensure that the entire surface has been scraped, and that an adequate amount has been removed. Marking the pipe surface with a permanent marker is a simple and effective way.*

Avoid all possible recontamination of the prepared surface. This includes handling or even touching the scraped pipe surface or the inside of the coupling as body oils and other contaminates can affect fusion joint performance. If the surfaces become contaminated, clean thoroughly with a clean, lint-free towel and a minimum 96 percent concentration of isopropyl alcohol and allow to dry before assembling. Do not use alcohol with any additives other than water.

Gouges that are deeper than the scrape depth may also require extra attention when scraping the pipe to ensure that any debris or contaminates embedded in the gouges are removed; use of a hand tool to scrape the gouge may be necessary. If the gouge exceeds 10 percent of the pipe wall thickness, that pipe section should be cut out and replaced to maintain the maximum pressure rating of the pipe.

Two guides detailing the steps for electrofusing joints and couplings for HDPE pipelines are available for free. Published by the Municipal Advisory Board - MAB - , the two documents are: *MAB Generic Electrofusion Procedure for Field Joining of 12 Inch* and *Small Polyethylene (PE) Pipe (MAB-01-2017) and MAB Generic Electrofusion Procedure for Field Joining of 14 inch to 30 Inch Polyethylene (PE) Pipe (MAB-02-2017)*. MAB serves as an independent, non-commercial adviser to the Municipal & Industrial Division of the Plastics Pipe Institute, Inc. (PPI). The mission of the MAB is to improve the design, installation, and operation of municipal HDPE water piping systems through the creation of partnerships among utilities, researchers, designers, contractors, and the HDPE industry.

The direct link to download MAB-01-2017 is: https://plasticpipe.org/pdf/mab-generic-ef-110515.pdf while the link for MAB-02-2017 is: https://plasticpipe.org/pdf/mab-02-generic-electrofusion.pdf

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The Plastics Pipe Institute, Inc. (PPI) *is the major North American trade association representing all segments of the plastic pipe industry and is dedicated to promoting plastic as the materials of choice for pipe and conduit applications. PPI is the premier technical, engineering and industry knowledge resource publishing data for use in the development and design of plastic pipe and conduit systems. Additionally, PPI collaborates with industry organizations that set standards for manufacturing practices and installation methods. For additional information, go to the Plastics Pipe Institute's website at: www.plasticpipe.org.*

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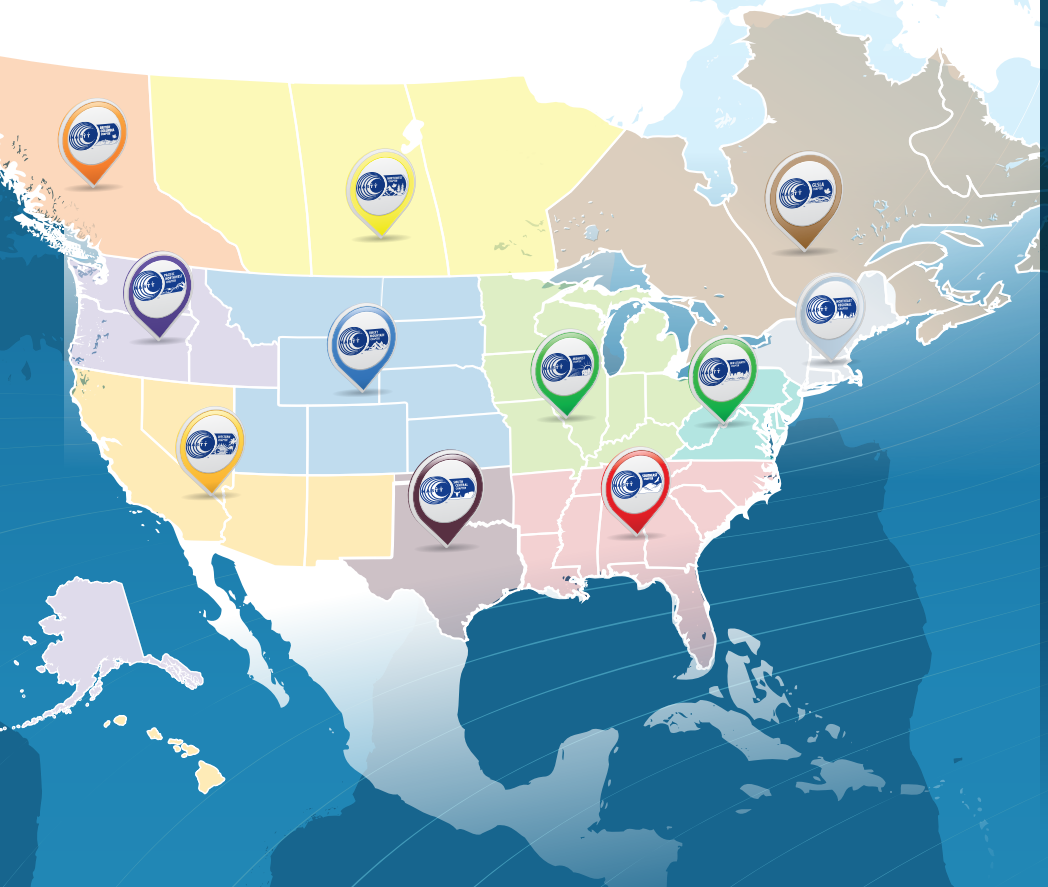

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WESTT 2020 Virtual Chapter Meeting

The WESTT Board of Directors invites you to attend the first virtual WESTT Chapter Meeting on November 12, 2020 from 11:00 to 12:30 PST. All NASTT members located in the Western Region (Arizona, California, Hawaii, Nevada, and New Mexico) are encouraged to attend. The meeting will provide updates on board activities this year, as well as our plans for how to best serve our chapter in the future. Topics to be covered include recap of our ongoing Webinar series, Board elections, outreach to under-represented regions of our chapter, student chapter engagement, and a financial status report. Registration information was sent to all chapter members on 10/20, please check your email!

For questions contact Brian Avon – Bavon@carollo.com or Kate Wallin – kate.wallin@bennetttrenchless.com.


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