Western Regional Trenchless Review 2011

L.A. Reaches Million-Foot Milestone

ALSO INSIDE:
• Pipeline Rehab in Wine Country
• Virtues of Vitrified Clay Pipe
• HDD on Sensitive Marshland
• Back to Nashville: No-Dig 2012!

Fall 2011
SMaRT is a transparent, multi-attribute, sustainable product standard and third party certification program. Certification depends on a robust analysis of a life cycle assessment and the associated environmental, economic and social impacts. Unlike some single-attribute certifications, you can’t get a SMaRT Certified based only on recycled content. This standard analyzes impacts from raw materials extraction, manufacturing, transportation, and end-use until disposal or recycling.
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Welcome back to our sixth edition of the Western Regional Trenchless Review! As our regional chapter continues to become established in the industry, we are excited to produce and distribute valuable information and ideas centered around a region of the country that continues to grow and thrive despite the difficult economy. Thank you to all the advertisers and article contributors for helping to make this year’s magazine a success.

This year, the Seventh Annual Conference will be held in San Jose, California, at the Wyndham Hotel on October 3-4. This year’s focus continues to be about our goal to become a “local” source for connecting individuals interested in learning about various trenchless technologies as a viable solution to their infrastructure needs. San Jose is a prime location in the Bay Area of Northern California that is accessible to dozens of municipalities who continue to face local challenges regarding state and federal water and wastewater regulations, the balance of water supply versus demand, and the struggling economy. Trenchless technology can be an economical and smart solution. We must all strive to continue to grow and learn.

I’m excited that this year’s conference is in my “neck of the woods,” as I currently work and live the East Bay of Northern California. I also find it fitting that this is where I will bid my farewell to the Chair position of WESTT and welcome in new leadership with fresh ideas and wonderful energy. My time as Chair of WESTT has been very rewarding, and I have learned a tremendous amount from others in the industry that I have been fortunate enough to work with while representing WESTT.

I will remain active with the Chapter and I look forward to another excellent year with great new leadership for trenchless activities in the Western region. I also welcome new members to join the Western Chapter. Please feel free to contact me at jglynn@rmwater.com or (925) 627-4151 or check out our website at www.westt.org if you require any information on WESTT or trenchless in general.

Warmest regards,

Jennifer A. Glynn, P.E.
Chairman, WESTT
Greetings from NASTT’s Chairman

George Ragula

With less than a month from the 7th annual Western Regional No-Dig Conference in San Jose, I cannot help feeling extremely excited for our volunteer members of our Western Chapter (WESTT). By the time most of you get a chance to read this, the conference will be well underway. From the presentations to the exhibits, attendees can expect another extraordinary event!

Since 2003, the WESTT Chapter has been and continues to be the focal point for advancing the use of trenchless methods and applications in Arizona, California, New Mexico, Nevada, and Hawaii. Indeed, the WESTT Chapter has always been one of our Society’s strongest.

The Chapter is fortunate to have great leadership at the helm from NASTT members, including Jennifer Glynn, Chair; Matt Wallin, Treasurer; Jason Lueke, Secretary; Kate Wallin, Conference Planning Chair; and Samuel Ariaratnam, who now serves as ISTT’s Chair, just to name a few. Many other chapter members are active in NASTT, serving on the No-Dig Program Committee, as instructors of our NASTT Good Practices Courses, and as student chapter faculty advisors. Others have served with distinction on NASTT’s Board of Directors.

Commitment and involvement are essential ingredients for success. The WESTT Chapter demonstrates an abundance of these attributes as illustrated by the breadth of its Chapter activities, which include conducting a first-class conference in every respect. As a further service to the region, WESTT plans on hosting a NASTT Good Practices Course in the spring of 2012.

And there’s more! In 2013, NASTT will host the annual No-Dig Show in your Chapter’s backyard – Sacramento, California. Sacramento was chosen as the location not simply for the obvious reasons of its attraction as a cosmopolitan destination, but also because of the strong support we know we will receive from NASTT members in the region.

I believe strongly in the role NASTT regional chapters can and must play in driving the growth of trenchless technology at the grassroots level. That’s why I am pleased to be joining you for the 7th annual Western Regional No-Dig Conference and to discuss how we can work together to accomplish the very worthy mission of NASTT. See you in San Jose!
WESTTT Board of Directors:
2010 - 2011

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Matthew Wallin, Treasurer
- Bennett Trenchless Engineers

Jason Lueke, Secretary
- Arizona State University

Samuel Ariaratnam, Advisor
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- Rain for Rent

Mike Stram, Director
- City of Reno

Read the article on page 39 to learn about full benefits of StifPipe™.
IN MEMORIAM:  PADDY RYAN O’TOOLE  
JUNE 29, 1958 – JULY 16, 2011

NASTT extends our deepest sympathies to the family and friends of Paddy Ryan O’Toole, founder and President of PTR Communications. After a courageous battle with cancer, Paddy passed away peacefully on Saturday, July 16, with his family and trusty dog Tessa close by his side.

Even in his final days, health rapidly declining, Paddy remained dedicated, bravely striving to bring high-quality magazines such as the next issue of Western Regional Trenchless Review to completion. For Paddy, publishing was more than mere work – it was his passion and higher purpose. He took great delight and satisfaction from carefully producing magazines for many of the NASTT Chapters with the highest written and artistic quality possible.

Paddy was forever attentive to the interests of the NASTT community and was a notable proponent and friend of the trenchless technology industry. He worked relentlessly at raising the profile and helping to further the cause of numerous NASTT Chapters. Very simply, Paddy LOVED trenchless! The magazines were his “love made visible.”

For those who knew him professionally and personally, Paddy was a great humanitarian with a deep love for the written word. He was a vastly talented writer, gifted musician and remarkably astute businessman. Charming, intelligent and a witty conversationalist, Paddy was always ready with a practical joke or funny play on words.

On behalf of NASTT and all the Regional Chapters, we thank Paddy for his significant contribution to the trenchless technology industry.

Mike Willmets  
Executive Director, NASTT

---

PLUG-IN TEETH

We are very excited to announce a new development regarding the teeth on the Mr. Manhole Six Shooter.

Previously, when the cutting teeth became worn or damaged they had to be cut off and new ones welded on. This process was lengthy and impossible to do on the work site. With new technology, the cutting teeth can now be replaced or rearranged in seconds, even on the job site. The new teeth have a harder carbide than previous versions, providing a longer cutting life. The new shape and reduced size allows for better performance when cutting in harder concrete. All teeth are exactly the same so they can be rearranged if the front teeth become dull.

The new tooth system for the six shooter provides longer cutting life, improved concrete cutting, and quick tooth replacement, all for an affordable price.

Mr. Manhole is always working on new ways to make the removal and leveling of manhole frames safe, fast and affordable.

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The No-Dig Show this year in Washington, D.C., drew a record crowd to the Gaylord National Resort & Convention Center. The 20th annual show attracted 1,814 people, the second-highest attendance for a No-Dig in North America (the International No-Dig in 2009 saw 1,903 members come to Toronto).

Nearly 140 exhibiting companies featured products and industry advancements in the 73,000-square-foot exhibition hall. There were also 140 peer-reviewed technical papers presented covering condition assessment and inspection, horizontal directional drilling, microtunneling, large-diameter tunnel, pipe bursting, auger boring, slippining, cured-in-place pipe relining, and more.

Of course, respected awards honoring the people and projects that shape the industry were given to recipients throughout the three-day event. These awards were presented at various social engagements.

Monday, March 28, saw the kick-off breakfast where the 2011 Trenchless Technology Person of the Year Award and the 2010 Outstanding Papers in Rehabilitation and New Installation awards were given out.

Attendees also experienced the comedy routine of Greg Schwem, labeled by Chicago Magazine as “America’s favorite corporate funny man.” Schwem tailored his routine, “Comedy With a Byte,” to the trenchless industry. He has previously performed to corporate crowds from McDonald’s, Microsoft, Motorola and United Airlines, among others.

The annual Educational Fund Auction and Reception was later Monday night with raised funds supporting NASTT’s 11 student chapters. Since 2002, the auction has raised more than $356,000 and directed those funds toward educational activities. This year, $72,000 was raised through silent auction and – new this year – an eBay online auction. Machine rentals, laptops, cameras, jewelry, golf clubs, various trips and even maple syrup were some of the featured items.

On Tuesday, the Gala Awards Dinner saw the presentation of the Trent Ralston Award for Young Trenchless Achievement, the Joseph L. Abbot, Jr. Innovative Product Awards, the NASTT Chairman’s Award for Outstanding Lifetime Service, and the various winners of the 2010 Trenchless Technology Projects of the Year in Rehabilitation and New Installation. After the dinner, the band Black Tie performed a wide genre of music spanning from early classics to the latest hits.

Wednesday’s closing luncheon celebrated the success of the 2011 show.

The 2011 Municipal & Utility Achievement Awards were announced during this event. These awards recognized the exceptional achievement among American and Canadian municipalities and public utilities.

The 2012 No-Dig Show will be in Nashville, Tenn., at the Gaylord Opryland Resort & Convention Center, March 11-15. The deadline to submit a 300-word abstract on NASTT’s online form is June 30. No e-mail, mail or fax abstracts will be accepted.

George Ragula is the 2012 program chair and says there will be an increased emphasis on sustainability and cost efficiency for the trenchless market. This will be the third No-Dig event in Tennessee, surely bringing back memories of past successful shows.

Visit www.nodigshow.com for more information on the upcoming convention.

Reprinted courtesy NASTT’S Trenchless Today.
Dear Trenchless Professionals,

Nashville, home of country music’s hottest stars, will host the industry’s premier trenchless technology event in North America – NASSTT’s No-Dig Show, the hottest ticket in town. We invite you to join us March 11-15 at the beautiful and well-appointed Gaylord Opryland Hotel.

Our 21st annual conference marks the third return of No-Dig to Nashville, rousing a sense of nostalgia for many. When we first met here a decade ago, some would say that it was a turning point, a sort of renaissance for the organization and the industry itself. The 2001 event sparked a renewed interest in trenchless technology as a viable method to repair/replace underground systems while minimizing surface disruption.

Since 2001, No-Dig has nearly doubled in size, keeping pace with the rapid growth of our industry. Cutting-edge technologies are continually being developed and introduced to the marketplace. Each year brings new products, new services and new players. Projects are continuously pushing the boundaries of what can be achieved with trenchless technologies. Our conference creates a unique opportunity for you to see, hear and interact with leaders in the industry who drive the trenchless marketplace today.

We have 155 technical papers in the conference program packed with timely topics and useful information that you can put to use right away. The papers and presenters are of the highest quality, making for an excellent technical program. We are pleased to announce the addition of a sixth track to the paper schedule, offering you even more educational opportunities!

That’s not all! The trenchless education provided at the No-Dig show is unmatched. You can choose to attend one of our pre- and post-conference courses on HDD, pipebursting, laterals, new installation methods and CIPP lining. New this year, we’re offering an expanded one-day “Introduction to Trenchless Technology” course on Sunday, March 11, with the latest advances in trenchless techniques.

Benefit from the in-depth sessions and courses offered at No-Dig in more ways than one. For every 10 hours you attend, you receive one continuing education unit to advance your professional career.

The overall No-Dig program is focused on one objective: helping you maximize your investment in trenchless technologies, services and applications. Owners, utilities and municipalities can immediately benefit. You will learn how to replace/repair and install pipelines with minimal excavation while reducing the impact to your surroundings. You will find that trenchless technology is not only the least disruptive option, but oftentimes is the most cost-effective. The technical sessions and exhibitions are designed to provide you with information you need to make the best possible decisions.

Starting with Monday’s Opening Kick-off Breakfast, you’ll have plenty of opportunities to network with your industry peers throughout the week. We also invite you to support our annual Education Fund Auction by donating or bidding on amazing items to help raise funds for NASSTT’s educational initiatives. This year’s Auction promises to be truly exciting with a country-western theme and costume dress-up. Also new this year, NASSTT will unveil its Trenchless Technology Hall of Fame awards at the Tuesday evening Gala Awards Dinner. Stay tuned for more details!

Please mark your calendars for March 11-15 in Nashville, where we hope you will join us as “Trenchless Takes Center Stage.” We look forward to seeing you in attendance. For conference updates and information, be sure to visit our website at www.nodigshow.com.

Sincerely,

George Ragula
No-Dig Program Chair

Kim Staheli
No-Dig Program Vice-Chair
All of the benefits of a national conference program in a smaller forum with a personalized touch!

Come to San Jose, California and learn about the latest in Trenchless Technology from experts in the field. Registration includes an informative technical program and product exhibit area.

The conference is useful to public officials, engineers, utility company personnel, designers, and contractors alike who are involved with designing, constructing, rehabilitating, and managing underground utilities.

**REGISTER ONLINE AT:**
WWW.NASTT.ORG/WESTT

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<td>* Non-Member registration fee includes NASTT membership for one year (2012)</td>
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Located 2 miles from the San Jose Airport

Mention “WESTT Conference” by 9/3/11 to get discounted room rates

**For questions about the conference, call:**
Kate Wallin - 916.294.0095
Jason Lueke - 480.965.7417
Sam Ariaratnam - 480.965.7399
The City of Los Angeles, the second largest city in the United States, has a collection system that consists of a network of 6,700 miles of sewer pipeline operated and maintained by the city. These pipelines range in size and shape from the smallest – six-inch and eight-inch main line sewers – to 10-by-12-foot semi-elliptical and 150-inch circular major outfall sewers.

Mary Thomas, PE, Civil Engineering Associate III
Mina Azarnia, PE, Civil Engineering Associate III
Keith Hanks, PE, Sr. Environmental Engineer,
City of Los Angeles, Bureau of Engineering, Wastewater Conveyance Engineering Division

A crew works on rehabilitation of the Lower North Outfall Sewer in Los Angeles.
Historically most of these sewers were constructed and repaired using conventional cut and cover methods. In cases where it is appropriate, tunneling has been used for new construction. The City has also adopted the use of trenchless methods for rehabilitation of the sewer system.

Examples of some of the large sewers that have been constructed or rehabilitated with trenchless methods include:

- The 7.2-mile-long, 60" x 73" elliptical Central Outfall Sewer completed in 1904 using both cut and cover and tunneling. Half of this sewer has just been rehabilitated using trenchless methods, and the design for the trenchless rehabilitation of the second half of the sewer has been completed.
- The 9.2-mile-long, 10.5’ x 12.25’ Lower North Outfall Sewer completed in 1924 using both cut and cover and tunneling. It has recently been rehabilitated using trenchless methods.
- The eight-mile-long, 150-inch North Outfall Relief Sewer tunnel completed in 1993.
- The 11-mile-long, 132-inch diameter East Central Interceptor Sewer tunnel completed in March 2005.

The City of Los Angeles collection system also includes more than 100,000 maintenance holes and various hydraulic structures such as siphons, diversion structures and junction structures.

Part of the City’s sewer system dates back to the late 1800s. The size of sewers and the materials used in their construction have changed over the years. The first known sewer, privately installed in 1863, was constructed of wood and connected the Bella Union Hotel to the zanja (water distribution ditch). The first known public sewer, installed in 1873, was 500 feet long and located in Commercial Street. It was also made of wood.

The first major outfall sewer was a combination of masonry construction and wood stave construction. This sewer, which was known as the Dockweiler sewer and was named after the City Engineer who built it, deteriorated rapidly and had a useful life of only approximately 10 years. The elliptical Central Outfall Sewer replaced the Dockweiler sewer as the
city’s primary outfall sewer and was placed into service in 1904. This sewer was of masonry construction and rapidly experienced corrosion damage and lack of sufficient capacity. By 1916 the City was proposing a sewer bond to replace the Central Outfall. The North Outfall Sewer, which succeeded the Central Outfall, was constructed of cast-in-place concrete with a clay tile lining to resist corrosion and was placed in service in 1924.

Primary sewers and major outfalls support the larger secondary system of local sewers. Approximately 75% of the sewers installed in the City are eight inches in diameter with some six-inch sewers. The sewer system has grown consistently to keep pace with the growth of the City, but has experienced two significant construction peaks in the 1920s and between 1950 and 1960. Up until about 1919, the material of construction of the secondary system was predominantly Vitrified Clay Pipe (VCP). During the 1920s and the 1930s both VCP and concrete were used for Secondary Sewer construction. Primary sewers
were of masonry or tile protected concrete. Since the 1940s the Secondary Sewer system is almost entirely VCP, and Primary Sewers were of T-lock-protected reinforced or pre-stressed concrete pipe. The expansion of the City sewer system is still ongoing with new projects currently in the pre-design and design phases.

Much of the City’s collection system has reached the point where replacement or rehabilitation is required. The primary reasons for rehabilitation include corrosion, root intrusion, and structural damage. Along with constructing new sewers, the Department of Public Works has embarked on an aggressive program to upgrade the sewer system and has entered into a settlement agreement with the Environmental Protection Agency (EPA) and other stakeholders. The City of Los Angeles uses both traditional open-cut methods and a variety of trenchless methods for rehabilitation and new installation. Such trenchless means include sliplining, cured-in-place pipe, cast-in-place grout-supported liners, microtunneling and traditional tunneling. Pipe bursting and Horizontal Directional Drilling (HDD) are other trenchless methods that have been used when it has been appropriate.

The majority of the rehabilitation in the small-diameter secondary system has been done using CIPP lining. The City of Los Angeles regulates the materials that will be used in constructing and rehabilitating the sewer system. Approved materials are listed on the Bureau of Engineering website in the Approved Products Tracking System. The selection of the particular CIPP lining system that will be used to rehabilitate any given sewer has been left up to the open bidding process, and several CIPP suppliers have installed their approved products in the sewer system.

Large-diameter circular pipe rehabilitation has been performed by sliplining since most of the major sewers do not offer a convenient bypassing capability and must be rehabilitated in the wet. As with CIPP products, the materials used in sliplining large sewers must also come from the list of products on the Approved Products Tracking System. Large-diameter circular sliplining has been predominantly done with Hobas pipe, and some Spirolite.

The City has approximately 65 miles of large-dimen-

Felt tube ready for lining at one of three circular inverted siphon barrels on the Lower North Outfall Sewer
Much of the City’s sewer system is in need of replacement or rehabilitation.

The City began using trenchless rehabilitation on a large scale following the 1994 Northridge earthquake. The Accelerated Sewer Repair Program (ASRP) pioneered the City’s use of a reduced format computer database oriented design for renewal or replacement of damaged sewers. Because the work could be defined on a reach-by-reach basis, and the repair or replacement dealt solely with existing sewers, a descriptive work order could be used, rather than a visual plan. For each reach the contractor is given a database including pipe condition and description, and the locations of each connecting lateral, crossing or parallel utility, and any spot repair. The contractor then either replaces the sewer or rehabilitates it as required by the plan.

In 2004, the City of Los Angeles launched its Secondary Sewer Renewal Program (SSRP)—also commonly referred to as the 60 Mile Program—to correct sanitary sewer overflows, root intrusion, and capacity-related issues in the City’s smaller-diameter secondary sewer lines. According to the settlement agreement, Los Angeles will replace or
rehabilitate approximately 420 miles of these sewers over the course of 10 years with the bulk of the actual construction being carried out in the final seven years, hence the 60-miles-a-year description. Although the bulk of the rehabilitation program includes secondary sewers (diameter less than 18 inches), it also involves rehabilitation and construction of primary sewers.

The year 2011 marks a milestone for the City’s rehabilitation program. Since the inception of the sewer rehabilitation program, the City of Los Angeles has reached a milestone of constructing or rehabilitating one million feet of sewers using trenchless methods.

At the time of this writing the City’s GIS database shows 1,034,750 feet of primary and secondary sewers having been installed or rehabilitated by trenchless methods. Of these, 168,000 feet were carried out for primary sewers, and 866,500 feet for secondary sewers. Approximately 75% of sewers lined are the eight-inch mainline sewers. The oldest sewers that the City has lined are 1,153 feet of 10” and 12” sewers that were constructed in 1888 and are located in Broadway.

By reaching this million-foot milestone, the City of Los Angeles has avoided more than a million feet of trench, and has thereby reduced traffic impacts and inconvenience to residents and businesses. The social cost of traditional versus trenchless construction has not been quantified in Los Angeles, but is recognized as a hot election issue, and has resulted in a Mayoral Directive restricting rush-hour traffic impacts.

Trenchless methods are typically less expensive than traditional open-cut sewer replacement. While a strict accounting has not been made of the cost savings from using trenchless methods, a ballpark estimate of the present value of the savings can be made by applying current SSRP program estimating prices to the work that has been accomplished. Using this approximate method, it is estimated that the City has saved the equivalent of more than $80 million (in today’s dollars) in construction costs. This is based on the City’s standard estimating costs for secondary sewers for open-cut sewers of approx-

A Re-Pipe crew works in the West Los Angeles area
immediately $125 per linear foot and an estimated $30 per linear foot for trenchless rehabilitation. The cost per linear foot obviously would be higher for primary sewers.

Building on the original computer database design concept developed for the ASRP Program, the City has also been creative in developing a proprietary software package called SMARTS (Sewer Management Automated Repair Tracking System) for the Secondary Sewer Repair Program. This program produces a reduced format design and bidding package, usually with no drawings, that significantly reduces the cost and time of preparing plans and specifications. Employing state of the art GIS technology, electronic plan retrieval and sewer video, this program brings all of the necessary information for the design of sewer rehabilitation projects to the engineer’s desktop.

The City of Los Angeles will continue to use trenchless methods as an effective means of managing its wastewater systems. The trenchless methods are well received by the public since their use limits project duration and minimizes traffic impacts and other community disruptions. These methods also offer substantial cost savings and environmental benefits as well. While a comprehensive carbon calculator has not been applied to determine the amount of greenhouse gas avoided by using trenchless methods, some of the needed data can be supplied. For the secondary system only (in Los Angeles defined as less than 18 inches in diameter) the approximate length of sewer rehabilitated is 866,500 feet. The average depth of these sewers is calculated as 10 feet, with the average sewer reach calculated as approximately 264 feet. With an average maximum trench width of 2.5 feet the amount of excavated soil that has not been handled is approximately 800,000 cubic yards.

The City of Los Angeles always looks to satisfy the triple bottom line of social, economic and environmental benefits, and trenchless construction enables the City to realize all of these goals.

Trenchless methods are well received by the public since they have minimal traffic impacts
The SceptaCon™ Solution

...an essential part of your SMART lighting solution

SceptaCon™ is one of the first PVC systems designed for the rigors of trenchless applications. Made of durable Schedule 40 PVC, SceptaCon links seamlessly to existing PVC conduit infrastructure and allows utilities to standardize on PVC throughout their entire electrical system.

Now available in a 2" diameter, SceptaCon is ideally suited for street lighting and traffic signal applications where installation requires a smaller diameter pipe than your typical electrical raceway. As the only approved, boreable PVC electrical raceway available in a 2" size, SceptaCon allows contractors to install RW cables instead of the more expensive TECK cables.

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With SceptaCon’s slide-in locking system, a watertight joint can be made in seconds, without fusion or cementing

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Installed one length at a time, SceptaCon doesn’t require the use of a reel...no reel deposit, no reel truck, and no need to return the reel after use

For more information visit www.ipexameric.com
The Livermore-Amador Valley Water Management Agency (LAVWMA) pipeline system transports over 30 MGD of treated wastewater effluent from the City of Livermore, the Dublin San Ramon Services District (DSRSD), and the City of Pleasanton to the East Bay Dischargers Authority (EBDA) pipeline, which empties into the San Francisco Bay. The 16 miles of export pipeline from the LAVWMA pump station to the EBDA pipeline was originally installed in 1979 and ranges in diameter from 24 to 36 inches. The Western Terminus of the export pipeline lies beneath the San Leandro Marsh, a restored wetland area which is habitat to several protected species, including the salt marsh harvest mouse and the clapper rail. The marsh is bounded by a residential development to the east, and the San Francisco Bay to the west.

In 1998, the LAVWMA system began a 10-year expansion project that would approximately double the capacity of the system. In conjunction with the expansion, several portions of the original pipeline were determined to require either replacement or rehabilitation. The 1,750-foot Western Terminus replacement project was the last section of the export pipelines to be replaced. The existing Western Terminus was 27 inches in diameter, but due to increased capacity needs, the replacement pipeline was designed as a 36-inch inner diameter (ID) pipeline.

Due to the numerous protected species that live in the marsh, the construction window was limited to four months in the late fall and winter for work within and under the marsh. Further limiting the available construction window,
work hours were restricted to 7 AM to 6 PM to limit impacts to the nearby residential community. Trenchless construction methods were essential for the majority of the pipeline replacement to reduce the environmental and social impacts from construction. The project also included approximately 550 feet of open-cut construction on the eastern end of the project. The trenchless construction methods that were considered for installing the 1,200-foot, 36-inch ID pipe across the marsh included microtunneling and horizontal directional drilling (HDD).

Microtunneling 36-inch ID pipe is very common; however, guidance becomes less accurate for small-diameter pipe as drive lengths increase beyond 600 feet. Because of environmental restrictions, it was impossible to place an intermediate shaft in the middle of the marsh to reduce drive lengths. In addition, the shafts required for microtunneling would need to be watertight to prevent seepage of groundwater into the shaft which could result in flooding and/or settlement around the shafts. The need for watertight shaft construction methods would further increase the cost and construction schedule. Due to the long drive length, it was also likely that intermediate jacking stations would be required to microtunnel the 1,200-foot drive, further increasing risk and cost.

Using HDD to install 1,200 feet of pipe is standard practice; however, the diameter of pipe required for this project is near the upper end of HDD capabilities. Installing large-diameter pipelines with HDD requires an annular space with approximately six inches of radial overcut to reduce friction during pullback. In soft soils, such as Young Bay Mud, a large HDD bore diameter can collapse and cause delays in construction, increased costs, and possible settlement damage. In addition, the risk of hydrofracture is significantly higher with HDD than with microtunneling. Due to the environmental permitting requirements, drilling fluid hydrofracture risk needed to be aggressively mitigated.

After considering the required length, diameter, construction schedule, risks, estimated cost and anticipated soil conditions, HDD was selected as the more applicable construction method for the Western Termius Replacement Project. Design of the Western Termius project was awarded to Brown and Caldwell in January of 2010, with geotechnical subconsultant DCM/GeoEngineers, trenchless subconsultant Bennett Trenchless Engineers, and construction manager The Covello Group. Final design was completed in June 2010, only six months after notice to proceed. The design timeline of the project was considerably more compressed than typical projects of this size in order for construction of the pipeline to occur during the construction window of 2010.

The geotechnical investigation for the entire LAVWMA expansion and rehabilitation project was conducted in 1998 by DCM/Joyal Engineering (now GeoEngineers). There were four borings performed for the Western Termius portion of
the pipeline in addition to four borings that had been previously performed in the area for other projects. The existing eight borings showed that the soil in the upper 20 feet was predominantly soft to medium stiff fat and organic clays, geologically identified as Young Bay Mud. The upper layer of Young Bay Mud was underlain by a layer of stiff lean clay and medium-dense sand, identified as Old Bay Mud. Groundwater levels were within 10 feet of the ground surface.

Young Bay Mud is under-consolidated soft clay, is very compressible, and is susceptible to high settlement and hydrofracture risks. Old Bay Mud is typically normally-consolidated medium-stiff to hard clays and medium-dense to dense silty sand, and is much less susceptible to settlement and hydrofracture. Therefore, due to the environmental restrictions within the marsh it was imperative to reduce the risks associated with HDD construction by locating the bore in the deeper Old Bay Mud as much as possible.

The west side of the crossing was chosen as the entry point for the HDD crossing due to the much larger work area available. Locating the rig on the west side also helped to minimize noise impacts to the residential neighborhood on the east side of the crossing. To site as much of the bore as possible in the more competent Old Bay Mud, the HDD bore alignment used steep entry and exit angles; the steep angles were selected to ensure that the bore reached a depth of 25 feet before starting the vertical curves. It was important that this depth be attained to ensure steering response in the stiffer Old Bay Mud. Conductor casing was specified at the entry to extend through the upper weaker soils into the deeper Old Bay Mud. This geometry resulted in the bore reaching a maximum depth of approximately 70 feet below the ground surface. A horizontal curve was required to remain largely within the existing LAVWMA easement.

Pullback-load and pipe-stress analyses were performed for this alignment using the ASCE Pipelines Guidelines. Based on the analysis of pullback loads and pipe stresses, HDPE and FPVC pipe materials were determined to be suitable for the project. Steel pipe was not considered due to the corrosive nature of the organic bay soils and the treated effluent, as well as the tight geometry. The 36-inch ID FPVC with the required stiffness class was not available within the short construction schedule, therefore 42-inch OD DR 13.5 (and DR 21 for the open-cut section) HDPE pipe was selected as the carrier pipe.

A detailed hydrofracture evaluation was conducted to help optimize the design to reduce the risk of hydrofracture. Hydrofracture calculations were performed according to the Delft Cavity Expansion Model and were based on the soils described in the Geotechnical Report and assumed drilling fluid properties and means and methods. The hydrofracture analysis results indicated that there was a heightened risk of hydrofracture near the exit point. Therefore, conductor casing was specified at the exit point to reduce risks of drilling fluids escaping the bore, as well as to provide additional bore stability in the soft Young Bay Mud.

The work area at the HDD entry point included a section of an elevated bike path that crossed east-west over the marsh. The work area needed to include a bike path detour around the site to ensure public safety and uninterrupted access. The work area on the eastern end of the alignment was insufficient to allow layout of the full length of fused pipeline without restricting access to residents and traffic. Therefore, to reduce impacts, the pipeline was designed to be fused in two 600-foot segments and staged in the work area and adjacent park. The two segments would then be fused during a three-hour pause in the pullback operation, slightly increasing the risk of the pipe becoming stuck. However, fusing two segments during pullback is relatively common and the risk was considered reasonable.

Bids for the Western Terminus Replacement Project were opened on July 21, 2010. Notice to proceed was provided on August 1, 2010 to the winning team, KJ Woods, with The HDD Company as the HDD subcontractor. Mobilization also included environmental training for all construction personnel and hand clearing wetland and upland plants to minimize disturbance to the protected species. At the entry, 60-inch conductor casing was installed at the entry to prevent hydrofracture and bore collapse.

The 10-inch pilot bore began on October 8, 2010, and reached the exit point in four days. There were several hydrofractures which occurred during the first 850 feet of the pilot bore. Unfortunately, downhole pressures were not monitored, so it is difficult to assess the reason for the hydrofractures. The soils at the exit point were more competent than anticipated and the bore hole was showing no signs of collapse. Therefore, because the chance of hydrofracture is greatest during the pilot bore, the contractor submitted a proposal to eliminate the conductor casing on the exit side of the bore and provide a credit to the owner.

Pipe laid out, ready for pullback
The contractor reamed the bore to 58 inches over the course of two weeks. The first segment of the 42-inch DR 13.5 HDPE was attached to a bore hole swabber, which is used to stabilize the soil surrounding the bore hole, and then attached to the drill pipe for pullback. After the first segment of HDPE pipe was pulled about 500 feet into the ground, pullback stopped and the second 600-foot segment was fused to the first. The pullback process began on October 28, 2010, and was completed in 19.5 hours, including the three hours of downtime required to fuse the two sections of pipe together. The average rate for HDPE pipe pull was 30 feet in five minutes; however, pumping and removal of displaced drilling fluid and bay mud as well as filling the HDPE pipe with water to counteract the buoyancy were the most time-consuming parts of the process. After the 1,200 feet of HDD pipe and 550 feet of open-cut pipe construction was complete, the contractor tied the new Western Terminus to the EBDA pipeline and the new LAVWMA export pipelines began flowing on December 8, 2010. Demobilization and site restoration were completed on January 14, 2011, one day before the permit expired.

There were several challenges encountered in the design and construction of the HDD crossing for the Western Terminus of the LAVWMA Export Pipeline Project. The primary challenge was the accelerated design and construction schedule. The complete schedule from award of design to completion of construction was less than one year. The accelerated schedule was facilitated by the availability of geotechnical data prior to award of design, extensive coordination within the design team and with the owner, and early and ongoing discussions with HDD contractors. During design the team solicited input and feedback from various HDD contractors to solve the challenges regarding work area constraints, ensuring emergency vehicle access, and bike path bypass. The narrow construction window required effective communication between the contractor, designer, and owner to resolve issues in an efficient manner.

The site geotechnical conditions were challenging for a large-diameter HDD installation due to the high risk of settlement, hydrofracture, and bore collapse in the upper layer of weak Young Bay Mud. These difficulties were overcome through the use of conductor casing through the Young Bay Mud to maintain bore stability, locating the majority of the bore within the more competent lower Old Bay Mud, and increasing the depth of cover to reduce the risks of hydrofractures and settlement.

The successful completion of this project marks the overall completion of the LAVWMA Export Pipeline Project begun over a decade earlier. The project’s final link, completed using HDD, also underscores the significant incremental advancements in HDD practice that ensured protection of sensitive species and minimized disruption to nearby residents.
AUI Inc. was, along with other qualified companies, invited to bid on a project to slipline aging and failing concrete sewer mains going into the privately held Central Valley Water Reclamation Facility in Utah.

As the saying goes, “Go big or stay home.” AUI went big, so to speak, and was the successful bidder even though AUI is headquartered many hundreds of miles from the facility.

The lines to be slimple are not only the largest in Utah, but also AUI Inc.’s largest slipline pipe size to date.

The biggest sewer line in AUI’s home state of New Mexico is less than 80 inches in diameter, says AUI trenchless division manager Mike Rocco. “We put a 74-inch pipe inside a 78-inch line once, and that was our biggest slinging job before Central Valley.

“We realized that the Central Valley job was going to be a little bit different from our usual work.”

Based in Albuquerque but operating across a wide geographic span, AUI offers a wide range of construction and engineering services. From specializing in pipe- and utility-related projects when it began as Albuquerque Underground in the early 1980s, it has expanded its expertise and work to include bridges, paving, channels, heavy dirtwork and more, always maintaining safety and quality as top priorities.

“Our specialty here at AUI is sliplining and pipebursting, but we do other things,” Rocco says. “We’re a diversified company.”

Now, about the Central Valley Water Reclamation Facility: The plant, located in Salt Lake City a bit west of the Veterans Memorial Highway, was created in the 1970s to meet the stringent

Central Valley board members represented districts and cities which operated five antiquated wastewater treatment plants that fell short of the law’s standards.

The facility was built on property owned by one of the centrally located board members and covers roughly 168 acres. The plant is designed to treat 75 million gallons of waste daily and serves over a half-a-million customers on a 24-7 schedule.

The demanding work was performed in Salt Lake City in September and October of 2010.

AUI’s project consisted of sliplining the existing 84-inch i.d. RCP with 82-inch o.d. fiberglass-reinforced polymer mortar pipe from Hobas Pipe USA, and sliplining 54-inch RCP with 52-inch Hobas pipe.

Texas-based Hobas was chosen as pipe supplier by Central Valley’s in-house engineers based on its product’s tight tolerances and high quality for years of uninterrupted service.

AUI was able to accomplish the sliplining project by first utilizing Southwest Sewer Services to clean and CCTV the lines. Once this was accomplished, AUI was successful in sliplining 1,270 LF of 82-inch pipe and 864 LF of 52-inch pipe.

Some of the early concerns of the project were due to the distance from AUI’s home office. AUI had to ensure the careful coordination of subcontractors, which also were coming from Albuquerque, ensuring that schedules were met and good communications were always in place.

Due to all the quality and safe work performed, the project was completed on time and on budget.

“The customer was impressed,” Rocco says. “This was their first time utilizing trenchless technologies, and they are already planning future projects on other areas of their lines utilizing the slipline method.

“AUI extends a note of special thanks to our project superintendent, Archie Lucero, and project foreman Dartanyan Woford for all their hard work and dedication to the project.

“We would also like to recognize the project’s subcontractors: Bogan Brothers Painting, who handled the specialized manhole coatings with Zeborn; Condeck Corporation, who grouted the annular space; and SW Sewer, who cleaned and CCTV inspected the lines before and after construction.”

Project Details

Project Name: Central Valley Road Sewer Rehabilitation
Length and Diameters: 1,270 feet of 82-inch, and 864 feet of 52-inch
General Contractor: AUI Inc, Albuquerque, NM
Engineer: Ron Roberts, P.E., Salt Lake City, UT
Owner: Central Valley Water Reclamation Facility

For additional information, contact Michael Rocco (505) 242-4848, Ext. 3004 or rocco@auiinc.net
New Mexico Contractor License No. 20617
Licensed in Arizona, California, Colorado, New Mexico, Texas, and Utah
The Rutherford Pipeline Rehabilitation project was bid in the fall of 2009. Construction began in February 2010 and was largely completed by June 2010. The existing pipeline had suffered significant corrosion leaks and had been repaired at 17 locations in recent years. The trenchless pipe bursting process was used successfully to complete the project.

Faced with the prospect of more leakage on the Rutherford water transmission line, the City of St. Helena, California, planned to replace 2,627 linear feet of 12-inch steel water main. The existing 12-inch welded steel pipe is located under a drainage ditch over most of the alignment that further complicates all excavations and would make an open-cut project extremely difficult and costly, and would encroach onto Highway 29. The City needed a less intrusive replacement method than open-cut construction. The existing alignment is in a very narrow right-of-way between heavily traveled Highway 29 to the east and the Napa Valley Wine Train railroad to the west.

Crews had to work with a busy state highway to one side of the job site and a rail line to the other.
More leaks in the line were predicted, so pipe replacement was considered. Maintaining a reliable source of water to the city and surrounding area in the Napa Valley was critical. The engineer for the City was in need of a repair solution for this section of the water transmission pipeline. Up to this point, repairs had been made mostly with full-circle repair clamps. This type of repair is costly and is usually done as an emergency, leaving the pipeline out of service for a period of time while repairs are completed.

In the fall of 2009, the city publicly bid a project to replace the aging pipeline using the static pipe bursting method. The successful bidder, Team Ghilotti of Petaluma, California, was awarded the contract. Trenchless pipe bursting was chosen for the project because the section of main ran along the highway and was constricted on the other side by the Wine Train. Numerous utilities were also in the same alignment, many in very close proximity to the 12-inch main. Another element became apparent; the entire run of the 12-inch steel pipe was joined, at 40-foot intervals, with Style 38 Dresser Couplings. This would prove to be a major challenge to successful pipe bursting. A conventional open-cut construction project would have forced the city to take a lane in the state-controlled highway; this was not an option. Another scheduling element required getting the project completed before the grape harvesting season, or “Crush” as it is known locally. Harvesting grapes in this region is a major component in producing some of the finest wines in the world.

**PROJECT BACKGROUND**

After a wet winter that pushed the project two-and-a-half months off schedule, Team Ghilotti, Inc. was under pressure to get the project started. After locating and removing all known couplings and repairs on the welded steel pipeline, crews constructed machine pits. From these launching and receiving pits, spaced approximately 400 lineal feet from each other, crews attempted to install the 12-inch fusible C900 PVC pipeline. Fusible PVC pipe was attached to the bursting head and cutter assembly. A “floating” pulling head for the fusible PVC pipe is used to isolate the actions of the bursting head from the string of new pipe.

The pipe was launched, but the bursting/splitting operation did not go as planned. The welded steel pipe was split successfully but progress was stopped in the first 40 lineal feet due to the Dresser couplings. The contractor was compelled to dig up each Dresser coupling to make forward progress. Over the next three days, with only 120 lineal feet of progress made, the project was in need of a new technical support team.

The couplings added several inches to the diameter of the pipe. Team Ghilotti contacted trenchless equipment manufacturer TT Technologies, Inc., of Aurora, Illinois, to brainstorm on a different method to split the pipe and couplings, which the other bursting system failed to do. TT Technologies was asked to determine if the pipe and couplings could, in fact, be split reliably. Between Team Ghilotti and TT Technologies it was decided to excavate, remove, and ship back to the factory a 10-foot-long section of welded steel pipe (WSP) containing a Dresser coupling in the middle for above-ground testing. The above-ground testing ensured all parties could witness the results and how the tests were carried out.

Within two hours of the decision to ship a piece of pipe, it was on a plane to Illinois. A Grundoburst 1250 G static bursting machine was utilized for the testing and subsequently for the City of St. Helena project on-site in Rutherford. TT Technologies was able to confirm that the burst test was successful. Team Ghilotti approached the City of St. Helena with new bursting procedure and a contract change order was agreed upon.

**BURSTING OPERATIONS**

The remaining project was divided into four bursting runs; one reach was approximately 600 linear feet while the others were in the range of 400-500 linear feet. A Grundoburst
1250G static pipe bursting system was shipped to the project while Team Ghilotti positioned pits for 400-500 lineal feet of pulls.

The first run was approximately 600 lineal feet to accomplish splitting the WSP with couplings that ran beneath a fast-running slough where the existing pipe was buried approximately 60 feet in width from the top of one bank to the next. This 600-foot pull was the toughest portion of the project as four-inch and six-inch tees, capped off from previous connections, also existed under the slough in the alignment. Team Ghilotti crews constructed two-way machine pits that were used to pull from each direction. The existing 12-inch steel pipe was approximately seven to eight feet deep. As spring runoff was at maximum, this was certainly one of the toughest parts of the project. It was imperative to be able to make it through this area. A dig-up was simply not possible. With a high water table, Team Ghilotti crews had to dewater the site continuously throughout the project, and the machine and launching pits were extensively shored.

Once the excavation was prepared, Team Ghilotti, Inc crews began by threading the exiting pipe with the Quicklock bursting rods. Once the rods were through the pipe and at the insertion pit, the cutterhead, expander, pulling head and Fusible C900 PVC pipe were attached.

The first run was completed without incident, taking approximately 2.5 hours of actual bursting time to complete. The second was performed two days later. The bursting unit, still set in the machine pit, was turned 180 degrees in order to burst the 320-ft section of pipe. The next pipe section was rodded and the cutterhead, expander and new FPVC were attached. At the second two-way machine pit, the Grundoburst machine was “shoehorned” into a vertically tight pit with multiple electric conduits visible in the upper portion of the excavation. Ultimately all runs were successfully burst and replaced in a couple of hours for each run.

The static bursting machine operated without interruption. The pulling forces were within the working range of the 150-
ton capacity machine. The cutter and expander reliably split, cut and expanded the 12-inch steel pipe and the steel Dresser couplings for each bursting run.

**LESSONS LEARNED**

As the project concluded, the contractor had become quite skilled at operating the specialized bursting equipment. The pipe bursting runs were virtually flawless. New 12-inch FPVC pipe was safely and successfully installed. Representatives from the City of St. Helena were very pleased with the project’s progress and successful completion. Once the new fusible PVC pipe was installed it was connected to the existing piping, a connection to a temporary pump station was made, and a handful of other connections were made for water services and fire service. The line was pressure tested successfully and the city was extremely pleased to have the project completed. With 35 years of experience in the underground business, Team Ghilotti was impressed by this project. Looking back, digging up repair clamps may not have been necessary.

The “Lessons Learned” representative for the city stated that in future projects, they would more closely specify the pipe bursting system to be utilized. Because of this project, splitting 12-inch welded steel pipe coupled with Dresser type couplings has been well documented. This will help future project designers to have the proper equipment for similar projects.

Because of the failures early in the project it is quite apparent that there is a need for advance testing or proven systems to be used. Substantial expense, lost time and high stress levels can be avoided. What started out as a major pipeline replacement project with great difficulty splitting 12-Inch steel pipe developed into a successful conclusion. Efforts made by the contractor, the city and the pipe bursting technology provider to test and verify the pipe bursting process resulted in a good model of cooperation that led to successful completion of the project. Going forward the city is interested in doing more of this work; however, funding is not available for those projects at this time.

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Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High-Density Polyethylene Pipe

Dr. Lawrence M. Slavin
Outside Plant Consulting Services, Inc.

ASTM F 1962 provides overall guidelines, addressing preliminary site investigation, safety and environmental considerations, regulations and damage prevention, bore path layout and design, implementation, and inspection and site cleanup for maxi-HDD operations. One of the significant contributions of ASTM F 1962 is the provision of a rational, analytical method for selecting the polyethylene pipe strength based upon the estimated installation and post-installation (operational) loads on the polyethylene (PE) pipe.

While considered convenient and practical to apply by experienced engineers for maxi-HDD operation, the equations and procedures provided in ASTM F 1962 represent relatively complicated formulae, and an extensive tedious methodology, when considering smaller, lower-cost operations associated with typical mini-HDD applications.

Mini-HDD operations are often performed during an upgrade of a large community, comprising many individual installations, with any single installation not requiring or receiving extensive analysis. Nonetheless, some mini-HDD installations may be considered to be relatively critical, or approach limits with respect to the capability of the available drill rig and/or the strength of the product pipe being installed. Furthermore, any construction procedure must address basic safety rules, avoid damage to existing facilities, adhere to applicable government regulations, and consider environmental issues. TR-46, Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe, was therefore developed to serve as an inclusive document, providing practices for placement of HDPE pipe using mini-HDD. It is anticipated that TR-46 will become widely used for mini-HDD pipeline installations, serving a similar role as ASTM F 1962 for maxi-HDD applications. The present guidelines may also be used for some midi-HDD installations, depending on the application and the judgment of the contractor or engineer.

Description of TR-46

Technical Report TR-46 comprises 10 main sections, plus six Appendices and References: Scope, Referenced Standards and Specifications, Terminology, Preliminary Site Investigation, Safety and Environmental Considerations, Regulations and Damage Prevention, Pipe Design and Selection Considerations, bore Path Planning and Drill Rig Setup, Implementation, Completion, Appendices (A-F), and References.

The Scope includes the design, selection considerations, and installation procedures for the placement of polyethylene pipe or conduit belowground using mini-HDD equipment. (It is beyond the scope of the TR-46 guidelines to provide detailed operational procedures for the various mini-HDD and auxiliary equipment. It is assumed that the contractor has gained the appropriate proficiency.) The primary focus is on pipe constructed of high-density polyethylene (HDPE) with a material designation code of either PE3608 or PE4710. Information is also provided for pipe of medium-density polyethylene (MDPE) PE2406/2708 material. Such PE pipe may be supplied in continuous lengths on a reel or discrete segments assembled together, typically by fusion, in the required length.

Applications include pipe for conveying fluids, such as water, natural gas, and oil, as well as ducts or conduits for containing communications (e.g., telephone or CATV) or electric power supply cables. TR-46 reflects the latest industry information, but also includes new information not readily available elsewhere. For example, guidelines are provided for proper drill rig positioning, consistent with meeting required placement depths and drill rod capabilities, in an easy to use, convenient format. Of particular interest, is a practical methodology for estimating the relevant forces and effects present during installation, based on the route geometry, facilitating proper selection of the pipe wall thickness.

In comparison to ASTM F 1962, which is generally intended for use by experienced engineers for major maxi-HDD installations, TR-46 contains a convenient calculation method appropriate for persons with various back-
grounds, including the operators of mini-HDD equipment and/or the utility engineers. In particular, the procedure presented provides a means of selecting the pipe strength to avoid collapse due to hydrostatic pressure at the desired placement depth, as well as to withstand the required pulling loads during installation. The pipe strength is directly related to the wall thickness, as specified by its dimension ratio (DR), defined as the pipe outer diameter by the (minimum) wall thickness. The methodology is based upon a simplification of ASTM F 1962.

The guidelines indicate that essentially all the commonly used wall thicknesses (e.g., DR 7.3 to DR 17) for HDPE pipe would be sufficiently strong for depths to approximately 15 feet, the typical limit for mini-HDD installations. For depths greater than 15 feet, thinner wall HDPE, MDPE pipe, or special situations, the adequacy of the product for the application should be verified using the information in the Appendix. The allowable depths assume an empty pipe during the installation and pre-operational phase, in the absence of internal fluids or pressure, which would offset the effects of the external pressure due to drilling fluid/slurry. Although some HDD installations, such as more complex maxi-HDD installations, or possibly some mini-HDD applications, may deliberately allow the pipe to be filled with water or drilling fluid in order to reduce pull loads due to buoyancy effects, as well as the net effective hydrostatic pressure, during installation, such practices are not typically employed in mini-HDD operations.

Table 1, reproduced from TR-46, provides the safe pull tension for HDPE (PE3608) for a variety of pipe sizes. The safe pulling load (in pounds) is conservative, and accounts for the effective cumulative tensile load duration on the pipe, assumed to be one hour, and a significant reduction relative to the nominal tensile test strength of HDPE to limit non-recoverable viscoelastic deformation, as well as some possible uncertainty in the estimated pull load. For MDPE pipe, the tabulated values must be adjusted by a factor of approximately 0.80 and, for PE4710 material pipe, increased by a factor of approximately 1.05.

The following equation was developed as a convenient means of estimating the peak force applied to the pipe as it is pulled throughout the bore hole:

\[
\text{Tension (lbs)} = \left(\frac{\text{Bore Length (ft)}}{\pi}\right) \times \frac{1}{2} \left(\text{Pipe Outer Diameter (in.)} \right)^2 - \text{Pipe Weight (lbs/ft)} \times 1.3 \times 1.6
\]

The buoyant weight may be calculated as: Buoyant Weight (lbs/ft) = \(\frac{1}{2} \times \text{Pipe Outer Diameter (in.)}^2\) – Pipe Weight (lbs/ft) ...

or may be conveniently selected from Figure 1.

The parameter \(n\) is equal to the number (or fraction) of 90-degree route bends due to cumulative route curvature, where \(n = n_1 + n_2\). The quantity \(n_1\) is the effective number of deliberate/planned 90° route bends, and \(n_2\) is the cumulative curvature (90° route bends) due to the unplanned undulations. The following value of \(n_2\) is suggested:

\[n_2 = \left(\frac{\text{Bore Length (ft)}}{500 \text{ ft}}\right) \times \left(\frac{2\text{-in}}{\text{Rod Diameter (in.)}}\right)\]

The criteria for selecting an appropriate pipe strength then corresponds to selecting a DR value (Table 1) with a safe pull tension at least as large as the estimated tension, as determined above. This procedure is analogous to the procedure incorporated in ASTM F 1962 for maxi-HDD installations. The present mini-HDD calculations, however, will generally result in considerably shorter possible placement distances than that corresponding to application of the methodology and equations provided in ASTM F 1962, which may also include the use of anti-buoyancy techniques to reduce buoyant weight to significantly reduce required pull loads. The shorter placement distances for mini-HDD are also due to the increased drag (“capstan effect”) generated by the additional route curvature of mini-HDD operations, due to path corrections, which are typically of greater magnitude and significance than that encountered in well-controlled maxi-HDD installations.

In general, therefore, the preceding formulas and methodology are recommended for estimating pull loads for mini-HDD installations. Other methods for determining pulling loads, including ASTM F 1962 or associated software tools, are typically based on well-controlled maxi-HDD installations and not representative of actual mini-HDD applications with respect to anticipated pull loads.
Bore Path Planning

TR-46 addresses the planning of the bore path, consistent with meeting the requirements of the project owner, including placement depth, as well as corresponding drill rig setup information, which is dependent upon the equipment parameters (e.g., allowable drill rod curvature). The information provided supports the design of the bore path in both the vertical and horizontal planes, which is typically performed by the contractor for mini-HDD installations. For more complex HDD operations, such as maxi-HDD installations, these functions would typically be performed separately, by experienced individuals or organizations.

The drill rig setup and related distances are controlled by the allowable radius of curvature (bend radius) of the steel drill rods, as specified by the manufacturer of the rods, and is a function of their diameter. For pipe constructed from HDPE or other very flexible material, the bend radius limitation of the drill rods is sufficiently large to be compatible with that of the product pipe.

Figure 2 illustrates a typical mini-HDD bore vertical profile trajectory, including occasional pits along the route. These pits may be required for pipe splicing, completing lateral connections, or to expose existing utilities. The pits may also be useful for collecting drilling fluid from the boring or reaming operations. Figure 2 designates certain points along the bore path and their relative distances from the drill rod entry and exit points. These distances are a function of the entry angle and drill rod characteristics, and determine the setup location and space requirements in which to perform and complete the pipe installation. Figure 3 shows a typical plot for the required setback distance, and also the rod to ground surface, indicates the minimum depth achievable at the beginning of the bore path to achieve a level trajectory.

Summary

Plastics Pipe Institute Technical Report TR-46 represents a comprehensive set of information supporting the placement of HDPE pipe by mini-HDD equipment. In general, the simplified formulas and methodology provided for estimating pull loads for mini-HDD installations are considered more appropriate for such cases than other methods for determining pulling loads, including ASTM F 1962 or associated software tools, which are typically based on well-controlled maxi-HDD installations. The latter procedures are not representative of actual mini-HDD applications with respect to anticipated pull loads.

Although the TR-46 guidelines are primarily described with respect to mini-HDD operations, the information may also be applicable to midi-HDD installations. Thus, guidelines for the use of midi-HDD machines and associated practices may be obtained from the present TR-46 document, as described herein, and/or ASTM F 1962, depending upon the particular application and the judgment of the contractor or engineer.
Managing Geotechnical Risks

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Abridged from the 2010 No-Dig paper co-authored by Marc Gelinas

Managing geotechnical risks is a key element to the success of all underground construction but especially so with trenchless installation of new pipelines. Trenchless installation of new pipelines involves sight-unseen excavation with complex equipment requiring a high degree of contractor experience and skill. The complexity of trenchless construction equipment makes trenchless methods of construction particularly sensitive to subsurface conditions and changes in subsurface conditions along a pipeline alignment. Subsurface conditions can determine the overall feasibility of individual trenchless methods, the selection of equipment tooling, and installation production rates. Encountering subsurface surprises during construction can result in first-party differing site condition claims and third-party property damage claims.

The following nine steps are critical to identify, avoid if possible, and manage geotechnical risks – and to minimize subsurface surprises that can lead to problems on trenchless projects:

1: Understanding Geologic Setting along the Pipeline Alignment: The evaluation of geologic setting is relatively straightforward and should be included in all geotechnical investigations for trenchless projects. Establishing geologic setting at an early stage is critical to evaluating project feasibility and alignment alternatives, and to providing the context for interpolation of subsurface conditions between borings. Evaluation of geologic setting includes two separate tasks: collecting and organizing published information along the pipeline alignment pertaining to geology, seismicity, soils, groundwater, fill, underground structure conflicts, and possible soil and groundwater contamination; and reconnaissance of the pipeline alignment and surrounding area to field check the collected geologic information. The alignment reconnaissance should include an area substantially larger than the linear pipeline alignment to incorporate regional trends in geology and geomorphology (landforms) and in particular upgradient source bedrock and depositional patterns in alluvium.

2: Research Development History along the Pipeline Alignment: The importance of this cannot be overstated. Too many trenchless projects have failed for lack of this relatively simple and inexpensive step. Alignment history can be evaluated from a variety of sources, including historic topographic maps and aerial photographs of urban areas.

3: Subsurface Investigations: The spacing of borings, groundwater-monitoring well locations, type and size of drill rigs and soil/rock samples should be based on both the alignment geometry (surface conditions) and alignment geology (geologic setting). Most subsurface investigations for larger trenchless projects are accomplished in two phases: preliminary subsurface investigation including borings, test pits and/or large diameter borings, cone penetration tests and geophysical testing, all widely spaced along the alignment; and final subsurface investigation including test borings at all shafts, mid-drive borings, large-diameter borings, test pits, cone penetration tests, geophysical testing and groundwater-monitoring wells. Sampling should be continuous through the pipeline zone and extend at least one diameter above and below the pipeline.

4: Laboratory Testing: Soils testing for trenchless projects includes typical physical testing for soil classification, unit weight, moisture content, shear strength, compressibility and permeability. For trenchless projects, full grain size distribution from two microns up to cobble and boulder size are particularly important. Additional testing on cobbles and boulders and...
bedrock often includes rock unconfined compressive strength, Cerchar abrasivity testing, and slake durability tests. The type of laboratory testing completed will vary depending on subsurface conditions encountered (soil or bedrock), the trenchless method to be used and shaft design considerations.

5: Ground Classification: Boring logs should classify soil composition in accordance with the Unified Soil Classification System (USCS) and consistency in accordance with Standard Penetration Test Blow Count (N) values and unconfined compressive strength in clays. For trenchless projects, it is critical that soil behavior also be described. This is typically not done on open-cut trenching projects. A careful description of soil behavior will tell the contractor what to expect at the tunnel heading, within an HDD bore path, and at shaft portal cuts. The standard classification system used in the trenchless industry to describe soil behavior is the Tunnelman’s Ground Classification System.

6: Specific Geotechnical Analysis and Calculations: Trenchless projects require analysis of several method-specific items that are not required on open-cut trenching projects. For example, estimation of jacking forces in microtunneling is critical to determine maximum drive lengths, reaction wall requirements and placement of intermediate jacking stations. The following are a few select examples of geotechnical calculations that should be performed on trenchless projects: shaft shoring design (for long-term conditions), thrust block/reaction wall capacity (may require ground improvement design in soft soils), and launch and reception portal stability and design of ground improvement or local dewatering to allow for safe portal cuts in shaft shoring.

7: Geotechnical Report Format: For trenchless projects, it is useful to follow the major underground construction and tunneling model and divide the geotechnical investigation report into two parts: the Geotechnical Data Report (GDR) and the Geotechnical Design Summary Report (GDSR). The GDR should contain all objective data generated by the geotechnical investigation (research results, geologic mapping, boring logs, lab tests, etc.). The geotechnical data can then be provided directly to bidding contractors in the contract documents. The GDSR should contain the geotechnical engineer’s interpretation of the geotechnical data, including interpolated subsurface soil profiles within the context of overall geologic setting and development history, and specific recommendations for trenchless design and construction based on the project-specific geotechnical analysis and calculations. The GDSR report should be carefully coordinated with the final project plans and specifications.

8: Contract Documents: A frequent question is whether to include the geotechnical report as part of the contract documents or provide the geotechnical report for “contractor reference” only. By using a carefully prepared two-part geotechnical report as described above, the owner can include all of the “objective” subsurface data developed for the project in the GDR for contractor use and reliance. The GDSR may or may not be included as a part of the contract documents but should be provided to the contractor with the provision that interpretations are the geotechnical engineer’s and the contractor may develop their own “reasonable” alternative interpretations consistent with the geotechnical data and contractor experience. It is essential that language be included in the contract documents that states that any GDSR “warnings,” “cautions” and “advice,” while not binding on the contractor, must be taken into account and specifically addressed by the contractor.

The technical specifications for trenchless projects should focus on performance rather than means and methods. Of particular importance on trenchless projects is the definition of obstructions, which can include differentiation between natural versus man-made objects, natural object size, and natural object strength. The specifications must include provisions to cover the costs of hitting and removing an obstruction. These definitions and cost provisions are highly critical in trenchless projects and must be carefully thought out to minimize downstream conflicts.

9: Construction Management and Inspection: The final step in managing geotechnical risks on trenchless projects is through construction management and inspection. It is imperative that construction inspectors have experience with the trenchless method undertaken. For example, an inexperienced inspector was not concerned to see a contractor pushing a microtunnel-boring machine hard in very stiff, highly expansive clays (not ideal conditions for microtunneling). This resulted in the machine’s face becoming fully impacted with compacted clay and stopping the machine. After restarting and slowing down tunneling advance rates, the remainder of the project was successful.

An inspector must be diligent in collecting daily records specified to be provided by the contractor. Inspectors need to be equally diligent in their own observation obligations. This includes providing detailed daily reports or logs, accurately labeled photographs of the work and events, documenting actual tunneling rates and down time, and taking periodic daily samples of tunnel spoils from slurry separation plant shaker screens.

Managing geotechnical risks on a trenchless project requires experience and judgment on the part of owners, engineers and contractors. If conscientiously followed, the nine steps outlined above will provide owners with the best possible means of managing geotechnical risks.
In January 2011, a task was set forth to rehabilitate 100-year-old stormwater tunnels in Butte, Montana. This task was met with the teamwork of Butte/Silver Bow’s metro sewer department, Water and Environmental Technologies consulting engineers, the Pipe Lining Division of Heitkamp, Inc., and Sekisui SPR Americas, LLC.

The project had many variables, which made choosing a rehabilitation method a task in and of itself. How would pipelines be rehabilitated to create a complete structural solution that was environmentally friendly, cost-effective, long-term, efficient, and safe to all workers involved?

To determine which technology would be an effective tool for the Anaconda Road Trunk Line, the team had to investigate the status of the current tunnel. The answer was a grouted-in-place, spiral-wound pipeline rehabilitation method using a PVC profile manufactured by Sekisui SPR Americas.

The original tunnels of the Anaconda Road Trunk Line were constructed of granite blocks, cobblestone, brick and concrete in the late 1800s with late-1800s technology. With the pipelines tunnels being more than 100 years old, they were cracking and losing their structural integrity. A collapse would mean destruction to the property and streets above.

Another challenge the team faced involved the length of tunnel in need of rehabilitation. Conventional methods considered had variables which did not make them suitable for this project. For example, using polyethylene pipe to join sections of the line together could potentially create a joint every eight feet, which was not a desired result. Using this method would have also involved excavating an access pit to allow the equipment to jack the pipe into the tunnel; this would have added extra cost and created a
During initial tunnel inspections, more problems were found. There were multiple lateral connections draining into the tunnel. The laterals would need to be reconnected. A new inspection technology was offered to Butte to provide a more accurate assessment of the tunnel’s condition. A laser profiling technology offered by Sekisui SPR Americas would be able to measure deformation, longitudinal cracking, offsets in joints, and size and location of connections, and provide all the information in a 3D format capable of being entered into the design programs the manufacturer and engineer would use to develop a rehabilitation solution.

Sekisui SPR Americas partner provided 3D laser profiling services to the city to document the existing condition of the tunnel. The inspection project took 10 days and included 161 separate scans that were tied together. The resulting data was converted into AutoCAD files to show the plan and profile of the pipe. A total of 36 AutoCAD plan and profile sheets were provided to the city, Heitkamp and Sekisui SPR Americas after the project was awarded.

With the information obtained from the laser profiling and the inspections, a proposal was offered to the City and the consulting engineer for a solution. They agreed that the answer was a newer technology from Sekisui SPR Americas. The technology is called Sekisui SPR™, which is a machine-wound PVC profile that mechanically provides a duel-locking mechanism on its monolithic profile. This technology has been extensively used globally, and has many benefits when used for pipeline rehabilitation.

Sekisui SPR™ is a spiral-wound grouted-in-place pipeline rehabilitation method with a relatively simple installation process. A spool containing the PVC profile sits above grade at a standard manhole or access point. The PVC profile is fed from the spool to the winding machine in the host pipe. The machine winds the profile while mechanically locking the profile onto itself. As it locks, the hydraulic winding machine travels through the host pipeline, creating one long, continuous monolithic PVC pipe. The process is seismic-rated and able to wind through manholes, which helped this project move faster. Along with being a 100-percent structural rehabilitation process, it has many other benefits that made it a great fit for Butte/Silver Bow.

Sekisui SPR™ is an environmentally friendly pipeline rehabilitation method. No chemicals are used during the installation of the PVC, which could be potentially harmful to workers or the environment. This method is also trenchless, so there is no excavating of streets causing a social distraction or disturbance. Local businesses and homeowners are not disturbed during construction. Also, due to the minimal size of the equipment and the typical site
setup, there is a small amount of personnel and vehicles on-site. Despite the extreme temperatures faced in Butte (as cold as -30 degrees Fahrenheit), Heitkamp was able to complete the project on time and accident-free.

Flow capacity was also not a concern for the trunk line; the main concern was structural integrity. Heitkamp was able to wind a 36-inch circular SPR™ PVC pipeline into the host tunnel. After the pipeline was wound in to place, service connections were reinstated, the annular space was grouted, and a new pipeline with a 50-year design life was created.

Heitkamp is a nationwide pipeline rehabilitation contractor and a certified installer of SPR, and their expertise increased productivity so that the rehabilitation of over 2000 LF was completed on time. Sekisui SPR™ was used because of its physical factors, as well as its economic benefits. It was cheaper than digging and replacing the line – an original consideration – and also more competitive than alternate solutions because of its efficiency and because it requires less equipment on-site and no excavation.

With the teamwork of all the parties involved, the project was completed in a timely fashion. The final result was a long-term, completely structural rehabilitation solution that is environmentally friendly and economical.

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www.sekisui-spr.com 1-866-62-SSPRA
In recent years, there has been a tendency towards designing liners to resist not only internal pressure, but also traffic and soil pressure, assuming that at some point in the future the host pipe will fully disintegrate. While this may pose an extremely conservative view, it essentially requires building a new pipe inside the old pipe that could perform independently of the latter.

The design of such pipes is controlled by buckling of the liner. The compressive strength of FRP products is lower than their tensile strength. That leads to installing layer after layer of carbon fabric inside a pressure pipe to create a thick enough liner with adequate stiffness. For such repairs, it is common to see designs calling for 10 or more layers of CFRP. Both the high cost of repair and the long time required to accomplish the repair offered opportunities for innovation. It is emphasized that most of these repairs must be performed under very tight shutdown schedules. So, shortening the repair time is of extreme value to the owners of these pipes.

The other option for repair of pressure pipes is to slip-l ine them with a new pipe. A major shortcoming of this technique is that the new pipe is smaller in diameter and thus has significantly less capacity than the original pipe.

For gravity-flow sewer pipes and culverts, there has been little use of the pricy CFRP liners. However, there are several lower-cost FRP liners that are supplied as long flexible tubes that are blown or inverted inside the host pipe. Curing is often with steam, hot air or water. These products do make the pipe water tight, but in many cases they cannot provide the required strength to carry the loads imposed by traffic and soil. Moreover, the cost of mobilization for these systems is a disadvantage for repair of shorter pipes and culverts.

The option of slip-lining can also be used for gravity-flow pipes, but many of these pipes are non-cylindrical. Slip-lining such pipes with a readily available cylindrical pipe can easily lead to 30- to 40-percent reduction in cross-sectional area and loss of flow capacity.

In light of the above challenges, PipeMedic has develop-
oped the patent-pending StifPipe™ that takes advantage of honeycomb technology. Honeycomb construction was originally developed by the aerospace industry to achieve strong and lightweight structures. It has also been successfully used in construction of boats, so exposure to water is not a concern. A layer of FRP is used as skin reinforcement that is applied to both faces of a lightweight honeycomb core. The principles of design are simple: By separating the outer skin layers with a honeycomb core, one can achieve high stiffness at a fraction of the cost of a solid cross-section.

Manufacturing can be done onsite or offsite. A mandrel is prepared as a template and the required number of layers of saturated fabric and honeycomb core are applied successively to create a pipe of desired shape, size and strength. Finished sections of StifPipe™ can be tested to verify that they meet the project specifications (see Test Box).

Development and Advantages

In the late 1980s, researchers at the University of Arizona were the first to introduce the concept of repair and retrofit of bridges and buildings with FRP to the construction industry (1). Fiber Reinforced Polymer (FRP) is made of fabrics of carbon or glass that are saturated with epoxy resins. In a process known as wet layup, the fabric is saturated with resin in the field and is bonded to the exterior surface of beam or column; upon curing in several hours, it becomes 2-3 times stronger than steel! The high tensile strength, light weight, durability and ease of installation have made these products very popular in repair and retrofit projects.

The use of wet layup carbon FRP to strengthen Prestressed Concrete Cylinder Pipe (PCCP) began in the late 1990s. As shown in Fig. 1, these pipes consist of a steel cylinder that is sandwiched between layers of concrete and wrapped on the outside with prestressed wires. PCCPs have been used extensively worldwide as water transmission lines. Improper design and poor construction practices have resulted in breaking of the stressed wires and catastrophic failure of many of the older pipes. As seen on many news stories, once the pipe fails large volumes of water under high pressure can create rivers running down streets and city blocks in seconds.

Wet layup carbon FRP (CFRP) is a cost-effective method to retrofit the weak segments of a PCCP prior to failure. In this trenchless repair technique, the crew can enter the pipe through access ports and apply carbon fabric to the interior surface of the pipe. Once the fabric cures, it creates a pressure vessel that can relieve the PCCP from carrying all or part of the internal pressure. This technique is fairly well accepted and recognized by the industry, and PipeMedic has been an award-winning (2) leader in this field with work that includes the world’s largest pipeline repair project using FRP (1.1 mile of an 84-inch pipe) (3).

Because the tensile strength of CFRP is 2-3 times that of steel, the application of a small number (typically 2-4) of layers of carbon fabric is sufficient to restore the integrity of the pipe. This makes the technique cost-competitive, especially in cases where digging and replacement of the pipe is not easy. But when the liner is expected to carry internal and external loads, the use of CFRP leads to many layers of carbon that make the projects too expensive and time-consuming. It was the combination of these problems and 25 years of R&D that led to the development of StifPipe™.

StifPipe™ has some unique and advantageous attributes, not least of which is that it can be manufactured to any size. Unlike conventional pipes, it is not limited to available “round” pipe diameter sizes only. For example, it is possible to line a 60-inch-diameter pipe with a StifPipe™ having an outside diameter of 59.5 inches, thereby maximizing the flow capacity.
StifPipe™ can be made to any profile for maximum capacity. For repair of non-circular pipes, it can be constructed to match the existing pipe profile, reducing the loss of cross-section and thus maximizing the flow capacity. Conventional sliplining of these pipes with commonly available cylindrical pipes leads to significant loss of capacity.

No lifting equipment is required; StifPipe™ is so light that it can be hand-carried to its final position.

There’s a shorter repair time. Manufacturing the pipe sections offsite before repairs begin will significantly reduce onsite repair time. The time savings are enormous when compared to installing many layers of carbon fabric inside the confined space of a pipe and delivering the raw materials to the workers under those adverse conditions at locations that could be hundreds of feet away from the access points.

There’s less volume to grout. By constructing the pipe profile to closely fit that of the existing pipe, little volume will be left to be grouted or filled with resin. This results in materials and time savings during the installation.

Virtually no lead time is required. For emergency repairs, unlike conventional pipes, no time is lost waiting for the manufacturing of pipes; the raw material is always available and pipe sections can be ready in 24 hours.

FRP products such as StifPipe™ do not corrode and have excellent chemical resistance.

StifPipe™ sections can be tested before they are installed to ensure that they meet the design specifications.

Finally, as mentioned earlier, StifPipe™ costs less than conventional carbon FRP liners.

References:

TEST RESULTS

The standard test for determining stiffness of liners is provided by ASTM D2412-02, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading. The photo below shows the setup for such tests at the University of Arizona’s Department of Mining and Geological Engineering.

A project for rehabilitation of a 36-inch diameter PCCP required two layers of carbon fabric to resist the internal pressure. However, the client’s requirement to design the pipe as a “free-standing” pipe capable of resisting both internal and external (gravity) loads, led to six layers of carbon fabric. To compare the effectiveness of StifPipe™, two sections of a 36-inch pipe were constructed. The first sample followed the conventional repair and consisted of six layers of unidirectional carbon fabric applied on top of one another; the average thickness for this liner was 0.30 inches. The second sample was constructed of a single layer of honeycomb core sandwiched between two layers of glass fabric on both faces. This liner had an average thickness of 0.71 inches.

StifPipe™ has a stiffness that is 2.1 times that of the conventional CFRP system with six layers of carbon fabric. The actual StifPipe™ for this project will include a single layer of glass or carbon on the outside. However, on the inside, we will use two layers of carbon fabric to meet the design requirements for resisting the internal pressure of the pipe. This will increase the stiffness of the StifPipe™ even further.
Although lateral bursting has been used for a number of years in BC for trenchless infrastructure rehabilitation, the following information is provided for those still unfamiliar with this technology. Before lateral pipe bursting was introduced, trenchless pipe replacement methods catered almost exclusively to municipal or government projects: horizontal directional drilling for new utilities, guided pneumatic impact moles for bursting large sewer and storm mains, hydraulic rod-pusher/pullers for replacing other sewer and utility lines. All of these earlier methods and machines shared a common scope of work. Each was defined by projects that were large and public. By contrast, the first lateral pullers entered an arena whose jobs were small and private.

In this new private market, there were significant challenges to overcome. One major obstacle was pipe approval. Fused high-density polyethylene (HDPE) had been used for years by the gas industry, and was common in the existing pipebursting establishment. However, for the fledgling lateral bursting industry, HDPE was not a preference; it was a demand. Yet this pipe material was not listed in building codes regulating sewer replacement on private property, and therefore was not allowed.

Other challenges were mechanical. Laterals commonly include physical turns—1/8 or 1/16 bends in the line—to accommodate the flow path from building exit point to municipal connection. Sewers can exit a building from various points, which are often in restricted space or covered by surface improvements. City or county connections can be at the property line, in a side or rear easement, or in the public right-of-way, depending on the local regulations that define owner responsibility. None of the previously available bursting technologies were designed to deal with multiple bends and relatively small pipe (most laterals are 4” in diameter). Cured-in-place (CIP) liners were not as permanent a solution, and compared to bursting were neither practical nor cost-effective for most laterals, especially those in serious disrepair.

In California, TRIC Tools Inc. introduced the first lateral bursting systems to meet these unique logistical conditions. Their solution paired flexible replacement pipe (HDPE) with flexible steel cable to negotiate the inevitable bends in the existing pipeline.
TRIC gained approval of HDPE for home sewers, city-by-city, in the San Francisco Bay Area where the company initiated commercial lateral bursting in the late 1990s. Since then, both pipe and process have been added to national and international codebooks.

The first TRIC pipebursting systems were devised using modified post-tensioning rams mounted on a pulley base against a resistance plate, directing the cable and pulling force vertically rather than horizontally. This allowed for a very small footprint, which was invaluable for sewers that were either shallow, obstructed, or in tight places (conditions that describe many home sewer laterals). These hydraulic rams were small, light, and high-pressure rated, making them portable enough to carry and position by hand, yet powerful enough to burst most home sewers easily.

Trenchless lateral replacement has since been widely accepted, and has become a specialized utility market segment. TRIC continues to expand its patented technology into other utility markets around the world, applying a philosophy of simple and effective solutions to various project scenarios in the underground construction industry.

For further information on applications for TRIC pipe bursting systems in your next trenchless project, please call 888-883-8742 or visit their website at www.trictools.com

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A GOOD TOOL makes any job easier. If the job is trenchless sewer lateral replacement, the tool of choice is on the right. TRIC introduced lateral pipe bursting to America and the world back in 1997, and we continue to make this business more efficient and more profitable for our users by building the lightest, simplest, and most reliable systems out there.

So if pipe bursting is on your list, stop digging.
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Vitrified Clay Jacking Pipe and Trenchless Installation Methods

Jeff Boschert, P.E.
National Clay Pipe Institute

Vitrified Clay Pipe (VCP) has become the material of choice for some trenchless installation processes for many reasons, but the most commonly cited are strength, abrasion resistance and lifecycle. VCP is uniquely suited to pilot tube microtunneling (PTMT), slurry microtunneling and static pipe bursting. Recently, in addition to the functional benefits of VCP, The Institute for Market Transformation to Sustainability (MTS) has certified the pipe material as an environmentally responsible choice.

**Pilot Tube and Slurry Microtunneling**

Vitrified Clay Jacking Pipe has been the predominant direct-jacked product pipe material used in the eight-inch thru 36-inch size range. Clay pipe, in the typical one- or two-meter lengths, is ideally suited for use with compact jacking frames and the small shaft sizes of pilot tube and slurry microtunneling installations. Tunnel equipment tooling is often sized to match the outside diameter and pipe lengths of VCP. Clay pipe has an average compressive strength of 18,000 psi to stand up to the considerable jacking force of installation. The vitrified nature of the pipe also provides the needed abrasion resistance to prevent external damage as the pipe is pushed or pulled through the surrounding ground. In these installation processes, the greatest load the pipe will ever encounter is the axial force incurred during installation.

With the accuracy of a guided tunneling system, such as pilot tube or slurry microtunneling, there is no need for a larger diameter steel casing and the grade-adjusted inner carrier pipe. A larger diameter steel casing is required for a non-guided boring installation technique when installing a gravity flow line with a slope less than 3%. Eliminating this casing pipe saves the additional cost of excavation, transportation, and disposal of spoil as well as the purchase of two separate conduits, thus resulting in a lower overall project cost.

The longest slurry microtunneling drive on record with the National Clay Pipe Institute was a single drive of 892

*An 18-inch pipe is loaded into the pit for a pilot tube microtunneling project in Honolulu, Hawaii.*
feet using 36-inch clay pipe completed in Sacramento County, California, in 2009. This particular job is illustrative of the challenges that have driven the adoption of VCP in the trenchless industry with depths of up to 61 feet below grade and 40 feet below the existing groundwater table.

Static Pipe Bursting
Over the last several years VCP has become more popular as the replacement pipe on static pipe bursting projects. Because the pipe sections have compression fit joints and are designed to be “jacked” during installation, a bursting system was designed to push each pipe joint “home” as well as keep the column of assembled pipe sections in compression during bursting. A ride-along hydrostatic machine (cylinder pack) attached to bursting rods inside the new pipe sections keep the column of assembled pipe segments in compression as the bursting progresses. As the bursting head is pulled forward, splitting the existing pipeline and expanding the fragments into the surrounding backfill, the rear cylinder pack pressure plate keeps the assembled pipe sections in compression. Damage to the external wall is eliminated when using a replacement pipe material with a high resistance to abrasion.

This method of pipe bursting keeps the jobsite footprint as well as shaft sizes relatively small and compact. Utilizing any segmented jacking pipe eliminates the need for a long laydown area on the project site as would be required with welded or fused pipe. This is highly beneficial in high-traffic urban settings where long strings of joined pipe can be problematic. Inhibited traffic flow, blocked driveway access and local business disruption before and during the bursting operation can be minimized using this method.

A recent example of a pipe bursting project using VCP was the Downtown Sewer Main Replacement in Riverside, California. This project replaced an existing six-inch sanitary sewer line with a new eight-inch line to meet the needs of a growing community. A densely populated area required that the project footprint and the traffic disruption both be kept to a minimum.

Gold Certification
SMaRT (Sustainable Materials Rating Technology) is the certification program of the MTS. It is like the LEED system applied to individual products instead of a complete project or building. SMaRT is a transparent third-party certification program that considers the triple bottom line of environmental, social and economic costs that should be taken into account before specifying or using a given product. The SMaRT standard analyzes impacts from the raw materials extraction, manufacturing, transportation and end-use through disposal or recycling. The transparency of the program means anyone can look at a scorecard and make their own evaluations based on their own priorities.

The products of the National Clay Pipe Institute (NCPI) member-companies have been given a Gold Certification under this program.

“We're proud to be the first infrastructure product to be certified under this program,” said Mike Van Dine, President of NCPI. “We’ve always said we were green before it was anything more than a color. It’s nice to have an objective third-party certification program validate that claim.”

Pipe Characteristics
VCP is manufactured from 100% natural materials, a blend of clays, shales, and slate. After this mix is blended and ground to a fine particle size, water is added and it is extruded,
dried, and fired at temperatures reaching 2000 degrees Fahrenheit to achieve vitrification.

For jacking pipe, a recess is ground into both ends of each pipe section to accept the sealing gasket and collar while at the same time cutting the ends square. Each section is done individually on a lathe with diamond cutting tools to precision tolerances after the vitrification process. This ‘end squareness’ is necessary to allow the axial jacking force to be uniformly transmitted from the jacking frame through each succeeding pipe section. The wall thickness of the jacking pipe is generally thicker than the corresponding bell and spigot pipe size for open trench construction.

Depending on the individual project conditions, a polyurethane, synthetic isoprene, EPDM, or nitrile elastomer can be used for the gasket material. Each compression joint is then coupled with a Series 316 stainless steel collar. Particleboard or chipboard compression rings, for axial load transfer during installation, are also supplied and used at each joint. Clay jacking pipe meets the specification requirements of ASTM C1208/C 1208M and EN 295-7.

The chemical resistance of VCP is unsurpassed by any other pipe material. Corrosion resistance is probably the single most significant influence on pipeline longevity. The nature of the ceramic material prevents it from changing with age, compared to limited life products, which experience degradation over time. The longevity of clay pipe in conjunction with the state of the art gasket and stainless steel collar system will provide the owner with an “unmatched” service life. Clay Pipe is the only sewer pipe material for which the United States Army Corps of Engineers assumes a 100-year life.

Vitrified Clay Jacking Pipe was introduced to the U.S. trenchless market in 1992. Since that time it has been specified and used on over 200 tunneling projects totaling over 700,000 linear feet. This gravity flow corrosion resistant sanitary sewer pipe has been used for pilot tube microtunneling, slurry microtunneling, static pipe bursting and as a carrier pipe inside a cased bore.

Many U.S. cities have VCP sewer lines that are over 100 years old and are still in service today. These pipelines perform and continue to serve their communities, despite having been manufactured and installed with outdated construction practices and little or no accepted standards governing the materials or installation practices.

Today’s high tech VCP Jacking Pipe, newer construction practices, more sophisticated machinery and exacting production standards are all leading communities around the country to explore the possibilities associated with a rigid pipe with high compressive strength and an expected service life of over 200-years.

Jeff Boschert, P.E., is a civil engineer with the National Clay Pipe Institute specializing in trenchless applications.
7th Annual Western Regional No-Dig Conference & Exhibition
Monday, October 3, 2011 - Tuesday, October 4, 2011
Wyndham Hotel – San Jose, CA

Contact Info:
Website: http://www.westt.org/no-dig-conference.html
Jennifer Glynn and Kate Wallin
Phone: 925-627-4151 and 916-294-0095

2nd Annual Rocky Mountain Regional No-Dig Conference & Exhibition
Thursday, October 6, 2011 - Friday, October 7, 2011
Doubletree Hotel – Westminster, CO

Contact Info:
Website: http://www.rmnastt.org/events.html
Tracy Lyman
Phone: 303-534-1100
Email: tlyman@brierleyassociates.com

NASTT’s An Introduction to Trenchless Technology Short Course
Thursday, October 6, 2011
Jacobs-believed-in-me Auditorium, Featheringill Hall,
School of Engineering, Vanderbilt University – Nashville, TN

Contact Info:
Sanjiv Gokhale
Phone: 615-322-5919
Email: s.gokhale@vanderbilt.edu

NASTT Cured-in-Place-Pipe Good Practices Course
Thursday, October 6, 2011
Doubletree Hotel – Westminster, CO

Contact Info:
Website: http://www.rmnastt.org/events.html
Al Paquet
Phone: 970-215-9115
Email: al.paquet@CH2M.com

Horizontal Directional Drilling (HDD) Good Practices Guidelines Course
Wednesday, November 9, 2011
University of North Florida’s University Center – Jacksonville, FL

Contact Info:
Website: http://www.trenchlessonline.com/road-shows/florida/index.html
Michelle Hill
Phone: 330-467-7588
Email: mhill@benjaminmedia.com

NASTT’s Cured-in-Place Pipe Good Practices Course
Wednesday, November 9, 2011
Holiday Inn - Raleigh/Cary, NC

Contact Info:
Peter Kurz, Tri-State Utilities
Phone: 757-366-9505 or 757-615-777
Email: PeteK@TriStateUtilities.com
NASTT’s Cured-in-Place Pipe Good Practices Course  
Wednesday, November 16, 2011  
Coast Plaza Hotel - Calgary, Alberta Canada

Contact Info:
Website: http://www.nastt-nw.com
Phone: 403-247-0321
Email: info@eventplan.net

15th Annual 2011 Northwest Trenchless Conference  
Wednesday, November 16, 2011 - Thursday, November 17, 2011  
Coast Plaza Hotel - Calgary, Alberta, Canada

Contact Info:
Website: http://www.nastt-nw.com  
Nadeer Lalji, Conference Planning Chair  
Email: nlalji@nastt-nw.com

NASTT’s Cured-in-Place Pipe Good Practices Course  
Tuesday, December 6, 2011  
Comfort Hotel & Conference Center – Victoria, BC, Canada

Contact Info:
Monica Perry  
Email: mwperry@telus.net

NASTT’s Laterals Good Practices Course  
Wednesday, December 7, 2011  
Delta Town & Country Inn – Delta, BC Canada

Contact Info:
Monica Perry  
Email: mwperry@telus.net

Horizontal Directional Drilling (HDD) Good Practices Guidelines Course  
Wednesday, January 25, 2012  
San Antonio, TX

Contact Info:
Angela Ghosh  
Phone: 330-491-0058  
Email: aghosh@nastt.org

NASTT’s Cured-in-Place Pipe Good Practices Course  
Wednesday, January 25, 2012  
San Antonio, TX

Contact Info:
Angela Ghosh  
Phone: 330-491-0058  
Email: aghosh@nastt.org

2012 NASTT No-Dig Show  
Sunday, March 11, 2012 - Friday, March 16, 2012  
Gaylord Opryland Hotel & Convention Center - Nashville, TN

Contact Info:
Web site: http://www.nodigshow.com  
Benjamin Media, Inc. (conference management)  
Phone: 330-467-7588  
Email: info@benjaminmedia.com

For more information, contact Angela Ghosh with NASTT, phone: 330-491-0058 or e-mail: aghosh@nastt.org.
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Upcoming High-Value TRAINING COURSES for 2011-2012

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See Full Course Descriptions at www.nastt.org
Questions About Trenchless?
We Have Answers

Get Connected to the Trenchless Industry
NASTT is your link to thousands of local, national and international trenchless professionals and industry leaders. Whether your business is engineering, public works and utilities, underground construction, or equipment manufacturing, NASTT is the definitive resource for the trenchless industry and the application of trenchless methods for the public benefit.

Continuing Education
NASTT’s Good Practices courses offer members a range of trenchless topics to choose from and the opportunity to earn valuable Continuing Education Units (CEUs) for their participation in class work held in various locations.

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The annual NASTT No-Dig Show brings together the trenchless industry to make important connections at vibrant locations throughout North America. Also get involved in your Regional Chapter and make key contacts, while staying informed about issues within your own region.

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- Members-only discounts
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- Subscriptions to industry trade magazines
- Leadership opportunities
- Involvement in your regional chapter
- And much more! Our members often join for one reason, only to discover the value of many others.

Joining is easy. Visit our Web site at www.nastt.org or call 613-424-3036 (in Canada) or 703-351-5252 (in U.S.) for membership details.

The Show!
The annual NASTT No-Dig Show is the largest trenchless technology event in North America, offering an impressive collection of quality papers, an exhibition hall with more than 135 trenchless companies displaying their products and services, a series of specialized training courses, and many entertaining networking events and special awards. Mark your calendars for NASTT’s No-Dig Show: March 11-15, 2012 in Nashville, TN!

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